REVIEW ARTICLE

Pharmacological Properties of North Indian Herbs of *Abelmoschus moschatus* -A Review

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ABSTRACT

Natural herbs and plants are the "heart of Every system of medicine" that are used to treat various diseases, disorders, pathogens and for prevention from harmful substances. *Abel moschatus*, which is commonly known as "*Musk mallow*", "*Annual hibiscus*", etc. and belongs to the family Malvaceae. It is an aromatic and medicinal plant used for culinary and medicinal purposes all over the world since the traditional system of medicine. This plant is natively seen in India and can be found in the wild in the Deccan, Karnataka, and Himalayan foothills. It is also cultivated in tropical regions such as South America, Asia and Africa. The plant *A. moschatus* was used for various disease treatment and it has also undergone extensive research resulting in the discovery of its pharmacological properties such as Antidiabetic, Antioxidant, Free-radical scavenging, Antimicrobial, Anti proliferative, memory strengthening effect, Anti-ageing, Antitussive, Antidepressant, Anxiolytic, muscle relaxant,

anticonvulsant, Hepatoprotective and possess various CNS effects and hemagglutinating activity. *A. moschatus* is used in the treatment of Neural disorders, cardiac debility, asthma, nausea, headaches, coughs, burning sensation, dyspepsia, flatulent colic, spermatorrhea, pectoral diseases, leukoderma, vomiting, ptyalism, this review intends to explain the phytochemistry and pharmacological properties of *Abelmoschus moschatus.*

Keywords: "heart of Every system of medicine", "*Musk mallow*", "*Annual hibiscus*", *Abelmoschus moschatus.*

INTRODUCTION

A. moschatus belongs to the genus *Abel moschus* which consists of 15 flowering plants and they belong to the family Malvaceae. It is also known as *Bamia moschata*, musk mellow, yorka okra, ornamental okra, annual hibiscus etc [1]. It is a type of under shrub or herb with erect posture, hairy stems, long leaves and yellow coloured flowers. Mostly this plant is used for its culinary, medicinal and aromatic purposes in the natives of Australia and Asia[2]. These plants tend to spread through both tropical and subtropical continents of the world natively and also introduced in many countries. The stem, bark, leaf, seed, flower are the important parts that have various uses in both traditional and modern medicinal systems for treatment of diseases. This plant is consumed in the form of food additives, oil, seed, spices and vegetables. It is also used in the production of soaps, detergents, lotions, creams etc,[3].

Botany
Botanical name: *Abelmoschus moschatus Medik.*
Genus: *Abelmoschus Medik.*
Family: Malvaceae.
Synonym(s): *Abelmoschus* (L.) and *Hibiscus abelmoschus* L. [4]
Common names
Bamia Moschata, musk mellow, yorka okra, ornamental okra, annual hibiscus, musk okra, ambrette, galu gasturi etc.

Description
Abelmoschus moschatus are herbs or under shrubs with prickly stems with palmately lobed and alternate leaves. The flowers are bisexual with mostly yellow colours, also found in pink, white and dark purple colour [5]. The fruits are capsule and ovoid and the seeds are uniform or globoes smooth.

Distribution
Abelmoschus moschatus is mostly found Asian countries and some of them are Australia, Bangladesh, China, Cambodia, Indonesia, India, Malaysia, Vietnam. In India they are distributed through Assam, Deccan and Himalayan foothills, Gujarat, UttarPradesh, Odisha. This plant is also cultivated in Africa, South America other than Asia.

Cultivation
cultivation of *A. moschatus* requires a humid tropical or subtropical climate for its propagation, continuous and heavy rainfall results in declining the growth rate. Mostly it grows up at altitude more than 1500m and could tolerate temperature levels up to 45°c and could not tolerate frost conditions. Neutral physical and plenty of organic nutrition is required for the well growth of the plants [6]. The seeds are soaked for 24hrs before germination and could take five to seven days for germination. The sowing time must be in the pre monsoon season such as June and July.

Ethno pharmacology
The roots, stem, leaves, petals and flowers are used for a wide range of pharmacological activities. The seed of this plant was used for its diuretic, demulcent, Antitussive, stimulant, Antispasmodic, Antiseptic, carminative etc. This is used in the treatment of headache, rheumatism, cystitis, fever, itchiness, gonorrhoea and headaches. The seeds are

used to obtain ambrette oil which is used in the cosmetic industry for its aromatic nature. These are mainly used in perfume preparation of various grades. The oil obtained from the plant is also used for the treatment of anxiety, stress, fatigue, depression, muscle aches, etc, by aromatherapy [7]. The leaves of these plants have anti-inflammatory and fibruge properties which are used to relieve severe headaches by making a poultice out of the leaves. The decoction of these leaves helps in childbirth. The leaves and flowers are used for scabies and swelling treatment. The bark of this plant was made into a paste and used to applied on cuts, sprains and wounds. Myricetin is considered as the main active constituent of the seed extract which have a significant antidiabetic activity and also used to increase insulin sensitivity. *A. moschatus* is also suitable for culinary purposes as it was an aromatic substance [8].

Phytochemistry

A. Moschatus was reported with a range of phytochemical constituents present in parts of the plant. Presence of primary and secondary metabolites and other constituents such as carbohydrates, protein, tannins, fixed oil, volatile oil, sterols, flavonoids, phenolic compounds, fatty acids etc, were found throughout the extract of the whole plant.

Seed

The seed of the *A. moschatus* was reported with the presence of 13.35% starch, 14.5% of lipids (fatty oils), 2.3% protein,31.46% crude fibre,11.14% moisture,5% resin, 0.2% to 0.6% volatile oil and the volatile oil (crude oil) is obtained by crushing the seeds. Volatile oils were also reported on the seed coat 2-methylbutyl-2-methylbutanoate. Presence of glycosides cynadin and glucoside such as myricetin-3sistosterol, beta D-glucoside, beta sitosterol were reported. The seed oil contains 0.12% of farnesol, which is a sesquiterpene alcohol as its main constituent. Ester forms of ambrettolic and acetic acid were also reported [9]. The seed oil contains ambrettolide, a ketone, which is responsible for the characteristic musk-like odour. It is a lactone of ambrettolic acid. The seed oil also contains a constituent furfural as water condensate. Higher fatty acid such as palmitic acid was present in the seed in large amounts and the volatile oil of the seed also contained fatty acids such as hexadecenoic acid, decanol, dodecanol, decyl acetate, octadeca-9,12-dienoic acid, Octadec-9-enoic acid etc,.

Flowers

cyanidin-3-sambubioside and cyanidin-3-glucoside from anthocyanins' presence were reported on the flower of *A. moschatus.*

Petals: The petals were found with β-sitosterol, flavonoid myricetin and its glucoside.

Leaves: Myricetin, its glucoside, β-sitosterol and its β-D-glucoside were found on the leaves[11]. Some of the phytochemical constituents are presented in Figure:2 along with its structure

Pharmacological Properties
Edibility

The seed oil is comparable to groundnut oil and was edible for use was reported on the evaluation for acute toxicity and safety studies on experimenting the effects of seed oil on albino rats [12]. The fatty acids obtained from the seeds are also close to the ratios recommended by the UN. It contains saturated, unsaturated, monounsaturated and polyunsaturated fatty acids. The studies assisted to determine the edibility of the seed components.

Diuretic action

The diuretic action of *A. moschatus* was studied with its methanolic extract experimented on rats. The rats shown increased urine excretion based on the given dose. The urine rate was increased 22% to 44% on the doses of 50 to 100 mg/kg respectively and increased sodium extraction is only reported in high doses [13]. Potassium conserving effect was also seen in the study. Also, alcoholic, petroleum ether and chloroform extract of this plant was studied for diuretic action but only alcoholic extract showed significant effect in urine excretion with concentrations of sodium, potassium and chloride levels.

Antioxidant activity

The extracts from the seed and leaf of the plant have significant antioxidant activity. This was studied by various methods such as DPPH, total antioxidant, ferrous reducing methods. Leaf extract shows higher ferrous reducing property of antioxidants than seed extracts. Both the leaves and seed extract show great result on DPPH radical scavenging activity , lipid peroxidation inhibition, hydroxyl radical and hydrogen peroxide scavenging activity [14]. The hydroalcoholic extract also shows the highest levels of DPPH and radical scavenging activity.

Anti-diabetic activity

The antidiabetic action of the plant was reported by the study on diabetic rats by inducing them with streptozotocin. The constituent myricetin is responsible for the enhancement of the glucose utilisation by activating the μ-opioid receptor on increased β-endorphin level thereby producing hypoglycemic effect and causing antidiabetic activity[15]. It is a dose dependent intravenous agent which decreases the plasma glucose concentration. Myricetin is also reported to increase the insulin sensitivity by enhancing the insulin action. Therefore, this plant has a potent use for insulin resistance patients and to stimulate insulin sensitivity.

Anti-proliferative activity

The hydroalcoholic seed and leaf extract of the plant shows inhibitory activity on two cell lines COLO-250 and Y79.This was studied by the evaluation of the leaf and the seed extracts of the plant on the cell lines of COLO-250 and Y79 cell lines[15] .The results of the tests shows that the seed extracts inhibitory action on the cell lines COLO-250 and Y79 was 73.33% and 74.40% respectively on concentrations 200μg/ml, whereas the inhibitory action of the leaf extract was found to be 78.25% and 78.8% on concentrations 200μg/ml respectively for both cell lines.

Antimicrobial activity

A. moschatus shows significant antimicrobial activity against various bacteria and fungi such as *Corynebacterium diphtheriae, staphylococcus aureus, bacillus megaterium, proteus vulgaris and proteus mirabilis*. This activity was reported by evaluation of the methanol, ethyl acetate, hexane and aqueous extract of the plant on a number of harmful microbes by assay method. The aqueous extract from the seeds showed antimicrobial activity against *Escherichia coli*, *Pseudomonas aeruginosa*, *P. vulgaris*, *Salmonella enterica Para typhi*, *Bacillus subtilis and S. aureus*. Silber aqueous extract of this plant using nanoparticles is also reported for its antimicrobial activity [16]. The Hydroalcoholic extract exhibit antimicrobial activity against pathogens such as *Candida albicans*. The extract of the plant's hexane showed action against *C. Diphtheriae*. A novel trypsin inhibitor of the extract from the seed also has antifungal and antibacterial action on various pathogens.

Antilithiatic activity

The Antilithiatic activity of the plant was reported from its hydroalcoholic extract by christina and muthumani in 2013.The plant's hydroalcoholic extract was given to induced urolithiasis in male Wistar albino rats by ethylene glycol at 200 and 400 mg/kg[9]. The result shows prevention and reduction in the formation of kidney stones by decrease in the levels of calcium, oxalate and phosphate. Therefore, the hydroalcoholic extract of the whole plant was reported for its nephroprotective as it reduces the risk of stone formation and other kidney related risk factors.

Hepatoprotective Activity

A. moschatus was reported for its hepatoprotective activity on its methanolic and aqueous extract on the seed based on the study of the extract against paracetamol induced toxicity rats at 300mg/kg dose. Both the extract shows hepatoprotective activity by preventing the lipid peroxidation of hepatic tissue and restoring enzymes on serum and the total bilirubin levels. The ethanolic extract shows significant activity than the aqueous plant extract [19]. Therefore, the plant's seed extract shows significant hepatoprotective activity and is used to relieve paracetamol induced toxicity.

Anti-ageing activity

The anti-ageing action of the extract from the seed was evaluated in in vivo and in vitro conditions on skin fibroblast and they showed promising anti-ageing activity. The in vivo results of the experiment showed significant activity in the Skin density, texture, elasticity, density and wrinkles, by preserving FGF-2 content of human skin [20]. The in vitro result of the experiment showed the anti-ageing action by protection of FGF-2 from thermal degradation. Therefore, the seed extract of the plant seed could be also used for cosmetic purposes.

Memory strengthening effect

The ethanolic extract of the seed was experimented on mice and shown results by enhancement of memory in learning and also relieved diazepam induced amnesia in rats on treatment in significant days [21]. This seed extract also shows a significant effect towards anti-cholinesterase, antioxidants, memory strengthening activity and increases brain glutathione levels. It could also have effects on dementia and Alzheimer's diseases.

Effects on the central nervous system

The seed extract of *A. moschatus* reported to have certain CNS effects such as antidepressant, antipsychotic, anti-anxiety, muscle relaxant activity and anti-convulsant. The study of the seed extract also shows effect in various behavioural tests such as forced climbing test, electroshock induced seizure, forced swim test, light and dark box test, tail suspension test, locomotor test, hole board test, rotard test, phenothiazine induced sleep time test, inducing convulsion various methods and inclined screen test on laboratory animals at 2 doses 200mg/kg and 400mg/kg of hydroalcoholic extracts of the seed on oral administration [22].

Hemagglutinating activity

The hemagglutinating activity of the seed extracts AMTI-I and AMTI-II was reported by evaluating it against the normal and trypsin-treated rabbit, rat, and human erythrocyte cells. This result in the both constituents are enough to cause agglutination reactions but the results from rats and rabbit trypsin-treated erythrocyte cells are lower than human cells [23]. The human trypsin-treated erythrocytes are also agglutinated irrespective of the blood groups. Therefore, the seed constituent has potent and stable hemagglutinating effect and it could be also used in agricultural purposes to develop insect resistant crops which are transgenic.

Summary

Abelmoschus moschatus is commonly known as "*Musk mallow", "Annual hibiscus*", etc. from the family Malvaceae. It is an aromatic and medicinal plant used for culinary and medicinal purposes all over the years in the system of medicine. The stem, bark, leaf, seed, flower are the important parts that have various uses in both traditional and modern medicinal systems for treatment of diseases. *A. moschatus* was reported with a range of phytochemical constituents present in parts of the plant. Presence of primary and secondary metabolites and other constituents such as carbohydrates, protein, tannins, fixed oil, volatile oil, sterols, flavonoids, phenolic compounds, fatty acids etc, were found throughout the extract of the whole plant. pharmacological properties such as hypnotist, antioxidant, free-radical scavenging, antiproliferative, antimicrobial, antilithiatic, hepatoprotective, memory strengthening, antidiabetic, hemagglutinating, anti-ageing, antidepressant, anxiolytic, anticonvulsant, hypnotic, and muscle relaxant activity are discussed detaily. To discover more properties of *A. moschatus*, there is a need for extensive study and research must be done with proper techniques and knowledge. Thereby we could able to biosynthesis more potent substances and improve its therapeutic quality.
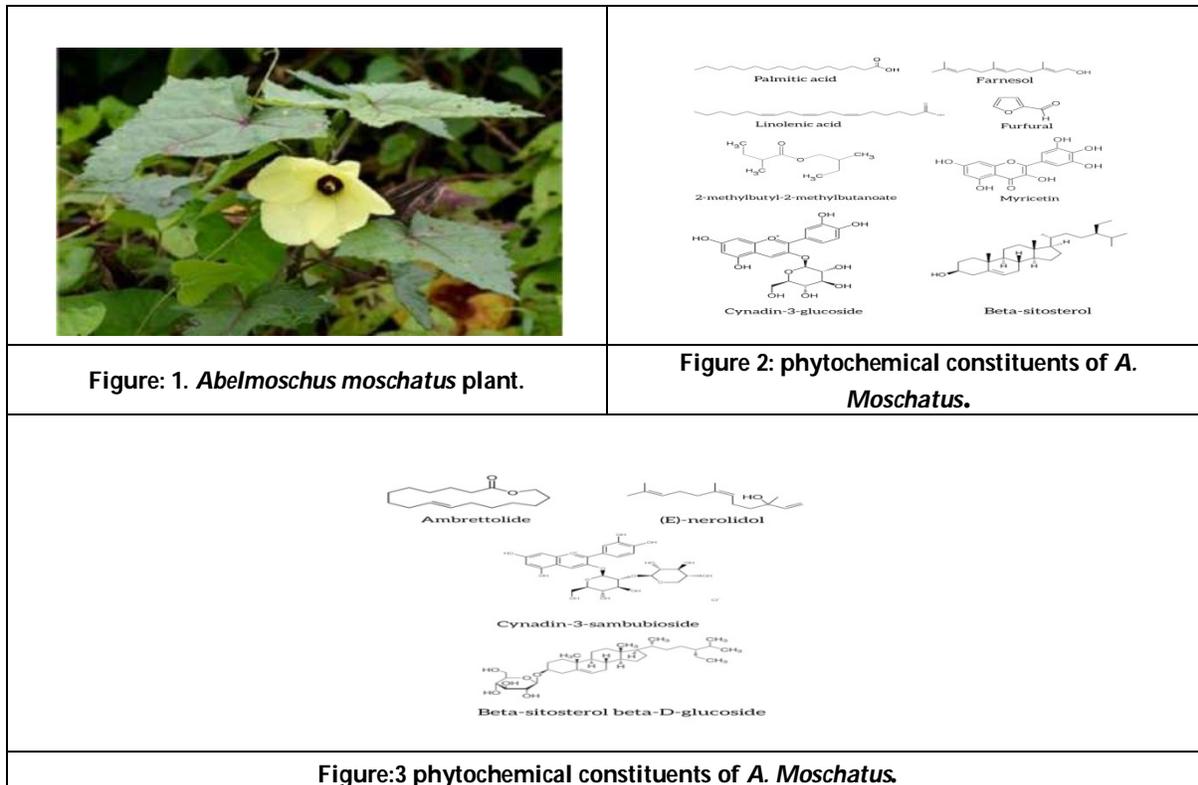
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Figure: 1. *Abelmoschus moschatus* plant.

Figure 2: phytochemical constituents of *A. Moschatus*.

Figure:3 phytochemical constituents of *A. Moschatus*.

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RESEARCH ARTICLE

Phytochemical Analysis and Antimicrobial Activity of *Vitex negundo*

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ABSTRACT

Vitex negundo is also known as "Chaste tree". The parts of flowers and leaves from *Vitex negundo* were collected and extracted using solvents such as ethanol, chloroform and water in different ratios.1:10 (1gm of plant sample and 10 ml of solvent) and1:50 (1gm of plant sample and 50 ml of solvent). Phytochemical such as alkaloids, saponins, carbohydrates, proteins, tannins, amino acid, anthraquinone glycosides, phenols, cardiac glycoside, coumarins, lipids, quinone were analysed. Water was selected as the solvent for the study as it is safe for the environment and human consumption when compared to solvents such as chloroform and ethanol. Fats and oils were determined qualitatively. Macromolecules such as carbohydrates, proteins, and phytosterols were also determined quantitatively. Alkaloids, coumarins and saponins were found to be present at a high level of concentration in both fresh and dried extracts of flowers and leaves of *Vitex negundo*. Quantitative levels of anthraquinone glycoside, carbohydrate and terpenoids showed moderate contents. Low level of cardiac glycosides, amino acid , phytosterols and tannins were confirmed. **.** Antibacterial activity was performed using different cultures such as *Escherichia coli, Enterococcus faecalis, Staphylococcus aureus, Salmonella typhi, Pseudomonas aeruginosa, Proteus vulgaris, Streptococcus pyrogenes, Klebsiella pneumoniae* was carried out by Well Diffusion and Disc Diffusion methods. Hence*Vitex negundo* is used to cure and prevent diseases such as bacterial diseases, cancer, asthma, rheumatoid arthritis and other ailments.

Keywords: Anthraquinone glycoside, Well diffusion, Terpenoids, Macromolecules.

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INTRODUCTION

Vitex negundo is known as Indian pivet, horseshoe *Vitex* and Chinese Chaste tree. It belongs to the family Verbenaceae. It is an aromatic shrub or a small tree and grows abundantly in tropical to temperate regions. *Vitex negundo* is grown in warm temperate to tropical regions ranging from sea level to height of 2000meters.It is preferably grown in well drained loamy soil. The small tree is grown in India, Asia, China, Kenya, and Tanzania[**15**].

MATERIALS AND METHODS

Phytochemical Screening

Phytochemical screening is a process of tracing plant constituents to know the presence of therapeutic agents. The plant was authenticated at Herbal Plant Anatomy Research Centre, Tambaram, and Chennai. Fresh plants were collected in Natesan nagar, Chennai**.** (Figure-1).The plants were washed, dried and powdered. Parts of *Vitex negundo* such as leaves and flowers were used. These were dissolved in three different solvents: Chloroform, Methanol and Distilled water.

Qualitative Analysis:[1-8]

Qualitative Analysis &Method	Procedure
Alkaloids-Hagner	1ml of extract+1ml of Hagner's test
Alkaloids-Wagner	1 ml of each extract+ Few drops of Wagner's reagent.
Alkaloids-Dragendroff	1 ml of extract +0.5ml of Dragendroff's reagent.
Saponins-Froth and Foam	0.05 ml of extract was made upto 20 ml of distilled water. The suspension was shaken in graduated cylinder for 15 minutes.
Proteins-Biuret	0.5 ml of extract + Biuret reagent.
CarbohydratesFehling	0.5ml of each extract +Fehling's reagent.
Quinone-Sulphuric acid	1ml of extract+1 ml of concentrated sulphuric acid
Quinone-Hydrochloric acid	1ml of extract +concentrated Hydrochloric acid
Anthraquinones- Borntrager	0.5ml of extracts +10% ferric chloride solution + 1ml HCl. Ammonia = few drops to observe for change in colour.
Fats and Oils-Saponification	Few drops of 0.5N alcoholic potassium hydroxide + few drops of phenolphthalein were added.
Coumarins-Absence of UV light	2 ml of 10% sodium hydroxide + few ml of each extract.
Coumarins-Presence of UV light	0.05grams of each + 0.1N sodium hydroxide solution under the influence of UV light for yellow fluorescence.
Cardiac glycoside-Keller Killani	2ml of the extract+ 1 ml of glacial acetic acid +1drop of 5% Ferric chloride
Phenols- Ferric Chloride	1 ml of each extracts +2 ml of distilled water +few drops of 2%of ferric chloride solution.
Phenols-Ellagic acid	Few drops of 5% glacial acetic acid +5% sodium nitrite solution
Tannins-Braymer	1 ml of 5%Ferric chloride +extract.
Amino acid-Ninhydrin	0.5 ml of extract+ few drops of Ninhydrin reagent
Triterpenoids and Sterols-Salwoski	Few ml of extract+ few ml of chloroform + 0.5 ml of concentrated sulphuric acid
Terpenoids-Salwoski	0.1ml of extract+2 ml of chloroform + 1ml of concentrated sulphuric acid
Phlobatannins-Hydrochloric acid	Few drops of 2% Hydrochloric acid+1 ml of each extract.

Glycosides-Borntrager	2 ml of filtered hydrolysate+0.5 ml of extract+2 ml of chloroform was added and shaken.
Flavonoids-Alkaline Reagent	0.5 ml of extract+ few drops of dilute sodium hydroxide.
Fats-Zak	2 ml organic solution of chloroform+0.5 ml ferric chloride +1 ml concentrated sulphuric acid + extracts.

Quantitative Analysis

1. Carbohydrates

Carbohydrates was determined by Anthrone reagent method. Glucose was used as a standard for calibration curve. Optical density was observed at 630 nm[1].

2. Total Phenolic content

Estimation of Total Phenolic content was determined by Folin's Ciocalteau method. Gallic acid was used as a standard for calibration curve. Optical density was measured at 760nm in colorimeter[2].

3. Flavonoids

Flavonoids was carried out by Aluminium Flavonoid complex method. The total flavonoid contents were measured by colorimetric assay using quercetin as standard for calibration curve. Optical density was observed at 430nm using colorimeter[3].

4. Proteins

The contents of proteins were quantified using Lowry's method. Bovine Serum albumin was used as a standard for calibration curve. Optical density was measured at 660nm[5].

5.Tannins

Tannins were estimated by Folin's Denis Reagent was added to all the test tubes. Tannic acid was used as standard for a calibration curve. Optical density was read at 700nm[8].

6. Amino acid

Amino acid was quantified using Ninhydrin method. Glycine was used as a standard. Optical density was read at 570nm[9].

7. Cardiac glycoside

Cardiac glycoside was quantified by Balijet Reagent method. For the preparation of Standard curve, 10 ml of different concentrations (12.5-100mg/L) of Securidase were prepared. Optical Density was read at 428nm[10].

8. Alkaloids

Alkaloids was quantified by Bromocresol green method. Atropine was used as a standard. Optical Density was read at 470nm**.**

9.Coumarins

Coumarins were quantified using Diazonium Method. P-coumaric acid drug was used as a standard. The Optical density was read at 470nm[4].

10.Terpenoids

Terpenoids were determined using Linalool method. The samples were transferred from assay tube to colorimetric cuvette. Standard was used as Linalool solution. 95% of methanol was used as blank and absorbance was recorded at 538 nm[6].

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11. Total Saponins

Total Saponins determination was done using Anisaldehyde reagent. Vanillin-sulphuric acid was used as a Standard. Absorbance was measured at 435nm[3].

12. Anthraquinone glycosides

0.3 grams of samples were taken in four test tubes.30 ml of distilled water was added to all test tubes and refluxed for 15minutes.The test tubes were allowed to cooled, weighed, and were centrifuged at room temperature for 10 minutes. 0.5 ml of supernatant was added to all the test tubes.0.1ml of 2M Hydrochloric acid and 5 ml of chloroform was added. Aqueous layer was removed from the test tubes.0.1 ml of sodium bicarbonate solution was added to all test tubes and were centrifuged at 4000 rpm for 20 minutes. The glycoside layer was removed after centrifugation. 5ml of 5.5% of Ferric chloride was added to all the test tubes. The calibration curve of the standard was used as rhein and made from five concentrations. The absorbance was measured at 515 nm[18,19].

13. Phytosterols

Estimation of Phytosterols was quantified using Zak's method. Cholesterol was used as a standard. Optical Density was read at 570nm.

Antimicrobial activity

Antimicrobial activity is defined as an active agent which is used to inhibit the growth of bacteria and helps to prevent the growth of microorganisms.[9,12].Antimicrobial activity of plant extracts were evaluated by two methods-
(i) Disc Diffusion method
(ii) Well Diffusion method.

Disc Diffusion method

This was first developed by W.Kirby and A. Bauer   in 1950, which was standardized by WHO. This method was used for antibiotic susceptibility testing. Disc Diffusion method was carried out by Kirby-Bauer.

Well diffusion method

Well Diffusion method was used to evaluate antimicrobial activity of plant and microbial extracts.

RESULTS AND DISCUSSION

Qualitative Analysis

Qualitative analysis was performed in three different extracts such as chloroform, methanol and aqueous extracts. Water was selected as the solvent for the study as it is safe for the environment and human consumption when compared to solvents such as chloroform and ethanol.(Table-1,2,3). In qualitative analysis, Phlobatannins, Glycosides, Sterols, Carbohydrates and fats were absent in ethanolic extract of fresh and dry extracts of *Vitex negundo* leaves and flowers.(Table-4).

Quantitative Analysis

The phytochemical contents of fresh extracts of *Vitex negundo* leaves and flowers were quantified and calculated in terms of milligrams. It was calibrated in the form of graph. (Table-5),(Figure-2).The phytochemical contents of dry extracts of *Vitex negundo* leaves and flowers were quantified and calculated in terms of milligrams. It was calibrated in the form of graph.(Table-5),(Figure-3)

Antibacterial activity

The antimicrobial properties of plant extracts were tested against Gram positive and Gram negative bacteria [*Escherichia coli, Pseudomonas aeruginosa, Salmonella typhi, Proteus vulgaris and Klebsiella pneumoniae*] and Gram positive bacteria [*Streptococcus pyrogenes* and *Staphylococcus aureus*](Table-6,&7).

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CONCLUSION

There are lot of plants in the world which are useful in preventing and treating various diseases. The shrub is used to prevent respiratory diseases such as   asthma, bronchitis and skin ailments like   leucoderma. The values which are obtained from the current study showed good results in fresh extracts when compared to dry extracts. It is concluded that aqueous extracts showed therapeutic activity with no side effects.

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Table.1: Interpretation of Qualitative Analysis.

Phytochemical constituents, Method&Interpretation
Alkaloids-Hagner-Yellow Precipitate
Alkaloids-Wagner-Red precipitate
Alkaloids-Dragendroff-Orange cocoa precipitate
Saponins-Foam and Froth-Appearance of 2 cm layer of foam
Proteins-Biuret-Violet colour.
Carbohydrates-Fehling-Reddish brown precipitate
Quinone-Hydrochloric acid-Red colour precipitate
Quinone-Sulphuric acid-Yellow colour precipitate
Anthraquinone-Borntrager-Pink or red colouration of aqueous layer.
Fats and Oil-Saponification-Formation of soap or partial neutralization of alkali
Coumarins-Absence of UV light-Yellow colour
Coumarins-Presence of UV light-Yellow colour
Cardiac glycosides-Keller-Killani-Appearance of reddish brown colour at the junction of lipid layers.
Phenols-Ferric chloride-Blue or green colour
Phenols-Ellagic method-Niger brown precipitate (muddy colour precipitate).
Tannins-Braymer-Intense green, blue, black, purple or dirty green precipitate.
Amino acid-Ninhydrin-Purple colour.
Terpenoids-Salwoski-A reddish brown colouration at the interface.
Triterpenoids and Sterols-Salwoski-Brown ring at the junction of the test tube.
Phlobatannins-Hydrochloric acid-Red colour precipitate
Glycosides-Borntrager-Pink colour precipitate
Flavonoids-Alkaline reagent-Yellow colour became colourless on addition of few drops of dilute acid.
Fats-Zak-Red coloured solution.

Table .2: Qualitative Analysis -Ethanolic Extract of *Vitex negundo* leaves& flowers:

Ethanolic Extract	VNL					VNF				
	1:10	1:20	1:30	1:40	1:50	1:10	1:20	1:30	1:40	1:50
Alkaloids	+	+	+	+	+	+	+	+	+	+
Alkaloids	+	+	+	+	+	+	+	+	+	+
Alkaloids	+	+	+	+	+	+	+	+	+	+

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Saponins	+	+	+	+	+	+	+	+	+	+
Carbohydrates	+	+	+	+	+	+	+	+	+	+
Proteins	+	+	+	+	+	+	+	+	+	+
Amino acids	+	+	+	+	+	+	+	+	+	+
Tannins	+	+	+	+	+	+	+	+	+	+
Anthraquinone	-	-	-	-	-	-	-	-	-	-
Fats & oils	+	+	+	+	+	+	+	+	+	+
Phenols	+	+	+	+	+	+	+	+	+	+
Phenols	+	+	+	+	+	+	+	+	+	+
Cardiac Glycosides	+	+	+	+	+	+	+	+	+	+
Coumarins	+	+	+	+	+	+	+	+	+	+
Coumarins	+	+	+	+	+	+	+	+	+	+
Lipids	+	+	+	+	+	+	+	+	+	+
Flavonoids	-	-	-	-	-	-	-	-	-	-
Carboxylic acid	-	-	-	-	-	-	-	-	-	-
Sterols & Terpenoids	-	-	-	-	-	-	-	-	-	-
Glycosides	-	-	-	-	-	-	-	-	-	-
Fats	-	-	-	-	-	-	-	-	-	-
Quinone	+	+	+	+	+	+	+	+	+	+
Quinone	+	+	+	+	+	+	+	+	+	+
Phlobatannins	-	-	-	-	-	-	-	-	-	-

Table.3. Qualitative Analysis -Chloroform Extract of *Vitex negundo* leaves and flowers.

Chloroform extract	VNL					VNF				
	1:10	1:20	1:30	1:40	1:50	1:10	1:20	1:30	1:40	1:50
Alkaloids	+	+	+	+	+	+	+	+	+	+
Alkaloids	+	+	+	+	+	+	+	+	+	+
Alkaloids	+	+	+	+	+	+	+	+	+	+
Saponins	+	+	+	+	+	+	+	+	+	+
Carbohydrates	+	+	+	+	+	+	+	+	+	+
Proteins	+	+	+	+	+	+	+	+	+	+
Amino acids	+	+	+	+	+	+	+	+	+	+
Tannins	+	+	+	+	+	+	+	+	+	+
Anthraquinone	+	+	+	+	+	+	+	+	+	+
Fats &oils	+	+	+	+	+	+	+	+	+	+
Phenols	+	+	+	+	+	+	+	+	+	+
Phenols	+	+	+	+	+	+	+	+	+	+
Cardiac glycosides	-	-	-	-	-	-	-	-	-	-
Coumarins.	+	+	+	+	+	+	+	+	+	+
Coumarins.	+	+	+	+	+	+	+	+	+	+
Lipids	+	+	+	+	+	+	+	+	+	+
Flavonoids	+	+	+	+	+	+	+	+	+	+
Carboxylic acid	-	-	-	-	-	-	-	-	-	-
Sterols& Terpenoids	-	-	-	-	-	-	-	-	-	-
Glycosides	-	-	-	-	-	-	-	-	-	-
Fats	-	-	-	-	-	-	-	-	-	-

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Quinone	+	+	+	+	+	+	+	+	+	+
Quinone	+	+	+	+	+	+	+	+	+	+
Phlobatannins	-	-	-	-	-	-	-	-	-	-

Table.4. Aqueous extracts of *Vitex negundo* leaves   and flowers

Aqueous extracts	VNL	VNF
Alkaloids	+	+
Alkaloids	+	+
Alkaloids	+	+
Saponins	+	+
Carbohydrates	+	+
Proteins	+	+
Amino acids	+	-
Tannins	+	+
Anthraquinone	+	+
Fats and oils	+	+
Phenols	+	+
Phenols	+	+
Cardiac glycosides	+	+
Coumarins	-	+
Coumarins.	-	+
Flavonoids	+	+
Carboxylic acid	+	+
Sterols & Terpenoids	+	+
Glycosides	+	+
Quinone	+	+
Quinone	+	+
Phlobatannins	+	+
Lipids	+	+
Fats	+	+

Figure.1.*Vitex negundo* leaves.	Fig. 2*Vitex negundo* flowers
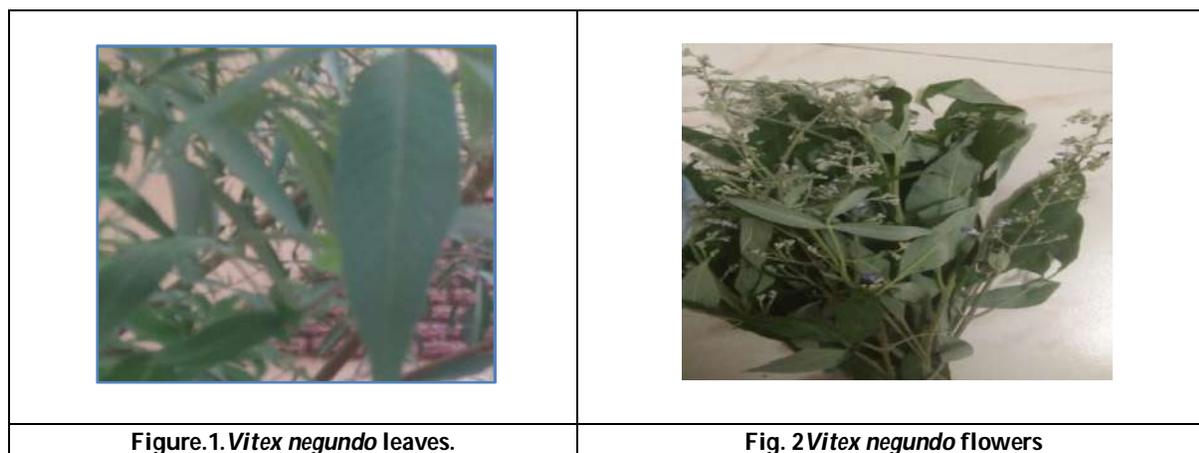
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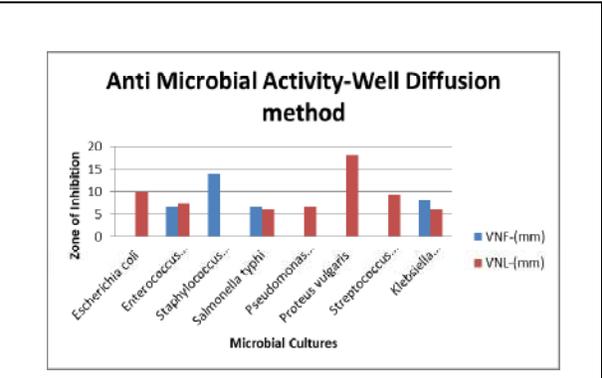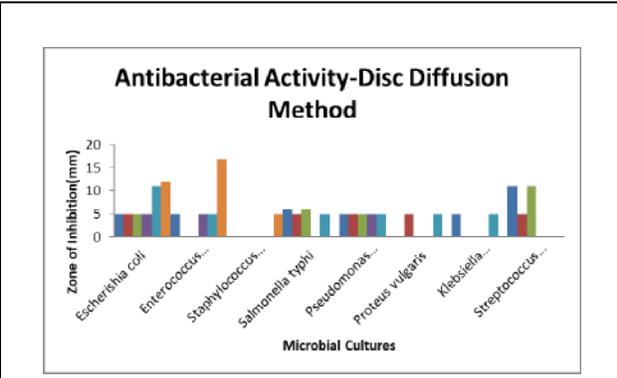
Graph-1.Antibacterial activity of *Vitex negundo* extracts by Disc –Diffusion method.

Graph-2.Antibacterial Activity of   *Vitex negundo* extracts by Well diffusion method.
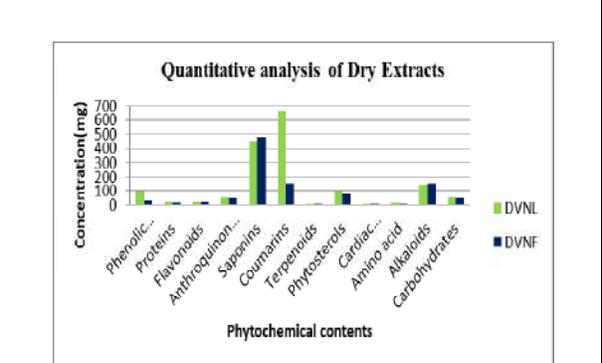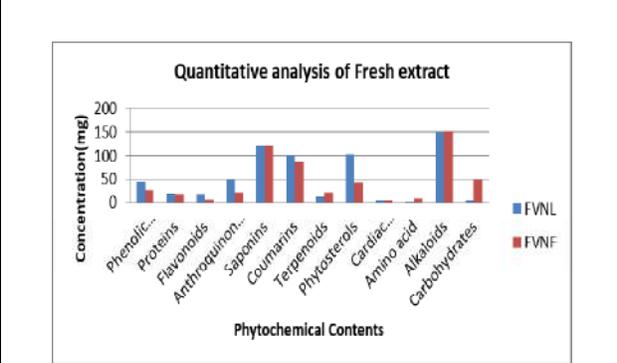
Graph. 3-Standard graph of Quantitative analysis of Fresh extract of *Vitex negundo* leaves and   flowers.

Graph.4-Standard graph of Quantitative analysis of Dry extract of *Vitex negundo* leaves and   flowers.

RESEARCH ARTICLE

Screening of Phytochemicals and Antimicrobial Activity of Lithophytic Fern *Pyrrosia porosa* (C.Presl) Hovenkamp

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ABSTRACT

The objective of the present study was to carry out phytochemical, inorganic constituents, GC-MS analysis, and antimicrobial activity of the lithophytic fern *Pyrrosia porosa* (*C.Presl*) Hovenkamp. The leaves of *Pyrrosia porosa* were subjected to preliminary phytochemical screening using four different solvents. Phytochemicals such as volatile oils, saponins, and steroids were present in petroleum ether extract. Glycosides, saponins, terpenoids, and steroids were present in chloroform extract. The ethyl acteate extract showed the presence of alkaloids, volatile oils, glycosides, resin, saponin, steroids, phenols, and flavonoids. Methanolic extract showed the presence of alkaloids, saponins, phenols, and tannin. Inorganic constituents from the chloroform leaf extract showed the presence of phosphate, nitrate and calcium. The GC-MS analysis of the chloroform extract showed 16 different compounds. The antimicrobial activity of *Pyrrosia porosa* against four bacterial and two fungal species was studied. Among four studied bacterial species, *Staphylococuus aureus* showed 09 mm zone of inhibition and a fungus, *Candida* species, showed 07 mm zone of inhibition.

Keywords: *Pyrrosia porosa*, Phytochemicals, inorganic constituents, GC-MS analysis, antimicrobial activity.

INTRODUCTION

The survival of the human race without plants on the earth is inconceivable. Since the beginning of the human race, humans have been dependent on plants. Herbal use was originally intended to produce a favourable interaction with body chemistry [1]. Traditional medicinal information is important not only for its potential contribution to drug development but also for people's healthcare. According to the World Health Organization, 80% of the world's population, mostly individuals in developing countries, depends on plant-derived medicines for their healthcare needs. Most of the aboriginal people are not well identified with the uses of pteridophytes ever since they're not simply available like flowering plants. Pteridophytes have a vital role in the earth's biodiversity [2]. The word "pteridophyta" has Greek origins. 'Ptero' means fern, 'phyta' means plant. Ferns and their ailles are one of the oldest major divisions of the Pteridophyta, the second largest group of vascular plants. They have a long fossil history on our planet in the early carboniferous period. They have been known since 380 million years ago. There are about 45,000 plant species, in which pteridophytes are represented by 144 genera and about 1200 species distributed in India [3]. Several plants or their parts have been exploited for this purpose. The value of these plants is attributed to the presence of some chemical substances that produce a definite physiological action. These substances are called phytochemicals. These phytochemicals have multiple biological functions such as antioxidant, anticancer, antimicrobial activities, *etc.* [4]. It is a well-known fact that plants produce these chemicals to protect them, but recent research demonstrates that they can also protect humans against diseases [5]. The GC-MS method for analysing plant extracts can be a useful tool for determining the amount of active principles in ferns used in cosmetics, drugs, pharmaceutical or food industry, environmental and forensic applications [6]. It combines two analytical techniques into a single method of analysing mixtures of chemical compounds. Gas chromatography separates the components of the mixture and mass spectroscopy analyses each of the components separately [7]. Since bioactive compounds occurring in plant material consist of multicomponent mixtures, their separation and determination still creates problems. Almost all of them have to be purified by the combination of several chromatographic techniques and various other purification methods to isolate bioactive compounds. Many ferns and fern allies have antimicrobial properties that could be used as alternative medicine for the treatment of various human illnesses instead of allopathic medicines. Therefore, the present study has been carried out to investigate the phytochemicals and antimicrobial properties of *Pyrrosia porosa*, a small lithophytic fern belonging to the family Polypodiaceae and distributed in abundance in the study area.

MATERIALS AND METHODS

Collection of plant materials

The plant material was collected from the Valparai Hills, Western Ghats. The collected specimen was identified and authenticated by Dr.M. Johnson, Director, Center for Biotechnology, St. Xavier's College, Palayamkottai, Trichy with reference number (CPB2097). The collected specimen was identified as *Pyrrosia porosa* (*C.Presl*) Hovenkamp. Leaves were shade dried for 30 days to remove all the moisture content and to preserve the maximum bioactive compounds. The organic solvents in the increasing order of polarity (Petroleum ether, Chloroform, Ethyl acetate, Methanol) were used to extract the powder sample of *Pyrrosia porosa* according to the method described by Harborne (1998). The sample was sequentially extracted using a soxhlet apparatus at a temperature (40–50°C) and was subjected to a test to detect the presence of different phytoconstituents.

PHYTOCHEMICAL ANALYSIS

Qualitative estimation of phytoconstituents

The petroleum ether, chloroform, ethyl acetate, and methanol extracts of *P. porosa were* tested using the standard procedures for the presence/absence of phytochemical constituents viz., alkaloids, glycosides, saponins, volatile oils, terpenoids, and resins [8]; phenolic compounds and flavonoids [9]; tannins, steroids, and anthraquinones [10].

Tests for inorganic constituents

The chloroform extract was tested for the presence and absence of the inorganic constituents *viz.*, chloride, sulphate, nitrate, carbonate, iron and calcium [11].

GC-MS Analysis

The Vellore Institute of Technology (VIT) in Chennai conducted a gas chromatography (GC) analysis. It is one of the key techniques generally used for the screening and identification of many groups of plant phytochemicals. The high attainable separation power in combination with the wide range of the detectors employing various detection principles to which it can be coupled makes GC an important, often irreplaceable tool in the analysis at trace level of plant phytochemical compounds. Gas Chromatographical study includes the important optimization processes such as introduction of the sample extract onto the GC column, separation of its components on an analytical column and detection of target analysis by using a Mass Spectrometric (MS) detector. The Clarus 680 GC was used in the analysis. It employed a fused silica column, packed with Elite-5MS (5% biphenyl, 95% dimethylpolysiloxane, 30m × 0.25mm ID × 250µm df), and the components were separated using helium as carrier gas at a constant flow of 1 ml/min. The injector temperature was set at 260°C during the chromatographic run. The 1µL of extracted sample injected into the instrument at the oven temperature was as follows: 60°C (2min); followed by 300°C at the rate of 10°C min-1; and 300°C, where it was held for 6m in. The mass detector conditions were: transfer line temperature of 240°C; ion source temperature of 240°C; and ionisation mode electron impact at 70 eV, a scan time of 0.2 sec, and a scan interval of 0.1 sec. The fragment size ranges from 40 to 600 Da. The spectra of the components were compared with the database of spectra of known components stored in the GC-MS NIST (2008) library.

Media preparation for antimicrobial activity

The materials which are required for bacterial and fungal media preparation were sterilized in an autoclave at 121°C for 15 min at 15lb pressure, and all procedures were done under Aseptic conditions.

Preparation of Agar plates

Muller Hinton agar (Hi Media) and Potato Dextrose Agar (PDA) was used for antibacterial and antifungal activity. The media was sterilized in the autoclave and was poured onto sterile petriplates and was allowed to solidify. The test organisms used for antibacterial activity were *Staphylococcus aureus*, *Bacillus spp.*, *Pseudomonas aeruginosa* and *Escherichia coli* and that for antifungal activity were *Aspergillus niger* and *Candida spp.*

Disc-diffusion method

Disc-diffusion method was adopted to study antibacterial and antifungal activity [12]. Circular disc of 5mm diameter were prepared and then sterilized in an autoclave. With a pair of sterile forceps (dipped into ethyl alcohol and flamed), a disc was picked up and placed into one sector of the plate. To the impregnated disc, leaf extract was added. The bacterial and fungal plates were then sealed and incubated in an incubator at 37°C for 24 hours and 48 hours respectively. They were then examined for the appearance of clear zone around the disc, *i.e.*, inhibition of growth of the test organisms.

RESULTS AND DISCUSSION

The results of the preliminary phytochemical analysis using different solvents such as petroleum ether, chloroform, ethyl acetate and methanol extracts of *Pyrrosia porosa* are given in Table 1. The petroleum ether extract of *P. porosa* showed the presence of three phytochemicals such as saponins, steroids, and volatile oils. The chloroform extract showed the presence of five phytochemicals such as glycosides, saponins, steroids, tannins, and terpenoids. The ethyl acetate showed positive results for alkaloids, volatile oils, glycosides, resins, saponins, steroids, phenols, and flavonoids. The methanol extract reported the presence of four phytochemicals, viz., alkaloids, tannins, saponins, and resins. Similar work was carried out by Pandian prabhakaran *et al.* [13] in six aqueous extracts of ferns, *viz.*, *Adiantum raddianum, Aspleniuma ethiopicum, Cyclosorus interruptus, Dicranopteris linearis, Diplazium polypodioides, and*

Pteridium aquilinum. A high amount of saponin was found in *C. interruptus, D. linearis,* and *P. aquilinum,* and the minimum amount of saponin was found in *A. raddianum, A. aethiopicum,* and *Diplazium polypodioides.* A minimum amount of tannins and phenols was found in all the fern extracts. Alkaloids were present in all the aqueous extracts except *A. raddianum* and *A. aethiopicum.* Shakoor *et al.* [8] evaluated the preliminary phytochemical screening of some pteridophytes from district Shopian (Jammu and Kashmir). 34 pteridophyte species were screened for phytochemical constituents. Screening was performed with acetone, ethanol, methanol and aqueous extracts of the plants that made up a total of 136 extracts. Out of 34 pteridophyte species, the aqueous extract of the ferns was found to contain flavonoids, terpenoids, saponins, and phenolic compounds.

Inorganic constituents

The chloroform extract of *Pyrrosia porosa* was subjected to the analysis of inorganic constituents, which revealed the presence of three inorganic constituents. The results are given in Table 2. The chloroform extract of *Pyrrosia porosa* was subjected to the analysis of inorganic constituents, which resulted in the presence of phosphate, nitrate and calcium, whereas chloride, sulphate, iron and carbonate were absent. The results confirm the presence of constituents which are known to exhibit medicinal as well as physiological activities. Bharti [11] reported the inorganic constituents present in the methanol leaf extract of *Lygodium flexuosum* and *Amylopteris prolifera.* The result revealed the presence of six inorganic constituents (sulphate, phosphate, potassium, iron, chloride, and calcium). In the present study, chloroform extract of *Pyrossia porosa* expressed positive results for three of the above mentioned inorganic constituents.

GC-MS Analysis

Chloroform extract of *Pyrossia porosa was* subjected to the identification of a number of compounds which were identified using mass spectrometry coupled with GC (Fig-2). Using the recorded retention time, molecular weight, molecular formula, peak area percentages, CAS number, and different compounds were identified (Table-3). The compounds identified in the chloroform extract of *Pyrrosia porosa* have important biological activities, which were illustrated in (Table -3). It showed 16 peaks majorly which indicates the presence of 16 compounds, with the retention time ranging from 2.593 to 30.519 minutes. The prevailing compounds identified with high or major peaks were observed with 25.063 area % at 2.593 retention time (RT), which mainly possessed butane, 2-ethoxy-2-methyl). The next major peak was observed with 13.631 area % at 18.620 retention time, which has 3,7,11,15-Tetramethyl-2-hexadecen-1-OL. Followed by Docosane, 2,4- dimethyl9.483 area % at 28.444(RT), Heptadecane,2,6,10,15-Tetramethyl- 6.993 area % at 17.074 (RT), Nonadecane – 6.337 area % at 19.315 (RT), Eicosane,9-octyl- 4.985 area % at 26.289 (RT), Phytol – 4.812 area % at 18.685 (RT),Nonadecane – 4.594 area % at 20.370 (RT), Hexadecanolc acid,2-hydroxy-1- (hydroxyme-methyl)ethylester- 3.938 area % at 25.127 (RT), Heptadecane,2,6,10,15-Tetramethyl- 3.774 area % at 18.205 (RT), 3,7,11,15- Tetramethyl-2-hexadecen-1-OL-3.362 area % at 19.100 (RT), Docosane, 2,4-dimethyl-3.111 area % at 28.559 (RT), Docosane, 2,4-dimethyl- 3.073 area % at 28.289 (RT), Eicosane,9-octyl- 2.478 area % at 29.324 (RT), 3,7,11,15-Tetramethyl-2-hexadecen-1-OL2.291 area % at 18.885 (RT), Henelcosane,3-methyl- 2.074 area % at 30.519 (RT).

Similar work was done by Arockia Badhsheeba and Vadivel [14] in methanol extracts of leaves and rachis of *Acrostichu maureum.* The GC-MS chromatogram of the leaf methanol extract of *A. aureum* shows 19 peaks, indicating the presence of 19 compounds, with the retention time ranging from 3.94 to 35.77 minutes. The prevailing compound identified with a high peak was DL-phenylalanine, N-Chlorodiflouro acetyl-ethyl ester (15.75%). In all, fifteen compounds with a retention time ranging from 3.92 to 27.12 minutes were identified in the rachis of methanol extract of *A. aureum.* The component that has the highest peak is Denotonium benzoate (31.14%). GC-MS studies have been increasingly applied for the analysis of medicinal plants. This technique has proved to be a valuablemethod for the analysis. GC-MS analysis of *A. aureum, A. trapeziformae, B. orientale, D. linearis* and *L. flexuosum* in ethanol extract evaluated the existence of the GC-MS Chromatogram of the 11, 14, 5, 3 and 7 peaks respectively. The majorcompounds like Tetradecanoic acid, ethyl ester, n-Hexadecanoic acid, Hexadecanoic acid, ethyl ester and Octadecanoic acid, ethyl ester shows important medicinal properties [15].

Antibacterial Activity

The chloroform extract of *Pyrrosia porosa* was subjected to the evaluation of antibacterial activity using Muller-Hinton agar and PDA medium by following disc diffusion method. The result of the study was reported in Table-4. The chloroform extract of *Pyrrosia porosa* showed no zone of inhibition against *Pseudomonas aeruginosa*and minimum zone of inhibition was observed against *Staphylococcus aureus* (09 mm), *Bacillus spp* (08mm) and *Escherichia coli* (05mm). This result reveals that chloroform extract of *Pyrossia porosa* do have some antibacterial activity against three test organisms out of four studied organisms. Similar work was carried out by Manhas *et al.* [16] in the fern *Christella dentata.* Antimicrobial activities of methanolic extracts at different fractions were evaluated by the agar well diffusion method according to their zone of inhibition against *Rhodococcus pyridinivorans* NIT-36 (gram positive) and *Geobacillus stearothermophilus* MAC 1. The zone of inhibition against *Rhodococcus pyridinivorans* NIT-36 and at a concentration of 260 mg was seen to be maximum at 25 mm with respect to the standard taken as antibiotic streptomycin at 26 mm. As in the case of *Geobacillus stearothermophilus* MAC 1, it did not show any zone of inhibition at any concentration, as this strain of bacteria can tolerate extreme conditions as its habitat. Being a thermophile, it is resistant to any amount of phytochemical action.

Antifungal Activity

The chloroform extract of *Pyrrosia porosa* were subjected for the evaluation of antifungal activity in Tryptone Soya Agar medium using disk diffusion method. The result of the study is reported in Table -5. The Chloroform extract of *Pyrrosia porosa* showed no zone of inhibition against *Aspergillus niger* whereas minimum zone of inhibition was observed against *Candida spp* (07mm). This reveals that Chloroform extract of *Pyrrosia porosa* possess antifungal activity against *Candida spp*.

CONCLUSION

The present study was proposed to investigate the secondary metabolites of *Pyrrosia porosa,* a fern that belongs to the family Polypodiaceae. The leaves of *Pyrrosia porosa* were analysed for their phytochemical and inorganic constituents. Preliminary phytochemical screening reported the presence of glycosides, saponins, terpenoids, and steroids in chloroform extract. The presence of alkaloids, volatile oil, glycosides, saponins, resin, flavonoids, steroids, phenol in ethyl acetate extract. The methanol extract reported the presence of four phytochemicals, viz., alkaloids, tannins, saponins, and resins. The petroleum ether showed the extract presence of three phytochemicals, viz., volatile oil, saponins, and steroids. The analysis of inorganic constituents in the chloroform extract of *Pyrrosia porosa* contains phosphate, nitrate, and calcium. The GC-MS analysis of chloroform extract showed 16 peaks corresponding to 16 different compounds. The antibacterial and antifungal activities of *Pyrrosia porosa* chloroform extract exhibited a minimum zone of inhibition. The compound phytol identified in the GC-MS analysis possesses anti-inflammatory activity. So, this studied fern may possess anti-inflammatory activity.

CONFLICT OF INTEREST
Anthors have no conflict of interest.

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Table.1: Phytochemical analysis of *Pyrrosia porosa* (C. Presl) Hovenkamp

Phytoconstituents	Petroleum ether	Chloroform	Ethyl acetate	Methanol
Alkaloids	-	-	+	+
Volatile oils	+	-	+	-
Glycosides	-	+	+	-
Tannin	-	-	-	+
Saponins	+	+	+	+
Terpenoids	-	+	-	-
Resin	-	-	+	-
Flavonoids	-	-	+	-
Steroids	+	+	+	-
Phenols	-	-	+	+
Anthraquinones	-	-	-	-

+ Present   - Absent

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Table 2: Inorganic constituents of *Pyrrosia porosa*

Elements	Observation
Chloride	-
Sulphate	-
Phosphate	+
Nitrate	+
Carbonate	-
Iron	-
Calcium	+

+ Present   - Absent

Table 3: Compounds identified in GC-MS analysis of chloroform extract of *P.porosa*

RT	Compound name	Molecular weight	Molecular formula	Area %	CAS No.	Biological role
2.593	Butane,2-ethoxy-2- methyl	116	$C_7H_{16}O$	25.063	919-94-8	-
17.074	Heptadecane 2,6,10,15-tetramethyl-	296	$C_{21}H_{44}$	6.993	54833-48-6	-
18.205	Heptadecane 2,6,10,15-tetramethyl-	296	$C_{21}H_{44}$	3.774	54833-48-6	-
18.620	3,7,11,15- Tetramethyl-2-hexadecen-1-OL	296	$C_{20}H_{40}O$	13.631	102608-53-7	-
18.685	Phytol	296	$C_{20}H_{40}O$	4.812	150-86-7	Anti-inflammatory activity Activitantiproliferative activity
18.885	3,7,11,15- Tetramethyl-2-hexadecen-1-OL	296	$C_{20}H_{40}O$	2.291	102608-53-7	-
19.100	3,7,11,15-Tetramethyl-2-hexadecen-1-OL	296	$C_{20}H_{40}O$	3.362	102608-53-7	-
19.315	Nonadecane	298	$C_{19}H_{40}$	6.337	629-92-5	NCL yeast anti-cancer drug screen.
20.370	Nonadecane	268	$C_{19}H_{40}$	4.594	629-92-5	NCL yeast anti-cancer drug screen
25.127	Hexadecanolc acid,2-hydroxy-1-(hydroxyme-methyl)ethylester	330	$C_{19}H_{38}O_4$	3.938	23470-00-0	-
26.568	Elcosane,9octyl	394	$C_{28}H_{58}$	4.984	13475779	NCL yeast anti-cancer drug screen
28.289	Docosane,2,4- dimethyl	338	$C_{24}H_{50}$	3.073	77536-30-2	-
28.444	Docosane,2,4- dimethyl	338	$C_{24}H_{50}$	9.483	77536-30-2	-
28.559	Docosane,2,4- dimethyl	338	$C_{24}H_{50}$	3.111	77536-30-2	-
29.324	Eicosane,9octyl		$C_{28}H_{58}$	2.478	23475-77-9	NCLyeast

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		394				anticancer drug screen
30.519	Henelcosane,3- methyl	310	$C_{22}H_{46}$	2.074	6418-47-9	-
9.081	Pentanoic acid, 2(Aminooxy)	133	$C_5H_{11}O_3N$		5699-55-8	-
20.370	Octacosane	394	$C_{28}H_{58}$	4.594	630-02-4	Antimirobial activity
20.370	Heneicosane	296	$C_{21}H_{44}$	4.594	629-94-7	Inhibits aflatoxin production, Antineoplastic
25.127	Hexadecanoyl hydrazide	270	$C_{16}H_{34}ON_2$	3.938	2619-88-7	-
28.289	2-Methyldocosane	324	$C_{23}H_{48}$	3.073	1560-81-2	-
28.289	1-Heptadecanamine	255	$C_{17}H_{37}N$	3.073	4200-95-7	NCI yeast Anticancer drug screen
28.289	1H-Tetrazol-5-amine	85	CH_3N_5	3.073	4418-61-5	NCI yeast Anticancer drug screen
25.127	1-Tridecene	182	$C_{13}H_{26}$	3.938	2437-56-1	Cell viability counter screen
25.127	3-Heptadecenal	252	$C_{17}H_{32}O$	3.938	900143-48-7	-
25.127	Octadocanoic acid,Octadecyl ester	536	$C_{36}H_{72}O_2$	3.938	2778-96-3	-
25.127	16-Hexadecanoly hydroxide	270	$C_{16}H_{34}ON_2$	3.938	2619-88-7	-
18.620	Hexadecanal	240	$C_{16}H_{32}O$	13.631	629-80-1	Antiviral activity
18.620	1-Octadecanol	250	$C_{18}H_{34}$	13.631	629-89-0	Antiviral activity, Anticancer
18.620	16-Heptadecanol	252	$C_{17}H_{32}O$	13.631	900144-57-9	-
18.620	16-Heptadecanol	252	$C_{17}H_{32}O$	13.631	900144-57-9	-
18.620	Cyclododecanol	184	$C_{12}H_{24}O$	13.631	1724-39-6	NCI yeast anticancer drug sreen
18.620	Tridecanal	198	$C_{13}H_{26}O$	13.631	10486-19-8	Nematicidal activity
18.620	Hexadecyne	222	$C_{16}H_{30}$	13.631	629-74-3	-
19.100	1-Octadecyne	250	$C_{18}H_{34}$	3.362	629-89-0	Antiviral activity, Anticancer
19.100	1-Hexadecyne	222	$C_{16}H_{30}$	3.362	629-74-3	-
19.100	1-Pentadecyne	208	$C_{15}H_{28}$	3.362	765-13-9	-
19.100	1-Tetradecyne	194	$C_{14}H_{26}$	3.362	765-10-6	-
19.100	1-Heptadecyne	236	$C_{17}H_{32}$	3.362	26186-00-5	-
19.100	1-Eicosyne	278	$C_{20}H_{38}$	3.362	765-27-5	Colorimetric assay for SAR study

18.685	3,4-dimethylcyclohexanol	128	$C_8H_{16}O$	4.812	5715-23-1	NCI yeast anticancer drug screen
9.081	2,6-Pyrazinediamine	110	$C_4H_6N_4$		41536-80-5	-
9.081	4-Nonanol	144	$C_9H_{20}O$		5932-79-6	-
29.324	2-methldocosane	324	$C_{23}H_{48}$	2.478	1560-81-2	-
29.324	Nona Hexacontanoic acid	998	$C_{69}H_{138}O_2$	2.478	40710-32-5	-
26.568	Di-N-Decylsolfone	345	$C_{20}H_{42}O_2S$	4.985	111530-37-1	Antifungal, Antimicrobial
26.568	15-Methyltriacontane	478	$C_{34}H_{70}$	4.985	900131-20-3	-
17.074	Octadecane	254	$C_{18}H_{38}$	6.993	593-45-3	NCI yeast anticancer drug screen
17.074	Heptadecane	240	$C_{17}H_{36}$	6.993	629-78-7	Antibacterial

Table 4: Antibacterial activity of *Pyrrosia porosa*

Test Organisms	Zone of inhibition in mm
Staphylococcuus aureus	09mm
Bacillus spp	08mm
Pseudomonas aeruginosa	No Zone
Escherichia coli	05mm

Table. 5: Antifungal activity of *Pyrrosia porosa*

Test Organisms	Zone of inhibition in mm
Aspergillus niger	No zone
Candida spp	07mm

| **Figure 1: Habit of *Pyrrosia porosa*** | **Fig. 2: Total ion chromatogram of Chloroform extract of *P.porosa*** |
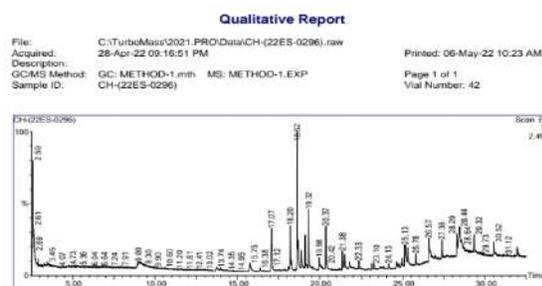
RESEARCH ARTICLE

An Investigative Study on Consumer Cognizance towards Electric Vehicles

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ABSTRACT

Electric vehicles are at an early stage of development in India. As the scale of production increases and battery costs decline, the prices of electric vehicles become lower. Providing a purchase subsidy to the consumer directly or through vendors or manufacturers as a discount at the time of purchase can maximize the impact of the subsidy on the consumer's purchase decision. The study addressed the consumer awareness and perception towards electric vehicles since most of the previous studies were made before pandemic. Sample of 150 respondents has been taken in Coimbatore District by adopting snowball sampling techniques. Tools such as percentage analysis, chi-square test, t-test, ANOVA and descriptive statistics have been applied. The study reveals that there is a significance difference among gender and place of residence with respect to awareness about electric vehicles. There is also a significance association between type of family and Preference towards electric vehicle at 5 per cent.

Keywords: Electric vehicles, Battery Cost, Subsidy, consumer awareness and perception.

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INTRODUCTION

Electric Vehicles plays an important role in protecting the environment from burning fossil fuels such as gasoline. The gasoline produces harmful to greenhouse gases. The electric vehicles are growing faster due to several factors, including cost reduction, technological progress, driving and parking access advantages, policy support and purchase incentives. The global stock of Electric Vehicles (EVs) and its rapid rise has been led by China, US, Japan and also by several European countries. In India, transport electrification is likely to be driven by Light Electric Vehicles (LEVs), consist of two-wheelers (scooters, motorcycles) and three-wheelers (passenger and cargo). Apart from these, cars and Light Commercial Vehicles (LCVs) are also the other key vehicle segments that are being electrified (According to Anders Hove and David Sandalow February 2019)[11]. Electric Vehicles (EV) have been charged in a variety of ways, depending on location and requirement. Similarly, charging infrastructure for EVs is also in various types and designed for various applications. Specifications and standards for EV chargers, also known as Electric Vehicle Supply Equipment (EVSE), differ from one country to another, depending on available EV models in the market and the distinctiveness of the electricity grid(According to NITIAayog, Ministry of Power *et al*)[3]. There are 3 types of electric vehicle such as Battery Electric Vehicle (BEV), Plug-in Hybrid Electric Vehicle (PHEV) and Hybrid Electric Vehicle (HEV).

A Battery Electric Vehicle (BEV) operates entirely by electric Motor and battery without the support of a traditional internal combustion engine. It must be plugged into an external source of electricity to recharge its battery. Like all electric vehicles, regenerative braking process is used to recharge the Battery Electric Vehicles which use the vehicle's electric motor to aid in slowing the vehicle, and to recover some of the energy normally converted to heat by the brakes. An advantage of battery electric vehicles (BEV) are no emissions, no gas or oil changes, ability to conveniently charge at home, fast and smooth acceleration and low cost of operation (According to Alternative fuels data center)[14]. Plug-in Hybrids (PHEVs) consists of both the electric motor and battery that can be plugged into the power grid to charge the battery and also supports an internal combustion engine that has been used to recharge the vehicle's battery and/or to replace the electric motor when the battery is low. Because Plug-in Hybrids use electricity from the power grid, they often realize more savings in fuel costs than tradition Hybrids Electric Vehicles (HEV). The advantages of Plug-in Hybrids are longer range than BEV, less gas consumption than gas only vehicle, fewer emissions and very simple mechanics.(According to Alternative fuels data center)[14]. Hybrid Electric Vehicles (HEVs) have two corresponding drive systems: a gasoline engine with a fuel tank and an electric motor with a battery. Both the engine and the electric motor can turn the transmission at a time. The transmission then turns the wheels. Hybrid Electric Vehicles cannot be recharged from the electricity grid. All the energy comes from gasoline and from regenerative braking. The advantages of Hybrid Electric Vehicles are longer range than BEV, less gas consumption than gas only vehicle and fewer emissions when compare to gas only vehicle (According to National Highway Travel Survey)[2].

Review Of Literature

According to National Highway Travel Survey (2021), Electric Vehicles (EVs) use electricity as their primary fuel. It improves the efficiency of conventional vehicle designs. All the electric vehicles referred to as Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs). In references, these vehicles are called electric cars, or simply Electric Vehicles, even though some of these vehicles still use liquid fuels in conjunction with electricity. EVs are known for providing instant and a quiet driver experience. According to NITI Aayog, Ministry of Power (MoP), Department of Science and Technology (DST), Bureau of Energy Efficiency (BEE) and WRI India (2021), The handbook provides a detailed approach of the EV charging infrastructure roadmap, moving from an assessment of EV charging requirements to location planning and arranging electricity supply to models of on-ground implementation. This book specifies that Electric vehicles (EV) can be charged in a variety of ways, depending on location and requirement. Specifications and standards for EV chargers, also known as Electric Vehicle Supply Equipment (EVSE), diverge from one country to another, based on existing EV models. NaanJu *et al* (2021) stated that consumers thought electric cars were sophisticated, luxurious, youthful, clean and that technical problems would be

resolved in the future. The inconveniences of charging and short-distance driving, the expenses and the lack of various dispute settlement measures have been shown to lower the intention to purchase electric vehicles. According to Aparna Menon, Zifei Yang and Anup Bandivadekar (2019) depicts that state governments play an important role in electric vehicle market development by complementing national actions with policies that fit local conditions. It also act as a bridge between national and city governments. To assist state-level policymakers in designing well-rounded electric vehicle policy packages, this study identifies and summarizes international best practices in promoting electric vehicles.

Objectives

➢ To know the demographic profile of the consumers and their preference towards electric vehicles.
➢ To identify the consumers' perception towards purchase of electric vehicles.
➢ To analyze the consumers' awareness about the purchase of electric vehicles.

Research Methodology

A structural questionnaire is used to collect the data in the area of Coimbatore District. A sample of 150 respondents has been taken for the study by adopting snowball sampling techniques. Tools such as percentage analysis, chi-square test, t-test, ANOVA and descriptive statistics have been applied to analyze the data.

Analysis And Interpretation

With respect to age group of the respondents it is clear that out of 150 respondents, 130 respondents belong to the age group of 18-25 years. Among them, Majority (64.0 per cent) of the respondents prefer Hybrid vehicle. Most of the female respondents (51.3%) prefer hybrid vehicle, Most of the Under graduate respondents (54.7%) prefer hybrid vehicle, Most of the students (56.7%) prefer hybrid vehicle, 45.3 per cent of the respondents annual income is below 200000 and 60 per cent of the nuclear family prefer hybrid vehicle. In the above table the chi-square result had shown that type of family have asignificant association with Preference towards electric vehicle at 5 per cent level. Hence, the null hypothesis has been rejected. Then the null hypotheses have been accepted with respect to age, gender, educational qualification, occupation and annual income of the respondents. From the mean ratings it is inferred from the table-2 that, the high mean rating has been found for the statement 'Electric vehicles are environmentally friendly because they have Zero emissions' (Mean 4.38) followed by the 'Electric vehicles are much quieter(less noise) than other vehicles' (Mean 4.36), 'The cost to charge an electric vehicle is much less than the fuel costs for a petrol or diesel vehicle' (Mean 4.03),' Electric vehicle technology has improved and they have a better range now' (Mean 4.03), and 'The purchase cost of electric vehicle is same as the cost of petrol or diesel vehicle' (Mean 3.48). Hence, based on high mean rating, it is evident that, most of the respondents have high perception about 'Electric vehicles are environmentally friendly because they have Zero emissions'.

It is observed from the above table that, the mean score (3.80) for "Awareness about different types of electric vehicles launched in our country" is high when compare to other statements followed by "Awareness about the companies that manufacture electric vehicles in India", "Awareness about the various incentives provided by our central and state government for the purchase of electric vehicle" etc., In the above table, the results have shown that gender and Place of residence have a significant variation among the awareness about electric vehicles. Hence, the null hypothesis has been rejected. The null hypotheses have been accepted with respect to age, educational qualification, occupation, marital status, type of family, annual income, number of vehicle owned, own a vehicle, preferred vehicle, electric model preferred and purchase choice of electric vehicle in future.

Suggestion

➢ There is a lack of charging infrastructure facility; therefore the government should make availability of existing private and public charging infrastructure for the convenience of the electric vehicle users.
➢ The availability of a range of electric vehicle models across multiple segments and consumer price points is a key factor for the broader adoption of electric vehicles. Therefore proper advertisement is needed to increases the sale of electric vehicle.

➢ The state government should identify the electric vehicle development objective and opportunity and understand barriers for electric vehicle in order to promote.

➢ Governments can motivate electric vehicle production through mandates or incentive programs. The State Pollution Control Boards (SPCBs) in India, under the Air Act of 1981, have the authority to regulate emissions and issue standards for all categories of automobiles.

➢ Promote businesses to set up electric vehicle and constituent manufacturing enterprises by providing financial incentives such as low-interest or interest-free loans, subsidies, reimbursement of SGST accrued to the state, stamp duty and land registration charge exemptions or discounts, subsidies for setting up effluent treatment plants etc.

CONCLUSION

Innovative and dynamic support is necessary to design and implement an electric vehicle policy that greatest fits the local framework. Apart from improvements in technology, government actions and initiatives have been made for electric vehicles, in order to achieve significant market shares. Electric Vehicles around the world, policy makers have instituted a suite of incentives to encourage buyers to try this new technology. The study has been concluded that, most of the respondents prefer to buy hybrid vehicles and they have high perception score on "Electric vehicles are environmentally friendly because they have Zero emissions" and "Awareness about different types of electric vehicles launched in our country". Finally it is concluded that there is a significance difference among gender and place of residence with respect to awareness about electric vehicles. There is also a significance association between type of family and Preference towards electric vehicle at 5 per cent level of significance.

Declaration of competing interest
The authors (we) declare that there is no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.
We affirm that the research article is our original contribution and it would not be sent elsewhere for publication.

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Table.1:Chi-Square Test - Personal Factors Vs Preference towards vehicle

Personal Factors		Hybrid vehicle		Electric vehicle		Total		P-Value	Significance
	18-25	No	%	No	%	No	%		
Age	26-35	96	64.0	34	22.7	130	86.7	0.239	Ns
	36-45	10	6.7	7	4.7	17	11.3		
Gender	Male	3	2.0	0	.0	3	2.0	0.571	Ns
	Female	32	21.3	14	9.3	46	30.7		
Education Qualification	School level	77	51.3	27	18.0	104	69.3	0.668	Ns
	Under graduate	11	7.3	3	2.0	14	9.3		
	Post graduate	82	54.7	29	19.3	111	74.0		
	Professional course	13	8.7	8	5.3	21	14.0		
Occupation	Student	3	2.0	1	.7	4	2.7	0.561	Ns
	Business	85	56.7	29	19.3	114	76.0		
	Employee	5	3.3	1	.7%	6	4.0		
	Home maker	18	12.0	10	6.70	28	18.7		
Annual Income	Below 200000	1	.7	1	.7	2	1.3	0.657	Ns
	200000-500000	68	45.3	28	18.7	96	64.0		
	Above 500000	35	23.3	12	8.0	47	31.3		
Type of Family	Nuclear family	6	4.0	1	.7	7	4.7	0.053	*
	Joint family	90	60.0	28	18.7	118	78.7		
		19	12.7	13	8.7	32	21.3		

(Source: computed)(Ns – Not significant,** - significant at 1 per cent level, * - significant at 5 per cent level)

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Table.2: Descriptive Statistics on Perception towards electric vehicles

Perception towards electric vehicles	N	Minimum	Maximum	Mean	Std. Deviation
Electric vehicles are environmentally friendly because they have Zero emissions	150	1	5	4.38	.766
The cost to charge an electric vehicle is much less than the fuel costs for a petrol or diesel vehicle	150	1	5	4.03	.870
The purchase cost of electric vehicle is same as the cost of petrol or diesel vehicle	150	1	5	3.48	1.128
Electric vehicle technology has improved and they have a better range now	150	2	5	4.03	.781
Electric vehicles are much quieter(less noise) than other vehicles	150	1	5	4.36	.805

(Source: Computed)

Table.3: Descriptive Statistics on awareness about electric vehicles

Awareness about electric vehicles	N	Minimum	Maximum	Mean	Std. Deviation
Awareness about the various incentives provided by our central and state government for the purchase of electric vehicle	150	1	5	3.63	1.071
Awareness about different types of electric vehicles launched in our country (Eg: Ola electric scooter)	150	1	5	3.80	1.087
Policies introduced by our government in order to promote the electric vehicle industry	150	1	5	3.40	1.182
Awareness about the number of recharging outlets in your locality	150	1	5	3.25	1.237
Awareness about the companies that manufacture electric vehicles in India	150	1	5	3.67	1.162

(Source: computed)

Table.4: Socio- economic Profile factors and awareness about electric vehicles

Variables	Group	Mean	S.D	No	t-value	F-Value	Sig
Age	18-25	3.50	.921	130		1.644	Ns
	26-35	3.93	.946	17			
	36-45	3.53	.231	3			
Gender	Male	3.78	.853	46	2.043		*
	Female	3.45	.937	104			
Occupation	Student	3.49	.922	114		1.472	Ns
	Business	4.07	.900	6			
	Employee	3.64	.904	28			
	Homemaker	4.40	.849	2			
Educational Qualification	School level	3.23	1.075	14		1.200	Ns
	Undergraduate	3.55	.884	111			

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	Post graduate	3.64	1.037	21			
	Professional course	4.15	.619	4			
Marital Status	Married	3.69	.914	11	.528		Ns
	Unmarried	3.54	.925	139			
Type of the family	Nuclear family	3.53	.943	118	-.522		Ns
	Joint family	3.62	.853	32			
Place of residence	Urban	3.57	.916	60		2.542	*
	Semi urban	3.34	.984	36			
	Rural	3.80	.840	43			
	Semi rural	3.13	.859	11			
Annual Income	Below 200000	3.51	.876	96		.245	Ns
	200000-500000	3.63	.970	47			
	Above 500000	3.57	1.298	7			
Number of vehicle owned	One	3.63	.872	46		.396	Ns
	Two	3.56	.901	58			
	Three	3.41	1.009	35			
	Four and above	3.62	1.025	11			
Own a Vehicle	Yes	3.25	1.071	13	-1.242		Ns
	No	3.58	.906	137			
Preferred vehicle	Hybrid vehicle (use both electricity and fuel)	3.52	.946	109	-.610		Ns
	Electric vehicle	3.62	.864	41			
Electric model preferred	Scooter	3.50	.860	82		2.199	Ns
	Bike	3.84	.830	33			
	Car	3.41	1.100	35			
purchase choice of electric vehicle in future	Yes I will purchase	3.62	.939	104		1.937	Ns
	No I will not purchase	3.95	.755	4			
	Not sure	3.33	.870	42			

(Source: computed)(Ns – Not significant; * - significant at 5 per cent level)

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RESEARCH ARTICLE

Response Surface Methodology Approach for Adsorptive Removal of Hexavalent Chromium: A Fixed-Bed Column Study

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ABSTRACT

Adsorption of hexavalent chromium from polluted aqueous solution was studied utilising iron impregnated sugarcane carbon (Fe–SCC) based on varied experimental settings of the continuous fixed–bed column. A three–level, four–factor Box–Behnken design (BBD) in RSM was used to examine the impact of various parameters on the breakthrough time for Cr(VI) adsorption, such as initial Cr(VI) concentrations of 20–50 mg/L, influent flow rates of 1.5–4.5 mL/min, and adsorbent dosages of 2.5–7.5 g. Using ANOVA, the quadratic model was found to be significant and adequate. As shown in the Perturbation plot, flow rate has the biggest impact on breakthrough time. Optimized results showed that Fe–SCC adsorbent was effective and economical to use, with a maximum breakthrough time of 1659 minutes when the tested variables were retained at 2.5 g Fe–SCC dose, 50 mg/L initial Cr(VI) concentration, and a flow rate of 4.5 mL/min, with a maximum desirable value of 0.938.

Keywords: Chromium, Adsorption, Removal, Column Study, RSM, BBD.

INTRODUCTION

Heavy metal water pollution is one of the most serious environmental problems because of the harm it causes to the ecosystem and to human health. Untreated or partially treated effluents from industries such as mining operations, electro–plating, leather tanning, water cooling, and pigment manufacture include chromium [1–3]. While Cr(III) and Cr(VI) are the two most stable forms of chromium found in water, Cr(VI) is highly poisonous, carcinogenic, and mutagenic [3–5]. According to WHO, the permissible limit of Cr(VI) in drinking water, internal surface water, and industrial wastewater are 0.05, 0.1, and 0.25 mg/L, respectively [6]. The industrial wastewater contains much higher

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concentrations of Cr(VI) compared to the WHO permissible limit which ultimately spreads into the environment through soils and water streams and finally accumulates along the food chain which causes human health hazards [7,8]. To comply with these legal requirements, high chromium–containing industrial wastewater must be treated to reduce the Cr(VI) to permissible limits before discharging into the environment by using proper removal technique [6,9,10]. Several physiochemical techniques including chemical precipitation, ion exchange, adsorption, membrane filtration, coagulation–flocculation, flotation, and electrochemical methods have been applied and reported to remove Cr(VI) from wastewater system [4,11–14]. Among these technologies, adsorption is the most versatile and widely used technique for the removal of Cr(VI) because of its low cost, ease of process, and simplicity of design [1,4,6]. In adsorption study, commercially available activated carbon has been extensively used as a potential adsorbent for Cr(VI) removal because of its extended surface area, micro/mesoporous structure, and significant adsorption capacity [15,16]. However, due to its high cost and difficult procurement of activated carbon [17,18], efforts are being directed to develop cheaper but effective adsorbents from a variety of agricultural, industrial, or biowaste materials [19–22]. Char carbon made from waste materials is likely to be a good substitute for activated carbon because of the chemistry on the surface. An alternate adsorbent for this purpose is carbonised sugarcane bagasse, which is also known as sugarcane carbon (SCC). Cr(VI) adsorption capacity was considerably increased by the use of iron–impregnated char carbon, which provides extra reactive sites for iron loading [23].

For adsorption research, the two most common experimental designs are batch and column. Using batch adsorption data on a wide scale like industrial wastewater treatment would be problematic because it is limited to the laboratory. On the other hand, column operations provide data that can be profitably used in industry [4,24,25]. Individual parameters' effects on the adsorption process have been studied in most adsorption experiments (batch/column), with other operating variables being unaltered during the investigation phase. Optimal levels can only be determined by doing a large number of sequential trials, which is both time demanding and likely to overlook the effects of interdependent parameters, perhaps resulting in erroneous interpretations of the results. RSM (response surface methodology) has been used to overcome this problem. It enables to optimise the effective factors with a minimal number of tests, as well as to study the combined effect of different variables influencing the adsorption process [20,26–28]. Iron impregnated SCC (Fe–SCC) could be used to remove Cr(VI) from an aqueous environment because of these properties. This merits more investigation. Using the Box–Behnken design (BBD) in RSM, a series of column operations were carried out to evaluate the ability of Fe–SCC to remove Cr(VI). The BBD is a tool for evaluating a system's performance under three different conditions of operation. ANOVA and lack–of–fit are used to evaluate the model's significance in the experiment's results. The findings of this investigation are presented and debated.

MATERIALS AND METHODS

Reagents and apparatus
Chemicals purchased from M/S, Merck India Ltd. were employed in the investigation as analytical grade. Potassium dichromate ($K_2Cr_2O_7$) was dissolved in double–distilled water to make a stock solution of hexavalent chromium (500 mg/L) and the working standard Cr(VI) concentrations were obtained by dilution on a daily basis. A 15 percent HNO_3 soak and a double–distilled water rinse was performed on all glassware and columns prior to the adsorption experiment.

Analytical determination
At 540 nm wavelength, a UV–visible spectrophotometer (Systronics Vis double beam Spectro 1203, India) utilising 1,5–diphenyl carbazide method was used to estimate the concentration of Cr(VI) in the pink complex [6,20,21,29,30]. A freshly prepared Cr(VI) standard solution was used to verify calibration everyday before to analysis. A blank experiment was performed to check that no adsorption was taking place on the apparatus's walls. Using Fe–SCC adsorbent, the control experiment revealed that no Cr(VI) was released by Fe–SCC; as well. In P. Roy et al. / Journal

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of Environmental Chemical Engineering 2 (2014) 585–597, the specifics of the preparation and characterization of Fe–SCC are presented.

Experimental setup

Borosilicate glass columns of 50 cm length and 3 cm internal diameter were used for fixed–bed column operations. To prevent adsorbent floatation and to ensure a tightly packed arrangement, the column was packed with varying amounts of Fe–SCC to obtain different bed heights. This was done between two supporting layers of 1–cm glass wool. Because different wastewaters have varying pH values, the original pH of the Cr(VI) solution was not altered for the column adsorption investigations. A peristaltic pump (Mrclab, PP–X–10, Israel) was used to pump a known concentration of Cr(VI) solution vertically up through the column at the specified flow rate. Treated water samples were taken from the column's outflow at regular intervals for the aim of determining the concentration of Cr(VI) in the water. Accordingly, the WHO maximum permitted value of 0.25 mg/L for industrial wastewater was adopted as a breakthrough point in this investigation; that is, when the Cr(VI) content in treated water exceeds that value, a breakthrough time is established [6,29]. When the breakthrough was made, the column's operation was halted. At 30° C, all experiments were carried out twice, and the average values were calculated from the results of the first and second trials.

Experimental design

This work was conducted in order to find the optimal set of Cr(VI) adsorption operational variables for the fixed–bed column. There were three independent variables (initial concentration of Cr(VI), flow rate, and adsorbent dosage) that were used in RSM to explore their influence on the breakthrough time of column adsorption studies using Fe–SCC adsorbent. Breakthrough time (response variable) was expressed in terms of the independent process variables in RSM. Table 1 provides the experimental range, units, and notation for the selected variables. 2^3 full factorial BBD was performed by applying Design–Expert (Stat Ease Inc., version 7.0.3, Minneapolis, USA) software. According to this design, a total of 17 experiments in a duplicate were employed to the BBD matrix as tabulated in Table 2.

RESULT AND DISCUSSION

EVALUATION OF BBD AND MODEL STATISTICS

Linear, 2FI, cubic, and quadratic models using BBD were tested to identify a model that may be utilised to predict the response to the experiment. Both the sequential model sum of squares (Table 3) and the summary of model (Table 4) were used to evaluate the models' suitability. R^2 was used to gauge the model's fitness, and the closer it gets to 1, the better. There is a decent fit between the quadratic model's coefficient of R^2 (0.9969), the adjusted R^2 (0.9929), and the projected R^2 (0.9766). It was determined that the quadratic model was preferable because of larger F–value (40.94) and lesser (< 0.0001) p–value. High F–value (249.36), a low p–value (< 0.0001), non–significant fit (39.65), and a high value of adequate precision (48.62) were all evidence that the quadratic model was the best match (Table 5). When comparing the predicted value range at the design points to the average prediction error, a signal–to–noise ratio of at least 4 is required for adequate precision. F–value indicates how well each component describes variation in data with respect to the data's mean. The p–value denotes each variable's degree of significance [30–34]. Using a probability map of the residuals, it was possible to verify or disprove the normality assumption. Studentized residuals were used to assess the standard deviations between the actual and projected values, which indicated that the model had met the ANOVA's assumptions [35,36]. As the residual plot nearly followed a straight line, the assumption of normality was proven to be correct (Fig. 1).

The actual and projected values of Cr(VI) adsorption for the fixed–bed column research are shown in Figure 2, and the results demonstrate excellent agreement. A reasonable amount of evidence supports the model's validity (significance and adequacy).Using the chosen quadratic model, this equation expressed empirical correlations between the breakthrough time and the tested independent variables in terms of unit–less regression coefficients. Breakthrough time (min) = + 496.67 – 132.23A – 201.01B + 234.01C + 401.02AB – 333.52AC – 358.65BC + 258.43A^2 + 347.70B^2 + 30.70C^2 [where A: initial Cr(VI) concentration, B: flow rate, and C: adsorbent dosage are in coded factors].

More than 0.1000 indicates that the model terms are negligible, whereas less than 0.0500 indicates that the model terms are significant. Main and interdependent impacts of Cr(VI) concentration, flow rate, and adsorbent dosage were extremely significant in this case (Table 5). The square effects of flow rate and the initial concentration of Cr(VI) were similarly significant.

INTERACTION OF VARIABLES
Response surface and contour plots
A contour plot (Figs. 3a, 4a, and 5a) and response surface (Figs. 3b, 4b, and 5b) were used to examine the interplay between the independent components and response. The graphs (Figs. 3, 4, and 5) show the impact of two variables and their interactions on breakthrough time while holding the other factor constant. Raising both the initial Cr(VI) concentration, and flow rate decrease breakthrough time, while the breakthrough is lengthened with an increase in adsorbent dosage. Adsorbents have a finite number of active sites, which become saturated at a specific concentration level [20,22,37]. The breakthrough time lowers as the inflow Cr(VI) concentration increases because the active sites on the adsorbent surface are more quickly saturated. As the flow rate increased, the adsorption capacity of the column decreased as the solution had insufficient time to settle in the column and the solute was able to diffuse into the pores of the adsorbent before equilibrium was reached; resulting an earlier breakthrough [25,27,38]. It's possible that the growing trend in breakthrough time with increasing adsorbent dosage is related to an increase in adsorbent surface area, which offered more active sites for chromium ions with the increased dosage. As a result of the longer interaction time between the adsorbent and Cr(VI), breakthrough is delayed [22,27,38].

Perturbation plot
There were a number of variables that were examined to see how they affected the breakthrough time. Plots like the one in Figure 6 show how different the effects of different independent variables are at different points in the design space. Unlike a one–factor experiment, the perturbation plot does not show the impact of interactions. By varying simply one factor over its range, the perturbation is plotted. The response is more sensitive to factors if the slope or curve is steep. A flat line indicates a lack of responsiveness to changes in that one component [30–34]. Flow rate, initial concentration, and adsorbent dosage all had a significant impact on breakthrough time, according to the graph.

OPTIMIZATION OF BREAKTHROUGH TIME BY BBD
An object's desirability can be measured on a scale from zero at the margins to one at the apex [20,30,34]. Each variable and response from the menu were given preference for the desired goal in numerical optimization [22,27,32]. Setting Cr(VI) concentration "maximum", "minimum" Fe–SCC dose, "in range" flow rate, and the criterion of aim (response) to "maximum" was used in the optimization process. The goal of this process was to have the longest breakthrough time possible while utilising the least quantity of adsorbent. Bar graph (Fig. 7) displays the optimization procedure's desired values. Each variable has a desirability value ranging from 0.495 to 1, and the combined desirability value is 0.938.When the initial Cr(VI) concentration was 50 mg/L, the Fe–SCC dose was 2.5 g, and the flow rate was 4.5 mL/min, the best local maximum breakthrough time was 1659 minutes (Fig. 8). Following the same conditions, a repeated column experiment was performed to corroborate the findings.

CONCLUSION

Cr(VI) was removed from the water using Fe–SCC adsorbent in the fixed–bed column investigation, and the process was explained using BBD in RSM. For the purpose of determining the impact of initial Cr(VI) concentration, flow rate, and adsorbent dosage on breakthrough time, BBD was developed. With an R^2 value of 0.9969, an F–value of 249.36, and a p–value of less than 0.0001, this study's response surface quadratic model was found to be suitable for its purpose. The quadratic model's validity was proved by ANOVA. Based on experimental results, the model's predictions were found to be mostly correct. Similarly, the normal residual plot matched the values of studentized residuals. It was possible to see how the experimental variables interacted with one another in terms of breakthrough

time by using contour and perturbation plots, respectively. Breakthrough times were found to be significantly influenced by a wide range of variables. According to the optimised results, a continuous column system using Fe–SCC was extremely effective and cost–effective in the removal of Cr(VI) from an aqueous environment. In the industrial sector, the findings of this study can be used by performing a column operation that removes hexavalent chromium from the water.

ACKNOWLEDGEMENT

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Table 1: Experimental ranges of independent variables

Variables	Units	Notations	Level of Variables	
			Low	High
Initial Cr(VI) concentration	mg/L	A	20	50
Flow rate	mL/min	B	1.5	4.5
Adsorbent dosage	g	C	2.5	7.5

Table 2: BBD matrix for the tested variables and the observed response

Standard order	Run order	Factor 1 A: Initial Cr(VI) concentration (mg/L)	Factor 2 B: Flow rate (mL/min)	Factor 3 C: Adsorbent dosage (g)	Response Breakthrough time (min)
1	1	20	1.5	2.5	910
2	14	50	1.5	5	725
3	7	20	4.5	7.5	925
4	17	20	1.5	7.5	2810
5	12	35	3	7.5	795
6	13	35	4.5	7.5	525
7	11	35	1.5	7.5	1600
8	3	20	3	5	920
9	9	35	1.5	5	1050
10	10	35	3	5	520
11	16	50	3	7.5	550
12	4	20	4.5	5	605
13	2	20	1.5	5	1850
14	5	20	1.5	7.5	2825
15	15	50	1.5	7.5	1110
16	8	35	1.5	2.5	515
17	6	20	3	7.5	1400

Table 3: Sequential model sum of squares

Source	Sum of Squares	df	Mean Square	F Value	p–value, Prob >F	
Mean vs Total	22678425	1	22678425			
Linear vs Mean	7888402.8	3	2629467.6	45.30	< 0.0001	
2FI vs Linear	256204.1	3	85401.4	1.71	0.2270	
Quadratic vs 2FI	471468.9	3	157156.3	40.94	< 0.0001	*Suggested*
Cubic vs Quadratic	26761.7	6	4460.3	39.65	0.1210	*Aliased*
Residual	112.5	1	112.5			
Total	31321375	17	1842433.8			

Table 4: Model summary

Source	Std. Dev.	R^2	Adjusted R^2	Predicted R^2	PRESS	
Linear	240.92	0.9127	0.8926	0.8471	1321119.20	

Palas Roy (P. Roy)

2FI	223.24	0.9423	0.9077	0.8292	1476410.97	
Quadratic	61.96	0.9969	0.9929	0.9766	202640.31	*Suggested*
Cubic	10.61	1.0000	0.9998			*Aliased*

Table 5: ANOVA and Quadratic model statistics of BBD

Terms	Coefficient Estimate	Sum of Squares	Standard Error	*F* Value	*p*–value, Prob >*F*
Model		8616075.80		249.36	< 0.0001
Intercept	496.67		42.94		
A	−132.23	29023.27	48.09	7.560	0.0285
B	−201.01	57723.42	51.84	15.04	0.0061
C	234.01	60377.74	59.01	15.73	0.0054
AB	401.02	380003.89	40.31	98.98	< 0.0001
AC	−333.52	262845.66	40.31	68.46	< 0.0001
BC	−358.65	212260.73	48.23	55.29	0.0001
A^2	258.43	182163.06	37.52	47.45	0.0002
B^2	347.70	316196.19	38.31	82.36	< 0.0001
C^2	30.70	1728.27	45.75	0.45	0.5238
Residual		26874.20			
Lack of Fit		26761.70		39.65	0.1210
Pure Error		112.50			
Cor Total		8642950.00			
Mean	1155	Adeq. Precision	48.62	C.V. %	5.36
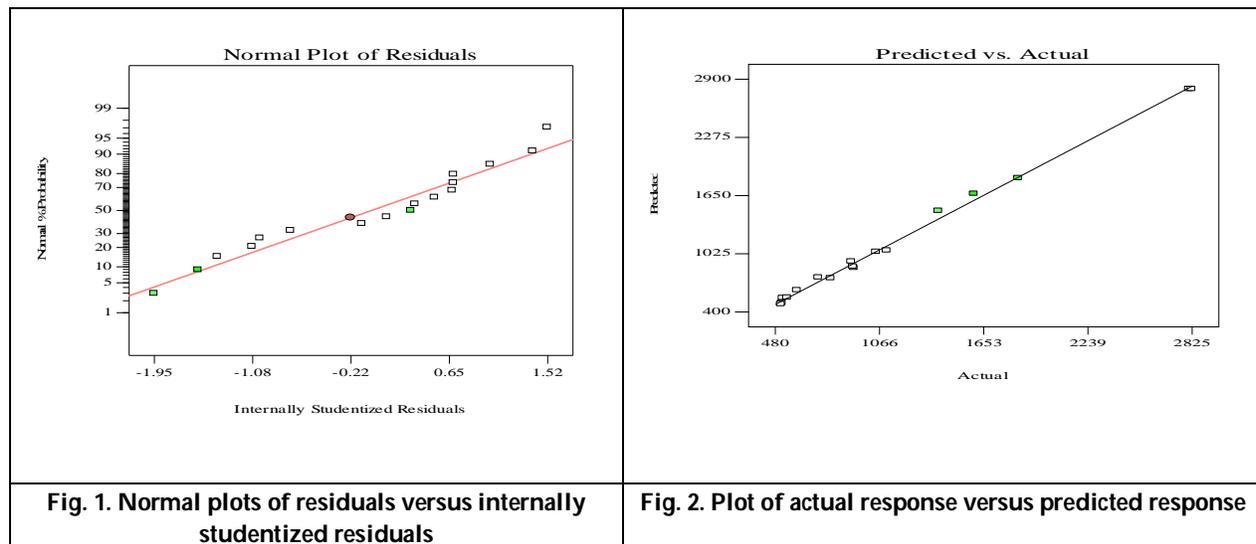
Fig. 1. Normal plots of residuals versus internally studentized residuals

Fig. 2. Plot of actual response versus predicted response

Fig. 3a. Two–dimensional contour plot

Fig. 3b. Three–dimensional response surface plot
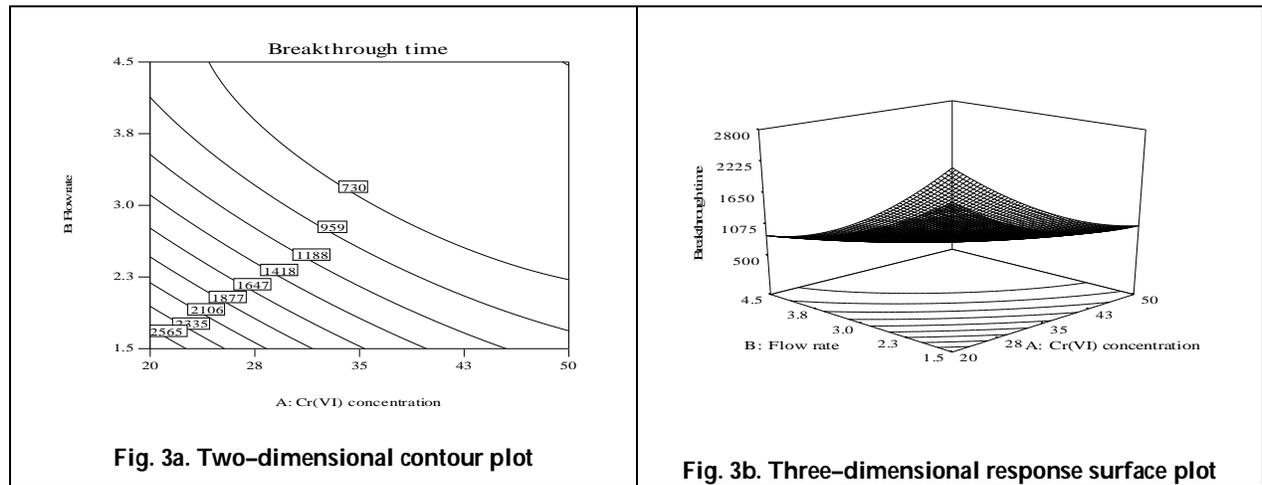
Fig. 3. Combined effect of initial Cr(VI) concentration and flow rate on breakthrough time
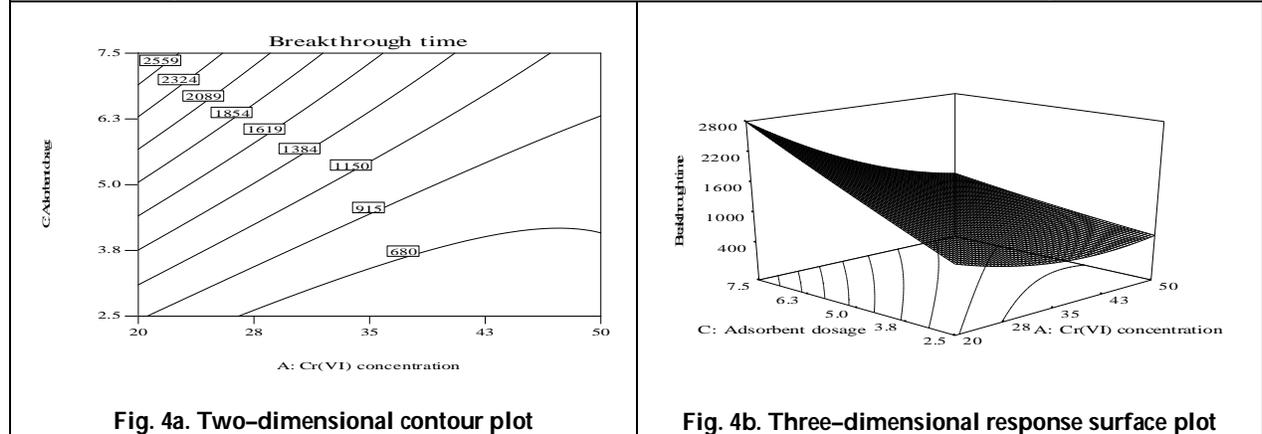
Fig. 4a. Two–dimensional contour plot

Fig. 4b. Three–dimensional response surface plot

Fig. 4. Combined effect of initial Cr(VI) concentration and adsorbent dosage on breakthrough time

Fig. 5a. Two–dimensional contour plot

Fig. 5b. Three–dimensional response surface plot
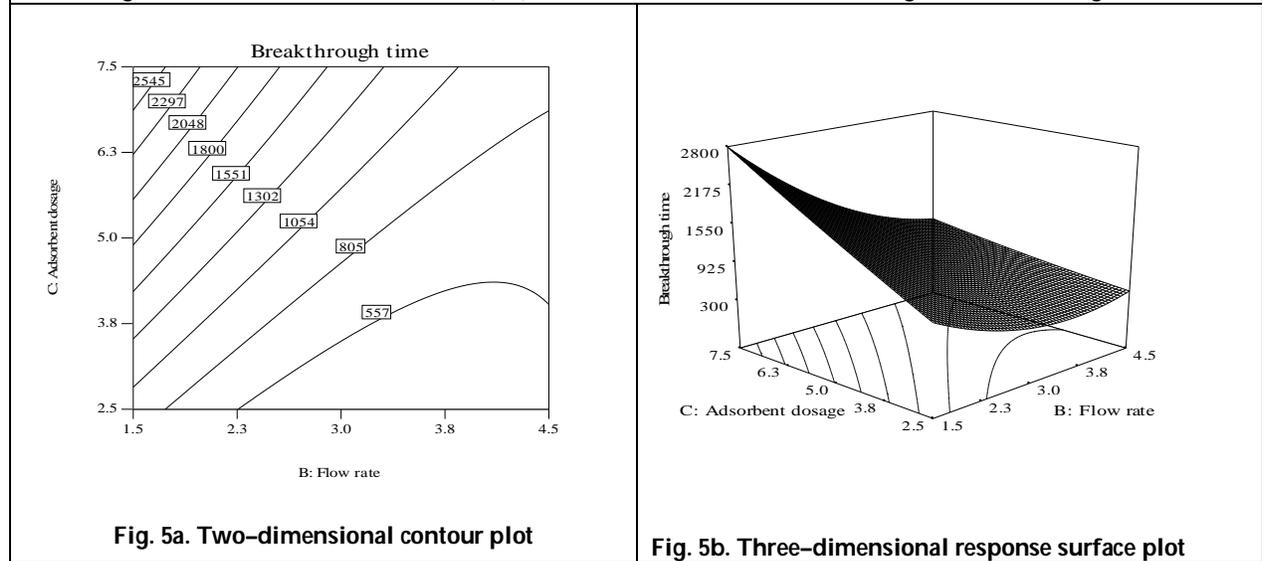
Fig. 5. Combined effect of flow rate and adsorbent dosage on breakthrough time

Palas Roy (P. Roy)
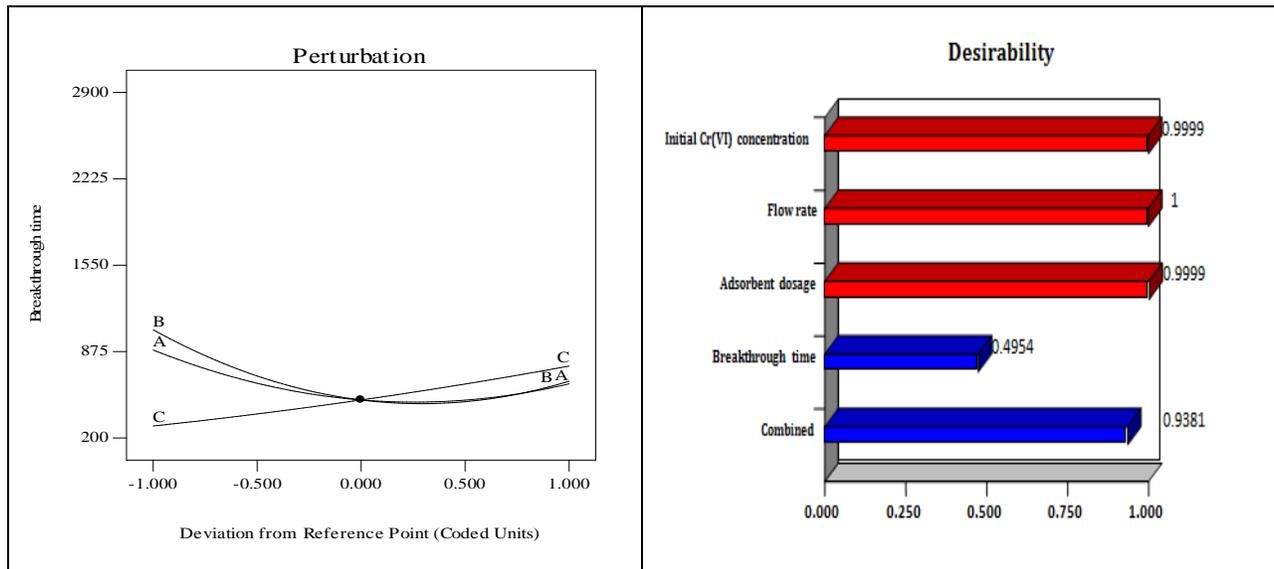
Fig. 6. Perturbation plot

Fig. 7. Bar plot for the optimization procedure
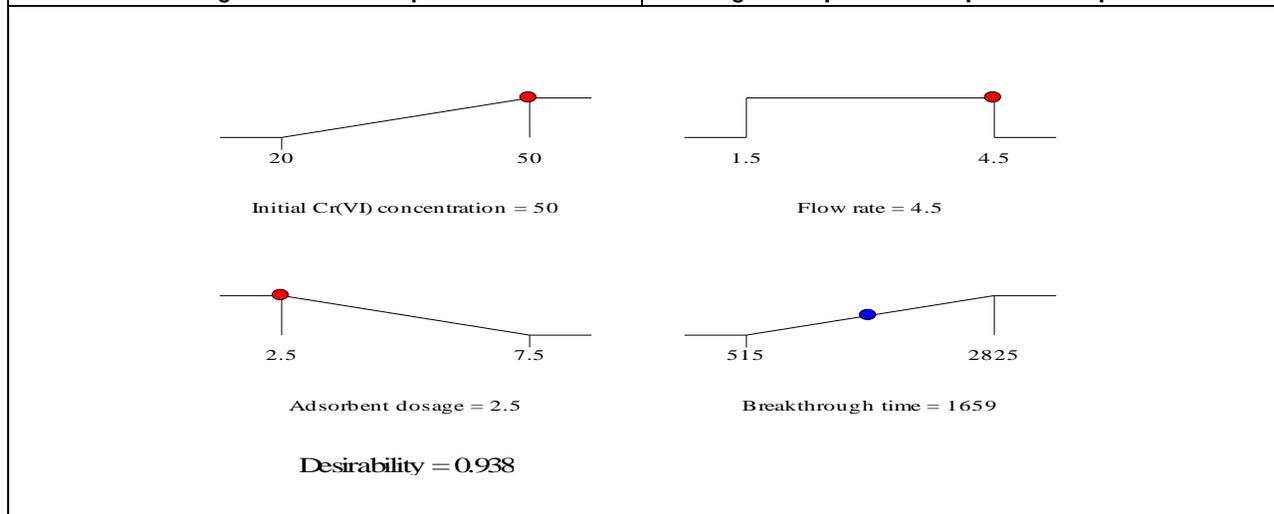
Fig. 8. Desirability ramp for numerical optimization

RESEARCH ARTICLE

Diversity of Cyanobacteria from Freshwater Habitats of Tehatta Subdivision, Nadia, West Bengal

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ABSTRACT

A systemic survey of cyanobacteria was carried out in different freshwater habitats of Tehatta subdivision of Nadia district, West Bengal, from January 2021 to May 2022. Tehatta subdivision covers a vast area of 871 km^2 and gives rise to many freshwater habitats, which are the main reservoirs of various types of cyanobacteria. During this survey, samples were collected from different freshwater habitats, mainly rivers, drains, ponds, Jheel, rice-fields etc. Altogether, 35 non-heterocystous and heterocystous cyanobacteria species belonging to 18 genera were identified. The most common and dominant cyanobacterial genera were *Oscillatoria,* representing 11 species, followed by *Anabaena* with 4 species, *Phormidium, Lyngbya, Nostoc* and *Calothrix* with 2 species each, *Microcystis, Chroococcus, Gloeocapsa, Gloeothece, Aphanocapsa, Synechocystis, Arthrospira, Spirulina, Cylindrospermum, Raphidiopsis, Rivularia* and *Haplosiphon* each with 1 species each.

Keywords: Cyanobacteria, Diversity, Freshwater, Tehatta, West Bengal.

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INTRODUCTION

Cyanobacteria are the photosynthetic prokaryotes and are the most interesting and fascinating organisms present on earth. They originated in the early precambian era and their origin was the most important step in evolution [1-4]. Cyanobacteia occurs in every type of environment where light and moisture are available and act as a producer in almost every type of ecosystem and contribute 80% oxygen to the earth's atmosphere [5]. Cyanobacteria have been reported to exist in association with lichens, plants and other phototrophs [6]. Cyanobacteria are also important members of symbiotic relationships with Diatoms [7] and other algal members [8]. Morphologically, cyanobacteria are unicellular to colonial (Chroococcales), with multi-cellular filaments (Oscillatoriales), with heterocystous trichomes, with or without false branching (Nostacales) and with true branching (Stigonematales). In India, as well as in many other countries, cyanobacteria have been useful to mankind in different ways for a long time. Due to their diverse occurrences and biochemical properties, they are investigated by Ecologists, Physiologists, Biochemists, Microbiologists and Biotechnologists. In West Bengal, the biology and taxonomy of cyanobacteria have been extensively reviewed by several workers. Martens first started the systematic survey of cyanobacteria in the late 18th century. Martens published three lists of Bengal algae, including Kolkata flora [9-11]. After Martens, many other workers studied taxonomy and distribution of cyanobacteria [12-24]. Mainly, the exploration and diversity of cyanobacteria is done by various workers in Kolkata and adjacent areas. Very little work has been done on the diversity of the algal flora of Nadia district. Among these few work, Keshri *et al*. [25] studied phytoplanktonic diversity of Baishar beel in Nadia district and reported 9 cyanobacterial taxa. Hence, in our present work, an attempt has been made to study the diversity of cyanobacteria from freshwater habitats of Tehatta subdivision of Nadia district, West Bengal, as there is no information is available in this area.

MATERIALS AND METHODS

Study area

The study area, Tehatta subdivision, is located on the eastern side of the state and northern side of the district and covers an area of 871 km². The survey was conducted in ten different areas of this subdivision. The sampling sites include Karimpur (23.97429 N, 88.62654 E), Betai (23.8057 N, 88.56257 E), Palashipara (23.79274 N, 88.45129 E), Sahebnagar (23.80968 N, 88.40681 E), Tehatta (23.72955 N, 88.52994 E), Shyamnagar (23.79288 N, 88.48738 E), Nazirpur (23.86747 N, 88.53882 E), Barnia (23.72566 N, 88.43554 E), Hanspukuria (23.72595 N, 88.46461 E) and Mahishbathan (23.93799 N, 88.61402 E). Tehatta Sub-Division shares boundaries in the south and west with Sadar subdivision of Nadia district, in the north with Murshidabad district and in the east sharing the long International border with Bangladesh. The subdivision is a part of the large alluvial plain formed by the Ganges-Bhagirathi system. The river Jalangi flows through the subdivision and other important rivers are Mathabhanga and Bhairabi. The samplings were done from January 2021 to May 2022.

Collection and identification of samples

In this present work, samples were collected from different freshwater habitats, mainly rivers, drains, ponds, rice-fields etc. from ten different areas of the Tehatta subdivision of Nadia district. Samples were collected with the help of fine forceps and scalpel, transferred in sampling-bottles and cleans biodegradable polythene bags, then immediately brought to the laboratory. Temporary slides were prepared for each sample for identification and were observed under trinocular bright-field microscope with attachment of a digital camera and computer with software (Olympus CH20i and Carl Zeiss Primo Star Microscope). We also measured the pH of the water at the sampling site. The samples were identified based on their morphological features like colour of thallus, cell-shape, cell-size, shape and size of heterocyst and akinete. The morphotaxonomic identification of the samples was done using standard monographs of Desikachary [26], Prescott [27], Anand [28] and Komarek [29]. A part of each collected cyanobacterial samples were preserved in 4% formaldehyde solution and were also deposited in the Phycology laboratory, P.G. Department of Botany, Ramakrishna Mission Vivekananda Centenary College, Rahara, for future reference.

RESULTS AND DISCUSSION

Systematic Enumerations of Cyanobacteria
Summary of the cyanobacterial taxa according to Desikachary 1959 is given below.

Order: Chroococcales
Family: Chroococcaceae

Microcystis flos-aquae (Wittrock) Kirchner
Fig. 1 B. Desikachary (1959): Page 94, Plate 17, Fig.11. Colonies spherical, with indistinct colonial mucilage, cells 3-6 µm in diameter, with gas vacuoles.

Chroococcus limneticus Lemm.
Fig. 1 F. Desikachary (1959): Page 107, Plate 26, Fig.2. Cells spherical with a distinct sheath, coloueless, cells 10-12 in diameter.

Gloeocapsa gelatinosa Kützing
Fig. 1 D. Desikachary (1959): Page 114, Plate 27, Fig. 6. Cells blue-green, with a mucilage envelope, colourless, cells spherical, 2-3 µm diameter.

Gloeothece samoensis Wille
Fig. 1 C. Anand (1989): Page 27, Fig. 27. Single colonies with mucilage envelop colourless, Cells 4-5 µm board.

Aphanocapsa grevillei (Hass.) Rabenhorst
Fig. 1 E. Desikachary (1959): Page 134, Plate 21, Fig. 9. Thallus is gelatinous, light blue-green coloured, cells round to spherical, cells 3-6 µm diameter, closely arranged.

Synechocystis crassa Woronichin.
Fig. 1 A., Anand (1989): Page 28, Fig. 34. Cells are free, spherical to oblong, single, without mucilaginous sheath cells 2-4 µm board.

Order: Nostocales
Family: Oscillatoriaceae

Arthrospira massartii Kufferath
Fig 2 L. Anand (1989): Page 29, Fig. 37. Trichomes coiled, sheath absent, cross wall cell distinct, terminal cell rounded apical not tapering, trichomes 6 µm board.

Spirulina gigantean Schmidle
Fig.2 Q. Desikachary (1959): Page 197, Plate 36, Fig. 14. Trichomes are spirally coiled, regularly spiral, trichomes 4 µm board.

Oscillatoria anguina Bory ex Gomont
Fig.2 A. Desikachary (1959): Page 210, Plate 38, Fig. 11. Trichomes blackish green, straight, slightly constricted at the cross wall, apical cell with a thickened outer wall. Trichomes are 6-8 µm wide.

Oscillatoria vizagapatensis C.B.Rao
Fig. 2 B. Desikachary (1959): Page 205, Plate 39, Fig. 16.Thallus is bluish green, Trichome is straight 10-12 µm board 4-5 µm long without constriction at the cross wall, the tip portion is slightly elliptical and forms cap like structure.

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Oscillatoria sancta Kützing ex Gomont

Fig. 2 C. Desikachary (1959): Page 203, Plate 42, Fig. 10. Thallus is dark blue green, mucilaginous sheath present, trichomes more or less straight end cell capitated, trichomes 8-11 µm board.

Oscillatoria raoi G.De Toni

Fig. 2 D. Desikachary (1959): Page 223, Plate 42, Fig. 16. Thallus is pale blue-green colour, trichomes straight without constriction, 5-7 µm board. End cells are rounded.

Oscillatoria tenuis C. Agardh ex Gomont

Fig. 2 E. Desikachary (1959): Page 223, Plate 42, Fig. 15. Thallus blue green, trichomes straight, slightly constricted at the cross wall, granules present, cells 6 µm board and 3 µm long.

Oscillatoria laetevirens Bang ex Forti

Fig. 2 F. Anand (1989): Page 38, Fig. 80. Thallus bluish green trichomes slightly bent at the tip portion, cross wall constricted end cells without calyptra, trichomes 5 µm board.

Oscillatoria agardhii Gomont

Fig. 2 G. Prescott (1962): Page 484, Plate 108, Fig. 15. Trichomes are blue-green colour, straight tapering to one end, apical cell conical shaped, capitate, trichomes 6 µm board.

Oscillatoria acuta Bruhl et Biswas

Fig. 2 H. Desikachary (1959): Page 240, Plate 39, Fig. 5. Trichomes are straight, solitary, not constricted at the cross wall, non calyptrate apex, and the apex is slightly bent. Trichomes 6 µm board.

Oscillatoria princeps Vaucher ex Gomont

Fig.2 I. Desikachary (1959): Page 210, Plate 37, Fig. 14. Thallus blue-green, straight, trichomes 18 µm board constriction absent in the cross wall, end cell rounded without thickened membrane.

Oscillatoria limosa C.Agardh ex Gomont

Fig. 2 J. Desikachary (1959): Page 206, Plate 42, Fig. 11. The thalus is dark blue-green, the trichomes are straight not constricted, and the trichomes are 15 µm boards, end cell fatly rounded.

Oscillatoria angusta Koppe

Fig. 2 K. Prescott (1962): Page 485, Plate 108, Fig. 24. Trichomes are straight, bent towards the apex, apical cell slightly narrow, trichomes 15 µm board.

Phormidium submembranaceum Kützng ex Gomont

Fig. 2 M. Desikachary (1959): Page 274, Plate 44, Fig. 19. Thallus is membranous with colourless mucilage, trichomes straight end cells attenuated, slightly capited, and trichomes 7 µm board.

Phormidium anomalum C.B.Rao

Fig. 2 N. Desikachary (1959): Page 206, Plate 45, Fig. 11. Thallus is thick expanded, mucilaginous, deep blue green colour, very thin sheath, sheath colourless, end cells rounded, trichomes 10 µm board.

Lyngbya ceylanica Wille

Fig. 2 O. Anand (1989): Page 33, Fig. 44. Filaments forming an expanded thallus with a thin sheath, filaments slightly bent, end cells rounded with distinct outer membrane filaments of 16 µm boards.

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Lyngbya holdenii Forti

Fig. 2 P. Desikachary (1959): Page 286, Plate 49, Fig. 6. Filaments with an expanded thallus, with a thin sheath, filaments 10 µm board trichomes constricted at the cross wall end cell rounded.

Order: Nostocales
Family: Nostocaceae

Cylindrospermum michailovskoense Elenkin

Fig.3 G. Desikachary (1959): Page 368, Plate: 65, Fig.1. Trichomes are pale blue green, slightly bent, cells cylindrical, heterocyst terminal oblong 5 µm boards and 7 µm long, akinete single ellipsoidal.

Nostoc commune Vaucher ex Bornet & Flahault

Fig. 3 A. Desikachary(1959): Page 387, Plate 68, Fig. 3. Thallus is gelatinous, blue green, filaments flexuous, thick, trichomes 5 µm board, cells short, spherical, heterocyst, nearly spherical 5-7 µm board.

Nostoc linckia (Roth) Bornet & Thur

Fig. 3 B, Prescott (1962), Page: 523, Plate: 119, Fig. 15. Thallus is gelatinous, irregularly expanded, and the cells are slightly sub-globose 3-5 µm board. Heterocyst sub spherical 6-8 µm board, 7-8 µm long.

Anabaena sphaerica Born. Et Flah

Fig. 3 C. Anand (1989): Page 47, Fig. 138. Thallus floccose, blue green colour, Akinete sub spherical, trichomes straight, akinete 9-16 µm in diameter, Heterocyst oval 6-9 µm diameter.

Anabaena variabilis Kützing ex Bornet & Flahault

Fig. 3 D. Desikachary(1959): Page 411, Plate 71, Fig. 5. Thallus is gelatinous Dark green, trichomes without sheath, slightly constricted at the cross wall, cells slightly barrel shaped , end cell conical, heterocyst oval 7 µm board and 8 µm long.

Anabaena laxa A. Braun

Fig 3. E. Anand (1989): Page 48, Fig. 134. Thallus is mucilaginous, trichomes with attenuated apices, heterocyst intercalary, akinete slightly cylindrical in a series. Heterocyst 8 µm board.

Anabaena oryzae Fritsch

Fig. 3 F. Desikachary (1959): Page 396, Plate: 72, Fig: 3.Thallus soft green, gelatinous, trichome short, straight, 2-3 µm broad, more or less barrel shaped, heterocyst intercalary , oval 6 µm board and 7 µm long.

Raphidiopsis mediterranea Skuja

3 I. Desikachary (1959): Page 422, Plate: 79, Fig: 2, 3. Trichomes straight, attenuated both ends, constrictions absent at the cross walls heterocyst present at the both ends, heterocyst 3 µm boards and 8 µm long.

Order: Nostocales
Family: Rivulariaceae

Calothrix stellaris Bornet & Flahault

Fig. 3 H. Desikachary (1959): Page 527, Plate: 108, Fig. 4, 5. Filaments single un-branched, slightly bent, swollen at the base, 8 µm boards. Sheath coloueless, heterocyst basal hemispherical, single.

Calothrix braunii Bornet & Flahault

Fig.3 K. Prescott (1962): Page 552, Plate 131, Fig. 12. Filament single gradually tapering towards the end ,sheath very thin colourless, heterocyst single hemispherical at the basal region , heterocyst 8 µm board and 10 µm long.

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Rivularia dura Roth ex Bornet & Flahault

Fig.3 J. Desikachary (1959): Page 551, Plate 115, Fig. 2. Filaments are compactly arranged sheath colourless, cells towards the base boarder towards the tip slightly narrower trichomes 7 µm board, heterocyst basal, spherical, heterocyst 8 µm board and 7 µm long.

Order: Stigonamatales
Family: Stigonemataceae

Haplosiphon welwitschii W.et G.S. West

Fig. 3 L. Komarek (2005): Page 525, Fig. 646.   Filaments single, Branched with short lateral branch, filaments 6 µm board. Heterocyst intercalary slightly quadrate.

Depending upon the morphological features, 35 cyanobacterial taxa belonging to 18 genera were identified, which include 23 non-heterocystous and 12 heterocystous forms (Fig. 1, 2, 3). Among the 23 non- heterocystous forms, 6 were coccid type and 17 were filamentous type. Among the 12 heterocystous cyanobacteria, one branched heterocystous cyanobacteria has been documented. The most common and dominant cyanobacterial genera were *Oscillatoria,* representing 11 species, followed by *Anabaena* with 4 species, *Phormidium*, *Lyngbya*, *Nostoc* and *Calothrix* with 2 species, *Microcystis*, *Chroococcus*, *Gloeocapsa*, *Gloeothece*, *Aphanocapsa*, *Synechocystis*, *Arthrospira*, *Spirulina*, *Cylindrospermum*, *Raphidiopsis*, *Rivularia* and *Haplosiphon* each with 1 species. The pH of the water bodies was measured ranged from 6 to 8.5. Cyanobacteria are ubiquitous in their distribution but soil and water pH is an important factor for cyanobacteria growth. Cyanobacteria generally prefer slightly neutral to alkaline pH for optimal growth. In acidic conditions (pH values below 4), cyanobacteria are generally absent [30]. In the present study, the same phenomenon of pH preference was observed. In similar studies, Chandra and Rajashekha [31] reported 59 cyanobacterial taxa which grow at a slightly moderate to alkaline pH (7.4-9.2). Muthukumar *et al.* [32] reported 39 cyanobacterial taxa which grow in pH of 6.5-7.3. Jayachitra *et al.* [33] reported 64 cyanobacterial taxa found at pH between 7.3-8.4. Heterocytous cyanobacteria play an important role in rice field soil fertility as they can fix atmospheric nitrogen. In our present study, 12 heterocystous cyanobacteria belonging to 7 genera were found in rice fields. In previous study, Sing *et al.* [34], Dey *et. al.* [35], Bharadwaj and Baruah [36], and Rahaman *et al.*[37] reported 7,6,12 and 8 heterocystous cyanobacteria genera respectively from the rice field of Malwa region of Punjab, Orissa, lower Brahmaputra Valley and Mangaldoi subdivision of Darrang district, Assam. From these studies, we can easily conclude that the Tehatta subdivision of Nadia district, West Bengal, showed a significant diversity of cyanobacteria. As previously no such types of work have been done in Nadia district, we expect this work to be utilized by researchers worldwide and explore a new horizon of work.

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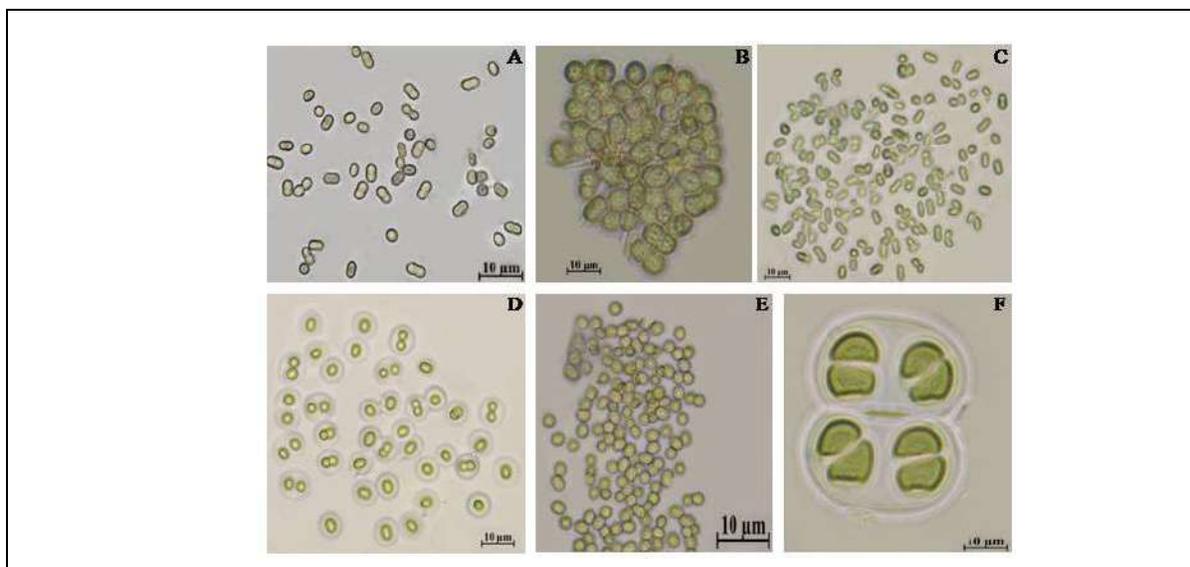
Figure 1(A-F): Microphotographs of coccoid cyanobacteria

(A). *Synechocystis crassa* Woronichin. (B). *Microcystis flos-aquae* (Wittrock) Kirchner (C). *Gloeothece samoensis* Wille (D). *Gloeocapsa gelatinosa* Kützing (E). *Aphanocapsa grevillei* (Hass.) Rabenhorst (F). *Chroococcus limneticus Lemm.*

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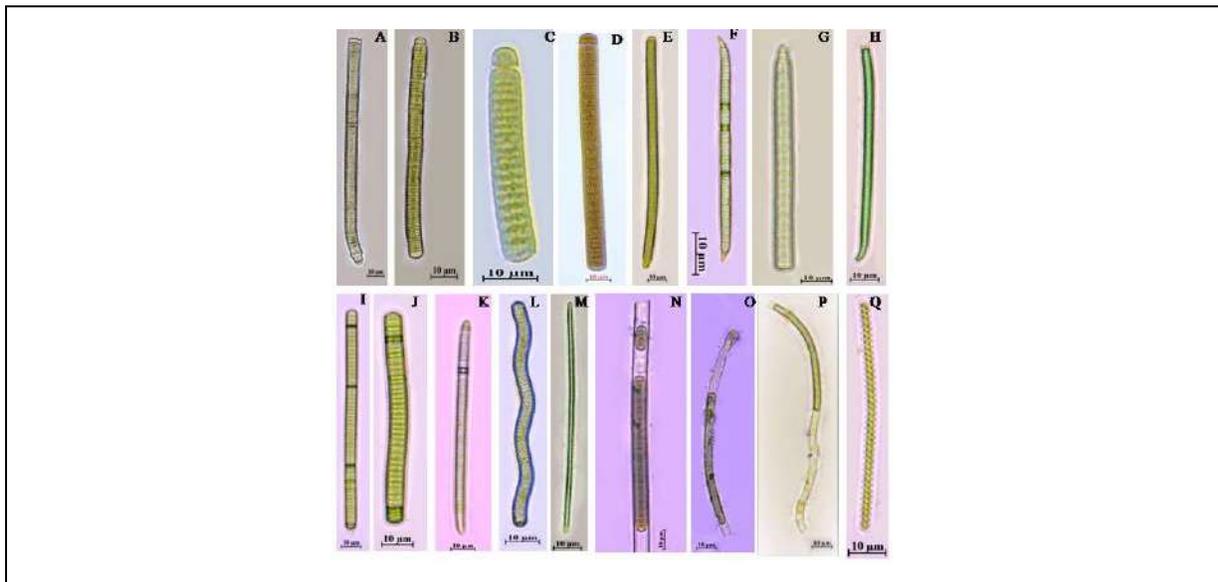
Figure 2 (A-Q): Microphotographs of filamentous non-heterocystous cyanobacteria

(A). *Oscillatoria anguina* Bory ex Gomont (B). *Oscillatoria vizagapatensis* C.B.Rao (C). *Oscillatoria sancta* Kützing ex Gomont (D). *Oscillatoria raoi* G.De Toni (E). *Oscillatoria tenuis* C. Agardh ex Gomont (F). *Oscillatoria laetevirens* Bang ex Forti (G). *Oscillatoria agardhii* Gomont (H). *Oscillatoria acuta* Bruhl et Biswas (I). *Oscillatoria princeps* Vaucher ex Gomont (J). *Oscillatoria limosa* C.Agardh ex Gomont (K). *Oscillatoria angusta* Koppe (L). *Arthrospira massartii* Kufferath (M). *Phormidium submembranaceum* Kützng ex Gomont (N). *Phormidium anomalum* C.B.Rao (O). *Lyngbya ceylanica* Wille (P). *Lyngbya holdenii* Forti (Q). *Spirulina gigantean* Schmidle
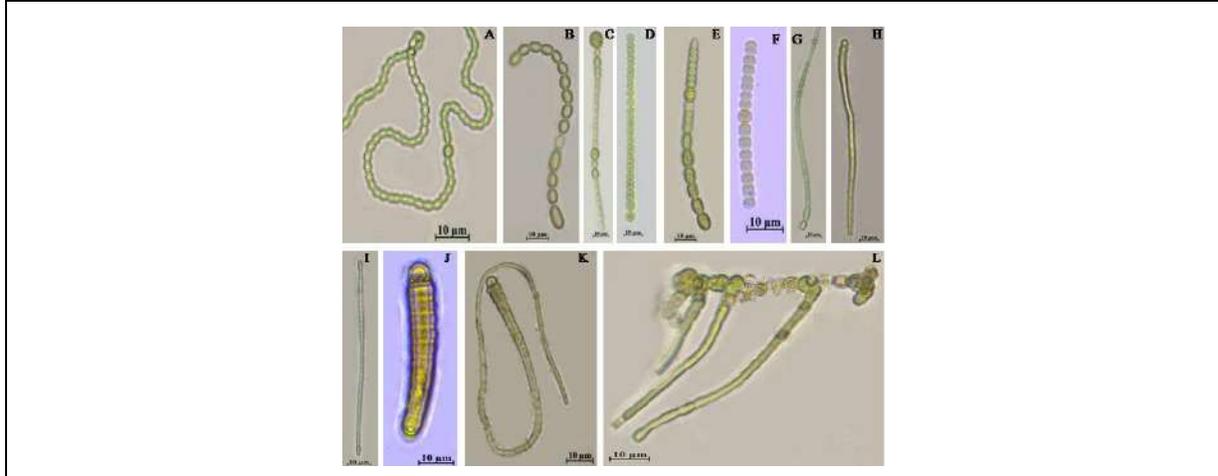
Figure 3 (A-L): Microphotographs of heterocystous cyanobacteria

(A). *Nostoc commune* Vaucher ex Bornet & Flahault (B). *Nostoc linckia* (Roth) Bornet & Thur (C). *Anabaena sphaerica* Born. Et Flah (D). *Anabaena variabilis* Kützing ex Bornet & Flahault (E). *Anabaena laxa* A.Braun (F). *Anabaena oryzae* Fritsch (G). *Cylindrospermum michailovskoense* Elenkin (H). *Calothrix stellaris* Bornet & Flahault (I) *Raphidiopsis mediterranea Skuja* (J). *Rivularia dura* Roth ex Bornet & Flahault (K). *Calothrix braunii* Bornet & Flahault (L). *Haplosiphon welwitschii W.et G.S. West*

RESEARCH ARTICLE

Contract Farming in India: A Theoretical Study

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ABSTRACT

India's sole source of income is agriculture. More than half of India's population works in agriculture. Agriculture is incredibly significant in India's economy; approximately 58 percent of the population works in agriculture. It's the foundation of our entire economic system. To discuss the significance of contract farming, To go over several sorts of contract farming, To determine the advantages and disadvantages of contract farming the present study has been done. Farmers can also benefit from contracts because they can have access to a variety of administrative, technical, and extended services that would otherwise be unavailable. Most commercial arbitration and mediation centers created in most nations seldom provide small farmers with quick and low-cost hands-on assistance. Government can also support by actively making public private partnerships and working with farmers making many such joint ventures and achieving the target of doubling farmers' income.

Keywords: Farmers, Contract Farming, Types and advantages, Legal risks and challenges in contract farming etc.,

INTRODUCTION

Agriculture is the foundation of our entire economic system. Several techniques has been used in agriculture and now-a-days, though contract farming has several advantages, awareness about contract farming among the farmers is still a question and apart from this there are so many risks and challenges in it. Farming requires working on the surface of the soil, spreading seeds, and nurturing edible plants. It's essentially a legal partnership arrangement between farmers and processing firms in which the farmers are expected to deliver the agreed-upon number and quality of crops within a specific time limit. In exchange, the cooperative firm pledges to buy the harvested product from the farmers at a predetermined price that all sides agree on.

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REVIEWS OF LITERATURE

1. Awotide *et al.* (2015)Due to contract farming involvement, ATE on the treatment resulted in a favourable and large boost in yield. Rice productivity increased by 58 percent, while rice revenue increased by 64 percent, according to the findings. People with credit problems were shown to be more likely to engage in contract farming.

2. Bellemare (2012) have contract farming participation boosted the likelihood of a farm household receiving a loan from a bank or a microfinance organisation by roughly 31%, according to a study.

3. Barrett *et al.*(2012), farmers may leave the CFA if they discover that it does not provide the expected profits, for example, if other outside options become available or their circumstances change. As a result, evolving business and smallholder features, as well as learning from both parties' poor contract implementation, may lead to a change in contractual status on both sides. This phenomenon, however, has received little attention. CFAs had come to a halt in numerous locations due to the regularity of ambiguous welfare results around the world, according to researchers.

4. Birthal *et al.* (2008) observed Big farmers in India had a significantly better likelihood of participating in contract farming, according to the study. Similarly, Pandit *et al.* (2014) discovered that large farmers had a better chance of growing a crop under contract in West Bengal, Swain (2012) for gherkin and seed rice in AP; Cai, Ung, Setboonsarng, and Leung (2008) for rice in Cambodia; Maertens and Swinnen (2009); Miyata et al. (2009) for green onion in China; Awotide, Fashogbon, and Awoye

5. Miyata *et al.* (2009) In becoming a contract farmer, there was some self-selection, but the criteria that influenced the decision to grow under contract were labour availability and location rather than land size. As a result, anecdotal evidence suggests that in many cases, the farmer decides whether or not to grow a certain crop under contract with a corporation.

6. Guo *et al.* (2007) and Li *et al.* (2018)Looking at China's People's Republic (PRC). Producers participate in contract farming for price stability and market access, according to Guo, Jolly, and Zhu (2007). Processors, for their part, cite increased product quality as the key motivation for entering into contract farming agreements with farms.

7. Dhillon *et al* (2006) Contract farming is more popular among medium-sized farmers in Pakistan's Punjab province, according to the study. Larger farmers prefer spot markets to contract farming because they have a higher willingness to take risks. They also discovered that farmers with a higher level of education are more inclined to participate in contract farming.

8. Sharma (2016) Contract farming increases agricultural productivity and revenue in India, according to research and through various mechanisms like group contracts and incentives for contracting agencies to collaborate with small farms can boost small farmers' participation.

Objectives

The following are the objectives of the study,

1. To discuss the significance of contract farming.
2. To go over several sorts of contract farming.
3. To determine the advantages and disadvantages of contract farming.

Research methodology

This is a secondary data-based descriptive research study. To reach these results, researchers looked at a variety of research journals, books, websites, and papers connected to contract farming.

Goals of contract farming

- Farmers are paid for working in the field as well as a range of other agricultural chores, resulting in job opportunities in rural areas.
- Farmers will be able to generate a steady stream of revenue as a result of this.
- It alleviates the strain on central and state-level labor systems.
- Contract farming is expanding due to private segment speculation in agri-business.

- It also focuses Indian farmers' crop selection on the market.
- Increasing rural self-sufficiency in general by combining locally available resources and knowledge to address new difficulties.

Types of contract farming

1. **Limited Management Contract**
   In this sort of contract farming, the farmer receives all of the necessary inputs for production and sells the harvests to the business. The farmer will have no assurance that he would be paid the amount he spent on production.

2. **Full Management Contract**
   The farmer will engage into an agreement with a business for a particular quantity of produce in a specific period of time under this sort of contract farming. The farmer will disclose the price of the crop that will be produced prior to the start of the season. As a result, the farmer would be at a lower danger. If the farmer meets all of the quality criteria, the business will handle the selling of the harvest.

3. **Market Specification Contract**
   In this sort of contract farming, the buyer and the farmer agree on a harvesting plan prior to production and are bound by particular terms and conditions, which aid in the sale of the produce. The price of the crop, the amount, the quality, and the time of production for delivery will all be factors.

4. **Resource providing Contract:**
   In this sort of contract farming, the purchasers or corporations provide the farmers with production inputs as well as marketing.

5. **Management and income guarantee in Contract**
   In this type of contract farming, the buyers will manage production and marketing. The purchasers will also deal with the marketing and price issues in addition to these two. The purchasers will also bring in some money for the farmers. However, with this deal, the buyer will be responsible for the majority of the farm's administration, and the farmer would have fewer rights.

Advantages of contract farming

1. Farmers have an assured market thanks to Contract Farming, which boosts their capacity to produce.
2. For the finest productivity, the organization supplies farmers with high-quality items, such as breeds, and the top consultants to supply them with effective counsel.
3. By guaranteeing that more farmers get paid and enjoy a pleasant living, contract farming helps to reduce unemployment in rural regions.
4. In comparison to other nations, contract farming contributes to our country's economic worth.

Disadvantages of Contract Farming

1. Because of the guarantee market, contractors keep rates low so that farmers may make the most money.
2. Farmers do not have access to customer input, which results in no production improvements owing to a lack of communication between consumers and farmers.
3. Farmers are contractually committed to produce a specific amount of crop at a specific period.

FARMER VS COMPANIES

Base	Farmers	Companies
Assure	Market and return assurance	resulting from long-term commitment
Threat eradicate	Protection against price fluctuations	Protection against market price fluctuations
Advantage	Anincrease in job opportunities	Increase the company's goodwill

Contract farming companies in India
- Baidyanath
- Aloe vera
- Dabur
- Patanjali
- Tulsi

Farmer benefits of contract farming

The key advantage of a legally binding course of action for agriculturists is that the support will about continuously concur to buy all of that nourishment created as long as quality and amount benchmarks are met. Farmers can also benefit from contracts because they can have access to a variety of administrative, technical, and extended services that would otherwise be unavailable. Farmers can use the contractual agreement as a security to borrow money from a commercial bank to purchase a contribution. As a result, the following are the most significant possible benefits for farmers:

1. Supply of materials and services for production
2. Creditworthiness
3. Implementation of the necessary technologies
4. Transfer of ability
5. Pricing that is both guaranteed and fixed
6. Market access that is trustworthy.

Client benefits of contract farming

1. They receive a consistent and ongoing supply of high-quality raw materials, which helps to safeguard them against market price fluctuations.
2. Because they have a focused raw material supplier base, they can plan their company for the long run.
3. The concept of contract farming may also be used to other crops, which serves to build goodwill for the company.

Contract farming business models

1) Informal model - The most transitory and risky of all contract farming methods, with both the promoter and the farmer risking default. However, it depends on the circumstances: contract dependency or long-term trustful relationships may lower the danger of opportunistic behavior.

2) Intermediary model - In this approach, The buyer employs an intermediary in the intermediary model (collector, aggregator, or farmer organization) to hire farmers on a formal or informal basis (a hybrid of the centralized and informal models).

3) Multipartite model - The nucleus or centralized estate models can be used to create this model. It involves a variety of organizations, including government statutory entities, commercial corporations, and even financial institutions.

4) Centralized model - In this approach, the purchasers' involvement might range from providing little input (e.g. certain kinds) to controlling most elements of production (e.g. from land preparation to harvesting). The most popular CF model is this one.

CHALLENGES OF CONTRACT FARMING IN INDIA

The following are some of the issues that farmers encounter with contract farming:

1. Contract farming benefits large farmers more in terms of production, hence small farmers make less profit than large farms.
2. In general, there are no rigorous norms and regulations in India regulating contract completion, which leads to contract failure.

3. In compared to corporate purchasers, there are a lot more sellers (farmers). Due of a shortage of buyers, this results in a monopoly.

LEGAL RISKS OF CONTRACT FARMING

The growing usage of production contract agreements with farmers by private enterprises, governments should consider regulating contract farming to safeguard smallholder farmers by establishing a set of contractual criteria. These might include a three- to five-year minimum contract duration, clarification of the farmer's position (independent contractor or employee), remuneration, and contract termination terms. Another issue that is frequently overlooked is the lack of accessible dispute resolution processes, not just for contract termination but also for recurrent concerns like payment, scales and measurements, quality and quantity. Most commercial arbitration and mediation centers created in most nations seldom provide small farmers with quick and low-cost hands-on assistance.

LIMITATIONS OF CONTRACT FARMING

1. Contract farming is sometimes accused for favoring large corporations or large farms while abusing small farmers' lack of negotiating strength.
2. Growers faced issues such as severe quality reduction on items by businesses, delayed factory deliveries, late payments, bad pricing, and insect assault on the contract crop, all of which increased production costs.
3. In India, contracts are in some cases verbal or casual, and indeed composed contracts might not bear consistent lawful security as in elective countries. Composed assention conditions that aren't enforceable might result in a breach of contract by either party.
4. Multiple Sellers – Single Buyer (Monopsony).
5. Gender disparities in contract farming - Women have less access to contract farming than males.

CONCLUSION

India is domestic to most of the little and negligible ranchers. They are unable to get certain essential agricultural services. This might be due to their lack of awareness of such services or their inability to use them. In India, this problem might be remedied via contract farming. Furthermore, market price fluctuations are regular, posing issues for not just farmers but also exporters and agro processing companies. This type of contracting provides them with a guaranteed price and timely exchange of farm produce. India must abandon its old farming practices. The first step is to adopt the contract farming system and scaling the model throughout the geography. Government can also support by actively making public private partnerships and working with farmers making many such joint ventures and achieving the target of doubling farmers' income.

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RESEARCH ARTICLE

Formulating Co₃S₄ on Graphene Oxide (GO) Nanocomposite as Active Electrode Material for Hybrid Supercapacitor by Solvothermal Method

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ABSTRACT

Metal sulfide with graphene oxide selectively studied as an active electrode material for hybrid Supercapacitor due to their high conductivity (GO) and superior capacitive nature of (Co) compared to oxide materials. Herin Co₃S₄ nanostructure on graphene oxide (GO) was fabricated via a simple solvothermal method using EG as solvent ammonia as reducing agent. The prepared sample was characterised by various technique viz., XRD FE-SEM TGA and FT-RAMAN. From XRD data, hexagonal structure was identified with grain size less than 10nm. From FE-SEM images, nano sheets like structure were observed. Electrochemical behaviour of sample was reported after measuring cyclic voltammetry and EIS studies. The results reveal that the inclusion of GO improves the electrode conductivity which in turn in process the capacitance property of the Co₃S₄ / GO nanocomposies with specific capacitance of 160 F/g.

Keywords: Co₃S₄, Graphene Oxide, Electro-Chemical Response, Solvothermal

INTRODUCTION

In recent years, environmental degradation and the great depletion of fossil fuels have accelerated the development of clean and renewable energy sources [1]. Now that the demand for vehicles is increasing rapidly, lithium-ion batteries, electrochemical Supercapacitor, and Ni-H batteries have attracted much attention [2]. The Supercapacitor is the most promising of these devices because of its high energy density, rapid charge-discharge characteristic, and long cycle life [3]. Since the electrochemical performance of supercapacitors depends on the electrochemical properties of the electrode materials, great efforts have been made to develop electrode materials for various supercapacitor applications.[4]Electrode materials are recognized to have a major influence on energy storage performance [6]. In general, the properties of the electrode material such as chemical activity, surface conductivity and configuration are important for supercapacitors. Consequently, finding novel electrode materials with desirable characteristics is an important task [7] Notably, cobalt sulfide (Co_3S_4), used as an electroactive material in lithium batteries, was introduced for pseudocapacitors [8-11]. Although metal oxides or sulfides are used, their low electrical conductivity and poor stability preclude their use in pseudocapacitors [8-11]. Nevertheless, whether metal oxides or sulfides, the low electrical conductivity and poor stability have hindered their applications in pseudocapacitors. Two-dimensional (2D) nanostructured graphene has unique mechanical and electrical properties, making it an attractive contender for energy storage materials [12]. Recently, various metal oxides have been incorporated into the formulation of electrode materials to improve the capacitive properties of pseudocapacitors by graphene oxide (GO) or reduced graphene oxide (RGO) [13-15]. Here, the facile solvothermal technique has been used to construct the Co_3S_4/GO embedded graphene oxide (GO) composite assisted by ethylene glycol. The prepared sample was annealed at 320℃ for increase the crystallinity .Through XRD, XPS, and FT-Raman investigation, well-characterized samples were identified as prepared. A detailed assessment of electrochemical performance has been conducted.

EXPERIMENTAL
MATERIALS

All chemicals Graphite powder, Sulphuric acid (H_2SO_4),Sodium Nitrate ($NaNO_3$), and Hydrogen Peroxide (H_2O_2) (30%), Cobalt Nitrate Hexahydrate ($Co(NO_3)_26H_2O$), Thiourea ($SC(NH_2)_2$), N-methyl-2-pyrrolidone (NMP), polyvinylidene fluoride (PVDF) and ethylene glycol are bought from (Sigma Aldrich) analytical grade and are employed without additional purification. Deionized (DI) water is being used in the treatment.

Synthesis of Co_3S_4/GO Nano Composite

A solvothermal synthesis method was used to synthesize Co_3S_4/GO nanocomposites. The modified Hummers technique was used to produce graphene oxide (GO) from graphite powder [16-17]. In this synthesis 1m mol $Co(NO_3)_26H_2O$ mixed in 40 mL of EG and stirred at ambient temperature for 1 hour to create a clear pink solution. Following that, 2mmolthiourea was added. Then, 60 mg of GO was distributed in 10 ml of EG and dissolved thoroughly for 60 minutes before the solution was poured drop wise for 10 minutes and swirled for one hour at 68 to 77°F temperature. Following that, the chemical mixture was transferred to a 50 mL Teflon-lined autoclave and held at 120 °C for eight hours. The final product was centrifuged and washed with ethanol and water before drying under vacuum for 12 hours at 60 °C, the final products were obtained after annealed at 320 0C for 2 hrs and 4hrs.

Materials Characterization

Scanning electron microscopy (FE-SEM, S-2400, Hitachi), X-ray diffraction (XRD, D/Max-2400 Rigaku), FT-Raman, and energy-dispersive X-ray spectroscopy (XPS, VG Scientific ESCALAB 250) were employed to examine the morphology, structure, phase, composition, and valance states of the as-prepared electrode materials.

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Electrochemical Measurements

The electrochemical studies were taking place with a standard three-electrode setup and a 2 M potassium hydroxide aqueous solution as the electrolyte. The working electrode, counter electrode, and reference electrode were the as-prepared electrode, nickel foil, and Ag/AgCl electrode, in that order. A CHI660D electrochemical workstation was used to measure Cyclicvoltammograms (CV), galvanostatic charge/discharge curves, and an electrochemical impedance spectrum are all examples of measurements (EIS). The EIS data were collected at frequencies ranging from 100 kHz to 0.01 Hz.

RESULTS AND DISCUSSIONS

Thermogravimetric analysis (TGA) is commonly used to assess thermal stability of a material and the quantity of constituent materials in a composite. Here The Co_3S_4/GO composites were estimated by thermogravimetric analysis (TGA) in N_2 environment. The sample was heated at a speed of 20°C min^{-1} from 10°C to 1000°C. The Co_3S_4/GO composite TGA curve shows three phases of weight decrease. The elimination of interpenetrating and physically adsorbed water molecules leads in a losing weight of 11 % and an endothermic reaction under 148°C. [18]. The second, occurring between 480 and 600 °C, is related to the heat breakdown of functional groups on the GO surface. This might be caused to EG combustion. After 600 °C, the third is caused by the oxidation of cobalt sulphide to cobalt oxide [19]. The products demonstrate that all prepared cobalt sulfide. All samples' crystal phase and material structural features were examined using the XRD technique. Figure 1 shows sample XRD patterns of GO, raw and annealed at 320 °C in two and four hours of Co_3S_4/GO. As prepared GO showed a prominent and strong diffraction peak centred at 11.2° [20], this corresponded to the (001) plane's reflection. The (002) plane was represented by a large peak at 21°, It might be linked to a small region of cohesive and simultaneous graphene sheet stacking. Co_3S_4/GO XRD spectra exhibited diffraction peaks at 31.09, 38.01, 47.27, 50.18, and 54.94, which corresponded to the projection of the (113), (004), (224), (115), and (044) planes of corolite Co_3S_4 (JCPDS card no. 42-1448) [21]. There is no graphene present in xrd **.**However, a Raman spectrum revealed the presence of graphene in the hybrid composite. Figure 3 depicts the Raman spectra of Co_3S_4/GO.

The interaction properties of functional groups found in samples were assessed by FT-RAMAN. Three prominent peaks seen at 460, 510, and 660 cm^{-1} in Raman spectra are ascribed to E_g, A_{1g}, and F_{2g} models of cubic spinel, respectively [22]. Two small peaks at 460 and 500 cm^{-1} are associated with Co-S bond vibrational modes, whereas the significant peak at 660 cm^{-1} is related to S-S stretching vibration [23]. Moreover, Spectral measurements from the GO sample indicated two wide peaks at roughly 1350 cm^{-1}(D-band) and 1591 cm^{-1} (G-band), which might be implicated in the mobility of the vibrational lattice (A_{1g} symmetry of k point phonon) distant from the stretching mode and the Brillion zone (E_{2g} symmetry of phonons) of sp2 carbon atoms. The FESEM was utilised to investigate the precise morphologies of Co_3S_4/GO structures, as shown in (Fig 4). The structure of Pristine Co_3S_4 is hierarchical. But it is composed of finely arranged thin Co_3S_4/GO Nano sheets. Because the diameters of the Cobalt particles are smaller than the diameters of the sheet -like Co_3S_4/GO structures, in (fig b) it is anticipated that some of the converted Co_3S_4/GO particles adhere to one another and form the massive particle as well as sheet like Co_3S_4/GO structures. Sheet-like morphologies often have diameters ranging from 2 to 5 Micro metres.

Xps survey spectrum has confirmed the presence of Cobalt, Sulfur, and Carbon (Fig.5a). In the Co_3S_4 /GO spectra, both Co 2p3/2 and Co 2p1/2 are separated into two peaks. (Fig 5b), that can be traced to Co3+ (778.6 eV and 793.1 eV) and Co2+ (781.6 eV and 796.8 eV) [24]. Fig.4b shows that the peaks of Co 2p3/2 and 2p1/2 for Co_3S_4/GO move to the smaller energy area (Co3+ 2p1/2 and 2p3/2 . The electron cloud skew from GO to metal cations gives compelling evidence of significant interaction and electronic coupling between Co_3S_4 and GO when compared to the pure Co_3S_4This is beneficial to the structural rigidity of Co_3S_4/GO [25]. As observed in the figure, the spectrum of S 2p consists of a satellite peak (167.3eV) and three peaks Fig. (5c) the peaks for S 2p3/2 and S 2p1/2 are located at 161.5 and 162.9 eV, respectively. The sulfur-metal (S-M) bond is responsible for the peak at 164.1 eV (Fig c). This confirms the presence of S$^-$[26].The binding energies of Carbon and oxygen spectrum are 285.2 eV and 532.5 eV established in

survey spectrum. As a consequence, the XPS data demonstrate the effective synthesis of Co_3S_4 /GO during the in-situ preparation procedure, Co_3S_4 and GO have a strong chemical bond.

Electro chemical properties

Using traditional cyclic voltammetry, three-electrode experiments in 3 M aqueous KOH electrolyte have executed to study the electrochemical characteristics of the Co_3S_4/GO electrodes. Figure 6 (a) depicts the standard CV curves. Co_3S_4/GO at various scan speeds, electrodes with potentials spanning from (-0.3 to 0.6 V) were generated. The CV curves have distinct oxidation and reduction peaks, particularly at low scan rates, demonstrating faradaic redox processes of the Co_3S_4/GO system. The scan rate raises from 5 to 50 mV s^{-1}, the current density also improved, showing that even at high scan rates, the Co_3S_4/GO electrode exhibits strong ion and electron mobility. In the CV curves, these results show unique pairs of redox peaks, demonstrating that the Co_3S_4/GO material exhibits pseudocapacitive characteristics. The current density increased as the sweep speeds go high, as well as the anodic and cathodic peaks shifted to too high and too low potentials, respectively. As illustrated in Fig6a. At 5mVs^{-1}, The highest capacitance of the composite measured 160 Fg^{-1}. When the current density rose, however, the capacitance decreased and reached 66.2Fg^{-1} at a sweep speed of 50 mVs^{-1}. This storing ability loss is mostly driven by an incomplete reversible redox reaction that takes place inside the voltage range at fast sweep speed. GCD investigation has carried out in a 3 M potassium hydroxide electrolyte solution across a potential range of 0.01 to 0.5 V, as shown in Figure 6 b, in the range of current densities has fixed 2 to 8 Ag-1. Both charge storing and releasing speed were nearly comparable across all current densities, indicating that columbic efficiency was high. The triangle charge-discharge curves revealed two distinct platforms at low current densities, which matched to alkaline medium redox processes. At a current density of 0.5 Ag^{-1}, the electrode provided a specific capacitance of 192 Fg^{-1} (Fig. 6 b).

EIS tests were run to further analyze the electrochemical character of Co_3S_4/GO materials at a potential of 5 mV in the frequency range of 100 kHz to 0.01 Hz which shown in fig 7. The Co_3S_4/GO electrodes' in the high-frequency zone, Nyquist figures show a narrower semi - circle and a lenear in the low-frequency region. The semi - circle and lenear represent the material's reduced redox oxidation and reduction response and charge transfer resistance [27]. The Co_3S_4/GO gives the little bit high resistance due to structure of the material that is the reason specific capacitance also very low. The greater charge motion of the Co_3S_4/GO nano-architecture, as well as the shorter ion diffusion paths in the flower as well as sheet like Co_3S_4/GO, must be linked to the improved electrode performance. Because the motion of the OH- ions rose with increasing current density and the active material utilisation ratio decreased considerably capacitance [26]. Following that, the capacitance rapidly reduced due to metal sulphide dissolving and conversion to hydroxide in alkaline environments, in addition to the separation of the active component from the electrode surface. The enhanced performance was attributed to the usage of conductive graphene helps and pretty active Co_3S_4/GO in a hierarchical Nano sheet structure.

CONCLUSION

In conclusion, our study established a simple technique for a one-step hydrothermal synthesis of Co_3S_4/GO and contrasted it with pure Co_3S_4 supported by ethylene glycol. Co_3S_4 nanoparticles of varying sizes are evenly anchored on wrinkled and restacking GO sheets. Taking advantage of the synergistic effects of Co_3S_4 and GO, the Co_3S_4/GO-based Supercapacitor achieves a maximum specific capacitance of 196 F g1 at 0.5 A /g (about twice that of pure Co_3S_4) and. Furthermore, this Co_3S_4/GO might be a viable electrode material for Supercapacitor and other power source devices.

ACKNOWLEDGEMENTS

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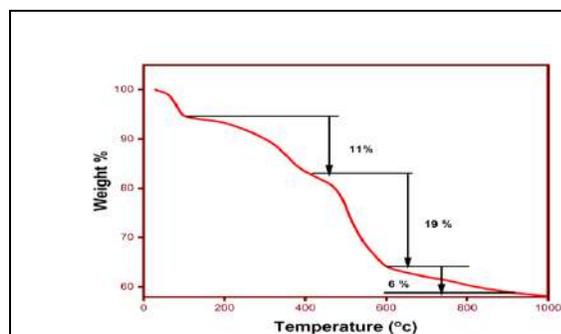
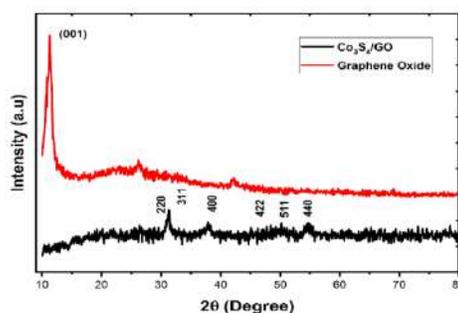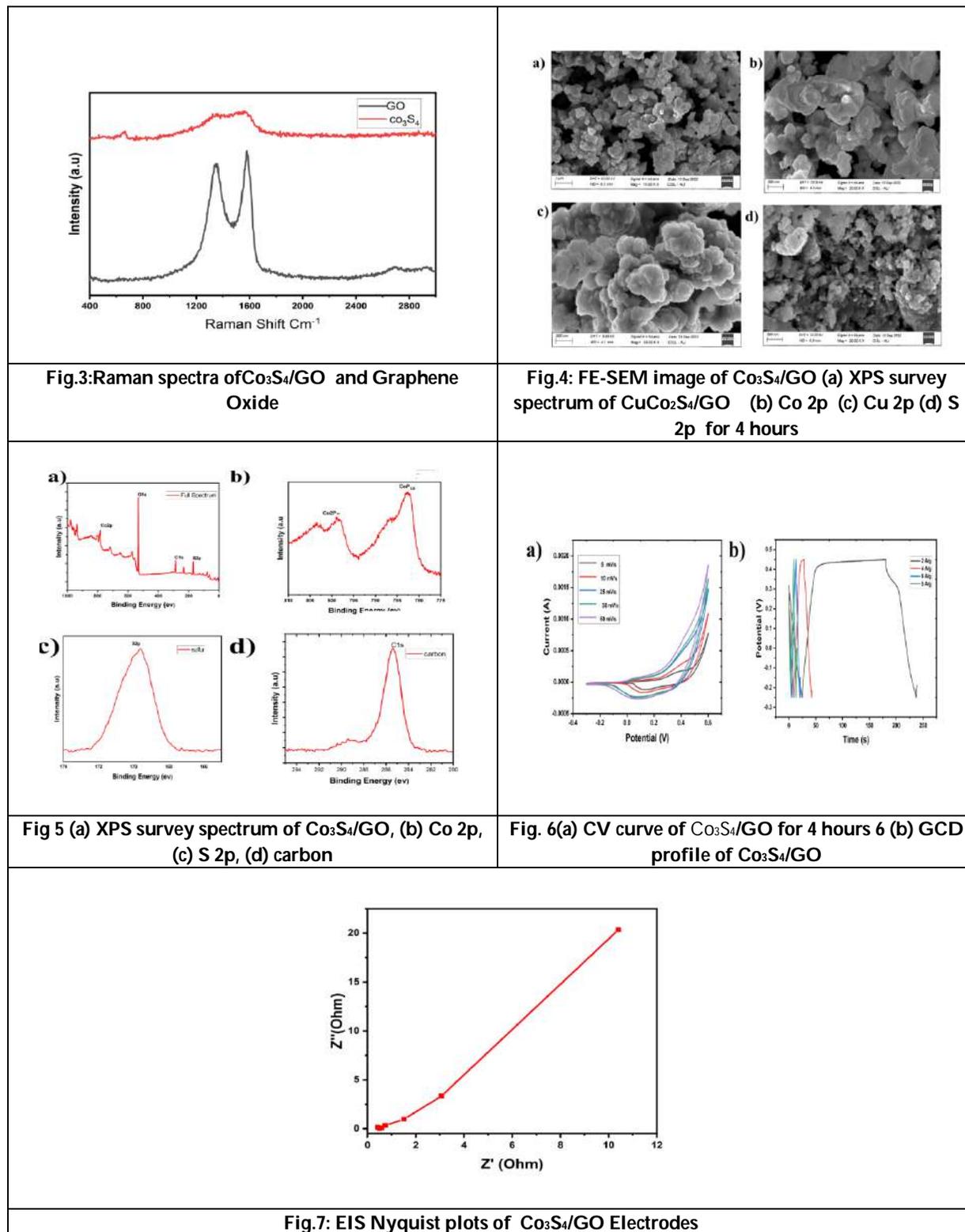**Fig.1: TG-DTA Curve of CuCo$_2$S$_4$/GO in N$_2$ Atmosphere**

Fig 2: XRD Pattern Co$_3$S$_4$**of /GO and Graphene oxide**

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Fig.3:Raman spectra ofCo₃S₄/GO and Graphene Oxide

Fig.4: FE-SEM image of Co₃S₄/GO (a) XPS survey spectrum of CuCo₂S₄/GO (b) Co 2p (c) Cu 2p (d) S 2p for 4 hours

Fig 5 (a) XPS survey spectrum of Co₃S₄/GO, (b) Co 2p, (c) S 2p, (d) carbon

Fig. 6(a) CV curve of Co₃S₄/GO for 4 hours 6 (b) GCD profile of Co₃S₄/GO

Fig.7: EIS Nyquist plots of Co₃S₄/GO Electrodes

RESEARCH ARTICLE

Emotional Neutrality and Human Well-being with Special Reference to the Teachings of Indian Vedic Literature

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ABSTRACT

A healthy lifestyle improves longevity and makes living more meaningful. Health is not merely the absence of disease but the presence of physical, mental, and social well-being in people. ("World Health Organization (WHO) Definition of Health") Human Well-being may be determined by several factors such as socio-economic conditions, environmental factors, and physiological and psychological factors. While there is an increase in socio-economic development across the world, we find an alarming increase in non-communicable diseases amongst the people. Research has shown that stressful responses often include negative emotions in people which may impact human wellbeing. Various Vedic literature has propounded adopting an emotionally neutral stance while dealing with life events . The objectives of this study are to examine the impact of emotional neutrality on human health and wellbeing and to examine the relationship between human ailments and emotions. The study was conducted using a survey method and purposive sampling among 115 service industry professionals to understand the impact of emotional neutrality on health. Bhagavad Gita verses specifically in chapters 2,5,14 were also studied to get insights into connecting human nature to emotions and their duty. The results revealed that respondents with a high Emotional neutrality score were found to be healthy and without any major diseases. The study suggested that People with emotional neutrality are healthy (more positive thoughts and fewer negative thoughts), and the Bhagavad Gita also provides suggestive evidence about how negative emotions lead to health issues and how one can have better health with positive thoughts

Keywords: Health and Well-Being, Negative Emotions, Non-Communicable Diseases, Lifestyle Disorder, Emotional Neutrality, Human Well-Being.

INTRODUCTION

We all live in a world where the progress of an individual is mostly measured in terms of economic and social well-being. Physical and psychological well-being is often overlooked when one tries to achieve success by the standards of society, he/she belongs to. However, slowly the trend is changing to adopt a healthier lifestyle physically and emotionally which improves the overall well-being. This increases one longevity and in a perfect world, it would mean living those additional number of years in good health. According to World Health Organization (WHO) Report[3], Global life expectancy was at 66.8 years in 2000 and it has increased to 73.3 years in 2019 whereas Healthy Life Expectancy (HALE) has increased only from 58.3 to 68.7 years. This ideally means that health is not just measured by disease-free life, but it is wholesome well-being physically as well as emotionally. While with the advancement of healthcare, people are surviving communicable diseases, non-communicable diseases like Blood Pressure, Cholesterol, diabetes, etc are attributed to an increase in health risk and mortality. Globally non-communicable diseases contributed 60.8% of deaths in 2000 and it has increased to 73.6% in 2019 as per WHO [3]. Several studies have been conducted to understand the impact of human emotions on physical well-being is influenced by human emotions, be it positive or negative.

In Behavioural Economics, emotional neutrality is defined as the concept of removing greed, fear, and other human emotions from personal and business decisions as referred to in Investopedia. The study of emotions relating to economics has proven beneficial in decision-making [1]. If this can be extended to human behaviour aspects concerning health, an emotionally neutral state can be viewed as the removal of negative attitudes, thoughts, and characters for better living. Psychologist Paul Ekman (1980)[10] explains emotions as innate, universal, or cross-cultural, and he further suggested that there are six basic emotions like anger, surprise, disgust, enjoyment, fear, and sadness. These emotions are broadly classified into positive and negative emotions. Many studies suggest that negative emotions like anger, hatred, jealousy, lust, greed, stress, anxiety, and animosity result in many non-communicable diseases such as blood pressure, cholesterol, diabetes, heart, kidney, and other diseases. Researchers around the world consider ancient literature as also a reliable source of suggestive pieces of evidence to back their studies. Ancient Indian scriptures encompass well-developed concepts about emotional well-being intertwined with religious principles One such literature Bhagavad Gita talks about modes of human nature, how emotions are interlinked to human nature, and how one can have a level of wisdom to become emotionally stable which in turn gives him a healthy life. This paper is an attempt to examine the effect of emotional neutrality on physical health and confirm teachings from our Vedic literature especially Bhagavad Gita regarding emotional neutrality and its impact on human health and wellbeing.

Objectives
The objectives of this research paper are,
• To examine the impact of emotional neutrality on human health and wellbeing
• To examine the relationship between human ailments and emotions

Experimental Section
Review of Literature
Emotions occur as a response to some trigger/stimuli which could be external or internal. Positive emotions convey the want for acceptance and negative emotions about avoidance. The impact of these emotions is not only on behaviour but on physiology too. For example, if a student is thinking about the exam tomorrow (Internal), the anxiety shows up as sweating / increased heartbeat, the same way if we see a snake (external stimuli), the negative emotion of fear not only creates a flight response but also bodily changes of shivering, sweating etc [7]. This was explained by many psychologists including Paul Ekman [3] and Cannon Brad. According to Cannon-Bard's theory of emotion, physiological arousal and emotional experience occur simultaneously, yet independently. While the connection of emotions to behaviour and body has been established, the research progress moved on to the impact of emotions on physical and mental health. Kubzansky *et al.* 2001[8]researched to understand the relationship between pessimism to coronary heart disease. And it was suggested that older men with a pessimistic outlook developed

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CHD(coronary heart disease) over 10 years. Peterson (1991) [9]suggested that optimists are likely to experience positive emotions. Considering the broaden-and-build theory of Barbara Fredrickson(1998) describes those positive emotions broaden an individual's momentary thought-action repertoire, in turn, suggests that positive emotions may have a positive impact on health as it enables people to acquire enough resources [16]. In Parallel, Bhagavad Gita was also reviewed to understand the association between emotions and health. The Bhagavad Gita is India's best-known scripture called "song of the Lord" This remarkable poetry is presented as a dialogue between a warrior prince named Arjuna and his charioteer and teacher, Sri Krishna, God in human form."[12]. In Chapter 2 Verse 48 of the Gita[10], it is mentioned that" Yogastha kurukarmani, sangamtyaktva Dhananjay "-tells us to follow equanimity coupled with practicality (i.e.) Practicing a state of neutrality by managing conflicting emotions with unbiased behaviours[2][11].Also in Chapter 14, verses 5 & 6, the three modes of human nature are listed which are sattva(goodness), rajas(passion), and tamas (ignorance) which in turn connect back to basic emotions identified by Psychologists. It has been mentioned that one who can manage emotions and be in Sattva (mode of goodness) is illuminating and full of health and well-being ("Anamayam").

Operative Definition

High Emotional neutrality score means getting low scores on negative emotions in the categories - Ego, Anger, Jealousy, Enmity and Pessimistic collected through the survey.

Research Question

How does emotional neutrality impact human health and well-being?

Research Method

Impact Study – Survey

The study conducted was an impact study and it followed the purposive sampling method to collect the data from the respondents based on a questionnaire with 11 questions covering five different emotions namely Jealousy, Ego, Anger, Enmity, and Pessimistic. The Demographic information along with health status including the kind of diseases, and medication was collected as well. The responses were captured through 5 points Likert scale to find the association between human emotions and human ailments. The total population of the study area was 300 Professionals in the Service industry, and the sample size was 115. The health status of every respondent was also recorded through questions and the data was analysed to see the percentage of sample size by various demographic factors to analyse the impact of emotions on ailments. Bhagavad Gita was also reviewed fully and narrowed down to chapters 2,13,14 to get suggestive information about connecting modes of nature to emotions which in turn connects to one's physical and mental health.

RESULTS

- Sample size of 115 out of 300 total population from service industry was considered from the age range of 20 to 60. The five-point Likert scale was scored based on the positivity across the scale of "always"," very often"," Sometimes"," Rarely" and "Never"
- 103 respondents out of a total of 115 (which is 89%) reported a high score of emotional neutrality.
- Among these high-scored respondents, 81% of them lead a healthy life without diseases and 19% lead their life with diseases.
- Out of 115 respondents, 28 falls within the age range of 20 to 30, 76 under 31-50, and 11 above 50. It was found that the higher the emotional neutrality, the higher the healthy living state, free of diseases across age ranges.

DISCUSSION

The results suggest that people with emotional neutrality are leading a healthy life without non-communicable diseases. Bhagavad Gita also provides suggestive evidence to support the results. Bhagavad Gita not only talks about the six vices of our mind, but it also explains how our mind / emotional state relates to our health and suggests ways

to keep the mind emotionally stable. In Chapter 14 verses 24-25 it is mentioned that one who stays unaffected by positive and negative emotions reaches the highest level of consciousness leading to a healthier and peaceful living [2][10]. This was also seen through the Impact study that the emotions that are more aligned to positive thoughts will make people healthy and happy (i.e.) the percentage of healthy people with high emotional neutrality scores was higher than people with low emotional neutrality scores. Thus, emotional neutrality will bring physical and mental well-being to people.

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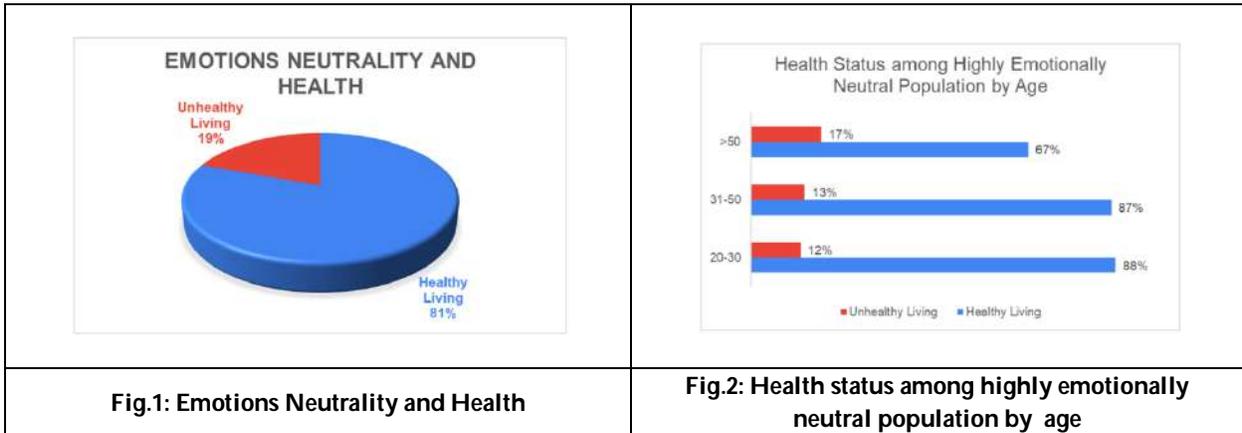16. The broaden-and-build theory of positive emotions. - PMC (nih.gov)

Table.1:The chart below depicts the healthy Living % among the population with a high score on Emotional Neutrality

Age	Total Respondents	High Emotional Neutrality Score	Healthy Living % of High Score
20-30	28	25	89%
30-50	76	63	83%
>50	11	6	55%

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| Fig.1: Emotions Neutrality and Health | Fig.2: Health status among highly emotionally neutral population by age |

RESEARCH ARTICLE

Analysis of Best Replacement Strategy during Sudden Failure using Pentagonal Neutrosophic Number

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ABSTRACT

The efficacy of the instruments will be declined over the period of use. The inefficiencies should overcame by applying individual/Group replacement Policy depending upon the situation. The best replacement strategy should be adopted to save economically. The replacement period should also be determined appropriately to reduce further decline of the equipment. So in this paper, we analyze the best replacement strategy under pentagonal neutrosophic environment.

Keywords: Neutrosophic number, sudden failure, Group replacement policy, Individual replacement policy, Pentaonal Neutrosophic number

INTRODUCTION

The problem occurs under imprecise case are first dealt by lofti. Zadeh in 1965 [12]. In 1995, Smarandache[10] introduced the idea of neutrosophy which includes indeterminancy along with truthiness and falseness. Many authors have developed triangular, trapezoidal, pentagonal, octagonal neutrosophic numbers and applied those in different fields. Pranab. Biswas et al., [8] discussed optimal replacement period under Fuzzy environment. Pranab Biswas and surapatipramanik [9] dealt fuzzy replacement problem with money value changes with time. Replacement policies are of two types. They are Individual and Group replacement policy. Individual replacement

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has been done immediately when the particular item fails. whereas Group replacement will be done in bulk whether the item fails or not. On bulk purchase the cost of an individual item will be less, which is the main advantage of group replacement policy. P.Kannagi, G Uthra [7], implemented the Group replacement strategy under fuzzy methods. Motivated by the paper we analyze the best replacement strategy using pentagonal neutrosophic number.

2. Preliminaries

In this section, we recall the basic definitions of Neutrosophic set, Single valued Neutrosophic set, Pentagonal neutrosophic number.

Definition 2.1:
Fuzzy Number

"A fuzzy number A is a subset of real line R, with the membership function μ_A satisfying the following properties:
(i) μ_A (x) is piecewise continuous in its domain.
(ii) A is normal, i.e., there is a $x_0 \in$A such that $\mu_A(x_0)$ = 1.
(iii) A is convex, i.e., $\mu_A(\lambda x_1+ (1-\lambda) x_2) \geq$ min $(\mu_A (x_1), \mu_A (x_2))$. $\forall$ x_1, x_2 in X".

Definition 2.2 (See [4]).
Neutrosophic set

"Let U be an universe of discourse then the neutrosophic set A is an object having the form A = {< x: $T_A(x)$, $I_A(x)$, $F_A(x)$ >, x $\in$U}, where the functions T, I, F: U $\rightarrow$]$^-$ 0,1$^+$[define respectively the degree of membership , the degree of indeterminacy, and the degree of non-membership of the element x $\in$U to the set A with the condition.
$^-$ 0 ≤ $T_A(x)$ + $I_A(x)$ + $F_A(x)$ ≤ 3$^+$
From philosophical point of view, the neutrosophic set takes the value from real standard or non-standard subsets of]$^-$ 0,1$^+$ [.So instead of]$^-$ 0,1$^+$[we need to take the interval [0,1] for technical applications, because   ]$^-$0,1$^+$ [will be difficult to apply in the real applications such as in scientific and engineering problems".

Definition2.3:
Single-Valued Neutrosophic Set[3]

"A Neutrosophic set in the definition 2.2 is said to be a single-valued Neutrosophic Set if x is a single-valued independent variable. $\widetilde{SA}$ = $\{\langle x; [T_{\widetilde{SA}}(x), I_{\widetilde{SA}}(x), F_{\widetilde{SA}}(x)]\rangle : x \in X\}$, where $T_{\widetilde{SA}}(x), I_{\widetilde{SA}}(x), F_{\widetilde{SA}}(x)$ denoted the concept of accuracy, indeterminacy and falsity memberships function respectively".

Definition2.4:
Single-Valued Pentagonal Neutrosophic Number[3]

"A Single-Valued Pentagonal Neutrosophic Number ($\tilde{S}$) is defined as and described as
$\tilde{S} = \langle [(g^1, h^1, i^1, j^1, k^1):\rho], [(g^2, h^2, i^2, j^2, k^2):\sigma], [(g^3, h, i^3, j^3, k^3):\omega], \rangle$, where $\rho, \sigma, \omega \in [0,1]$. The accuracy membership function $(\theta_{\tilde{S}}): \mathbb{R} \to [0,\rho]$, the indeterminacy membership function $(\emptyset_{\tilde{S}}): \mathbb{R} \to [\sigma, 1]$and the falsity membership function $(\psi_{\tilde{S}}): \mathbb{R} \to [\sigma, 1]$ are given as:

$$\theta_{\tilde{S}}(x) = \begin{cases} \theta_{\widetilde{Sl1}}(x) & g^1 \leq x \leq h^1 \\ \theta_{\widetilde{Sl2}}(x) & h^1 \leq x \leq i^1 \\ p & x = i^1 \\ \theta_{\widetilde{Sr2}}(x) & i^1 \leq x \leq j^1 \\ \theta_{\widetilde{Sr1}}(x) & j^1 \leq x \leq k^1 \\ 0 & otherwise \end{cases} \quad \emptyset_{\tilde{S}}(x) = \begin{cases} \phi_{\widetilde{Sl1}}(x) & g^2 \leq x \leq h^2 \\ \phi_{\widetilde{Sl2}}(x) & h^2 \leq x \leq i^1 \\ \sigma & x = i^2 \\ \phi_{\widetilde{Sr2}}(x) & i^2 \leq x \leq j^2 \\ \phi_{\widetilde{Sr2}}(x) & j^2 \leq x \leq k^2 \\ 1 & otherwise \end{cases}$$

$$\psi_{\tilde{S}}(x) = \begin{cases} \psi_{\widetilde{Sl1}}(x) & g^3 \leq x \leq h^3 \\ \psi_{\widetilde{Sl2}}(x) & h^3 \leq x \leq i^3 \\ \omega & x = i^3 \\ \psi_{\widetilde{Sr2}}(x) & i^3 \leq x \leq j^3 \\ \psi_{\widetilde{Sr1}}(x) & j^3 \leq x \leq k^3 \\ 1 & otherwise \end{cases}$$"

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2.5 Score and accuracy function[6]:

Score function is scaled as

$$\widetilde{SC_{pen}} = \frac{1}{15}[F_1 + F_2 + F_3 + F_4 + F_5] \times [2 + \pi - \rho - \sigma]$$

Accuracy function is scaled as

$$\widetilde{AC_{pen}} = \frac{1}{15}[F_1 + F_2 + F_3 + F_4 + F_5] \times [2 + \pi - \sigma]$$

Here, $\widetilde{SC}_{Pen} \in R, \widetilde{AC}_{Pen} \in R$

2.6 Relationship between any two PNN[6]:

Let us consider any two pentagonal neutrosophic number defined as follows

$F_{Pen1} = (\pi Pen1, \sigma Pen1, \rho Pen1)$
$F_{Pen2} = (\pi Pen2, \sigma Pen2, \rho Pen2)$
$SC_{Pen1} > SC_{Pen2}, F_{Pen1} > F_{Pen2}$
$SC_{Pen1} < SC_{Pen2}, F_{Pen1} < F_{Pen2}$
$SC_{Pen1} = SC_{Pen2}, F_{Pen1} = F_{Pen2}$
Then,
$AC_{Pen1} > AC_{Pen2}, F_{Pen1} > F_{Pen2}$
$AC_{Pen1} < AC_{Pen2}, F_{Pen1} < F_{Pen2}$
$AC_{Pen1} = AC_{Pen2}, F_{Pen1} = F_{Pen2}$

3. Group Replacement policy under pentagonal Neutrosophic number:

Let us consider a problem of Group replacement at fixed interval 'n' along with replacing individual item on their failure. Let Ñ denotes the total number of items in the system. $Ñ_i$ denote number of items failed during the ith period, i=1,2,3… (n-1) $\widetilde{C_1}$ denotes the cost of replacing an individual item $\widetilde{C_g}$ denotes the cost of an item in group replacement. $\tilde{C}(n)$ denotes the total cost of replacing the items in an interval. [Group replacement Cost + individual replacement cost].

Average cost (per period) is.

$\tilde{A}(n) = \frac{\widetilde{C_n}}{n}$ ----------- (1)

$\quad = \widetilde{N}cg + \widetilde{C_1}[\widetilde{N_1} + \widetilde{N_2} + \cdots + \widetilde{N_{n-1}}]$

$\quad = \widetilde{N}cg + \widetilde{C_1} \sum_{i=1}^{n-1} \widetilde{N_i}$ ----------- (2)

$\tilde{A}(n)$ is minimum, for the value of n for which $\Delta\tilde{A}(n-1) < 0 < \Delta\tilde{A}(n)$ ----------(3)

$\Delta\tilde{A}(n) = \tilde{A}(n+1) - \tilde{A}(n)$

$= \dfrac{\tilde{C}(n+1)}{n+1} - \dfrac{\tilde{C}(n)}{n}$

$= \dfrac{\widetilde{C_1}Ñ_n - \frac{\tilde{C}(n)}{n}}{n+1}$

Similarly,

$\Delta\tilde{A}(n-1) = \widetilde{C_1 N_{n-1}} - \dfrac{\tilde{C}(n-1)}{n-1}$

By (3),

$\dfrac{\widetilde{C_1 N_{n-1}} - \frac{\tilde{C}(n-1)}{n-1}}{n} < 0 < \dfrac{\widetilde{C_1}Ñ_n - \frac{\tilde{C}(n)}{n}}{n+1}$

$\Rightarrow \widetilde{C_1 N_{n-1}} - \dfrac{\tilde{C}(n-1)}{n-1} < 0 < \widetilde{C_1}Ñ_n - \dfrac{\tilde{C}(n)}{n}$ ……. (4)

$\Rightarrow \widetilde{C_1}Ñ_n > \dfrac{\tilde{C}(n)}{n} \,\&\, \widetilde{C_1}Ñ_{n-1} < \dfrac{\tilde{C}(n-1)}{n-1}$ … …. (5)

From this,

Group replacement will be preferred at the end of nth period if the cost of individual replacement (n^{th} period) > average cost per period (n^{th} period).

Group replacement should not be preferred at the end of nth period if, Individual replacement [$(n-1)^{th}$ Period] > Average cost per period [$(n-1)^{th}$ Period].

Illustrative example 1: [failure rate is a pentagonal Neutrosophic number]
The mortality rate of transistors in a computer has been given as follows in pentagonal neutrosophic number.

End of week	1	2	3	4	5
Failure rate in pentagonal neutrosophic number	(10,15,25,30,40; 1,0,0)	(21,31,41,51,61; 0.6,0.3,0.2)	(10,20,30,40,50; 0.5,0.2,0.6)	(54,64,74,80,90; 0.4,0.2,0.6)	(29,40,61,81,91; 0.4, 0.7, 0.2)

The cost of replacing a failed transistor is Rs.1.25. The decision is to replace all the transistor in a fixed time interval and also to replace an individual transistor when they fail in service. If the cost of group replacement in 30 paiseper transistor, find the interval between group replacement.

Solution:
Let us convert the pentagonal Neutrosophic number into crisp value using score function

$$\widetilde{SC_{pen}} = \frac{1}{15}[F_1 + F_2 + F_3 + F_4 + F_5] \times [2 + \pi - \rho - \sigma]$$

End of Week	1	2	3	4	5
Failure rate	16	28.686	17	38.61	30.195
Probability	0.123 P_1	0.220 P_2	0.130 P_3	0.296 P_4	0.231 P_5

Assume $N_0 = 1000$
$N_1 = N_0 P_1 = 123$
$N_2 = N_0 P_2 + N_1 P_1 = 235.129$
$N_3 = N_0 P_3 + N_1 P_2 + N_2 P_1 = 185.980$
$N4 = N_0 P_4 + N_1 P_3 + N_2 P_2 + N_3 P_1 = 386.593$
$N5 = N_0 P_5 + N_1 P_4 + N_2 P_3 + N_3 P_2 + N_4 P_1 = 386.44$

Cost of Group replacement

Week	Total Cost	Average Cost
1	1000 × 0.30 + 123 × 1.25 = 453.75	453.75
2	453.75 + 235.129 × 1.25 = 747.66	373.83
3	747.66 + 185.980 × 1.25 = 980.135	**326.711**
4	980.135 + 386.593 × 1.25 = 1463.37	365.844
5	1463.37 + 386.44 × 1.25 = 1946.42	389.284

The average cost per week reaches its minimum value at the end of 3 weeks.
Therefore, Group replacement period = 3 weeks
The minimum cost per week is Rs. 326.711

Individual replacement policy

Week	Probability	Average Life Time
1	0.123	0.123
2	0.220	0.44
3	0.130	0.39
4	0.296	1.184
5	0.231	1.155
Average life time of a Transistor		**3.292 weeks**

Average number of Failures "Per week" $= \frac{1000}{3.292}$

$$= 303.766$$

$$\simeq 304.$$

Average Cost of Individual Replacement = Rs. 304 × 1.25

$$\simeq Rs.380$$

 Average cost of individual replacement is greater than average cost of group replacement.

⇒ **Group replacement is preferable**.

Illustrative Example 2: [Cost of individual/ Group replacement is a Pentagonal Neutrosophic number].

A large township maintains 1000 lights. The failure rates have been observed as follows.

End of month	1	2	3	4	5
Probability of failure	0.3 P_1	0.1 P_2	0.1 P_3	0.2 P_4	0.3 P_5

The replacement cost for individual fused lights are (15,21,41,61,70; 0.6,0.2,0.3). A decision is made to replace all the items in a fixed interval of time and also to replace the individual item when they fail. The cost of group replacement is (10,20,40,55,65; 0.35,0.10,0.20). Determine the interval between group replacement?

Solution:

Assume that 1000 lights are in use. Let N_i – the number of failure during the ith month.

$N_0 = 1000$

$N_1 = N_0 P_1 = 300$

$N_2 = N_0 P_2 + N_1 P_1 = 190$

$N_3 = N_0 P_3 + N_1 P_2 + N_2 P_1 = 187$

$N4 = N_0 P_4 + N_1 P_3 + N_2 P_2 + N_3 P_1 = 305.1$

$N5 = N_0 P_5 + N_1 P_4 + N_2 P_3 + N_3 P_2 + N_4 P_1 = 489.23$

On De-neutrosophication using Score and accuracy function, individual replacement cost = 29.106 Rupees per light.

Individual replacement cost

Month	Probability	Average life time
1	0.3	0.3
2	0.1	0.2
3	0.1	0.3
4	0.2	0.8
5	0.3	1.5
Average life time		3.1 months

Average number of failures per month $= \frac{1000}{3.1} = 323$

Therefore average cost of individual replacement = 323 × Rs.29.106 **=** Rs. 9401.238

On De-neutrosophication using Score and accuracy function, Group replacement cost = Rs.6.96

Month	Total cost	Average Cost
1	1000 × 6.96 + 300 ×29.106 = 15691.8	15691.8
2	15691.8 + 190 × 29.106 = 21221.94	10610.97
3	21221.94 + 187 × 29.106 = 26664.762	8888.254
4	26664.762 + 305.1 × 29.106 = 35545	**8886.25**
5	35545 + 489.23 × 29.106 = 49784.5	9956.90

Group replacement reaches its minimum value at the end of 4 months.

Group replacement period = 4 months.

The minimum cost per month = Rs.8886.25

The average cost of individual replacement is greater than average cost of group replacement.

⇒ **Group replacement policy is preferable.**

Example 3: [When failure rate and cost are pentagonal neutrosophic number]

The failure rate of certain product is given in pentagonal neutrosophic number.

End of week	1	2	3	4	5
Failure rate in PNN	(54,64,74,80,90; 0.4,0.2,0.6)	(5,10,20,15,20; 0.1,0.3,0.15)	(10,15,25,30,40; 1,0,0)	(29,40,61,81,91;0.4,0.7,0.2)	(10,20,30,40,50; 0.5,0.2,0.6)

The cost of replacing a failed product is (10,20,30,40,50;1,0,0). The cost of replacing all the products simultaneously is (5,14,10,15,20;0.2,0.3,0.4). The decision made is to replace all the items at fixed period and also to replace the individual item when they fail. Determine the optimal interval for group replacement.

Solution:

End of week	1	2	3	4	5
Failure rate (Crisp)	38.61	7.698	16	30.195	17
Probability	0.35	0.07	0.15	0.27	0.16

$N_0 = 500$

$N_1 = N_0 P_1 = 175$

$N_2 = N_0 P_2 + N_1 P_1 = 96.25$

$N_3 = N_0 P_3 + N_1 P_2 + N_2 P_1 = 120.937$

$N_4 = N_0 P_4 + N_1 P_3 + N_2 P_2 + N_3 P_1 = 210.307$

$N_5 = N_0 P_5 + N_1 P_4 + N_2 P_3 + N_3 P_2 + N_4 P_1 = 223.759$

On De-neutrosophication using Score and accuracy function, Cost of individual replacement = Rs.30.

On De-neutrosophication using Score and accuracy function, Cost of group replacement: = Rs. 6.39

Cost of group replacement

Week	Total Cost	Average Cost
1	500 × 6.39 + 175 × 30 = 8445	8445
2	8445 + 96.25 × 30 = 11332.5	5666.25
3	11332.5 + 120.937 × 30 = 14960.61	**4986.87**
4	14960.61 + 210.307 × 30 = 21269.82	5317.45
5	21269.82 + 223.759 × 30 = 27982.59	5596.518

Since average cost of individual replacement is greater than average cost of group replacement, ⇒Group replacement is preferable.

CONCLUSION

Here we have discussed the best replacement policy when large number of items in a system are under consideration. In this paper we analyzed in three directions when failure rate, cost of individual/group replacement and both is PNN. In all the 3 cases we conclude Group replacement policy is preferable.

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RESEARCH ARTICLE

Study of Teaching and Learning Second Language through Authentic Documents

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ABSTRACT

In order to teach and learn a second language, various dimensions are required. A proper selection of resources, a teaching style that is suited for the learning environment and the learners' level, and teaching strategies are all essential in the acquisition of a second language. It is important to note at this point that the teacher who serves as the organizer guides these diversifications. The purpose of this article is to present the role, advantage and limitations of Authentic Documents for beginners in French Language class.

Keywords: second language, teaching, organizer guides, Authentic Documents

INTRODUCTION

The teaching and learning of a Second / foreign language is a long process. Both the teacher and the learner must adapt well to this process by carrying out their tasks. A teacher has a primary responsibility of conducting the classes effectively in a continuous manner. In order to do this, the teacher must determine and set the objectives well so that the learners achieve the desired goals. These may be linguistic, communicative and cultural objectives. An important thing here is to create an effective atmosphere in the classroom to attract the attention of learners. The major objectives here are increasing motivation of the student and maintaining their concentration on the subjects studied. Germain states that "the strategic teacher is also a motivator." In order to sustain motivation, the strategic teacher makes it obvious to the student the personal, social or professional relevance of the activities he has chosen and their link with the real world, outside the classroom, where the student will have to reuse the knowledge and skills acquired. The two essential points on which Germain emphasizes are motivation and the other is the link between class and society. In this research, the use of authentic document can contribute to the exploitation of lessons by

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creating an interaction between the social world and class activities. Teaching a language is not only a transmission of knowledge through activities carried out in the classroom, it is inevitable to also have missions which aim to practice what has been learned in the outside world. In the environment where language teaching is carried out, it is commonly known that learners do not just need grammatical knowledge and skills (with regard to the language studied), but must also have the ability to use the language in question. The term "Authentic Document" was introduced in the didactics of language in the year 1970 with the Communicative Approach. In the teaching of French as a Foreign Language, "Actes de Parole" – Speech Acts replaced the dialogues with the Communicative Approach. In order to perform the speech acts, real documents that are not fabricated, were generalized for the situation of communication. Under the Communicative Approach the teaching remained learner centered and the exploitation of authentic documents helped the learner to remain in direct contact with the target language just like as in real life situations.

What are Authentic Documents?
An authentic document is a written, audio or audiovisual document intended for native speaker that a teacher collects for use in the activities that he will propose in class. A document is said to be authentic as it was not designed for educational purposes but for communicative objectives. It is presented to learners asit is, i.e. in its original state. There is no modification made to this document. There is no omission or deletion of paragraphs to reduce the level of information or the addition of connectors between sentences to facilitate deduction. In the words of Robert, "the authentic document differs from the pedagogical or fabricated document created from scratch for the class by a designer of methods or by a teacher, according to linguistic and pedagogical criteria."

Different types of authentic documents
A real document can be a train or a plane ticket, a calendar, telephone book, an advertisement, a magazine,a travel map or a plan, a tourist brochure, a newspaper, a weather report, a mail order, acatalogue, train schedules, telegram, passport, classified ads, a bank note, cheque, a cooking recipe, a television programme, an administrative form, a form, a comic strip, a family photo, a song, a film or documentary, video clips from TV shows, books, etc. Any kind of authentic document given above has communicative, linguistic or cultural objective. These objectives reflect on the one hand the cultural motives and on the other hand present the diverse linguistics of the target language. In the words of Ntinoy, ''Authentic documents constitute a teaching tool for French as a foreign language classes intended for all learners." But the teacher must be careful while choosing the documents for different levels and ages of learners so that they can properly adapt them to the target culture.

Authentic Documents as a medium of interaction (Speaking)
Authentic documents in the form of text or image help to conduct interaction in the language class. The teacher can give situation, objective, role play, and type of interaction to the participants. The participants are given the context and the teacher gives a base by introducing initial sentence structures. The learner reemploys the structures and vocabulary known. He also produces new imitated structures over the structures already known. The learner learns new vocabulary and expresses himself by communicating as tasked by the teacher. Taking an example of a train ticket. The teacher asks the participant to buy ticket from the ticket seller thus asking him to open dialogue with salutation. Here the learner is acquainted with the vocabulary related to time, place, arrival and departure. Besides he is spontaneous and follows a precise and regulated speech. The learner is thus engaged personally to perform the speech act. The learner learns to work in group and make the discussion.

Authentic Documents as a means to develop Reading
When a text is given for reading, it involves a set of operations. Cuq states "the learner first of all observes the document as a whole, its images, title, sub title, etc. This is the first contact with the language." So the visual organization helps to give an idea of preliminary of the text, a kind of sensitization. In the words of Cuq, "a reader should avoid reading word to word".i.e. he should get informed if the text is all about, on economics, a natural phenomenon or on linguistics. On reading the text he should be able to realize an activity or act, for e.g. making a recipe or talking over phone.

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Authentic Documents to develop Listening

An audio as an authentic material can be used for developing listening skills. It can be an audio in the voice of a native or a speaker of the target language for e.g. speech of a leader in proper French accent or a song. On listening to the oral document, the learner learns the words and expressions used by the speaker in the native accent. The learner listens, detects and memorizes. Under the brain storming activities proposed by the teacher, he recalls what, how and when the action passed and then responds to the questions.

Authentic Documents to develop Writing

The written authentic texts can serve as a model for learners in an implicit manner to develop writing skills like an advertisement or a comic strip. The learner identifies the key words in the text. He takes hold of the structures in the text that allow information to be given about. The learner observes the idea and analyzes the corpus. He pens down a rough draft of his opinion or argument to be given copying some structures and using new words. The imitation of the right dialect helps to enhance his writing creativity.

Advantages of Using Authentic Documents

Learners are thus confronted with a standardized language, with correct French and sometimes even at a high level of language. They offer an authentic and rich image of the outside world and thus contribute to developing a favorable attitude of the learner towards the foreign language and culture. They contribute to the autonomy of the learner in his learning. They accustom him to engage with the least possible assistance in decoding, location, comprehension activities on documents similar to those with which he will be confronted later in the outside world. In the absence of textbooks, they correspond to the linguistic particularity. In the words of J M Defays: "Authentic documents have the advantage of encouraging the teacher to vary the materials so as to motivate, intrigue and surprise his learners, as well as exposing them to language and languages in all their forms and in all their manifestations". It is an ideal support for describing the intercultural dimension. For example, if we have a document or a text that talks about PACS, union of same or opposite sex in France, the learners understand better the culture of France. In the words of Geneviève Zarate "the student is confronted with the same cultural objects as the native."

Disadvantages of Using Authentic Documents

Authentic documents in the language class have their own limitations. They are not often dated and at times, the references are insufficient. In addition, the choice of these documents has a limited time period because this material is destined to disappear. When it comes to selecting and organizing documents, it is a difficult task for a teacher to do so if he or she has not been trained. It should be noted that any authentic document does not remain authentic for long when it is no longer linked to the authentic situation in which it originated. When a document is used out of its context, certain parameters change: deferred communication, diversion of the statement, temporal markers, presence of a new receiver whose skills are not those of a native. We also observe a space and time gap leading to socio cultural gap while using authentic documents. The document as a whole can be transferred but the original environment cannot. For example while listening the songs of Carla Bruni, a native would receive the song better as compared to a learner who is an Indian.

Some Suggestions while using Authentic Documents in Language Class

While using the Authentic Documents, a teacher must carefully check the source from where it is taken and mention it properly. The document chosen should be attracting the attention of the learner as per his level of understanding and age. The theme selected should motivate the learner and arouse his curiosity. The document selected should take into account the needs of learner, his interests and learning objectives.

CONCLUSION

Authentic documents play an important role especially with the beginners as they cater to the needs of these learners. These documents aid in mastering the communicative skills. They make it probable to respond to the

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diverse needs of the learners in target language. Above all they help to enhance creativity of a class, a stage where everyone comes collectively and helps each other to carry out the tasks proposed by the teacher. Even the teacher finds the pleasure of teaching. The professional skills of the teacher are honed thus creating pleasure in teaching and learning and he acquires knowledge to manage the preparation time for lessons. The teacher feels motivated and use multimedia, understanding its importance in the language classroom. Thus the teacher has the autonomy to make his class interesting and pleasing.

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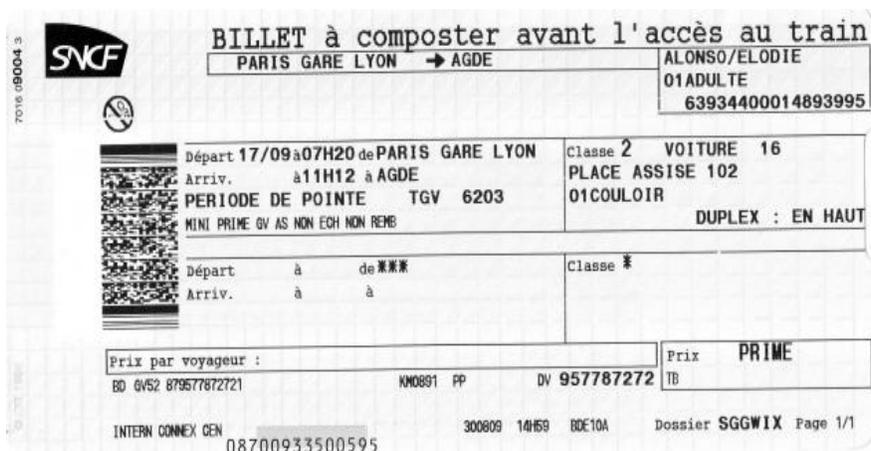
Fig 1: Taking an Example of a Train Ticket

RESEARCH ARTICLE

A Study to Compare the Effect of Upper Extremity Exercise Versus Lower Extremity Exercise Training on Blood Pressure in Subjects with Hypertension

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ABSTRACT

To investigate the effect of upper extremity exercise versus lower extremity exercise on blood pressure in subjects with hypertension. 60 Subjects with essential hypertension were recruited, and resting blood pressure was taken. Subjects were randomly divided into two groups. Group -A subjects received upper extremity exercise and Group B subjects received lower extremity exercise. This group was subsequently shown to possess a similar demographic distribution to the two exercise groups. Both groups received training sessions held 5 times a week for 4 weeks. Exercise training in the upper extremity and lower extremities significantly improved systolic and diastolic blood pressure. But lower extremity exercise training was comparatively better than upper extremity exercise training to improve systolic and diastolic blood pressure in a short duration. A statistically significant difference was seen in systolic and diastolic pressure before and after the exercises. The efficacy of lower extremity exercise is higher than of upper extremity exercise training on systolic and diastolic blood pressure reduction subjects with essential hypertension. Both exercises have an impact on reducing blood pressure but patients who want quick recovery should go for lower limb exercises.

Keywords: hypertension, upper and lower extremity exercise, blood pressure.

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INTRODUCTION

Hypertension, also known as high or raised blood pressure, is a condition in which the blood vessels have persistently raised pressure [1]. Blood is taken from the heart to all parts of the body in the vessels. heart beats and it pumps blood into the vessels. Blood pressure is created by the force of blood pushing against the walls of blood vessels (arteries) as it is pumped by the heart. The greater the pressure, the heart has to pump [1]. High blood pressure, or the chronic rise in arterial pressure at rest to above 140 mmHg for systolic and/or 90 mmHg for diastolic blood pressure, is the utmost notable and modifiable risk factor for cardiovascular disease (i.e., coronary artery disease, stroke, and heart failure) [2]. The prevalence of high blood pressure varies by ethnicity and gender. Hypertension ranks as the second leading risk factor for men and women globally. Hypertensive patients have significant changes in their cardiovascular systems in comparison with healthy people. The overall prevalence of hypertension among adults in India is about 30% with an urban prevalence of 34% and a rural prevalence of 28%. Unfortunately, only 25% of rural and 38% of urban Indians with hypertension are being treated. This condition, if not treated appropriately, may lead to mortality in 50% of patients with hypertension from coronary artery disease or heart failure, 33% from stroke, and 10-15% from kidney failure [3]. Cardiovascular advantages of regular exercise include a decrease in resting blood pressure (BP), which is critical in reducing the risk of cardiovascular disease (CVD). Blood pressure is the pressure exerted against the arterial walls as the blood is ejected from the heart i.e., systolic blood pressure (SBP) whereas the heart fills i.e, diastolic blood pressure (DBP). Values are reported as SBP over DBP (i.e., SBP/DBP) and are noted in millimeters of mercury (mmHg) [4]. According to the American College of Cardiology (ACC) / American Heart Association (AHA) hypertension guideline

· JNC 8 Classification:

Classification	Systolic Blood Pressure (mmHg)		Diastolic Blood Pressure (mmHg)
Normal	<120	AND	<80
Prehypertension	120-139	OR	80-89
Stage 1 HTN	140-159	OR	90-99
Stage 2 HTN	≥ 160	OR	≥ 100

Although hypertension is a chronic disease associated with many complications, using cost-effective strategies for controlling this disease seems necessary. Despite those antihypertensive drugs being effective and often having minimal side effects, healthcare costs are rising. Treatment guidelines for primary and secondary prevention of high BP recommend that lifestyle changes, such as increased physical activity, should be considered as the first-line non-pharmacological treatment. Considerable evidence indicates that regular exercise reduces systolic and diastolic blood pressure. The exercise-induced antihypertensive effects are often reported in people doing exercises: a reduction of 5-7 mmHg after an exercise session (immediate effect) or after an exercise period (long-lasting effect) [5]. Regular physical activity makes your heart stronger. A stronger heart can pump extra blood with reduced effort. As a result, the force on your arteries decreases, lowering your blood pressure. Upper and lower extremity exercise training is beneficial to reducing blood pressure and resting heart rate, which exercises training is more beneficial to reducing blood pressure in short duration is not well documented[6]. In addition, to our knowledge, no studies have examined upper versus lower extremity exercise training in hypertensive subjects. Hence, the purpose of this study was to compare the effects of systolic and diastolic blood pressure between upper and lower extremity exercises in hypertensive subjects.

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The study hypotheses are as follows

1- upper extremity exercise training can affect blood pressure in hypertensive patients.

2- lower extremity exercise training can affect blood pressure in hypertensive patients.

3- upper and lower extremity exercises training have different effects on blood pressure in hypertensive patients.

Aim of the study

To compare the effect of upper and lower extremity exercise training on Systolic and diastolic blood pressure in hypertensive subjects.

Objectives of the Study

1. To determine the effect of upper extremity exercise training on Systolic and diastolic blood pressure in hypertensive subjects.
2. To determine the effect of lower extremity exercise training on Systolic and diastolic blood pressure in hypertensive subjects.
3. To compare the effectiveness of upper extremity exercise training versus lower extremity exercise training on Systolic and diastolic blood pressure in hypertensive subjects.

METHODOLOGY

Sampling

Purposive sampling

Study design

Experimental comparative study

Sampling technique

Simple random sampling

Duration of training

5 days a week for 4 weeks.

Sample size

60 subjects were randomly selected from Shri K. K. Sheth Physiotherapy College, Rajkot.

The study was conducted on 60 subjects between the age group of 45-75 years. Subjects were taken from clinics in and around Rajkot based on random sampling. Before participation aims and objectives of the study were explained. All subjects were screened and detailed medical history was taken to exclude any serious illness. Informed consent was signed by the subjects for their voluntary participation. Then the following information was recorded for each patient: name, age, sex, address, height, weight, BMI, heart rate, systolic and diastolic blood pressure. Subjects were requested to continue their normal activities and avoid any other form of exercise for the duration of the study.

Inclusion Criteria

- Age: 45-75 Years
- Both male and female
- patients who are having essential hypertension.
- Individuals who are willing to participate in the study

Exclusion criteria
- Subject with a known case of any neurological condition
- Subject with a known case of any other cardiovascular conditions
- Subject with any history of upper or lower limb fracture and other musculoskeletal disorders disease that would restrict the performance of the exercise.
- Athletes
- Those who are performing regular physical exercise
- Smokers and alcohol drinkers

MATERIALS

1.Mercury Sphygmomanometer
2.Stethoscope
3.Stopwatch
4.Pen
5.paper
6.Assessment form
7.Consent form
8.Plinth

Tools used for the study

Sphygmomanometer

Systolic and diastolic blood pressure is measured with a sphygmomanometer. It is measured in mm Hg(millimeters of mercury).

- To measure blood pressure, the patient should be in a comfortable relaxed sitting position for 5-10 minutes.
- Then, the cuff is placed around the bare and stretched-out upper arm and inflated until no blood can flow through the brachial artery. Then the air is slowly let out of the cuff.
- As soon as the air pressure in the cuff falls below the systolic blood pressure in the brachial artery, blood will start to flow through the arm once again. This creates a pounding sound when the arteries close again and the walls of the vessels hit each other after a heartbeat. The sound can be heard by placing the stethoscope close to the elbow. Right, when you start to hear this pounding for the first time you can read your systolic blood pressure on the pressure meter.
- The pounding sound stops when the air pressure in the cuff falls below the diastolic blood pressure in the brachial artery. Then the blood vessels remain open. Right when the pounding stops, you can read the diastolic blood pressure on the pressure meter.

Procedure

60 subjects with essential hypertension were randomly selected and the study was explained to them then subjects were randomly assigned to two groups.
1.Group-A: 30 subjects had received upper extremity exercise training.
2.Group-B: 30 subjects had received lower extremity exercise training.
Subjects in both groups had received exercise training 5 days a week for 4 weeks.
In each group, the subject was given 10 minutes of a general warm-up including stretching and mild intensity of exercise followed by 20 minutes of exercise according to protocol and the last 10 minutes of cool down.

Exercise Protocol: [7]
- **Group-A** (Upper extremity exercise training):

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1. Exercise on an overhead pulley in a sitting position
2. Push up
3. Arm raises in a quadruped position
4. Shoulder flexion-extension exercise in a sitting position
5. Gripping exercise

• **Group-B** (Lower extremity exercise training):[16,17]
1. Partial squats (do not bend the knee more than 45 degrees)
2. Forward lunges
3. Side lunges
4. Leg raises in a quadruped position
5.Step up and down (height 6 inches)

Each exercise was repeated for 40 seconds, followed by 20 seconds ofrest for 4 minutes.
The training was terminated if the subject experience dyspnea or fatigue.
SBP and DBP were recorded on the 1st day of exercise and after 4th week of exercise.
Both the group's blood pressure was taken in the following period.

1.1st-day exercise training
2.After 4 weeks of exercise training
All the data were collected and statistical analysis was done.

RESULTS

Statistical Analysis:
Study design: Experimental comparative study.
Test: The collected data were analyzed by paired t-test to compare the result within the group and unpaired t-test to compare the result between groups with a 0.05 level of significance with a 95% of confidence interval.
Table. 1 Baseline data for demographic variables
As per Table -1 value comparison of groups at the baseline demographic data shows no significant difference in mean age and body mass index.
Table. 2 Comparison of pre-and post-training blood pressure
Graph: 1 Comparison of pre-and post-training blood pressure

DISCUSSION

The baseline data of the demographic and outcome variable did not show any significant difference between the subjects in the two groups indicating homogeneity of the subjects. The study concluded that both upper extremity and lower extremity exercise training are effective to reduce blood pressure but lower extremity exercise training was more beneficial than upper extremity exercise training. Upper extremity exercise training in Group–A decreased systolic and diastolic blood pressure. The present study showed a reduction in blood pressure which is supported by a previous study. They found upper extremity training resulted in decreased blood pressure. This might be due to increased elasticity of capillary and low requirement of blood flow to the upper extremity compare to the lower extremity[8]. The upper extremity capillary lumen size is narrow. So, during upper extremity exercise, more increase in blood pressure compared to lower extremity exercise at the same workload. This is associated with early severe dyspnea and termination of exercise at low workload than lower extremity exercise [9]. The absolute work-loads were 2.5-3 times greater during lower limb exercise compared to upper limb exercise. Heart rates were the same in both types of exercise. Arterial noradrenaline and adrenaline levels became higher during leg compared to arm exercises [10]. The mechanisms proposed for exercise-induced antihypertensive effects include hormonal-

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neurological, vascular, and structural adaptations. Decreased catecholamine and overall peripheral vascular resistance, increased insulin sensitivity, altered vasodilators, and vasoconstrictors, and reduced sympathetic nerve activity are some of the hypothesized explanations for exercise-induced antihypertensive effects.

Aerobic concentric exercises have been employed safely and successfully in patients with coronary artery disease for more than three decades [11]. In Group B, lower extremity exercise training had shown a reduction in blood pressure. That was also supported by previous studies and they concluded that lower extremity exercises are beneficial to reducing blood pressure and improving cardiac function [12]. Lower-limb exercise, such as walking, has consistently been shown to reduce blood pressure. The research results show that the maximum cardiovascular and pulmonary responses, systolic blood pressure, and mean arterial pressure were significantly lower during lower extremity exercises than in upper extremity exercises in the same workload in young adults. This feature makes lower-limb exercises suitable for long-term rehabilitation [13]. The study reported a significant reduction in SBP after 10 sets of 10 repetitions of leg extension exercises when compared to elbow flexion exercises. Many patients with hypertension report dyspnea and fatigue early when they are performing upper extremity functional activity compare to lower extremity functional activity [14].

The reduction in blood pressure after lower extremity exercise is mainly due to the aerobic training effect, because of large muscle mass and large capillary lumen size (that reduce peripheral vascular resistance) than the upper extremity. So, it requires more blood flow compared to arm muscle [15]. So, both exercise training is beneficial to reduce blood pressure but, lower extremity exercises are better than upper extremity exercises to reduce blood pressure in a short duration. The probable reason could be that the upper extremity capillary lumen size is narrow and has a small muscle mass. So, during upper extremity exercise peripheral vascular resistance is high compared to lower extremity exercise. Arterial noradrenaline and adrenaline levels became higher during lower limb exercises compared to upper limb exercises. So, increase adrenaline level reduces blood pressure [16]. Also, blood flow requirements during upper extremity exercise average 20 – 30% lower training lower extremity exercise. Similarly, arm exercise produces higher values for diastolic blood pressure. These differences relate to the relatively smaller muscle mass activated in arm exercise and smaller capillary lumen size [17]. Systolic and diastolic blood pressure increased significantly pre- and post-training which is because of aerobic training, education in peripheral vascular resistance, change in the elasticity of arterial wall, and an increasing the contractibility of cardiac muscle. So, this study is also in agreement with previous studies suggesting that "lower extremity exercise training is more effective than upper extremity exercise in terms of blood pressure control".

Clinical implication
Results suggest that LEET is more beneficial to reduce blood pressure. So, this can be used for cardiac disease patients to reduce blood pressure in the early stage of exercise prescription, and later on, UEET can be also added for the progression of exercise. In the early stage of hypertension subjects can go for UEET but in the chronic or late stage of the disease, first, give only LEET then go for UEET or avoid it if the patient feels dyspnoea.

Further recommendation
1.HR can be included in this study.
2.Spo$_2$ can be measured.

CONCLUSION

Upper extremity exercise training and lower extremity exercise training resulted in a significant reduction in systolic and diastolic blood pressure. While the efficacy of lower extremity exercise is higher than that of upper extremity exercise training in a subject with essential hypertension for a reduction in blood pressure.

Abbreviations

LEET: Lower extremity exercise training

UEET: Upper extremity exercise training

SBP : Systolic blood pressure

DBP : Diastolic blood pressure

HR   : Heart rate

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Table.1: Baseline Data For Demographic Variables

Group	Group-A(UEET) Mean + SD	Group B (LEET) Mean + SD
Number	30	30
Age in year	55 ±1	57±1
Body mass index	20.90±2.324	21.05±1.86

Table.2: Comparison of Pre-And Post-Training Blood Pressure

GROUP	A		B	
PFT	PRE-UEET (MEAN±SD)	POST-UEET (MEAN±SD)	PRE-LEET (MEAN±SD)	POST-LEET (MEAN±SD)
Systolic BP (mm Hg)	134 ± 9.00	128 ± 8	135 ± 10	126 ± 9
DiastolicBP (mm Hg)	72± 10.00	68 ± 9.00	78 ± 8	70 ± 10
HR	70 ± 4	90 ± 2	65 ± 4	89 ± 2
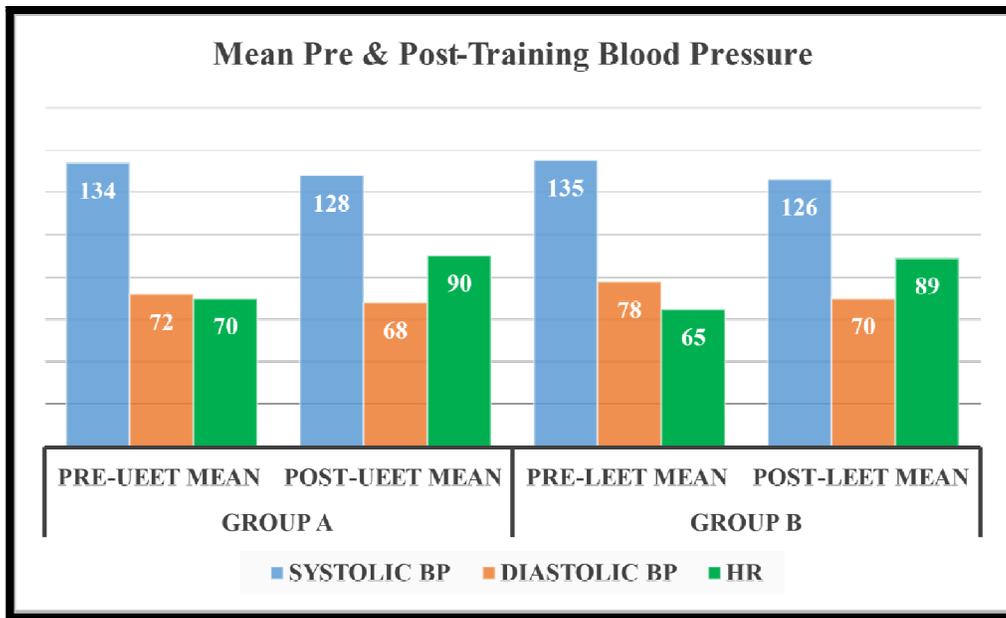
Graph.1:Comparison of pre-and post-training blood pressure

RESEARCH ARTICLE

Bipolar Valued Multi Fuzzy Function in Bipolar Valued Multi Fuzzy Subnearring of A Nearring

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ABSTRACT

In this paper, bipolar valued multi fuzzy functions in bipolar valued multi fuzzy subnearring of a nearing are discussed and using these functions, some theorems are stated and proved.

Subject Classification. 97H40, 03B52, 03E72.

Keywords: "Bipolar valued fuzzy subset, bipolar valued multi fuzzy subset, bipolar valued multi fuzzy subnearring, bipolar valued multi fuzzy normal subnearring, antihomomorphism, image and preimage".

INTRODUCTION

In 1965, Zadeh [10] introduced the notion of a fuzzy subset of a universal set. W.R.Zhang [11, 12] introduced an extension of fuzzy sets named bipolar valued fuzzy sets in 1994 and bipolar valued fuzzy set was developed by Lee [4, 5]. Bipolar valued fuzzy sets and intuitionistic fuzzy sets look similar each other. However, they are different each other [5]. M.S.Anithat et.al [1, 2, 3] introduced the bipolar valued fuzzy subgroup. Sheena. K. P and K.Uma Devi [7] have introduced the bipolar valued fuzzy subbigroup of a bigroup. Shanthi.V.K and G.Shyamala[8] have introduced the bipolar valued multi fuzzy subgroups of a group. Yasodara.S, KE. Sathappan [9] defined the bipolar valued multi fuzzy subsemirings of a semiring. Bipolar valued multi fuzzy subnearring of a nearing has been introduced by S.Muthukumaran and B.Anandh [6]. In this paper, the concept of bipolar valued multi fuzzy functions in bipolar valued multi fuzzy subnearring of a nearing is introduced and established some results.

1.PRELIMINARIES
Definition 1.1
([11]) **"**A bipolar valued fuzzy set (BVFS) B in X is defined as an object of the form B = { < x, $B^+(u)$, $B^-(u)$ >/ x∈X}, where B^+ : X→ [0, 1] and B^- : X→ [–1, 0]. The positive membership degree $B^+(u)$ denotes the satisfaction degree of an element x to the property corresponding to a bipolar valued fuzzy set B and the negative membership degree $B^-(u)$ denotes the satisfaction degree of an element x to some implicit counter-property corresponding to a bipolar valued fuzzy set B**"**.

Definition 1.2
([9]) **"**A bipolar valued multi fuzzy set (BVMFS) A in X is defined as an object of the form B = { ⟨ x, $B_1^+(u)$, $B_2^+(u)$, …, $B_n^+(u)$, $B_1^-(u)$, $B_2^-(u)$, …, $B_n^-(u)$ ⟩ / x∈X }, where B_i^+ : X→ [0, 1] and B_i^- : X→ [–1, 0], for all i. The positive membership degrees $B_i^+(u)$ denote the satisfaction degree of an element x to the property corresponding to a bipolar valued multi fuzzy set B and the negative membership degrees $B_i^-(u)$ denote the satisfaction degree of an element x to some implicit counter-property corresponding to a bipolar valued multi fuzzy set B**"**.

Definition 1.3
([6]) **"**Let (N, +, ·) be a nearring. A BVMFS B of N is said to be a bipolar valued multi fuzzy subnearring of N (BVMFSNR) if the following conditions are satisfied, for all i,

(i) $B_i^+(u–v) \geq \min\{ B_i^+(u), B_i^+(v) \}$

(ii) $B_i^+(uv) \geq \min\{ B_i^+(u), B_i^+(v) \}$

(iii) $B_i^-(u–v) \leq \max\{ B_i^-(u), B_i^-(v) \}$

(iv) $B_i^-(uv) \leq \max\{ B_i^-(u), B_i^-(v) \}$, $\forall$ u, v∈N**"**.

Definition 1.4
Let R be a nearring. A bipolar valued multi fuzzy subnearring A of R is said to be a bipolar valued multi fuzzy normal subnearring (BVMFNSNR) of R if $A_i^+(x+y) = A_i^+(y+x)$, $A_i^-(x+y) = A_i^-(y+x)$, $A_i^+(xy) = A_i^+(yx)$ and $A_i^-(xy) = A_i^-(yx)$, for all x, y in R and for all I**"**.

Definition 1.5[2]
"Let R and R^I be any two nearring. Then the function f: R → R^I is said to be an antihomomorphism if f(x+y) = f(y)+f(x), f(xy) = f(y)f(x) for all x, y in R.

Definition 1.6
Let X and X^I be any two sets. Let f : X→ X^I be any function and let A be a bipolar valued multi fuzzy subset in X, V be a bipolar valued multi fuzzy subset in f(X) = X^I, defined by $V_i^+(y) = \sup\limits_{x\in f^{-1}(y)} A_i^+(x)$ and $V_i^-(y) = \inf\limits_{x\in f^{-1}(y)} A_i^-(x)$, for all x in X and y in X^I, for all i. A is called a preimage of V under f and is denoted by $f^{-1}(V)$**"**.

2. PROPERTIES.

2.1 Theorem
Let R and R^I be any two nearrings. The homomorphic image of a BVMFSNR of R is a BVMFSNR of R^I.

Proof
Let V = f (A), where A = ⟨ A_1^+, A_2^+, …, A_n^+, A_1^-, A_2^-,…, A_n^- ⟩ is a BVMFSNR of R. We have to prove that V is a BVMFSNR of R^I. Now, for f (x), f (y) in R^I, for each i, $V_i^+(f(x)–f(y)) = V_i^+(f(x–y)) \geq A_i^+(x–y) \geq \min\{A_i^+(x), A_i^+(y)\}$ = min $\{V_i^+(f(x)), V_i^+(f(y)) \}$ which implies that $V_i^+(f(x)–f(y)) \geq \min\{ V_i^+(f(x)), V_i^+(f(y)) \}$, for all f(x), f(y) in R^I. And $V_i^+(f(x)f(y)) = V_i^+(f(xy)) \geq A_i^+(xy) \geq \min \{A_i^+(x), A_i^+(y)\} = \min \{V_i^+(f(x)), V_i^+(f(y)) \}$ which implies that $V_i^+(f(x)f(y)) \geq \min\{V_i^+(f(x)), V_i^+(f(y))\}$, for all f(x), f(y) in R^I. Also $V_i^-(f(x) –f(y)) = V_i^-(f(x–y)) \leq A_i^-(x–y) \leq \max \{A_i^-(x), A_i^-(y)\} = \max\{V_i^-(f(x)),$

$V_i^-(f(y))\}$ which implies that $V_i^-(f(x)-f(y)) \leq \max\{V_i^-(f(x)), V_i^-(f(y))\}$, for all $f(x)$, $f(y)$ in R^l. And $V_i^-(f(x)f(y)) = V_i^-(f(xy)) \leq A_i^-(xy) \leq \max\{A_i^-(x), A_i^-(y)\} = \max\{V_i^-(f(x)), V_i^-(f(y))\}$ which implies that $V_i^-(f(x)f(y)) \leq \max\{V_i^-(f(x)), V_i^-(f(y))\}$, for all $f(x)$, $f(y)$ in R^l. Hence V is a BVMFSNR of R^l.

2.2 Theorem
Let R and R^l be any two nearrings. The homomorphic preimage of a BVMFSNR of R^l is a BVMFSNR of R.

Proof.
Let $V = f(A)$, where $V = \langle V_1^+, V_2^+, ..., V_n^+, V_1^-, V_2^-, ..., V_n^- \rangle$ is a BVMFSNR of R^l. We have to prove that A is a BVMFSNR of R. Let x, y in R. For each i, $A_i^+(x-y) = V_i^+(f(x-y)) = V_i^+(f(x)-f(y)) \geq \min\{V_i^+(f(x)), V_i^+(f(y))\} = \min\{A_i^+(x), A_i^+(y)\}$ which implies that $A_i^+(x-y) \geq \min\{A_i^+(x), A_i^+(y)\}$, for all x, y in R. Also, $A_i^+(xy) = V_i^+(f(xy)) = V_i^+(f(x)f(y)) \geq \min\{V_i^+(f(x)), V_i^+(f(y))\} = \min\{A_i^+(x), A_i^+(y)\}$ which implies that $A_i^+(xy) \geq \min\{A_i^+(x), A_i^+(y)\}$, for all x, y in R. And $A_i^-(x-y) = V_i^-(f(x-y)) = V_i^-(f(x)-f(y)) \leq \max\{V_i^-(f(x)), V_i^-(f(y))\} = \max\{A_i^-(x), A_i^-(y)\}$ which implies that $A_i^-(x-y) \leq \max\{A_i^-(x), A_i^-(y)\}$, for all x, y in R. Also $A_i^-(xy) = V_i^-(f(xy)) = V_i^-(f(x)f(y)) \leq \max\{V_i^-(f(x)), V_i^-(f(y))\} = \max\{A_i^-(x), A_i^-(y)\}$ which implies that $A_i^-(xy) \leq \max\{A_i^-(x), A_i^-(y)\}$, for all x, y in R. Hence A is a BVMFSNR of R.

2.3 Theorem
Let R and R^l be any two nearrings. The anti-homomorphic image of a BVMFSNR of R is a BVMFSNR of R^l.

Proof
Let $V = f(A)$, where $A = \langle A_1^+, A_2^+, ..., A_n^+, A_1^-, A_2^-, ..., A_n^- \rangle$ is a BVMFSNR of R. We have to prove that V is a BVMFSNR of R^l. Now, for $f(x)$, $f(y)$ in R^l, for all i, $V_i^+(f(x)-f(y)) = V_i^+(f(y-x)) \geq A_i^+(y-x) \geq \min\{A_i^+(x), A_i^+(y)\} = \min\{V_i^+(f(x)), V_i^+(f(y))\}$ which implies that $V_i^+(f(x)-f(y)) \geq \min\{V_i^+(f(x)), V_i^+(f(y))\}$, for all $f(x)$, $f(y)$ in R^l. Also $V_i^+(f(x)f(y)) = V_i^+(f(yx)) \geq A_i^+(yx) \geq \min\{A_i^+(x), A_i^+(y)\} = \min\{V_i^+(f(x)), V_i^+(f(y))\}$ which implies that $V_i^+(f(x)f(y)) \geq \min\{V_i^+(f(x)), V_i^+(f(y))\}$, for all $f(x)$, $f(y)$ in R^l. And $V_i^-(f(x)-f(y)) = V_i^-(f(y-x)) \leq A_i^-(y-x) \leq \max\{A_i^-(x), A_i^-(y)\} = \max\{V_i^-(f(x)), V_i^-(f(y))\}$ which implies that $V_i^-(f(x)-f(y)) \leq \max\{V_i^-(f(x)), V_i^-(f(y))\}$, for all $f(x)$, $f(y)$ in R^l. Also $V_i^-(f(x)f(y)) = V_i^-(f(yx)) \leq A_i^-(yx) \leq \max\{A_i^-(x), A_i^-(y)\} = \max\{V_i^-(f(x)), V_i^-(f(y))\}$ which implies that $V_i^-(f(x)f(y)) \leq \max\{V_i^-(f(x)), V_i^-(f(y))\}$, for all $f(x)$, $f(y)$ in R^l. Hence V is a BVMFSNR of R^l.

2.4 Theorem
Let R and R^l be any two nearrings. The anti-homomorphic preimage of a BVMFSNR of R^l is a BVMFSNR of R.

Proof
Let $V = f(A)$, where $V = \langle V_1^+, V_2^+, ..., V_n^+, V_1^-, V_2^-, ..., V_n^- \rangle$ is a BVMFSNR of R^l. We have to prove that A is a BVMFSNR of R. Let x, y in R. For all i, $A_i^+(x-y) = V_i^+(f(x-y)) = V_i^+(f(y)-f(x)) \geq \min\{V_i^+(f(x)), V_i^+(f(y))\} = \min\{A_i^+(x), A_i^+(y)\}$ which implies that $A_i^+(x-y) \geq \min\{A_i^+(x), A_i^+(y)\}$, for all x, y in R. And $A_i^+(xy) = V_i^+(f(xy)) = V_i^+(f(y)f(x)) \geq \min\{V_i^+(f(x)), V_i^+(f(y))\} = \min\{A_i^+(x), A_i^+(y)\}$ which implies that $A_i^+(xy) \geq \min\{A_i^+(x), A_i^+(y)\}$, for all x, y in R. Also $A_i^-(x-y) = V_i^-(f(x-y)) = V_i^-(f(y)-f(x)) \leq \max\{V_i^-(f(x)), V_i^-(f(y))\} = \max\{A_i^-(x), A_i^-(y)\}$ which implies that $A_i^-(x-y) \leq \max\{A_i^-(x), A_i^-(y)\}$, for all x, y in R. And $A_i^-(xy) = V_i^-(f(xy)) = V_i^-(f(y)f(x)) \leq \max\{V_i^-(f(x)), V_i^-(f(y))\} = \max\{A_i^-(x), A_i^-(y)\}$ which implies that $A_i^-(xy) \leq \max\{A_i^-(x), A_i^-(y)\}$, for all x, y in R. Hence A is a BVMFSNR of R.

2.5 Theorem
Let R and R^l be any two nearrings. The homomorphic image of a BVMFNSNR of R is a BVMFNSNR of R^l.

Proof
Let $V = f(A)$, where $A = \langle A_1^+, A_2^+, ..., A_n^+, A_1^-, A_2^-, ..., A_n^- \rangle$ is a BVMFNSNR of R. We have to prove that V is a BVMFNSNR of R^l. By theorem 2.1, clearly V is a BVMFSNR of R^l. Let $f(x)$, $f(y)$ in R^l. For all i, $V_i^+(f(x)+f(y)) = V_i^+(f(x+y)) \geq A_i^+(x+y) = A_i^+(y+x) \leq V_i^+(f(y+x)) = V_i^+(f(y)+f(x))$ which implies that $V_i^+(f(x)+f(y)) = V_i^+(f(y)+f(x))$, for all $f(x)$, $f(y)$ in R^l. And $V_i^-(f(x)+f(y)) = V_i^-(f(x+y)) \geq A_i^-(x+y) = A_i^-(y+x) \leq V_i^-(f(y+x)) = V_i^-(f(y)+f(x))$ which implies that $V_i^-(f(x)+f(y)) = V_i^-(f(y)+f(x))$, for all $f(x)$, $f(y)$ in R^l. Also $V_i^+(f(x)f(y)) = V_i^+(f(xy)) \geq A_i^+(xy) = A_i^+(yx) \leq V_i^+(f(yx)) = V_i^+(f(y)f(x))$ which

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implies that $V_{i^+}(f(x)f(y)) = V_{i^+}(f(y)f(x))$, for all $f(x)$, $f(y)$ in R^I. And $V_{i^-}(f(x)f(y)) = V_{i^-}(f(xy)) \geq A_{i^-}(xy) = A_{i^-}(yx) \leq V_{i^-}(f(yx)) = V_{i^-}(f(y)f(x))$ which implies that $V_{i^-}(f(x)f(y)) = V_{i^-}(f(y)f(x))$, for all $f(x)$, $f(y)$ in R^I. Hence V is a BVMFNSNR of R^I.

2.6 Theorem
Let R and R^I be any two nearrings. The homomorphic preimage of a BVMFNSNR of R^I is a BVMFNSNR of R.

Proof
Let $V = f(A)$, where $V = \langle V_{1^+}, V_{2^+}, \ldots, V_{n^+}, V_{1^-}, V_{2^-}, \ldots, V_{n^-} \rangle$ is a BVMFNSNR of R^I. We have to prove that A is a BVMFNSNR of R. Let x and y in R. By theorem 2.2, clearly A is a BVMFSNR of R. For all i, $A_{i^+}(x+y) = V_{i^+}(f(x+y)) = V_{i^+}(f(x)+f(y)) = V_{i^+}(f(y)+f(x)) = V_{i^+}(f(y+x)) = A_{i^+}(y+x)$ which implies that $A_{i^+}(x+y) = A_{i^+}(y+x)$, for all x, y in R. And $A_{i^-}(x+y) = V_{i^-}(f(x+y)) = V_{i^-}(f(x)+f(y)) = V_{i^-}(f(y)+f(x)) = V_{i^-}(f(y+x)) = A_{i^-}(y+x)$ which implies that $A_{i^-}(x+y) = A_{i^-}(y+x)$, for all x, y in R. Also $A_{i^+}(xy) = V_{i^+}(f(xy)) = V_{i^+}(f(x)f(y)) = V_{i^+}(f(y)f(x)) = V_{i^+}(f(yx)) = A_{i^+}(yx)$ which implies that $A_{i^+}(xy) = A_{i^+}(yx)$, for all x, y in R. And $A_{i^-}(xy) = V_{i^-}(f(xy)) = V_{i^-}(f(x)f(y)) = V_{i^-}(f(y)f(x)) = V_{i^-}(f(yx)) = A_{i^-}(yx)$ which implies that $A_{i^-}(xy) = A_{i^-}(yx)$, for all x, y in R. Hence A is a BVMFNSNR of R.

2.7 Theorem
Let R and R^I be any two nearrings. The anti-homomorphic image of a BVMFNSNR of R is a BVMFNSNR of R^I.

Proof
Let $V = f(A)$, where $A = \langle A_{1^+}, A_{2^+}, \ldots, A_{n^+}, A_{1^-}, A_{2^-}, \ldots, A_{n^-} \rangle$ is a BVMFNSNR of R. We have to prove that V is a BVMFNSNR of R^I. By theorem 2.3, clearly V is a BVMFSNR of R^I. For $f(x)$, $f(y)$ in R^I and for all i, $V_{i^+}(f(x)+f(y)) = V_{i^+}(f(y+x)) \geq A_{i^+}(y+x) = A_{i^+}(x+y) \leq V_{i^+}(f(x+y)) = V_{i^+}(f(y)+f(x))$ which implies that $V_{i^+}(f(x)+f(y)) = V_{i^+}(f(y)+f(x))$, for all $f(x)$, $f(y)$ in R^I. And $V_{i^-}(f(x)+f(y)) = V_{i^-}(f(y+x)) \leq A_{i^-}(y+x) = A_{i^-}(x+y) \geq V_{i^-}(f(x+y)) = V_{i^-}(f(y)+f(x))$ which implies that $V_{i^-}(f(x)+f(y)) = V_{i^-}(f(y)+f(x))$, for all $f(x)$, $f(y)$ in R^I. Also $V_{i^+}(f(x)f(y)) = V_{i^+}(f(yx)) \geq A_{i^+}(yx) = A_{i^+}(xy) \leq V_{i^+}(f(xy)) = V_{i^+}(f(y)f(x))$ which implies that $V_{i^+}(f(x)f(y)) = V_{i^+}(f(y)f(x))$, for all $f(x)$, $f(y)$ in R^I. And $V_{i^-}(f(x)f(y)) = V_{i^-}(f(yx)) \leq A_{i^-}(yx) = A_{i^-}(xy) \geq V_{i^-}(f(xy)) = V_{i^-}(f(y)f(x))$ which implies that $V_{i^-}(f(x)f(y)) = V_{i^-}(f(y)f(x))$, for all $f(x)$, $f(y)$ in R^I. Hence V is a BVMFNSNR of R^I.

2.8 Theorem
Let R and R^I be any two nearrings. The anti-homomorphic preimage of a BVMFNSNR of R^I is a BVMFNSNR of R.

Proof
Let $V = f (A)$, where $V = \langle V_{1^+}, V_{2^+}, \ldots, V_{n^+}, V_{1^-}, V_{2^-}, \ldots, V_{n^-} \rangle$ is a BVMFNSNR of R^I. We have to prove that A is a BVMFNSNR of R. By theorem 2.4, clearly A is a BVMFSNR of R. Let x and y in R. For all i, $A_{i^+}(x+y) = V_{i^+}(f(x+y)) = V_{i^+}(f(y)+f(x)) = V_{i^+}(f(x)+f(y)) = V_{i^+}(f(y+x)) = A_{i^+}(y+x)$ which implies that $A_{i^+}(x+y) = A_{i^+}(y+x)$, for all x, y in R. And $A_{i^-}(x+y) = V_{i^-}(f(x+y)) = V_{i^-}(f(y)+f(x)) = V_{i^-}(f(x)+f(y)) = V_{i^-}(f(y+x)) = A_{i^-}(y+x)$ which implies that $A_{i^-}(x+y) = A_{i^-}(y+x)$, for all x, y in R. Also $A_{i^+}(xy) = V_{i^+}(f(xy)) = V_{i^+}(f(y)f(x)) = V_{i^+}(f(x)f(y)) = V_{i^+}(f(yx)) = A_{i^+}(yx)$ which implies that $A_{i^+}(xy) = A_{i^+}(yx)$, for all x, y in R. And $A_{i^-}(xy) = V_{i^-}(f(xy)) = V_{i^-}(f(y)f(x)) = V_{i^-}(f(x)f(y)) = V_{i^-}(f(yx)) = A_{i^-}(yx)$ which implies that $A_{i^-}(xy) = A_{i^-}(yx)$, for all x, y in R. Hence A is a BVMFNSNR of R.

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RESEARCH ARTICLE

Agricultural land suitability Assessment for the part of Dharmapuri District using AHP and GIS Techniques

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ABSTRACT

The current study was planned to assess the agricultural land suitability for six firkas of Dharmapuri district using AHP and GIS techniques. A total of 125 soil samples were collected by random sampling method based on the soil series and the location of the soil sample was recorded using GPS. The Analytic Hierarchy Process (AHP) is a common MCDM (Multi Criteria Decision Making)classification method were used in this study. The agricultural land suitability map was generated according to the land suitability classification of the United Nations Food and Agriculture Organization (FAO).The soil parameters pH, EC, soil separate content, organic carbon, calcium carbonate, available NPK were chosen as criteria for AHP analysis. The final suitability map was generated through weight overlay analysis using QGIS 3.16. As evidenced by the results, it was estimated that the study area of about 150.42 km^2 is highly suitable, 208.98 km^2 is moderately suitable and 163.32 km^2 is marginally suitable. 53.85 and 68.32 km^2 currently non-suitable and permanently non suitable for agricultural purpose.

Keywords: Land suitability –MCDM-AHP-GIS-Dharmapuri district.

INTRODUCTION

The growing population, acutely in developing countries has intensified the pressure on both natural and agricultural resources. An improved economic return is necessary to satisfy the rising global population's economic needs. Increased urbanisation and population growth have put more, strain on agricultural resources (Abdullah and Hezri, 2008). Therefore, reliable and precise land value is crucial to the decision-making processes involved in creating land use policies that would support sustainable Agriculture. Land evaluation techniques will be necessary to create models for predicting the land's suitability for various forms of agriculture in terms of production (Attual and Fishe, 2014). To maximise the utilisation of a piece of land for a particular application, the suitability of the land is evaluated for rational cropping system (FAO, 1976; Sys et al., 1991). When a set of alternatives needs to be assessed based on competing and incommensurate criteria, MCDA has been developed to help with spatial decision making. According to Malczewski (2006), MCDA is a useful device for multiple criteria decision-making problems and aims to investigate various options for multiple criteria and multiple objectives. Multi criteria decision analysis provides mathematical methodology that incorporates the values of decision makers and stakeholders as well as technical information to select the best solution for the problems by higher logical and scientifically defensible decision to be made. The method allows for preferences and performance about different management alternatives to be assessed in a clear, formal way that is mathematically rigorous and transparent to stakeholders. This method combines all the spatial factors that are important and results in a map with the best locations for a certain type of land use. Most often, with MCDA the goal is to find the most suitable location for certain land use. MCDM methods can analyze the problems, produce alternative solutions and evaluate the alternatives. The general purpose of these methods is to facilitate decision-makers choice of the suitable use among the alternatives (Ohman *et al.*, 2007).

Many GIS-based land suitability analysis approaches have been recently developed, although these approaches lack a well-defined mechanism for incorporating the decision-makers preferences into the GIS procedures (Malczewski, 2006). This may be solved by integrating GIS and MCDA method sasan effective tool for analysing land use planning with its hierarchical structure of many classes and orders which is used to explain it (Malczewski 2004). The crucial technique that has been applied for analysing the suitability of a piece of land is MCDA. A well-known multi-criteria technique called the Analytical Hierarchy Process has been used along with GIS to classify the appropriateness of the land. The analytical hierarchy process (AHP) is often used to make multi-criteria decisions on the suitability of a piece of land for a certain field. Based on pairwise comparisons of numerous factors in accordance with their relative relevance, it establishes the weight of importance for various land uses (Miller et al. 1998). Saaty (1980) developed the analytical hierarchy process, which shows a graded model for solving complex problems of land management with the best options (Malczewski 2006; Cengiz and Akbulak 2009).

GIS can overlay maps to carry out various tasks using spatial and attribute data (Silva and Blanco, 2003).GIS is a tool for making decisions related to site appropriateness studies and development projects (Khahro *et al.*, 2014). The incorporation of the AHP into a GIS further enhances decision-making process with strong visualisation and mapping capabilities, which subsequently make it easier to create maps of land use suitability and optimise land use planning. Mangan *et al.* (2022) evaluated the land suitability for the Barmer area, Rajasthan used for sustainable organic farming using the analytical hierarchy process (AHP) and GIS approach. Karma and Gibji (2021) studied the land suitability analysis (LSA) of Malus Domestica in the West Kameng district of Arunachal Pradesh, India (GIS). Hawar *et al.* (2020) researched on the Erbil province of Iraq. In order to use all of the used criteria on the weighted overlay methodology (WOM) based on the Geographical Information Systems (GIS) technique and GIS methodology. In light of the above, the present study was planned to evaluate the agricultural land suitability of six firkas of the Dharmapuri district using AHP and GIS techniques. In this study, viz., climate, topography, and soil parameters thematic maps were used as criteria to assess the land suitability by the weighted overlay method using GIS.

MATERIALS AND METHODS

Description of the study area

The study area is the part of Dharmapuri district, Tamil Nadu, India and extends between North Latitudes 11º45' and 12º15', East Longitudes 77º30' and 78º30' with an area of 644.92 sq.km. The elevation of the study area ranged from403 to 1213m MSL. The study area receives the rainfall from southwest monsoon (June-September), northeast monsoon (October-December), and non-monsoon periods (January-May). The mean annual rainfall ranged from 650 to 900 mm, through southwest and northeast monsoons. Regarding the climate, the maximum temperature of 38°C at May and minimum temperature is about 17°C on January. The study area is occupied by diverse range of igneous and metamorphic rocks, crystalline rock formations of archaean metamorphic complex are exposed in the district. The southern part mainly consists of charnockite with minor intercalations of granitic gneiss while northern portion is made up of granitic gneiss with discontinuous patches of schistose rocks.

Soil sample collection and laboratory analysis

The soil samples were collected between February and April 2021. A Garmin76CSx Global Positioning Systems (GPS) device was used to record the exact soil sample location. The soil samples were taken from the plough layer after the surface litter was removed; a total of 125 samples were collected. At each sampling point, a 15-cm deep 'v'-shaped cut was made using spade, soil was collected from each side. The soil samples were air-dried and pulverized using a wooden mallet. The samples were sieved using a 2-mm sieve and packed in plastic bags or airtight containers. The samples were analyzed for pH, EC, Soil separates, bulk density, water holding capacity, organic carbon, calcium carbonate, available NPK. Soil pH was determined using a glass electrode pH meter (McLean, 1982), EC of soil by a conductivity meter (Rhoades, 1982). Soil separates determined by bouyoucos hydrometer method (Bouyoucos, 1927). Bulk density determined by measuring cylinder method (Jackson, 1973) Water holding capacity was determined by the Keen Rackzkowski method (Keen and rackzkowski, 1921). Organic carbon content was determined by wet oxidation method (Walkley and Black, 1934), Calcium carbonate determined by rapid titration method (Piper, 2010), available Nitrogen was determined by Alkaline potassium permanganate method (Subbiah and Asija ,1956), available phosphorus by spectrophotometer method (Olsen, 1954), and available potassium by Flame photometer method (Stanford,1949). Fig.1 Study area map and soil sample location

Criteria selection for land suitability analysis

Among the soil parameters the following parameters were selected as the soil pH, EC, Soil texture, organic carbon, available nitrogen, available phosphorus, available potassium and calcium carbonate. Further, climatic parameters namely annual average rainfall and annual average temperature and topographic parameters in slope were chosen as criteria.

AHP and GIS based agricultural land suitability analysis

The following steps were used to carry out the land suitability by AHP technique.

Step 1: Assigning the ranks

All the criteria were aligned as the rank by the expert opinion, highly influenced criteria was assigned as 1(pH) and low as 10 (Calcium carbonate).

Step 2: Pairwise comparison matrix

In this step, the pairwise comparison matrices were calculated. All scores were assembled in a pairwise comparison matrix with diagonal and reciprocal scores located in the lower left triangle

Step 3: Calculation of consistency ratio

Here, the consistency ratio was calculated to ensure avoiding over or under-fitting. A CR value of 0.1 or less shows reasonable consistency.

Step 4: Calculating normalized pairwise comparison matrix
The cell value of PCM was divided by the column sum to obtain the cell value in the Normalised Pairwise comparison matrix (Akinici *et al.,* 2013).

Step 5: Calculation of weight
The cell values of NPCM are average in a row to calculate the criterion's weight.

Step 6: Land suitability assessment
Each criterion weight was multiplied with each spatial variability map and overlaid each other to generate the final suitability map. The weight overlay map was reclassified by the natural break method to create the final suitability map of the study area. The following formula is used in weighted overlay analysis.

Land suitability analysis = (Annual average rainfall $*W_1$) +(Annual average temperature$*W_2$) + (Slope $*W_3$) + (pH$*W_4$) + (Soil Texture$*W_5$)+(SOC$* W_6$)+ (Available nitrogen $* W_7$)+(Available phosphorus $*W_7$) + (Available potassium $*W_8$)+(Calcium carbonate $*W_9$)

RESULTS AND DISCUSSION

The present study elaborately discusses the land suitability for the parts of Dharmapuri districts using GIS and AHP techniques. The climate, topography and soil parameter namely pH, EC, texture, organic carbon, available NPK, calcium carbonate were used as criteria.

Climate
The minimum temperature (<26 ºC) was occupied about for 523.44 km^2 and maximum temperature (>26 ºC) was occupied about for 121.46 km^2. The average annual rainfall(<900mm) was occupied about for 220.19 km^2, (900-1200mm) was occupied about for 424.70km^2(Table 1). Fig.2 Criteria distribution maps of the study area l

Slope
The topography of the region, or more specifically, its geomorphological characteristics, has a significant impact on the natural development of soils. With an increasing slope, the soil layer's thickness decreases, while with decreasing slope, it grows accordingly, soil growth slows down and soil depth and fertility drop as the slope degree increases (Atalay, 2006). The debris carried away by erosion grows as the slope angle increases. Indirectly, slope limits agricultural productivity by negatively influencing soil qualities; additionally, slope directly reduces agricultural production by restricting machinery and management practices such top soil tillage, irrigation, and drainage. Nearly the entire area is included in the very steep and rugged class (Table 1).The slope map reveals (0-1%) level observed in 127.41 km^2, very gentle slope (1-3%) for 216.56 km^2, gentle slope of (3-8%) occupied for 182.73 km^2, moderate slope of (8-15%) occupied for 46.27 km^2 the marginal slope of soil (15-30%) occupied for 45.70 km^2 and steep slope of soil (>30%) occupied for 26.23 km^2.Slope affects crop productivity significantly; steep slopes cause soil erosion after heavy rains, making it difficult to prepare the ground and manage the water and crops, especially for mechanized farming. Additionally, steep slopes do not allow infiltration of rainwater; thus, water is not retained in the soil for use during dry spells (Grealish *et al.,* 2008).

Land use and land cover
The region's LULC categorization provides information about the current state of the land. Several studies have employed LULC categorization for LSA, land appraisal, and land use planning, including Shalaby *et al.* (2006), Bandyopadhyay *et al.* (2009), Chandio and Matori (2011), and Rabia *et al.* (2013). The spatial distribution and features of different types of land, such as agricultural land, plantations, settlements, fallow land, barren land, mixed trees, built-up land, forests, wastelands, and water bodies, are shown through LULC analysis. Bayesian supervised classification approach maximum probability is used for LULC mapping with five dominant classes i.e. forest

109.95km^2, agriculture 197.63km^2, waterbodies21.92 km^2, buildup96.25km^2, and waste land 219. 17km2.Rocky land, barren land, dense forest, settlement and water bodies are permanently not suitable for agricultural purposes (Bandyopadhyay *et al.,* 2009)

Physico-Chemical Properties
The solubility of elements and their availability for crops is determined by the soil pH, which also establishes the appropriateness of the soil for a given crop (Halder, 2013). In the spatial variability map, pH of the soil Neutral (6.5-7.5) was occupied for about 407.85 km^2, whereas alkaline pH (> 7.5) occupied for about 236.88 km2(Table 1).It is known that salt effected soils typically develop in arid and semi-arid areas due to high evaporation rate. Sodium chloride soils negatively impacted plant growth in several ways. The soil EC of the study area ranges from a minimum 0.14 dsm^{-1} to maximum 1.3 dsm^{-1} with the mean value of 0.34dsm^{-1}.

Soil texture
One of the crucial aspects of soil is texture. The majority of the soil's physical properties are influenced by texture class. In the research area, there were four different texture classes: sandy loam (SL), clay loam (cl), and sandy clay loam (scl). The sand of the soil from the study area ranged from 41.5 to 73.8 % with a mean value of 65.8 %, the silt values were varied between 2 and 29.3 % with a mean value of 5.75 % and clay varied between 21.7 to 32.2 % with the mean value of 27.7. Soil textural class, sandy clay loam occupied for about 524.66 km^2, clay loam soil for 75.24 km^2, and sandy loam soil occupied 45.22 km^2(Table 1).

Chemical Constituents
Soil organic carbon is an excellent source of nutrients and is crucial for soil fertility, complex water and nutrient exchange mechanisms in plant root zones, and land degradation (Bandyopadhyay *et al.,* 2009). SOC frequently lays the groundwork for effective application of mineral fertilizers. Agriculture and plant life are significantly impacted by SOC losses primarily in downstream zones (Bhagat, 2013). The natural soil quality and soil management affect the spatial variation of soil organic matter. Low soil organic carbon of the soil (<5g kg^{-1}) was occupied for about 544.40,km^2. Medium (5.0-7.5 g kg^{-1}) of soil was occupied about 100.53 km^2 of the study area(Table 1).Due to the organic carbon content, mineral fertilizers offer the plant the nutrients it needs, the combination of organic matter and mineral fertilizers creates the ideal environmental conditions for crops (FAO, 2000). However, soil organic carbon is insufficient to achieve the farmer's desired level of yield. In addition, mineral fertilizers must be used. The majority of the soil's physical features are influenced by its texture class (Mustafa *et al.* 2011). Fig.3 Criteria distribution maps of the study area Specifically, the development and production of leaves and stems depend on nitrogen for plant growth (Chapin and Shaver, 1985).

From the spatial variability map, the low available N content (<280Kgha^{-1}) occupied about 524.78 km^2 and medium (280-450 Kgha^{-1}) ranged occupied about 102.15 km^2. Because the forest floor contains less litter and humus, having these factors may explain a low and medium of accessible nitrogen in the upper layer. The quantity and characteristics of organic materials greatly influence nitrogen availability (De Hann, 2007). Therefore, the lower and medium concentrations of organic matter in the floor may account for the top layers' nitrogen content. Phosphorus promotes flowering, seed production, crop maturity, root formation and expansion. For optimal plant growth, acidic or alkaline soil requires a greater amount of P. The low available P content (<11Kgha^{-1}) occupied 24.08 km^2, medium (11-22Kgha^{-1}) was occupied for about 136.67 km^{2}and high (>22Kgha^{-1}) was occupied for about 484.17 km^2. It could be because of mineral phosphorus solubilized by soil microbial community and plant which may account for the increased phosphorus content of soils(Table 1).Potassium is essential for a variety of plant processes, including photosynthesis, adding stiffness to stalks and stems, disease resistance, drought tolerance, making kernal and seeds plump, firmness, texture, size, and colour of fruits, and oil content in oil seeds. Lack of potash causes plants to lose their green hue, turn yellow, lose their lower leaves, and produce less. Regarding the potassium of soil medium range (118-280Kgha^{-1}) was occupied for about 87.66 km^2 and high (>280Kgha^{-1}) was occupied for about 557.27 km^2.Due to the occurrence of potassium carry minerals including illite, muscovite, gluconite, biotite, phlogopite, sanidine, and orthoclase, most Indian soils are known to be rich in potassium (Naidu *et al.,* 2011). This may account

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for the higher quantities of accessible potassium in the soil (Sekhon, 1999). The variability of calcium carbonate slightly calcareous soil (1-5%) was occupied for about 150.99 km^2, calcareous (5-10%) was occupied for about 338.62 km^2 and very calcareous (>10%) was occupied about 155.32 km^2(Table 1).

Land suitability analysis through GIS and AHP technique
The weight values of selected parameters calculated in the Analytic Hierarchy Process and designated scores of sub-criterion were used to generate the land suitability for six firkas of Dharmapuri district. The main objective of the current study was to use an AHP and GIS to determine the appropriateness of some land in the Dharmapuri district. To evaluate Land Suitability of the study area, three primary types of criteria, climate, topography, and soil parameter were chosen. Out of the several climate characteristics, the annual average temperature and rainfall were chosen as the climate criteria. For the topographical portion of this study, the slope was chosen as a criterion. The criteria for AHP analysis were the soil parameters soil pH, soil texture, soil organic carbon content, available nitrogen, available phosphorus, available potassium, and calcium carbonate. Every criterion was picked in accordance with the advice and suggestions of experts, farmers, and subject specialists. Based on literature reviews, field research, and advice from experts, sub criteria were created.

The most important step in the multi-criteria evaluation process is determining the weight of each factor based on Saaty's scale. All of the factors were ranked from 1 to 9 based on the fundamental scale introduced by Saaty (1980). The pairwise comparison matrix used in this the pairwise comparison matrix contains the AHP weight rank and its reciprocal value. Using this table, the consistency index and consistency ratio were calculated to find out the consistency of this study i.e., over or under predicted. The consistency is accepted only by CR value if equal to or less than 0.1. In this study, λ max, the consistency index, and consistency were 0.044, 0.029, and 1.49, respectively, which indicated that all of the matrices were consistent. The next was to compute the weight of each criterion by the normalized geometric mean of the rows of the pair-wise comparison matrix.

Final land suitability analysis
All criteria were multiplied with its weight and combined with weighted overlay analysis. The following formula is used to find out five land suitability analysis performed in raster tool.

Land suitability = (Annual average rainfall *0.154) +(Annual average temperature *0.071) + (Slope *0.154) + (pH*0.127) + (Soil Texture*0.122) +(Soil Organic Carbon*0.097) + (Available nitrogen * 0.085) +(Available phosphorus *0.081) + (Available potassium *0.055) +(Calcium carbonate *0.050)

According to agricultural land suitability map generated, map showed that 150.42 km^2 of the study area is highly suitable for agriculture (S$_1$). Further, the Moderate suitable (S$_2$) for agriculture was about 208.98 km^2. The area about 163.32km2 of the study area was occupied as marginally suitable (S$_3$) and 53.85 km$_2$ was currently not suitable (N$_1$) for agricultural purposes. The   permanently unsuitable (N$_2$) class was about 68.32 km2. According to suitability map after obtained after removing forest, water body and settlement, the area of about109.95 km^2, 21.92 km^2 and 96.25km^2 of the study area were highly suitable, moderately suitable and marginally suitable of the agricultural purposes. The area about 31.12 km^2 and24.99 of the study area were currently unsuitable (N$_1$) and permanently unsuitable (N$_2$) for agriculture. Fig.4 Criteria distribution maps of the study area A) Land use suitability for agriculture B) Suitability map obtained after removing forest land, water body and settlement.

CONCLUSION

This study aims to assess the agricultural land suitability in part of Dharmapuri district, Tamil Nadu, India. Topography, climate, and soil were considered as criteria used to predict the agricultural land suitability of the study area. The best approach for evaluating land suitability was GIS integrated GIS with AHP techniques. Five classes of land suitability have been made based on the FAO land suitability classification, viz., highly suitable (S$_1$), moderately

suitable (S2), marginally suitable (S3), currently not suitable(N1), and permanently not suitable(N2), which covers 150.42, 208.98, 163.32, 53.85, and 68.32, respectively After removing the forest, settlements and water bodies (228.12 km2), suitable classes S1, S2, S3, N1, and N2 cover about 102.09, 144.96, 113.69, 31.12, and 24.99 km2, respectively. Based on the results, rainfall, slope pH, and soil texture were highly influenced by the suitability of the study area. Out of these four criteria, rainfall and slope have highly influenced land suitability. The final land suitability map will assist farmers, policymakers, and legislators in overcoming constraints in the study area and ensuring long-term agricultural protection in the study area.

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Table 1. Weights of all criteria used in the study area

Influencing factor	Class	Area in km²	Area in %
Average annual rainfall (mm)	<900mm	220.19	34.14
	900-1200mm	424.70	65.86
Average Annual temperature(ºC)	<26ºC	523.44	81.17
	>28ºC	121.46	18.83
Slope(%)	Level (0-1%)	127.41	19.76
	Very gentle slope (1-3%)	216.56	33.59
	Gentle slope (3-8%)	182.73	28.33
	Moderate slope (8-15%)	46.27	7.18
	Marginal slope (15-30%)	45.70	7.08
	Steep slope (>30%)	26.23	4.06

pH	Neutral (6.5 – 7.5)	407.85	63.25
	Alkaline > 7.5	236.88	36.75
Soil texture (%)	Sandy clay loam	524.66	81.32
	Clay loam	75.24	11.67
	Sandy loam	45.22	7.01
Organic Carbon (g kg^{-1})	Low (< 5.0)	544.40	84.41
	Medium (5.0-7.5)	100.53	15.59
Available N (Kgha^{-1})	Low (< 280)	542.78	84.16
	Medium (280-450)	102.15	15.84
Available P (Kgha^{-1})	Low (< 11)	24.08	3.73
	Medium (11-22)	136.67	21.19
	High (>22)	484.17	75.08
Available K (Kgha^{-1})	Medium (118-280)	87.66	13.60
	High (>280)	557.27	86.40
Calcium carbonate (%)	Slightly calcareous (1-5%)	150.99	23.41
	Calcareous (5-10%)	338.62	52.50
	Very calcareous (>10%)	155.32	24.09

Table 2. Weights of all criteria used in the study area

Influencing factor	Class	Class weight (CW)	Factor weight (FW)	CW*FW
Average annual rainfall (mm)	<900mm	2	0.154	0.308
	900-1200mm	3		0.462
Average Annual temperature(ºC)	<26 ºC	2	0.071	0.142
	>26 ºC	3		0.213
Slope (%)	Level (0-1%)	6	0.154	0.924
	Very gentle slope (1-3%)	5		0.77
	Gentle slope (3-8%)	4		0.616
	Moderate slope (8-15%)	3		0.462
	Marginal slope (15-30%)	2		0.308
	Steep slope (>30%)	1		0.154
pH	Neutral (6.5 – 7.5)	3	0.127	0.381
	Alkaline > 7.5	2		0.254
Soil texture (%)	Sandy clay loam	3	0.122	0.366
	Clay loam	3		0.366
	Sandy loam	2		0.244
Organic Carbon (g kg^{-1})	Low (< 5.0)	1	0.097	0.097
	Medium (5.0-7.5)	2		0.194
Available N (Kgha^{-1})	Low (< 280)	1	0.085	0.085
	Medium (280-450)	2		0.17
Available P (Kgha^{-1})	Low (< 11)	1	0.081	0.081
	Medium (11-22)	2		0.162
	High (>22)	3		0.243
Available K (Kgha^{-1})	Medium (118-280)	2	0.055	0.11
	High (>280)	3		0.165
Calcium carbonate (%)	Slightly calcareous (1-5%)	3	0.050	0.15
	Calcareous (5-10%)	2		0.1
	Very calcareous (>10%)	1		0.050

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Table 3. Final Suitability map before and after removing forest, water body and settlement

Suitability class	Before masking		After masking	
	Area km^2	Area in percent (%)	Area km^2	Area in percent (%)
Highly Suitable (S$_1$)	150.42	23.33	102.09	15.84
Moderate suitable (S$_2$)	208.98	32.40	144.96	22.48
Marginally suitable(S$_3$)	163.32	25.32	113.63	17.62
Currently not suitable (N$_1$)	53.85	8.35	31.12	4.82
Permanently not suitable (N$_2$)	68.32	10.60	24.99	3.87
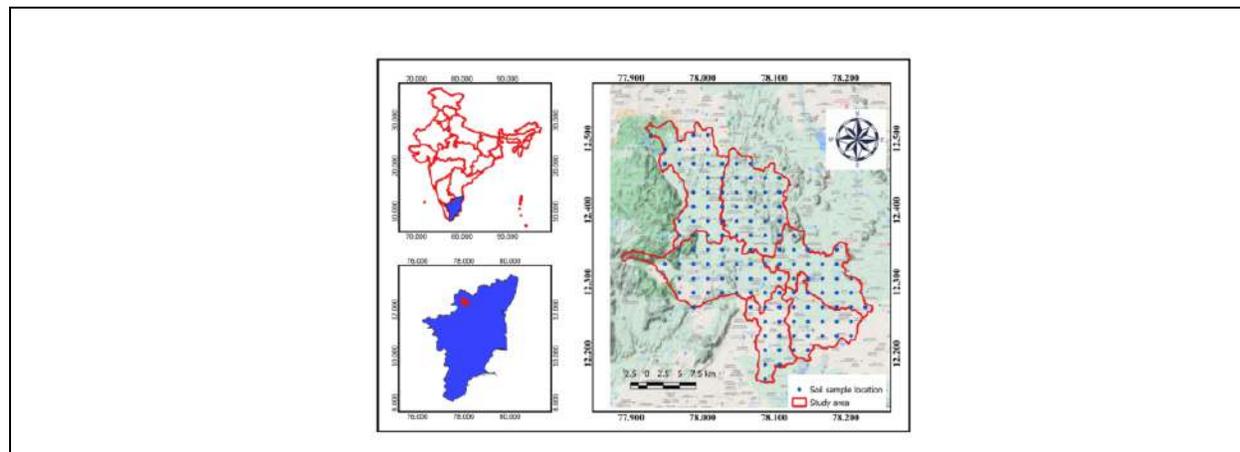
Fig.1 Study area map and soil sample location
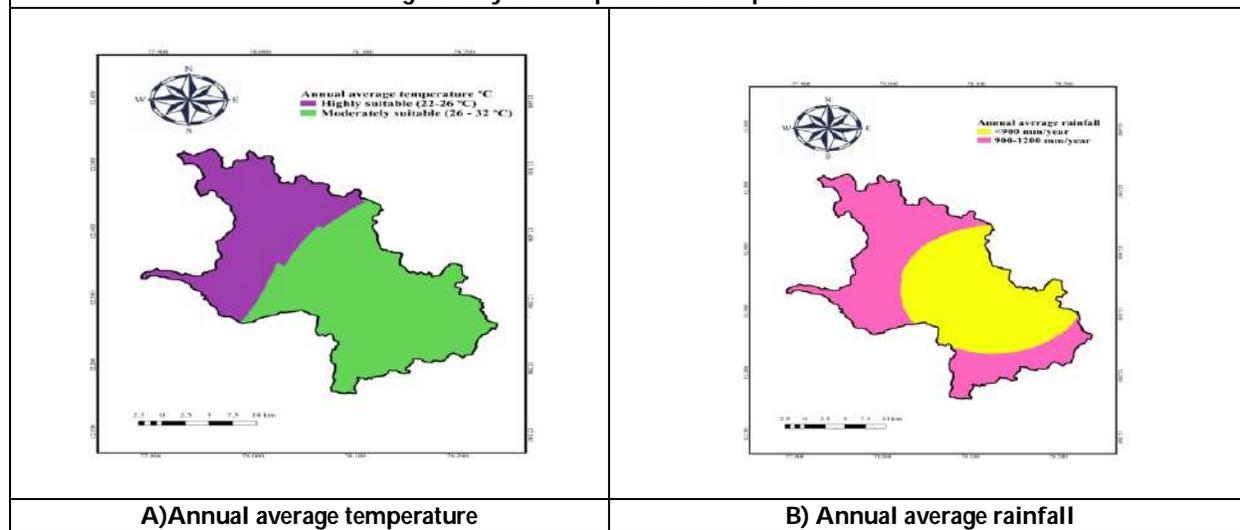
A)Annual average temperature

B) Annual average rainfall

C) Slope

D) Land use/ land cover

E)Soil pH

F)Soil texture

Fig.2 Criteria distribution maps of the study area

G)Soil organic carbon

H) Available nitrogen

I) Available phosphorus

J) Available potassium
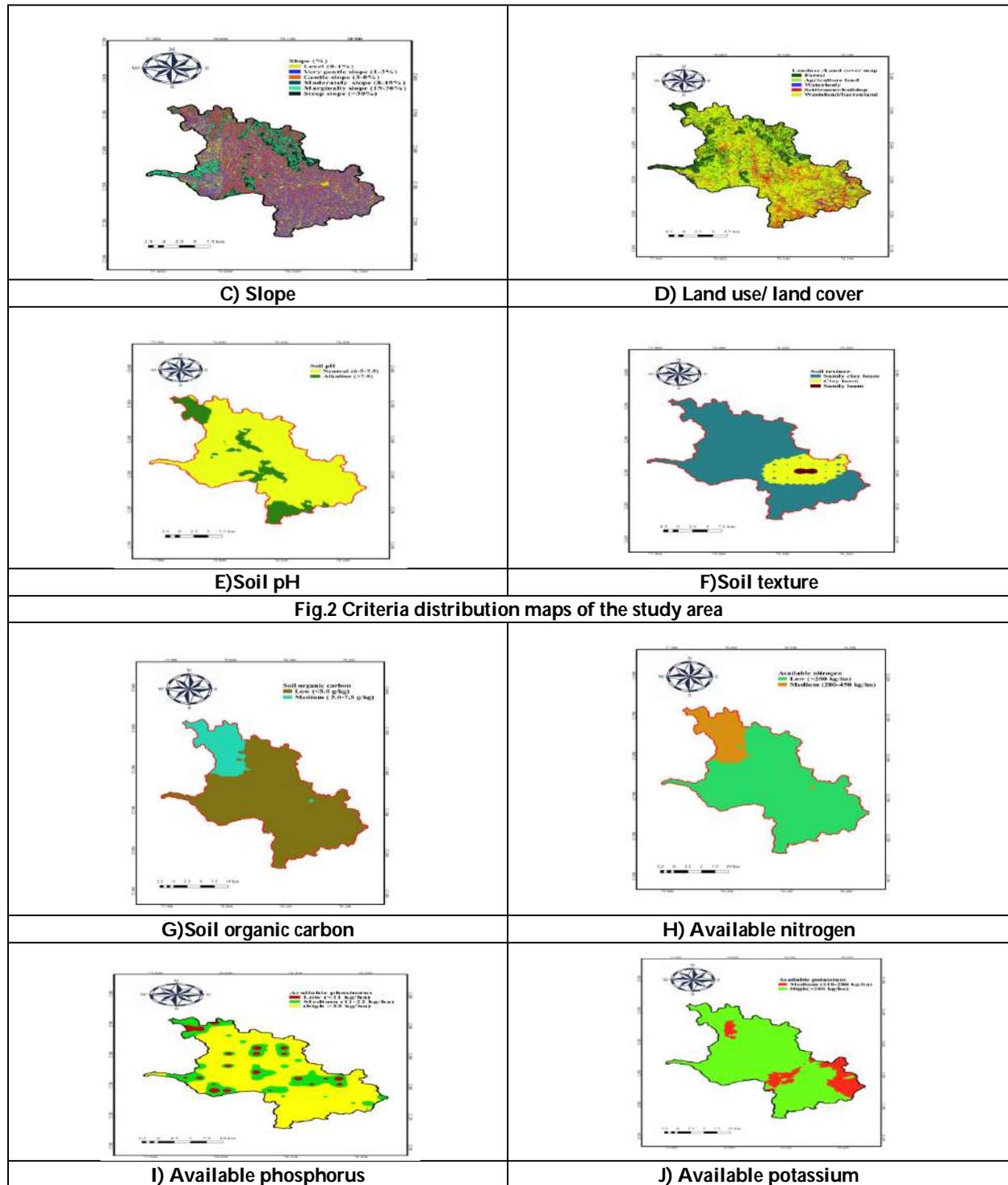
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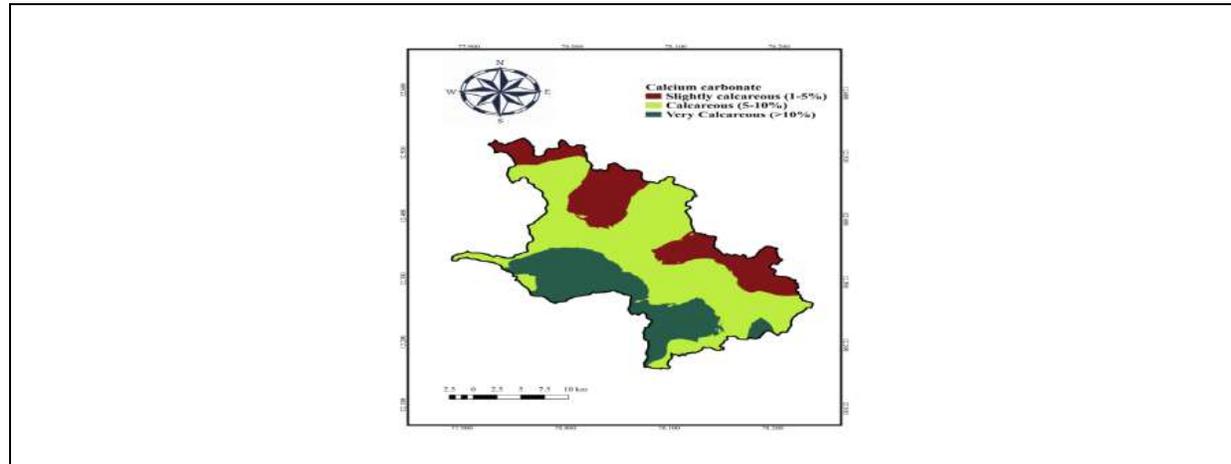
K) Calcium carbonate (%)

Fig.3 Criteria distribution maps of the study area
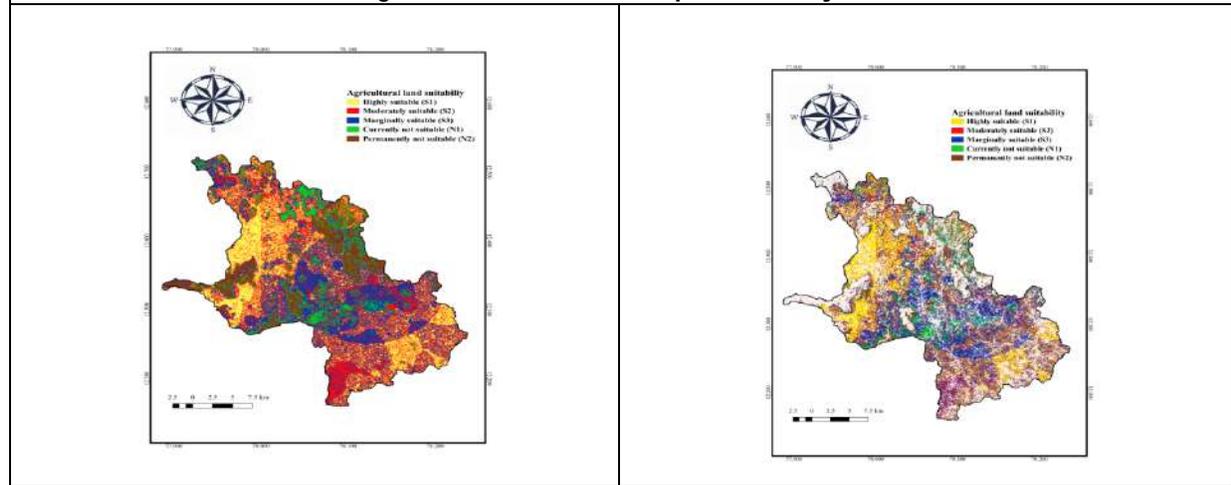
| **A) Land use suitability for agriculture** | **B) Suitability map obtained after removing forests land, water body and settlement** |

Fig.4 Criteria distribution maps of the study area

RESEARCH ARTICLE

Mosaicplasty for Osteochondral Defect – A Case Study

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ABSTRACT

Chondral and osteochondral fractures of the lower extremities are important injuries because they can cause pain and dysfunction and often lead to osteoarthritis. These injuries can be misdiagnosed initially which may impact on the healing potential and result in poor long-term outcome[1]. Focal chondral and osteochondral defects of loading surfaces often cause several problems for the patient, such as pain, swelling, clicking, and instability, and may lead to early degenerative changes. Several treatment options involving surgical resurfacing are available to treat such defects[2]. Mosaicplasty is used to repair articular cartilage defects is an established technique. Articular cartilage damage in an adult knee, if left untreated, will proceed to degenerative osteoarthritis and is a serious cause of disability and loss of function in an individual[3].

Keywords: Osteochondral fracture, Mosaicplasty, Chondral defects.

INTRODUCTION

Autologous osteochondral grafting (mosaicplasty) was first proposed as a treatment and popularised by Hangody *et al.* is being applied in an effort to reconstruct the affected articular surface with properties similar to those of hyaline cartilage[4] Articular cartilage lesions are a common problem and 63% of knees have these lesions at arthroscopy. Five percent are in patients less than 40 years old and in the form of full– thickness cartilage defects [4] Mosaicplasty has been developed over recent years and involves multiple cylindrical osteochondral grafts harvested from a weight-bearing area of less importance in the knee joint and inserted into the drilled holes at the defect site[4]. osteochondral autograft transplantation (OAT), including mosaicplasty, replaces a cartilage defect with an

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osteochondral autograft typically obtained from minimally weight-bearing portions of the femur. Although there is no clear definition in difference between OAT and mosaicplasty, conventionally mosaicplasty represents a surgical technique inserting three or more plugs and forming a mosaic appearance, whereas OAT represents a technique inserting one or two plugs[5]. This surgery can be performed as arthroscopic or open. The potential benefit with the open procedure is a better visualization of the harvest and recipient sites. Also, it enables surgeons to directly get access to almost all intra-articular lesions. The arthroscopic procedure is more beneficial cosmetically and is less invasive, though it requires a learning curve[5]. Fractures of the patella occur as a result of a compressive force such as a direct blow, a sudden tensile force (as occurs with hyperflexion of the knee), or from a combination of these. A variety of fracture patterns results, depending on the mechanism of injury. The primary types include transverse (most common), vertical, marginal, and osteochondral fractures. Fractures can be displaced or non displaced[6]. Osteochondral fractures of the lateral femoral condyle or the medial facet of the patella have been documented by arthroscopy in 40% and 50% of patellar dislocations[7]. Mosaic-like transplantation of multiple, small-sized, cylindrical osteochondral grafts harvested from the relatively less–weight-bearing periphery of the patellofemoral joint might provide a congruent resurfaced area[2].The major advantage of using mosaicplasty for osteochondral defect is mosaicplasty never depend on a laboratory for procedures of chondrocyte proliferation, matrix implantation or mesenchymal cell proliferation. The hyaline cartilage is harvested from the donor site of the same knee joint. Thus, mosaicplasty is a safe, one–stage and low-cost procedure having no risk of disease transmission or immunological reaction to the graft. This also can be applied as minimally invasive arthroscopically or a mini-incision arthrotomy[3].

Case Report

A 32-year-old male patient has a history of fall on December 2021 from the bike and entire weight of the bike came on the left lower limb following which patient had a complain of left knee pain. For that patient went to the doctor where x-ray was done and patient was advised for crepe-bandage for 8 days and all movements were permitted. After that patient was not having any relief in pain so he consulted orthopedic doctor who advised him for MRI. For the same POP cast was given from mid-thigh region up to the metatarsals head for 2 months in a non-weight bearing position. After 2 months cast was removed and physiotherapy was advised. But there was no relief of pain and he was having a complain of difficulty while walking and stair climbing, so he consulted another orthopedic surgeon in April 2022 where x-ray was taken and surgeon identified that the patient as having osteochondral defect in Lt. knee medial femoral condyle in weight-bearing position. So, for that patient was advised to undergo mosaicplasty, which was done on 29/04/22. After which patient was advised for non-weight bearing for about 1.5 months and then partial weight bearing for another 1 month was advised. So, following this complete phase of restricted weight bearing full weight bearing (FWB) was allowed. When patient started FWB he has a complain of pain around knee while walking, difficulty in walking and negotiating stairs, and while lifting the lower limb patient had a complain of tremor in lower limb, for this he consulted the surgeon where the operation was done, and he was advised for the physiotherapy, so from then patient has started taking physiotherapy. Physiotherapy assessment of the patient reveals that patient is having reduced strength in affected lower limb, atrophy in calf region on affected side, altered gait pattern, and quadriceps lag is present, scar is mobile, complete knee flexion ROM is present, there is no muscle tightness present. With support patient can easily climb up or climb down the stairs, but without support patient has a lack of control in knee movement while ascending or descending the stairs. So currently the patient is taking the treatment in the form strengthening of B/L lower limb muscle and gait training.

DISCUSSION

Articular cartilage injuries occur frequently as a result of trauma, tumour or osteoarthritis (OA) [8]. Articular cartilage lesions are typically irreversible, due to the unique features of this tissue, including its avascular nature and consequent lack of access to a pool of potential reparative cells and humoral factors[8].Cartilage repair techniques included microfracture, osteochondral autograft transfer (mosaicplasty), osteochondral allograft transplantation, and autologous chondrocyte transplantation [9]. Autologous chondrocyte implantation (ACI) and mosaicplasty have

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both been described for repair of symptomatic defects of the articular cartilage in the knee[10].The Mosaicplasty is indicated for the treatment of focal chondral and osteochondral defects in the knee and talus in patients under the age of 45 [11]. The term mosaicplasty is reserved to describe use of multiple smaller-diameter grafts. Mechanical studies have shown superior fixation of larger traditional osteochondral grafts versus smaller mosaic multiple grafts [12]. Mosaicplasty, however, offers more surface area for osseous integration and potentially improved contouring [12]. Mosaicplasty grafts survive, with intact hyaline cartilage. According to author Gary kish the immediate sequence of harvesting to grafting, small size of the plugs, gentle press-fit implantation, early motion, and gradual load bearing are key elements to ensuring the chondrocytes' survival and their continued production of matrix constituents. The viability of chondrocytes is essential to the survival of the grafts because only living cartilage cells can produce and maintain the extracellular matrix (ECM) of proper load-bearing capacity. The observed viability of the chondrocytes is in keeping with the current understanding of chondrocyte nutrition, function, and response to transplantation. In addition, requisite postoperative range of motion, isometric exercises, and protected progressive weight bearing encourage normal cartilage function [11]. According to L. Hangody *et al.* after the open mosaicplasty technique, the knee is drained for 24 hr. Then non-weight bearing is advised for 4–6 weeks depending on the size and location of the defect. This period is followed by 2 weeks of partial weight bearing. During these postoperative phases, range of motion and isometric exercises as well as swimming [13]. Role of physiotherapist after mosaicplasty is to teach patient proper walking technique with assistive devices such as walker, or crutch, during restrictive weight-bearing phase as well as to minimize muscle atrophy and to develop joint stability isometric exercise can be prescribe [14]. Physiotherapist can help patient to achieve full range of motion following surgery and help them to regain the muscle strength, if scar is adhered then soft tissue manipulation can be given [15] . Once the patient is allowed for full weight bearing the ultimate goal for the physiotherapist is to make patient independent by achieving full range of motion, enough strength and endurance so that patient doesn't have any complain in their activity of daily living.

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Declaration of patient consent
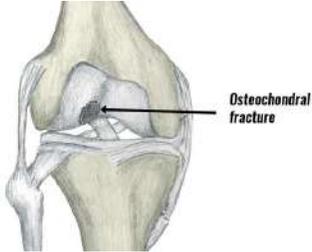Informed consent was taken from patient.

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Figure 1: SCAR	**Figure 2: Knee remains in slightly flexed position**
Figure 3: Patient doing Knee Extension	**Figure. 4: Pictorial representation of Osteochondral Fracture**

RESEARCH ARTICLE

Global Research Trends in Sustainable Development Goals between 2000 and 2021

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ABSTRACT

This present study explored how research themes and trends have developed in the field of sustainable development goals (SDGs) research, aiming to provide a comprehensive understanding of SDGs literature based on prior literature. A scientometric analysis will help current and future researchers figure out where the gaps are and how to fill them. The current study applied a bibliometric method, to identify yearly output, country collaboration, prolific authors, and contingency matrix between the keywords and journals themes and trends in the SDGs research. Publications related to the application of bibliometrics from 2000 to 2021were harvested from the Web of Science bibliographic database. A number of 21441 academic articles were found, and all bibliographic data were analyzed by the Bibliometrix and Cortext Manager. The trend in the production of research was positive. This study offers a clear picture of the development of SDGs research as well as helpful recommendations for future SDGs research.

Keywords: Sustainable development goals; Web of Science; Cortext manager; Country collaboration

INTRODUCTION

The need for sustainable development for the whole world has given rise to the SDGs' concept swiftly. The Sustainable Development Goals were established at a meeting of world leaders held on September 25, 2015, in New York. These 169 targets and 17 goals lay out a plan for sustainable development for all countries that emphasizes

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social inclusion, economic progress, and environmental conservation (Meschede, 2020). The agenda now shifts from establishing the goals to putting them into action and attaining them (Moyer & Hedden, 2020). However, the interconnections and relationships between goals are largely ignored by these implementation aims. This raises the prospect of undesirable effects and missed synergies (Hák *et al.*, 2016).

The bibliometric analysis assists in providing a detailed overview and categorization of prior and ongoing research as well as in identifying potential future directions for this field of study(Wallin, 2005). It efficiently grasps research hotspots and permits the simultaneous analysis of hundreds of documents using mathematical statistics approaches. To explore the scattered structure, quantitative link, dynamic pattern, and quantitative management of documentation, bibliometrics uses statistical methodologies to examine the structure, features, and patterns of fundamental science and technology (Zupic & Čater, 2015). It is a technique for identifying that is employed by modern academics anywhere in the world to examine emerging patterns in a particular body of information (Koseoglu *et al.*, 2016). Bibliometrics has been widely used in a wide range of circumstances, from the conventional evaluation of the impact of citations to the identification of environmental impact variables. Bibliometrics is a statistical technique used to examine and classify different characteristics of the subject of interest (Amees *et al.*, 2020). Countries' contributions, key journals, the most active researchers, international cooperation, the rise of publications each year, and the most cited articles in the area are a few examples of these factors (Hossain & Batcha, 2021).

As a result, we used the idea of bibliometric analysis, a method that makes use of scientific databases to infer links between citations in academic journals as well as trends and future directions for study in particular fields. Through a thorough investigation of authors and journal citation reports, the notion offers a deeper knowledge of the various facets of science. Therefore, the purpose of this bibliometric analysis is to evaluate the current state and future directions of research on the SDGs from 2020 to 2021.

Objectives
The study's goal was to examine the development of research literature from a historical viewpoint concerning the use of scientometrics in SDGs.
• To study the growth of SDGs research literature (2000-2021)
• To identify the distributions of the document types on SDGs
• To find out affiliations and country collaboration
• To know the funding agencies in the field of SDGs
• To study the contingency matrix between the keywords and journals on SDGs

Review of Literature
There are scientometric and bibliometric studies examining research related to sustainable development. The manufacturing of sustainability in the area of bibliometrics and research assessment is narrated by Bhatt *et al.*, (2020).To explore the influential arguments, perspectives, emphasis, and limitations of resulted from quantitative analysis, the study used six paradigms for constructing the content analysis. the study created a co-citation analysis using the top 80 co-cited articles out of 162 articles based on the findings of the co-citation study. The top 15 cited papers were among them. The following were the most productive journals, as determined by our bibliometric analysis, that has published the top co-cited articles: The Journal of Cleaner Production published 19% of the articles in the study, followed by the International Journal of Operations & Production Management (13%), the International Journal of Production Economics (9%), Production and Operations Management (7%), and the Journal of Operations Management (3%). Di Vaio *et al.*, (2020) mapped and analyzed 60 publications indexed in the Web of Science and Google Scholar databases from 1990 to 2019. The purpose of this study is to present a comprehensive and systematic review of the scholarly research on the role of integrated reporting and integrated thinking in establishing long-term business models. The study explored major themes in previous literature on IR and IT to meet the SDGs, as well as contributing to the identification of critical problems that businesses face while seeking to achieve long-term goals. To find out a bibliometric analysis of the contribution of water research to the accomplishment of SDG 6 in Belgium,

a study has been organized by Ho *et al.,* (2020). They noticed long-term collaboration between scientists from Belgium and countries around the world, as well as a growing rate of cooperation with countries in the Global South. In Belgium, there were 5,703 water publications research, the first of which was published in 1926 and of which more than half were published from 2010 to 2019. The most commonly published document type was an article with 82%, followed by a conference paper with 10%, a review with 4%, and a book chapter with 3%. The most common language was English with 95%, followed by French at 3%, and Dutch at 1%. The major finding of research, Belgian water research had the most productive publication rate of 2.9 articles per 100,000 residents in 2019, higher than France with 1.9% and Germany with 2.1%, but lower than the UK with 3.1% and the Netherlands with 4.8%. The global research in the field of sustainability and project management explored by Toledo *et al.,* (2019). The study uses a scientometric assessment from 2006 to 2018 employing analysis of keywords, co-author, sources, organizations and country analysis. A total of 400 bibliographic documents were chosen and evaluated from the Web of Science and Scopus. The findings show that the study area has evolved to include sustainability Triple Bottom Line in project management operations based on the Brundtland Commission's concepts. The goal of this data post is to help readers understand the current state of sustainability and project management studies around the world.

Meschede & Henkel, (2019) aimed to identify important relevant research topics to identify and analyze 102 journals and conferences for this research in field libraries and information science publications. They found and examined 81 papers on sustainability and sustainable development. A large portion of the documents dealt with sustainable development and libraries. Information and communication technology (ICT) and information systems are the subjects of other publications. Only a few papers cover additional issues such as government, urban growth, or scientific output. Aria & Cuccurullo, (2017) in their area of research analyzed the result through the R tool and the importance of science mapping analysis. They offered a unique open-source tool created by the authors, country, and keywords to perform extensive science mapping analysis. The study analyzed documents related to bibliometrics in management, business, and public administration obtained from Google Scholar from 1985 to 2015. The researcher did not include co-citations, bibliographic coupling, scientific collaborations, or co-word analysis retrieved from titles and abstracts. Gálvez, (2016) expressed that public health research in the Revista Española De Salud Publica from 2006 to 2015. Visualization maps were designed using the VOS viewer based on the analysis of keywords, and clustering techniques. A total of 512 documents were obtained from the Web of Science. The use of bibliometric maps to determine the conceptual understanding of this scientific topic is an appropriate technique. Based on the finding, there is a macro line of consolidated investigations, which engages in studies on epidemiology, prevalence and prevention of diseases as well as the protection of rights.

Han *et al.,* (2014) studied the global research publications on sustainable hydropower development between the period 1901 and 2004 indexed in the Web of Science database. They conducted statistical analyses and evaluations on research development, recent trends, and future directions in eight categories. Based on keywords, the keyword "Turkey" showed rapid growth between 2007 and 2012, with the highest value in 2012. The number of documents published increased from 2001 to 2012. Influential hotspots for hydropower sustainable research have ended up as "Turkey", "Eco-", "Small Hydro-" and "Fish". Olensky *et al.*, (2013)attempted a study entitled "Evaluation of the Citation Matching Algorithms of CWTS and iFQ in Comparison to the Web of Science". The bibliographic 300 documents were downloaded in the WoS from 1998 to 2012. According to the finding, the algorithms of the bibliometric study group work better than the Web of Science algorithm. The algorithm does not allow for any variation. The WoS algorithm still does a good job (F1 score: 96.41 percent), but it struggles to match references with errors.

METHODOLOGY

The bibliometric technique is used by researchers for different purposes, including: First, objective evaluation is regarded as less relevant than research studies containing data. Second, conventional reviews can provide subjective and critical summaries of scientific papers.

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Finally, bibliometric techniques assist in obtaining summaries of scientific reviews. The methodology for this study is divided into five steps: data extraction and identification, data screening, eligibility analysis, and finally bibliometric analysis. The literature search was done on 05-05-2022 using the Web of Science database. Most of the important papers are included in the "Web of Science Core Collection," which is used in a variety of scientific fields. The bibliometric analysis used data from the Science Citation Index, Arts & Humanities Citation Index and Social Sciences Citation Index collection. The data were obtained from Clarivate Analytics' ISI Web of Science. The time frame for the investigation was chosen between 2000 to 2021.We refined data on the subject of sustainable development goals where the file was retrieved by exporting the data to a plain text file, to obtain pertinent information, various topics (title, abstract, author keywords, keywords plus®) were researched.

The exact keyword search is presented below:
ALL=(No poverty) AND ALL=(zero hunger) AND ALL=(good health and well-being) AND ALL=(quality education) AND ALL=(gender equality) AND ALL=(clean water and sanitation) AND ALL=(affordable and clean energy) AND ALL=(decent work and economic growth) AND ALL=(industry, innovation and infrastructure) AND ALL=(Reduced inequality) AND ALL=(Sustainable cities and communities) AND ALL=(Responsible consumption and production) AND ALL=(Climate action) AND ALL=(Life below water) AND ALL=(Life on land) AND ALL=(Peace, justice and strong institutions) AND ALL=(Partnership for the goals) OR ALL=(sustainable development goals)
https://www.webofscience.com/wos/woscc/summary/7ea3cbed-3a4d-4b72-ae5c-f78b98e3dc9d-4e47cac2/relevance/1
Different software was employed to carry out the bibliometric analysis of the WoS database. "Microsoft Excel" was used to calculate the statistical data, including the impact factors for journals and the annual trends in publications by various nations. The CorText Manager (Maniquiz-Redillas *et al.*, 2022) was used to display the main collaboration networks between the journal and keywords.

RESULTS AND DISCUSSIONS

Evolution of papers by twenty-two years
We have presented the characterization of the number of publications, open-access articles, citations, average per paper and h-index in Table 1. The number of papers published related to sustainable development goals research from the Web of Science database between 2000 and 2021. Our descriptive results show that the research on the theme has increased over the years, with emphasis on the period between 2004 and 2021, except in 2014. An increase in the number of papersrelated to SDG sresearch from 2014 to 2021, with an average per paper from 2014 to 2016. In 2008 and 2003 were identified the average per paper was. Even though 2021 had less occurred h-index concerning the subject, this year was the highest number of articles published, which indicates that studies are being developed to fulfil the gap. Two years found the highest h-index from 2017 to 2021. According to open-access (OA) articles yearly published between 2000 and 2021, the number of documents increased from 2012 to 2021, which year OA articles were published in 2021. In terms of citations, the highest citation was received in 2021 with 10808 citations and the lowest citation was found in 2004.

Documents distributions on SDGs
A total of 21441 publications were found in sixteen documents about SDGs research as shown in Figure 3. Articles, as the most frequent type, made up 84% (2238 documents) of the total publications. Followed by Review Articles 10% (2153 documents), Editorial Material4% (747 documents), Proceeding Papers (247 documents), and Early Access (87 documents) of the documents, respectively. The other document kinds (Film Review, Retracted Publication), which made up less than one of all the records, were the rarest. This research focuses solely on the important publishing form known as Journal Articles.

Organizations/Affiliation's performance
We identified 16408 institutions conducting research related to SDGs. The ones that conducted the most research on the subject (Table 2) were mostly located in the top 20 affiliations. The main institution was the University of

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London, which has published 639 of all studies on the subject and the citations, h-index ranked first. The majority of institutions were from the United States and the United Kingdom. The Chinese Academy of Sciences in China published 508 of the total publications and performed slightly poor in the citations (10607, ranked 17th) and the h-index (57, ranked 6th). The University of California System has published 459 papers and this university citation and h-index 2nd ranked among the top twenty organizations. It was noticed that all affiliations were received above the 50 h-index.

Country performance

Table 3 shows the addresses of the authors that were acquired and utilized to evaluate the contributions of various nations. As a result, it was found that the authors were from 164 different nations across six different continents. Which 20 nations are the most productive in terms of the overall number of papers published may be seen by looking at Table 1. Additionally, it displays the total number of citations for each country, the number of publications for which each country has been cited, and each country's h-index. The United States article output ranked first, accounting for 5012 of the total records, and the h-index ranked first. It's worth noting the USA has the most article citations among others, around 149034 times. The UK published 2948 of the total publications and performed the second position in terms of citations and h-index. Next China published 2751 of the total publications and performed well in the number of citations (58637, ranked 2nd) and h-index (112, ranked fourth). Furthermore, it was found in the term of articles published the Indian authors shared 1077 articles related to SDGs research.

Author's top rank with publications

Around 78078 authors took part in different publications on sustainable development goals. Among them, twenty authors that published on the subject (Table 4) were responsible for 462 of the published works between 2000 and 2021. Only the USA's half of the main authors have their origins in one of the countries that most published on the subject.Van Vuuren, Detlef P. (Netherlands)stands out as the most published author on the subject. Although he presents investigations not only in sustainable development, he is one of the pioneers of the environmental sciences. That is why most publications were theoretical, searching to discuss the concepts of this subject in several sectors, including energy systems and climate change. Leal, Walter has the second largest articles published related to SDGs. The study also found Sinha, Avik had a prominent author from India. Authors such as Bhutta, Zulfiqar and Hay, Simon I. have developed studies related to SDGs with the third largest (n27 papers), although they have not directly investigated the agri food sector in every article. In terms of citations and h-index have found, Mokdad, Ali H. (University of Washington, USA) has the highest citation received from 26 articles and a value of 23 h-index.

Funding agencies

The top twenty funding agencies that are financially assisting research activities on SDGs are shown in Figure 4, the funding agencies between the country and funding agencies created by the Cortext manager. The National Natural Science Foundation of China (1103 papers) emerged as the top funding agency, followed by European Commission in the UK (984 papers), UKRI – UK Research and Innovation (718 papers), CGIAR in France (356 papers), and the National Science Foundation: NSF in the USA (336 papers) were funded to the researchers for their works. The study found the country of the USA and the UK was supporting research related to SDGs research.

The contingency matrix between the keywords and journals on SDGs research

The results show that the term "sustainable development goals", "sustainable development" and "sustainability" are the most recognized. The Journalof Sustainabilityfocuses heavily on food security, which is consistent with the aim and scope of this journal.

Despite the proposed correlations, the Environment Development and Sustainability and Water journals have shown the lowest correlation with the terms "sustainability" and "goals". The Cortext Manager used the lexical term extraction method, which is used to extract keywords from metadata files in the WoS on SDGs. With consideration for phrase frequency, the term extraction algorithm may find 70 relevant terms in the selection. As a result, the script chooses terms in situations when phrases are found with at least 20 co-occurrences based on a trade-off between

frequency and specificity. With a maximum of 14 nodes for the specified journal name and keyword fields, this method was utilised to create contingency matrices for the WoS outcomes of this inquiry, as shown in Figure 5. A heat map is used to display the degree of connection between the journal name and the keyword. The heatmap's numerical scale runs from -5 to 5, and it shows a comparison between the actual co-occurrences and the combined count of the two fields that were chosen (keyword and journal name).

CONCLUSION

The present study examined the features and trends in sustainable development goals research. A bibliometric analysis was performed to analyze 21441 publications that report research on SDGs) from 2000 to 2021. The most common record type was Articles, which accounted for 2238 of all documents. For further analysis, country performance, journals and keyword analysis were conducted. Results showed that the article production of the USA placed first, and citations and the h-index scored first. By utilizing contingency matrix analysis, it was examined that the terms "sustainable development goals", "sustainable development" and "sustainability" are the most recognized. The Journal of Sustainability focuses heavily on food security, which is consistent with the aim and scope of this journal. Regarding affiliations, the University of London, which has published 639 of all studies on the subject and the citations, h-index ranked first. Scholars and researchers, professionals, policymakers, and individuals who are interested in additional research in this area can all benefit from these findings. As a way to overcome the limitations faced by this work, although database such as the Web of Science brings consolidated results, these databases include mostly international journals between 2000 and 2021.

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Table 1. Evolution of papers by twenty-two years on SDGs (2000-2021)

Year	Articles	Citations	Average/Paper	h-index	OA Articles
2000	80	19	36.89	26	4
2001	81	21	65.2	26	8
2002	71	18	33.85	25	5
2003	95	49	61.92	34	9
2004	85	11	60.53	29	6
2005	130	41	53.85	45	19
2006	158	46	56.41	45	28
2007	195	84	49.72	52	38
2008	231	100	61.85	57	36
2009	263	164	53.01	57	61
2010	323	174	44.44	61	64
2011	379	264	44.36	64	109
2012	389	243	43.75	60	105
2013	503	403	43.57	69	141
2014	497	405	36.64	72	195
2015	760	697	39.34	84	283
2016	1041	1175	40.02	86	565
2017	1501	1674	36.12	100	848
2018	2103	2792	31.22	104	1268
2019	2831	3749	20.6	88	1744
2020	4048	6447	13.91	79	2622
2021	5677	10808	5.74	52	3595
Total	21441	29384		1315	11753

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Table 2. The top 20 producing affiliations contributed to publications

Rank	Organizations	TP	TC	H	C	Rank	Organizations	TP	TC	H	C
1	University of London	639	26608	79	England	11	UDICE French Research Universities	252	14124	57	France
2	Chinese Academy of Sciences	508	10607	57	China	12	University College London	242	12120	54	England
3	University of California System	459	25394	77	USA	13	University of Queensland	242	12708	50	Australia
4	World Health Organization	408	22767	69	Switzerland	14	Johns Hopkins University	231	13903	52	USA
5	CGIAR	360	11210	53	France	15	State University System of Florida	229	14852	53	USA
6	Harvard University	338	19143	62	England	16	University of North Carolina	226	9201	43	USA
7	Wageningen University Research	329	15742	64	Netherlands	17	Centre National De La Recherche ScientifiqueCnrs	212	9721	48	France
8	University of Oxford	317	15009	55	England	18	University of Washington	211	14557	54	USA
9	Utrecht University	296	9024	55	Netherlands	19	University of British Columbia	208	14317	51	Canada
10	London School of Hygiene Tropical Medicine	260	15058	53	England	20	University of Washington Seattle	208	14474	54	USA

Note: TP- Total Publications; TC- Total Citations; H- h-index; C- Country

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Table 3. The top 20 producing countries contributed to publications

Rank	Country	Publications	Citations	h-index	Rank	Country	Publications	Citations	h-index
1	USA	5012	149034	174	11	Switzerland	1046	46848	104
2	UK	2948	91944	150	12	Sweden	969	29160	104
3	China	2751	58637	112	13	South Africa	894	30360	83
4	Australia	1823	57226	119	14	France	887	34138	96
5	Germany	1641	49133	112	15	Brazil	818	24413	77
6	Canada	1388	40817	96	16	Japan	609	18710	69
7	Spain	1381	29795	83	17	Austria	495	20013	77
8	Netherlands	1295	45877	106	18	Scotland	481	19817	67
9	Italy	1271	37580	96	19	Portugal	476	16093	56
10	India	1077	27966	85	20	Norway	469	19211	71

Table 4. Author's top rank with publications on SDGs research

Position	Author	Address	Publications	Citations	h-index
1	Van Vuuren, Detlef P.	The Netherlands Copernicus Institute, Utrecht University, Netherlands	37	2869	27
2	Leal, Walter	Department of Natural Sciences, Manchester Metropolitan University, UK	34	957	15
3	Bhutta, Zulfiqar	Centre for Global Child Health, Hospital for Sick Children, Canada	27	3782	20
4	Hay, Simon I	Department of Health Metrics Sciences, School of Medicine, University of Washington, USA	27	6642	23
5	Mokdad, Ali H.	Institute for Health Metrics and Evaluation, University of Washington, Washington	26	7965	23
6	Liu, Jianguo	Department of Fisheries & Wildlife, Center for Systems Integration and Sustainability, USA	26	1058	17
7	Fujimori, Shinichiro	Department of Environmental Engineering, Kyoto University, Kyoto, Japan	24	834	14
8	Hill, Peter Stewart	School of Public Health, The University of Queensland, Australia	24	249	9
9	Smith, Pete	Institute of Biological and Environmental Sciences, University of Aberdeen, UK	22	2704	16
10	Murray, Christopher J. L.	Department of Health Metrics Sciences, University of Washington, USA	22	5710	22
11	Krey, Volker	Industrial Ecology Programme and Department of Energy and Process Engineering, Norwegian University of Science and Technology, Norway	21	1769	14
12	Sinha, Avik	Centre for Excellence in Sustainable Development, Goa Institute of Management, India	21	658	18
13	Hoogenboom, Gerrit	Department of Agricultural and Biological Engineering & Food Systems Institute, University of Florida, USA	21	194	9
14	Fu, Bojie	State Key Laboratory of Urban and Regional Ecology, Chinese Academy of Sciences, China	19	231	10
15	Lozano, Rafael	Department of Health Metrics Sciences, University of Washington, USA	19	4751	11
16	Mohammed, Shafiu	Health Systems and Policy Research Unit, Ahmadu Bello University, Nigeria.	19	6520	17
17	Alvis-Guzman, Nelson	Facultad de Economía, Universidad de la Costa CUC, Colombia	19	7277	18
18	Sala, Serenella	Joint Research Centre, Italy	18	874	14
19	Koyanagi, Ai	Research and Development Unit, Parc Sanitari Sant Joan de Déu, CIBERSAM, Spain	18	5775	16
20	Bartram, Jamie	Gillings School of Global Public Health, University of North Carolina, USA	18	918	17

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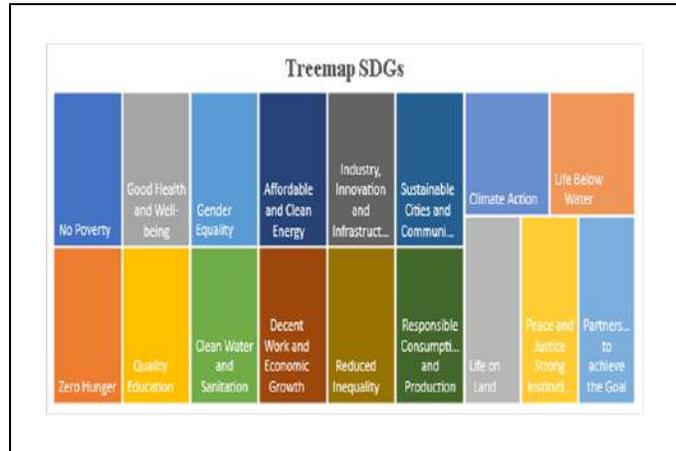
Figure 1. UN's 17 goals for sustainable development
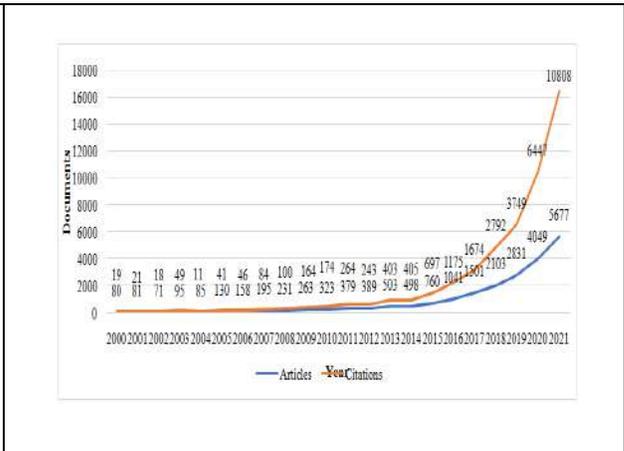
Figure 2. Quantity year of publications and citations (2000-2021)
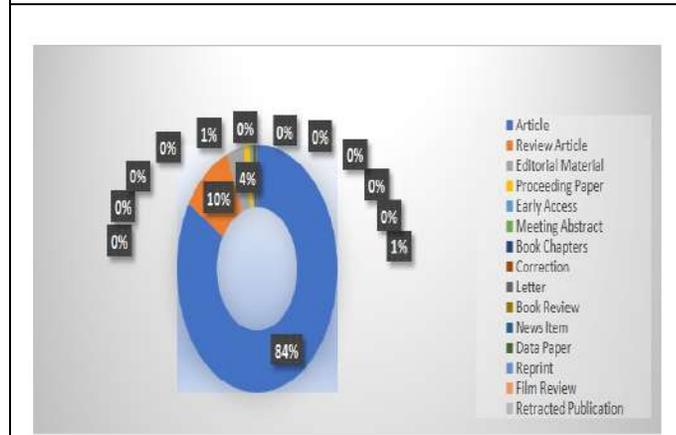
Figure 3. Documents distributions on SDGs
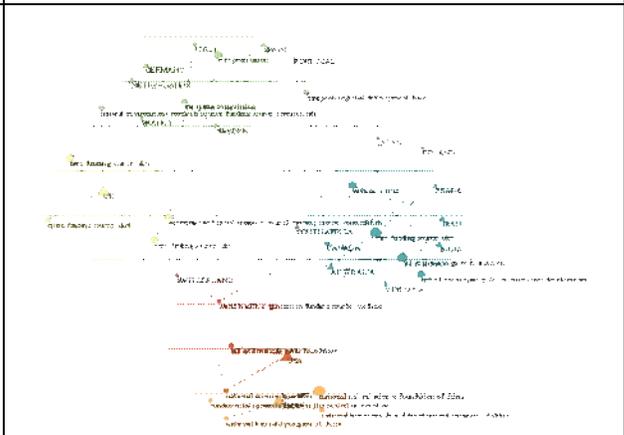
Figure 4. Funding agencies on SDGs research
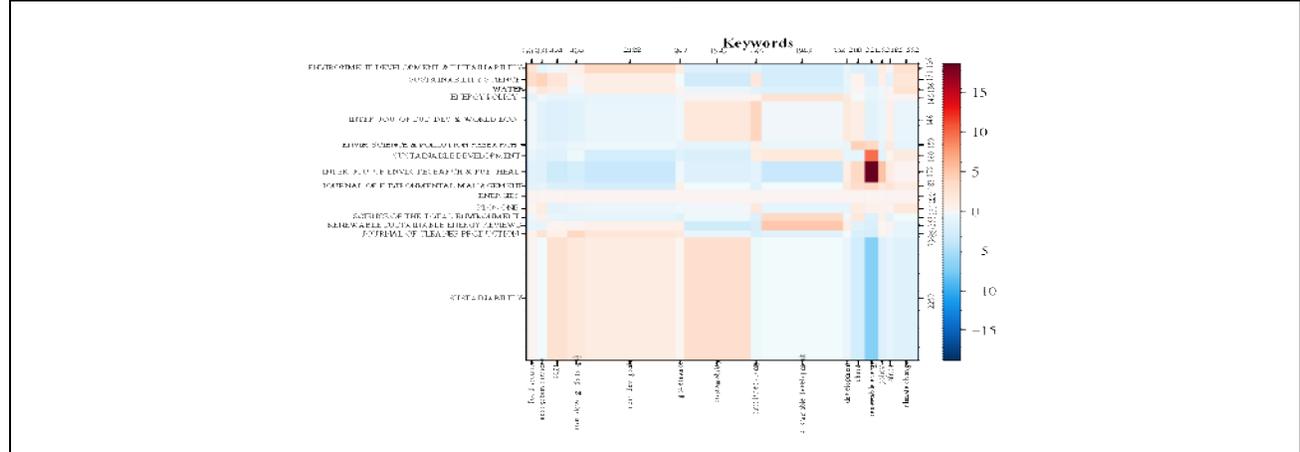
Figure 5. The contingency matrix between the keywords and journals

RESEARCH ARTICLE

Enhancing the Quality of Higher Education using Process Mining and Lean Six Sigma

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ABSTRACT

Higher education is the backbone of a country growth, which ensures stability and success of individual person in all fields around the society. The impact of Covid pandemic around the world changed the perspective of all sectors including higher education. The infusion of digital components makes all the works simpler, more transparent and directly impact on quality of it. Inevitable situation of producing quality products aroused and it demands in all industries, to acquire it management of respective organizations started to infuse some sort of quality principles in their routine work. Higher education sector encompasses of complex process in it because the persons involved in it are from different field and they are all processed and worked together to achieving several outputs which is highly beneficial for individuals and society too. Our idea is to address all the process of higher education and study the flow of it through process mining. Later we introduce Lean Six Sigma in the process for ensuring the quality in that work flow.

Keywords: Covid, digital, education, society.

INTRODUCTION

Quality
The growth, consistency and premiumness of organization is purely depends on the quality of their output. To attain the better quality there are huge number of methods and models available today. It is big challenge to freeze a method to follow on for ensuring the quality, every day the new variants are evolved in current technical generation. Creating the awareness and infusing the knowledge of quality methodology to the workers in the institution is

tedious task. Even then it must for an organization to implement quality method to ensure it success in this competitive world.

Higher Education

The higher education system broadly classified into five categories namely management, students, teachers, parents and third parties. The interactions among all these five parties are already defined according to their affiliation status to their respective government authorizing council. The working principle of education methodology is multi layered according to their respective departments and all the work are executed for the betterment of student. The involvement of stake holders in education system is needed in all through the process at various levels. The fig.1 shows the work process of education institutions. Three important components of institution are types i) Administrative People ii) Qualified Teachers iii) Infrastructures & Facilities. As a institution the regulations and standards which is prescribed by government authorization body are followed for the respective courses [1]. Higher education system consists of many processes such as (i) Curricular Phases (ii) Teaching and Evaluation methodology (iii) Research Contribution (iv) Infrastructure Consistence (v) Student Supporting Process (vi) Managerial Structure (vii) Progressive Plans for full filling the overall education method in society. A good life cycle of education will improve trade and commercial commodity of society and also it will improve the quality of educational system in progressive manner.

Lean Six Sigma (LSS)

Lean Six Sigma is a combined quality methodology for empowering the industry with minimal input and maximum output. The rate of errors and flaws are very less after the infusion of LSS in respective organizations. Initially, the Six Sigma is with ideology of finding the deviation from the actual plan and minimizing it in the process, Lean is on the other side which avoids the waste in the process. Both of them yield good output in their respective ventures. Later these two quality methods are combined together and act as single ideology which is inevitable for producing quality product with minimal effort nowadays in industries. Thus nowadays many industries and service sectors are implementing it for its consistent performance over the years. By following this practitioner quality method many organizations are consistently performing in the business world and retaining their brand value in the market.

Process Mining (PM)

[5]Process Mining is much effective concept for organization to improve their process by analyzing it with impactful techniques and respective proper data sets to it. Key component of process mining is event log, which holds all the basic and important information about the events which are happening inside the organization. By having this handful data user can analyze the process with proper framework and produce data driven output. Three phase of analyzing are in process mining (i) Process Discovery: This phase takes inputs from event log and emulate the corresponding process model to it, using this user can find the structure of flow, path of process flow and frequency of path used along with distributions occurred in the path. (ii) Conformance Checking: This is a vital activity because it determines the deviation of actual process from assumed process. Domain expert of it will give clear picture about how far the process gone through according to the specific standards which is expected in the organization. (iii) Process Enhancement: This event helps existing model to improve its work flow by providing additional insights.

Process discovery is key part of attaining all requirements and determining the process model of the system. For doing this there are different discovery algorithms are available with respective advantages and disadvantages. From fig 2 we can get few algorithms 1) Alpha Miner is first algorithm which determined the model in petri net with observed data.2) Inductive Miner is used to bisect the event log and discover all the hidden transactions in the system to produce the output in the form of process trees.3) Heuristics Miner is algorithm which works along with direct follows graphs to handle the noise and produce output as heuristics net. 4) Directly follows graph is where the events are represented in the form of nodes and edges through this we can evaluate the frequency and performance of the events in the respective system.

Process Mining for enhancing Lean Six Sigma

Lean Six Sigma is comprised with DMAIC methodology which is Define, Measure, Analyze, Improve and Control for intact its process in the respective organization [5]. Process mining is giving a wonderful insight to LSS method with proper supporting data to it, the three phases of process mining giving proper parallel data driven support to all of it DMAIC idea. Fig 3 show the comparison of DMAIC and Process mining phases, it is clearly shown that its give sounding structure to LSS for making wise decision in choosing the correct problem statement to yield par better results. For collecting information in the LSS process it is tedious one and time consumption because of it is manual nature. Process mining is bridging this gap by providing proper structure to choose wise process by analyzing it with proper techniques. Hence this will be proper supporting framework for LSS.

LSS for Higher Education Institution

The feasibility of all existing technology and quality principles are quite challengeable in their initial days but once they started to yield the results of its methods then slowly it grasped the attention of people and now it is having its own cemented role in all organizations. In manufacturing and various others industry are still practicing a lot even after following principles LSS in its organization, because of its depth and to understand its concepts consumes lot of time. Proper knowledge is needed to put this idea to yield good results. Quality is much expected in all transactions which is made by human kind, thus it is much expected in education sector too. Already education organizations are following and having their own plan and methods to run the process, but still lot of areas are yet to achieve its perfection in the aspect of quality. From the last decade the idea of implementing LSS in education sector aroused and it is moving in right path to emote education sector to next level [2]. Quality standard and continuous improvement is must in educational institution today. Higher education should express its concern and values in achieving the goals to sustain its growth [3]. Several key process where Lean Six Sigma can be implemented to uplift the quality are (i) Improving the student pass ratio in examination (ii) Reducing the risk in getting placements from companies (iii) Enhancing the students progression in academic process (iv) Building the transparent feedback system (v) Proper methodology for enriching the research contributions (vi) Decreasing the cost by utilizing resources wisely (vii) Inducting new teaching and learning framework (viii) Promoting a parallel structure to achieve better results in accreditation process to improve the standard to next level [4]. LSS approach is implemented around the globe mainly American and British universities are front runners in it, other than that several universities in countries like Mexico, Finland, China, South Africa, India and Saudi Arabia are involving this approach in their processes.

Challenges and Issues While Implementing of LSS in Higher Education

Introducing the LSS into higher education is new and it has own challenges in it. Already education system is revolving with plan and process, by adding this approach to it will bring lot of challenges [6]. The big challenge is to find a right tools and techniques for education sector process. It is very difficult to make everyone in the organization to understand the concept of LSS and its benefit. For effective results its must that from top management to end worker have to believe and work in this approach, if not then its ends up with negative. Proper problem finding and project selection is needed before implementing LSS in higher education, otherwise its shows moderate results. Another vital challenge is that getting voice of customers is very difficult, because it consists of different types of customers in the process. To picking the right one is very challenging. For the workers in the organization it highly tedious to continuously participating and working in this approach, because of the nature of work its compulsory to provide the necessary resources to full fill for doing their contribution effectively. The higher education bundled with many process to provide its service to the society. Among that to find important process and involved stake holders is a hectic work. The work flow of process is also not clear to understand because the hierarchy involved lot of people and it took lot of time to complete.

Incorporation of Process mining Techniques in Lean Six Sigma process for better implementation in Higher Education Institution

Finding the process along with the involved parameters, conditions and stakeholders in higher education is quite difficult. In the implementation of Lean Six Sigma in education institution needs lot of clarity in addressing the

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correct process. For addressing this particular issue and we are trying to infuse process mining ideology into LSS. The process discovery is the initial phase in process mining which inculcates algorithms for finding process from the event log. This part of finding proper process will enhance the idea of freezing correct process to implement LSS in higher education. The next stage of process mining is conformance checking which will give clear idea of the deviation of process from its actual plan this part will help the process in-charge to understand where system breaks with concrete details. Final and third stage of process mining is process enhancement it will give clear clarity to improve the existing process and to enhance the existing model to yield better results.

CONCLUSION

The important problem of implementing LSS in higher education is to find the right process and its flow, because of its diversity nature among the various stake holders it is massive job. The interrelation among the stake holders in the education system makes understanding process even more complex. The trending and new ideology of process mining giving good hand to address this issue by providing a proper analyzing techniques of process with tools its makes to user to select the proper process and its flow. By implementing process mining techniques in Lean Six Sigma approach it will give better clarity to select the right process in higher education institution methods. This feature enables wonderful opportunity of selecting correct path for the implementation of LSS in the higher education organization, thus the goal of enhancing the quality will be attained.

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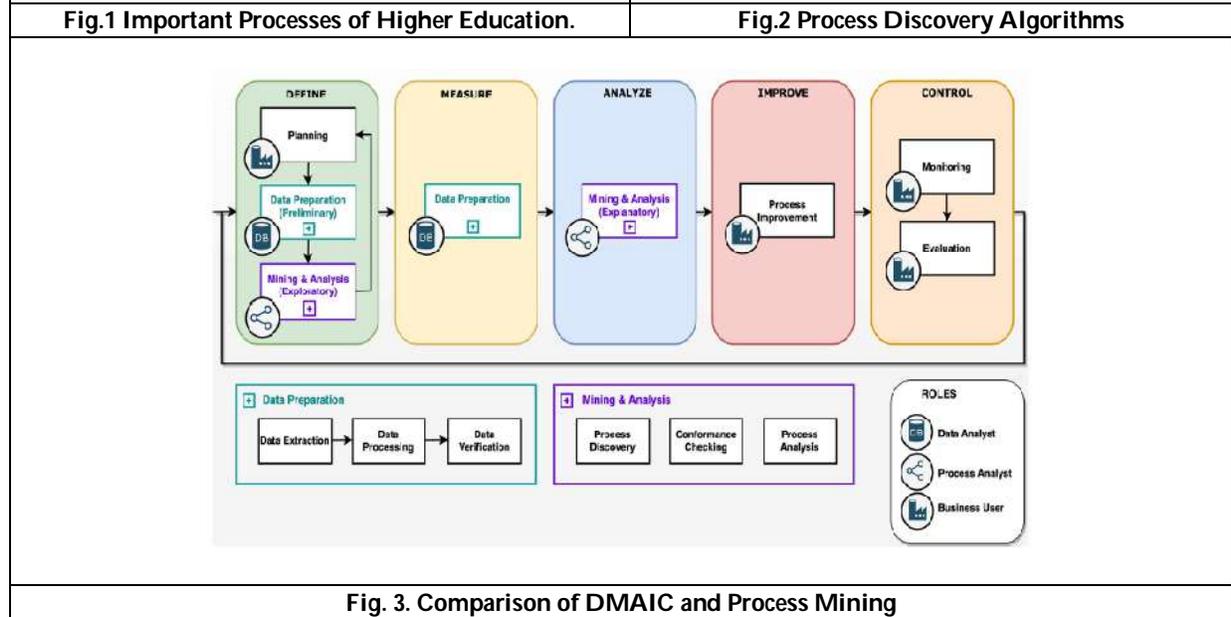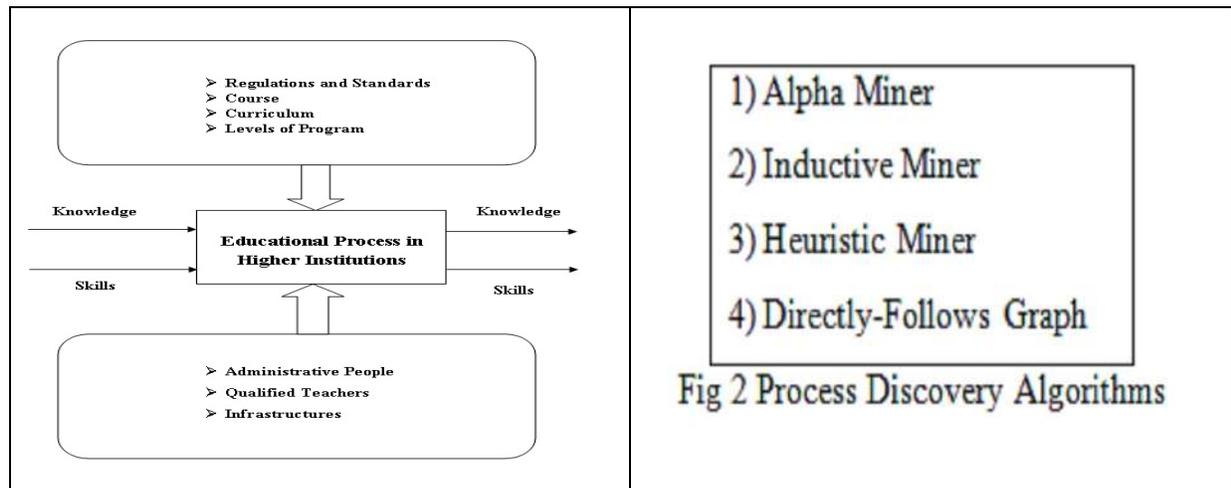
| **Fig.1 Important Processes of Higher Education.** | **Fig.2 Process Discovery Algorithms** |

Fig. 3. Comparison of DMAIC and Process Mining

RESEARCH ARTICLE

Reframing Leadership Practices to Improve Employee Engagement and Retention in Remote Working Environments

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ABSTRACT

The onset of the Covid-19 pandemic has brought about an overhaul in the operating mechanism of many companies. Digitalisation has been adopted by most of them to aid remote working environments. However, this change has not been without challenges, as leaders are finding it harder to engage and retain key employees. In this study, the main aim was to examine the changes brought about in leadership practices of such companies in order to enhance employee engagement and retention through a survey of 93 employees from the Indian service sector. Using a close-ended questionnaire as the survey instrument, the researcher also identified the effect of these changed practices. The study found that present leadership is aimed at reducing employee burnout and stress with changes such as encouraging trust in the leadership, creating a flexible work environment, being sensitive to their needs and emotions, boosting their morale, encouraging virtual one-on-one sessions between employees and customers for constructive criticism and positive feedback, and improving the overall communication quality in the organisation. Moreover, the study concludes that transformational leadership is identified as the most effective form of leadership in the present working environment.

Keywords: Employee Engagement, Retention, Remote Working, Organizational goal, Leadership Practices

INTRODUCTION

Leadership in businesses is focused on value chain management with the best practices of the industry refined with individual solutions to improve efficiency. However, having the skills in leaders is not enough, rather it needs to be adopted in practices oriented to build relationships and have a well-functioning team (Lauritzen, Grøn, & Kjeldsen, 2021). Several studies (Al Altheeb, 2020; Dusun & Demir, 2015; Naile & Selesho, 2014) have pointed out the role of leadership practices impacting team performances and motivation in every environment. This is particularly relevant for the circumstances of remote working shaped by the pandemic of Covid-19. The crisis has brought to notice the need for leaders who are talented and empowering those leaders to rise to the challenges shaped by the new normal. The remote working conditions have led to a distributed workforce for the companies (Contreras, Baykal, & Abid, 2020). Here, reframing the leadership policies became particularly imperative to make use of formal policies and use new ideas to build teams that can achieve organizational goals. The role of remote leadership is particularly relevant for the continuity of business as it is responsible for the generation of continued trust and support of the workforce (Deloitte, 2020). Leadership practices are also important in remote working as the leaders need to focus on communication, relationship building, training, and performance management all when the team is not on-site and the complexities of varied culture and multiple time zones are to account for (Flood, 2019). Reforming practices of leadership practices are also required in remote working as the leaders need to coach, develop, and motivate employees within a virtual environment (Flood, 2019). Considering the same the current paper seeks to examine the reframed leadership practices for operating in the remote working environment and its impact on the team.

Aim
In view that the role of leaders in the remote working environment is expected to offer security and guidance apart from the traditional roles they had to fulfill, the current paper seeks to examine the importance of reframing leadership practices in India's current remote working culture.

Literature Review
For fulfillment of the aim of this study, the current section will review previous reports and academic studies to understand the importance of reframing leadership practices in India's current remote working culture. To begin with, the importance of employee engagement is comprehended. Employee engagement is developing provides the workforce with focused energy and sense of purpose that is translated into a behavioural display of adaptability, personal initiative, and effort persistent towards the accomplishment of organizational goals (Bhuvanaiah & Raya, 2014). Employee engagement is important for organizations to create a continuous culture focused on the creation of a highly productive workforce. It is also significant to ensure that team is more resilient to face changes and exhibitsa positive attitude and quality work that helps companies do remarkably well even in tough economic circumstances (Bhuvanaiah & Raya, 2014; Osborne & Hammoud, 2017). The role of leadership in driving employee engagement is particularly relevant as they influence interpersonal behaviours of the team which directly impact employee productivity and consequently that of the organization as well (Hausknecht & Holwerda, 2013). Leadership is also central in driving employee engagement as it provides the employee with psychological safety and a perception of fair treatment to enhance the meaningfulness of their job (McManus & Mosca, 2015). Thus, employee engagement is imperative for enhanced organizational goal achievement and leaders can influence the engagement by enhancing commitment from employees as well as their willingness to stay.

Similarly, for understanding leadership practices in remote working it is also imperative to recognize the importance of employee retention and the role of leadership in it. Employee retention is an organizational practice directed towards reducing the turnover among employees and keeping them with the organization for maximum time or till the time of objective completion (Menaria & Choudhary, 2016). Retention of the employees is important to ensure that the objectives and goals of organizations are met with the help of a productive and desirable workforce. It is important for the organization as it helps companies in reducing their cost expenditure, specifically hiring new employees and training them (Iqbal & Hashmi, 2015). The role of leadership in ensuring employee retention is

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important as the leaders are the immediate force through which the workforces make perceptions regarding the work environment. The methods of consultation, encouragement, and delegation positively impact the performance of employees as well as their retention (Khalid & Nawab, 2018). The leaders have a role of recognizing the specific needs of the workforce that will encourage employees to attain their goals and that of the organization addressing the problems of attrition of employees (Adekanbi, 2016). Thus, employee retention is imperative for business continuity and leaders play an important role in it by designing employee involvement to achieve positive perceptions from the workforce and increase their efficiency. In the light of the importance of employee retention and engagement in a remote working environment and the role of leadership in it, it is imperative to understand the challenges that current leadership styles have to face. Prominent styles of leadership include autocratic, laissez-faire, participative, transactional, and transformational.

Based on the dominance of leaders on the employees, autocratic leaders are closed for opinions, while participative leaders involve employees in decision-making (Zylfijaj, Mahmutaj, & Grubi, 2016). Laissez-faire leaders believe in the decisions made by their followers (Tosunoglu & Ekmekci, 2016). Transactional leaders on the other hand make use of rewards and punishment to attain their goals. Finally, transformational leaders empower and encourage their employees (Murari, 2011). Among the challenges to leadership styles working in the remote environment is to maintain engagement and reduce attrition in conditions of spatial separation with the employees. The remote leadership style faces the challenge of motivating the employees while keeping and encouraging their shared sense of responsibility for the organization (De-La-calle-durán & Rodríguez-Sánchez, 2021; Steude, 2021). Other challenges include the need to create and maintain a flexible work environment, reduce stress and burnout among employees, boost their morale, encourage trust of employees in the leadership, be sensitive to their needs and emotions, encourage virtual one-on-one sessions between employees and customers for constructive criticism and positive feedback, and improving the overall communication quality in the organisation (De-La-calle-durán & Rodríguez-Sánchez, 2021; Dima *et al.*, 2021; Kniffin *et al.*, 2021). Thus, the surveys of literature reveal that remote working creates challenges for leadership for engagement and retention of the workforce.

RESEARCH METHODOLOGY

The research methodology is the theoretical and systematic analysis of techniques that will be applied in the study to arrive at the findings. The current study is based on the primary data type. The data is collected using a survey from respondents working in a remote environment in India. The respondents are chosen randomly and are surveyed using Google forms. The appropriate sample size is selected using the Cronbach formula i.e.

$N = (z^2 p(1-p))/e^2$ Wherein,

N = sample size

Z = confidence level Z score value (i.e., 1.96 at 95% confidence level)

P = proportion of population participating in study

E = desired level of precision or margin of error (i.e., 0.05)

$N = (1.96^2 * 0.93 (1-0.93))/0.05^2 = 100.04$

By taking the P-value as 0.93. The selected sample size for the current study is approximately 100.Out of the 100 respondents, 7 forms were partially filled making the sample size for the research 93. The data is gathered from the survey respondents using a close-ended structured questionnaire. The questionnaire enquires about the demography, background, and perception of the respondents on prevailing leadership practices. The data gathered is then analysed using frequency analysis for the background and demographic sections and SPSS software for analysis of the perception of the respondents' using methods of correlation and regression. The patterns and themes arising in the data are then analysed.

Data Analysis

The data gathered from 93 respondents are analysed using frequency analysis, correlation, and regression methods. First, the demographic findings of the study are presented in the figure.1 to shed light on the basic background of the survey respondents in the figure1. The figure above shows that the maximum of the survey respondents is between the age 35 to 40years (37.6%), male (59.1%), undergraduate (34.4%), have a work experience of 5-10 years (31.2%), and are employed in IT (28%). Further, the questionnaire analysed the ability of the respondents to answer the questions related to reframing leadership practices to improve employee engagement and retention in remote working environments. The findings are presented in the figure.2 in the frequency chart. The figure above reveals that all respondents surveyed were working remotely (100%), maximum of them have been working for 12-18 months (29%), have a moderate impact on remote leadership (31%), while working on an entirely different location than the leader (58.1%), are aware of leadership style (98.9%), and think that transformational leadership is the best suited for reframing the remote leadership practices (39.8%).

In addition, the respondents were enquired about their perception of reformed practices of leadership to support remote working. For inferential analysis, hypothesis testing is conducted, which is assumed as follows:

H_0: Reframed leadership has no significant role to play in enhancing employee engagement and retention by addressing the challenges of distance working.

H_1: Reframed leadership has a significant role to play in enhancing employee engagement and retention by addressing the challenges of distance working.

The responses gathered were analysed using SPSS analytical tools. Firstly, the statements used for enquiring on the perception of the respondents are coded and presented in the table.1.

The coded statements were analysed using Cronbach's alpha test for reliability of the statements to represent the opinion of the respondents. The findings of the test are presented in table.2. The test revealed that the total Cronbach alpha value is 0.96. As suggested in a study by Okada, (2015) the acceptability for the reliability of the statements for group comparisons is 0.8. As the total value is more than 0.8, the statements are considered reliable. Further, the table shows the Cronbach's Alpha value if item deleted for all statements to be either less than or equal to the total alpha. This suggests that all statements will be included in the model for further analysis. With the reliability of the statements analysed, correlation analysis is done is the study to examine the degree of relationships between the variables under study. The following table.2 presents the analysis of Pearson correlation. The above table shows that the values of the Pearson correlation coefficient for all variables are more than 0.5 suggesting the degree of association between the variables. (Senthilnathan, 2019) a study suggested that a higher degree of correlation proves useful in the assessment of predicting accuracy in linear regression models. As all variables have a degree of association higher than 0.5, these variables are included in the regression analysis and findings of which are presented in the table.3. The above table shows that the r square and adjusted R square values of the model are 0.95 and 0.94. This denotes that the independent variables represented by statement RL1 to RL 13 predict the dependent variable of remote leadership being reframed to enhance employee engagement and retention by addressing the challenges of distance working.

Also, the F value of the model is 122.19 which is greater than the required value of 1 for the construction of a viable model. In addition, the regression analysis further reveals that the variables RL3 (0.04), RL4 (0.00), RL5 (0.00), RL7 (0.00), RL9 (0.00), RL12 (0.00), and RL13 (0.00) have significance value of less than 0.05. As maximum statements in the model have a significance value of less than the requirement the null hypothesis of reframed leadership has no significant role to play in enhancing employee engagement and retention by addressing the challenges of distance working is rejected. The analysis further reveals that the contributor of helping in achievement of organizational goal through the behavioral display of adaptability, personal initiative, and effort persistent towards the accomplishment of organizational goals, driving employee engagement by providing employees with psychological safety and perception of fair treatment, retain employees to ensure that the objectives and goals of individual employees and organizations are met, recognizing needs of employees to encourage them in attainment of their goals and that of the organization and is sensitive to them, create and maintain a flexible work environment, encouraging virtual one-on-

one sessions between employees and customers for constructive criticism and positive feedback, improving the overall communication quality in the organisation as reframed leadership practices enhances employee engagement and retention by addressing the challenges of distance working by (0.08%), (0.14%), (0.09%), (0.13%), (0.10%), (0.15%), and (0.12%) respectively. These findings are similar to those by Chanana & Sangeeta, (2021), who found that leadership is one of the key drivers of employee engagement that leads to enhancement of employee retention. The data analysis thus reveals that demographic and background details of the respondents are representative of the population and the inferential analysis identifies the role of reframed leadership in enhancing employee engagement and retention by addressing the challenges of distance working.

CONCLUSION

The findings of the study conclusively suggest that leadership drive employee engagement for enhancement of their goal achievements and meaningful association that impact their and organizational productivity. Similarly, the leadership by designing employee involvement retains employees for business continuity and achieves positive perceptions from the workforce to increase their efficiency. The findings suggest that leadership practices essentially influence engagement and retention among employees. This is particularly relevant in the conditions shaped by the remote working circumstances curved by the pandemic of Covid-19. However, remote leadership style faces the challenge of motivating the employees, need to create and maintain a flexible work environment, reduce stress and burnout among employees, boost their morale, encourage trust of employees in the leadership, be sensitive to their needs and emotions, encourage virtual one-on-one sessions between employees and customers for constructive criticism and positive feedback, and improving the overall communication quality in the organisation. The study surveyed 93 respondents working under remote leadership to understand the role of reframing leadership practices to improve employee engagement and retention in remote working environments. The study conclusively found that the respondent associated with transformational leadership style to maintain engagement and reduce attrition in conditions of spatial separation with the employees. Furthermore, the test of the null hypothesis of reframed leadership has no significant role to play in enhancing employee engagement and retention by addressing the challenges of distance working is rejected in the study. The study was thus conclusively able to find that the factors of reformed leadership in helping in the achievement of organizational goal through the behavioral display of adaptability, personal initiative, and effort persistent towards the accomplishment of organizational goals, driving employee engagement by providing employees with psychological safety and perception of fair treatment, retain employees to ensure that the objectives and goals of individual employees and organizations are met, recognizing needs of employees to encourage them in the attainment of their goals and that of the organization and is sensitive to them, create and maintain a flexible work environment, encouraging virtual one-on-one sessions between employees and customers for constructive criticism and positive feedback, improving the overall communication quality in the organisation are significant.

Limitations and Recommendations

With the aim of the current paper realized, it is important to understand the limitations. The quantitative sample size of the study is limited to only 93 respondents based in India. For the generalization of the findings, the sample size and the study area have to be increased. The recommendations based on the findings are:

- Use new methods of digital communications to enhance trust in leadership and allow the workforce to manage themselves while operating remotely with effective and routine one-to-one meetings to cover personal and work developments.
- The leadership should set clear goals with the employees to ensure that engagement is maintained and employees feel valued enough to be retained by the firm.
- The leader should communicate to ensure each employee feels included in the working of the organization and the organizational culture ensures that the employees feel they can continue with the organization for a longer period.

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Table.1: Coding for statement representing the impact of reformed remote leadership practices

Statement	Code
Do you think that remote leadership is reframed to enhance employee engagement and retention by addressing the challenges of distance working	RL
Helps to engage employees to have focused energy and sense of purpose in the organization.	RL1
Creates employee engagement through a culture of a highly productive workforce.	RL2
Helps achievement of organizational goals through the behavioral display of adaptability, personal initiative, and effort persistent towards the accomplishment of organizational goals.	RL3
Helps in driving employee engagement by providing employees with psychological safety and perception of fair treatment	RL4
Helps retain employees to ensure that the objectives and goals of individual employees and organizations are met	RL5
Use methods of consultation, encouragement, and delegation to positively impact the performance of employees as well as their retention.	RL6
Recognize needs of employees to encourage them in the attainment of their goals and that of the organization and is sensitive to them	RL7
Helps motivate employees and encourages them to develop a shared sense of responsibility for the organization.	RL8
Create and maintain a flexible work environment	RL9
Work towards reducing stress and burnout among employees.	RL10
Encouraging trust of employees in the leadership	RL11
Encouraging virtual one-on-one sessions between employees and customers for constructive criticism and positive feedback.	RL12
Helps in improving the overall communication quality in the organisation.	RL13

Table.2: Correlation Analysis for the statement representing reformed leadership practices impact.

	Pearson Correlation
RL	1.000
RL1	0.830
RL2	0.751
RL3	0.773
RL4	0.789
RL5	0.746
RL6	0.782
RL7	0.798

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RL8	0.782
RL9	0.770
RL10	0.773
RL11	0.756
RL12	0.758
RL13	0.797

Table.3: Regression Analysis for the statement representing reformed leadership practices impact.

Statement	Coefficient	t statistics	P-value	R Square	Adjusted R Square	F- Ratio
(Constant)	-0.10	-0.94	0.35	0.95	0.94	122.19
RL1	0.06	1.28	0.20			
RL2	0.00	0.11	0.91			
RL3	0.08	2.11	0.04			
RL4	0.14	3.49	0.00			
RL5	0.09	3.18	0.00			
RL6	0.04	1.02	0.31			
RL7	0.13	3.26	0.00			
RL8	0.04	1.18	0.24			
RL9	0.10	2.92	0.00			
RL10	0.04	1.43	0.16			
RL11	0.03	1.19	0.24			
RL12	0.15	4.85	0.00			
RL13	0.12	3.00	0.00			
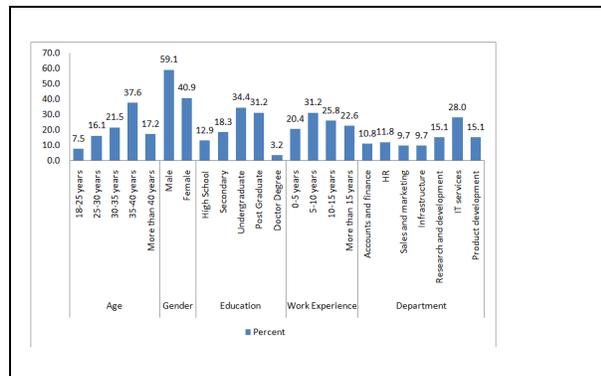
Figure.2: Demography of the surveyed population
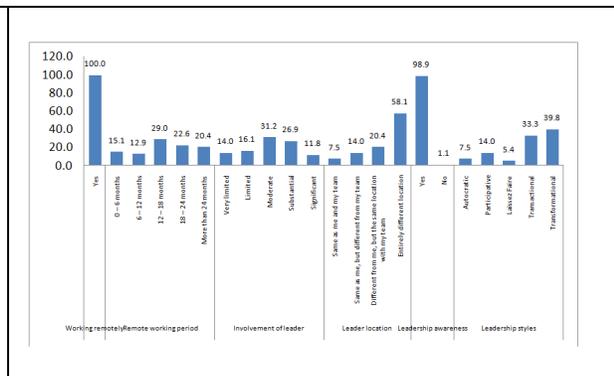
Figure.3: Background Survey of Respondents

RESEARCH ARTICLE

Maiden use of Carboxymethylated Tamarind Kernel Powder in the Design, Development and Evaluation of Melt in Mouth Films of Caffeine

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ABSTRACT

The project's major goal was to create a novel work on the polymer Carboxy methylated tamarind kernel powder, rapid-dissolving oral film based upon the platform of portable, paper-thin drug-loaded film called melt in mouth, which allows for faster disintegration and better bioavailability. The present study will attempt to mask the bitterness of caffeine by using beta-cyclodextrin as a complexing agent. Furthermore, beta-cyclodextrin caffeine complex will be used in the solvent casting method to prepare oral thin films. Caffeine, a central nervous system stimulant from BCS class 1, was used in melt in mouth films.The formulations out of the trials were analysed, came to be optimise the polymer Carboxy methylated tamarind kernel powder with different concentrations (300,400,500 mg) (taste masking agent) β-cyclodextrin, plasticizer (Glycerol), surfactant (Tween 80), and sweetener (Saccharin sodium), superdisintegrants (Crosspovidine) saliva stimulating agents (Citric acid) Thickening agent (Maltodextrin) The films that resulted were assessed for a variety of factors as such Weight variation of films, Thickness, surface p^H, p^H Value, *In vitro* Disintegration time, Folding Endurance, Drug content of melt in mouth films, % moisture loss, percent elongation, tensile strength, stability, FTIR and DSC studies. The formulations F6 (CMTKP), which was taste masked by Beta-Cyclodextrin and disintegrated in 19 seconds using the hot melt extrusion process, were determined to be promising. Drug content was 98.66 percent, with thickness of 0.051 mm, pH values of 6.71, surface pH of 7.91, percentage moisture loss

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of 1.17, and folding endurance of more than 250. FTIR spectra were used to confirm the drug's compatibility in the formulations, and all of the functional groups in the drug and formulations were present and further characterized by DSC showed no interaction between the drug and polymer as there was no major shift in peaks obtained.

Keywords: Melt in mouth films, Caffeine, CMTKP, β-cyclodextrin.

INTRODUCTION

The oral route is the most favoured delivery method among the others. However, due to the difficulties in swallowing or chewing solid dosage forms for geriatric, paediatric and for dysphasia patients, the oral medication delivery method still need some improvements. Because the most common complaint about tablets is their size, appearance, and taste and in travelling period patients may not have availability of water all the time hence fast dissolving medication delivery systems were developed[1]. Because most Oral Disintegrating Tablets are delicate and brittle, they require special packaging for depository and during transportation, they can be packed as like single, blister or even multiple units. Hence the films are pliable, easy to transport, better consumer handling, and for storage. For each of the strips, precision in the provided dose is ensured, in contrast to the dosage forms like drops or syrup, without the need of water, effective design that is convenient and portable[2]. Oral films have a broad array of applications as they minimise the risk of choking, avoid first-pass metabolism, have good stability, are easy to administer to patients with dysphagia, recurrent emesis, motion sickness, and mental problems, and have a faster onset of action[3]. The drug used is caffeine, that is CNS stimulant (central nervous system) belongs to the methylxanthine class. As it the most extensively used psychoactive drug[4] and is used to reduce fatigue and drowsiness[5] Caffeine's effects on learning and memory are vary at typical levels, but in general it enhances the focus, alertness and for motor coordination[6]. Caffeine also improves aerobic and anaerobic sports performance, as well as cycling power output, and delays muscle exhaustion [7].

MATERIALS AND METHODS

Carboxymethylated tamarind kernel powder, β-cyclodextrin, Maltodextrin, Crosspovidine, Citric acid, Menthol, Tween 80, Glycerol, Saccharin sodium, Water. All materials used are of analytical grade.

Method of Preparation of melt in mouth films
Solvent casting [8]
Melt in mouth films were prepared by using Carboxymethylated tamarind kernel powder as polymer and water as solvent. To this drug dissolved solution is added with continuous stirring. To the resulting solution maltodextrin, Crosspovidine, citric acid, menthol, tween 80, glycerol, saccharin sodium were added thereafter and stirred about 15 minutes of 100 RPM on magnetic stirrer. The solution is degassed about 10 minutes, and then casted on to the glass petri plates of having diameter about 4.5 cm without the formation of any air bubbles in the solution. (Each melt in mouth films of 6*6 cm² consists 50 mg of the drug). The glass petri plates were kept aside for about 24 hours and films are made to dry at room temperature and are carefully taken out from the glass plates and made cut to desired sizes and stored in butter paper and further more evaluated. Table 1 provides detailed formulation of melt-in-mouth films.

Calculation of dose for caffeine
The dose of caffeine is 50 mg. Therefore, amount of caffeine required in (6x6) cm is 50 mg.
- Area of film of 6X6 sq.cm is 36 sq.cm.
- Area of petridish of 9 cm diameter is 63.62 sq.cm.

- Amount of drug present in 36 sq.cm of film is 50 mg.
- Amount of drug present in 63.62 sq.cm of petridish is 88.36 mg.

Evaluation of Melt in Mouth Films of Caffeine

Weight variation of film [9-11]

The patches were subjected to weight variation study by individually weighing of all formulations. The average of three observations of each batch was calculated. Such determinations were carried out for each batch in all formulations. The computed weight should not depart from the average weight by more than 7.5 percent, and no one should exceed 15%.

Thickness of melt in mouth films [12,13]

The thickness of melt in mouth films were measured by using a digimatic micrometre at five different spots to verify uniformity. The average thickness was calculated of all formulations and films having thickness variation, more than 5% were excluded from evaluation. the ideal thickness of oral thin films lied between 50 and 1000 µm.

Folding endurance of melt in mouth films [14]

The folding endurance of melt in mouth films was manually measured. A 6x6 cm^2 of melt in mouth films was made cut uniformly and folded over and over until it tears. A precise measure of folding endurance is the number of times the oral film may be folded in the same spot without breaking.

Surface pH [15]

A pH metre was used to measure the surface pH of the melt-in-your-mouth film. With the help of distilled water, films become slightly damp. An electrode was placed on the surface of the oral film to determine the pH. The pH of the oral film must be maintained since an acidic or alkaline pH can irritate the mucosa of oral cavity, so as to keep the pH of the surface near to neutral (6.5-7)

***In vitro* Disintegration time [16,17]**

A film was placed on the surface of the petriplates which contained 10 ml of water, the
amount of time it took for an oral film to disintegrate will be recorded. The time taken for disintegration of oral films will be calculated based on the average of three tests.

Percentage Moisture Loss[18]

To know the physical stability of the film, percentage moisture loss test is carried out. A film of size 6×6 cm^{2}was cut and weighed initially. In a desiccator containing of anhydrous calcium chloride oral film is kept for three days at room temperature. After three days, film is weighed again i.e. final weight and the percentage moisture loss will be calculated. Acceptance criteria below 2%. %Moisture Loss = (Initial Weight of the film - Final Weight of the film / Initial Weight of the film)×100

Tensile Strength

Tensile strength is carried out by Tecsol UTM make 2016 which is equipped with a 5 kN load cell of capacity and the Cross head speed of 0.001 mm per min. The films were cut into sizes of 10 × 2 mm strips. The tests were carried out according to the standard of ASTM D3039 international test method. On the tensile grips of the texture analyzer, each oral film was mounted. The initial rate of grip separation was reported to be 5mm/min.When the oral film breaks, the test was considered. In order to assess the tensile features of the films,With the help of the load required to break the film and cross sectional area, tensile strength was estimated. Tensile strength which is computed by dividing the maximum load by the initial cross-sectional area of the specimen and expressed in force per unit area, is the highest stress applied to a spot at which the film specimen breaks.
Tensile Strength = Force at break (N)/ Cross sectional area (mm^2)

Percent Elongation [19,20]

Films were taken and the initial length was measured. Then, it was stretched to a lesser extent and the final length was measured.

% Elongation = $[L – L_0]$ X 100 / L_0

where,　L_0= Initial LengthL= Final Length

pH Value [21]

pH can be determined by dissolving an oral film in the 10ml of distilled water and measured by the obtained solution. Films must have a pH value that is relatively ranges from 6.7-7

Drug Content [15]

Drug content of caffeine oral films are determined by taking films equivalent dose of 50 mg and dissolved in water of 25 ml and this solution is sonicated for 10 minutes further filtered through the Whatman filter paper (grade 1).10 ml of water was added to 1 ml of filtrate from this solution. By using a UV Spectrophotometer, the solution's absorbance is measured at 273 nm and the drug content is calculated.

Physical appearance and Surface Texture [22]

Evaluation of surface texture was done by visual appearance of oral films which were categorized from smooth to rough surface.

FTIR Interaction studies

FTIR spectroscopy of pure drug caffeine and the polymer, Carboxymethylated tamarind kernel powder, Beta cyclodextrin and mixture of drug and excipients of final formulations were carried out to determine their interactions.

Differential Scanning Calorimetry

DSC of drug, Carboxymethylated tamarind kernel powder, Beta cyclodextrin and physical mixture of finalised formulations were carried out to determine the thermal properties.

Stability Studies

The optimized formulation F6 was evaluated for stability studies according to ICH guidelines. It was stored under 3 different conditions of temperature $30^0C± 2^0C$,Relative Humidity of 65% RH± 5%, $40^0C± 2^0C$ and RH of 75%± 5%, $25^0C ±2^0C$ and RH of 60%± 5% for three months. From the above evaluation, showed that there was no significant change in Appearance, Folding endurance, Drug content, pH and *invitro* disintegration.

RESULTS AND DISCUSSIONS

Graph of batch tensile test showing tensile load vs maximum displacement given from figure 4 – 10

Drug-Excipient Compatibility Studies
FTIR- Spectroscopy:
The compatibility of caffeine with polymer was determined using FT-IR spectroscopy. Separate scans were conducted on each drug and polymer. The comparison of the two spectra was done to validate the presence of any similar peaks. The lack of significant difference in peak position and intensity for caffeine with the polymer indicated that they both were compatible to each other. Table 4 lists the distinctive peaks and the observed peaks. Fig. 11-15illustrates the drug and excipient spectra [23].

Differential Scanning Calorimetry [24]
DSC of drug, polymers and its mixture were carried out and The thermo gram of caffeine which exhibited

endothermic peak at 253.04^{0}C while Carboxymethylated tamarind kernel powder exhibited an endothermic peak at 136.48^{0}C and 223.88^{0}C respectively and beta- cyclodextrin at 155.46^{0}C, the peak of caffeine was slightly shifted by 4.95^{0}C in physical mixture with the beta-cyclodextrin and Carboxymethylated tamarind kernel powder. There was no chemical interaction between the caffeine and polymers, as seen by the physical mixture's identical peaks that correspond to pure drug. The thermo grams of caffeine and polymers are shown from Fig. 16-19.

CONCLUSION

Melt in mouth films of caffeine were successfully prepared by using Carboxymethylated tamarind kernel powder as polymer with different concentrations with the help of solvent casting method. The films prepared by using Beta cyclodextrin has taste masked the films and improved the solubility of melt in mouth films. Among all formulations, films which were prepared using beta-cyclodextrin by kneading method and hot melt extrusion, showed best results by disintegrating in 19 seconds, drug content was found to be 98.66%, folding endurance was found more than 250 which showed good stability of film and by FTIR study showed that formulation was good compatible with the excipients and by DSC of caffeine showed peak at 253.04^{0}C and in mixture of sample showed 248.09^{0}C thereby we can conclude no major shift in peak as there was difference of 4.95^{0}C.

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Table.1: Formulation of Melt in mouth films of Caffeine (for whole patch) SC- solvent casting KM- kneading method HME- Hot melt extrusion

INGREDIENTS	FORMULATION CODE (for whole patch)						
	F1	F2	F3	F4	F5	F6	F7
CAFFEINE ANHYDROUS (mg)	88.36	88.36	88.36	88.36	88.36	100	100
CARBOXYMETHYLATED TAMARIND KERNEL POWDER (mg)	300	400	500	300	400	300	400
BETA-CYCLODEXTRIN (mg)	--	--	--	88.36	88.36	100	100
MALTODEXTRIN (mg)	50	50	50	50	50	50	50
CROSS-POVIDINE (mg)	10	10	10	10	10	10	10
CITRIC ACID (mg)	0.8	0.8	0.8	0.8	0.8	0.8	0.8
MENTHOL (mg)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
TWEEN 80 (ml)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
GLYCEROL (ml)	0.1	0.1	0.2	0.1	0.1	0.1	0.1
SACCHARIN SODIUM (mg)	50	50	50	50	50	50	50
WATER (ml)	10	10	10	10	10	10	10
METHOD	SC	SC	SC	KM	KM	HME	HME

Table. 2: Preformulation studies

Pre formulation studies of Caffeine	
Physical Appearance	White, Odourless, Crystalline powder with hygroscopic nature.
Melting Point	235^0 - 238^0C
pH Determination	6.7

Table 3: Evaluation Parameters

FORMULATION CODE	WEIGHT VARIATION	THICKNESS	TENSILE STRENGTH	PERCENT ELONGATION	FOLDING ENDURANCE	DISINTEGRATION TIME	SURFACE pH	pH	%MOISTURE LOSS	DRUG CONTENT
F 1	0.476	0.054	11.718	5.82	257	21	8.11	6.80	1.26	97.35
F 2	0.545	0.061	16.448	10.4	265	28.66	8.12	6.79	1.59	96.20
F 3	0.632	0.085	17.293	14.37	269.33	36.6	8.11	6.83	1.43	95.54
F 4	0.407	0.053	14.167	4.7	254	19.6	8.04	6.69	1.45	98.18
F 5	0.608	0.071	18.542	11.78	261	22	8.14	6.83	1.26	97.77
F 6	0.683	0.051	13.058	4.28	256.33	19.33	7.91	6.71	1.17	98.66
F 7	0.698	0.076	19.25	12.91	263.66	22.66	7.81	6.75	1.14	97.46

Table 4: Melt in mouth films FT-IR spectra data

Functional groups	Characteristic peaks cm-1	Peaks observed for the caffeine	CMTKP	β - cyclodextrin	Formulation 1	Formulation 4
C – H	3000-2850	2944	2924	2916	2936	2928
O – H	2500-2700			2695		
C = O	1850-1600	1694	1731		1696	1696
C = C	1500-1600	1543	1540		1546	1546
C = C	1635-1440			1643		
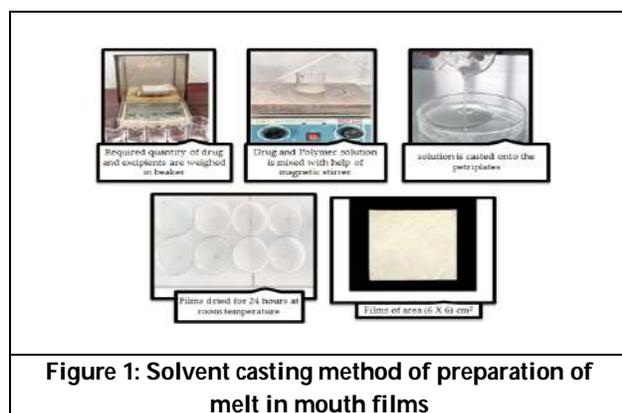
Figure 1: Solvent casting method of preparation of melt in mouth films

Figure 2: Digimatic Micrometre
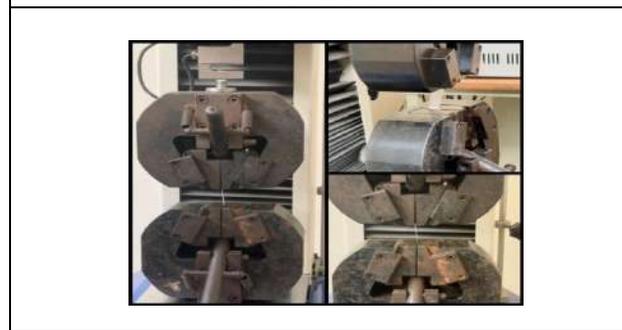
Figure 3 : Tecsol UTM (2016)

Figure 4. Tensile Load vs Maximum Displacement

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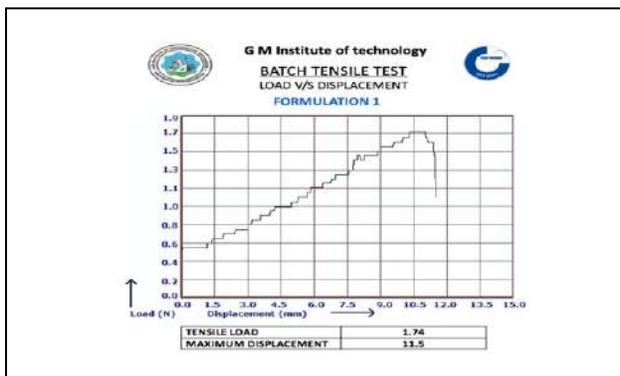
Figure 5. Tensile Load vs Maximum Displacement

Figure 6. Tensile Load vs Maximum Displacement
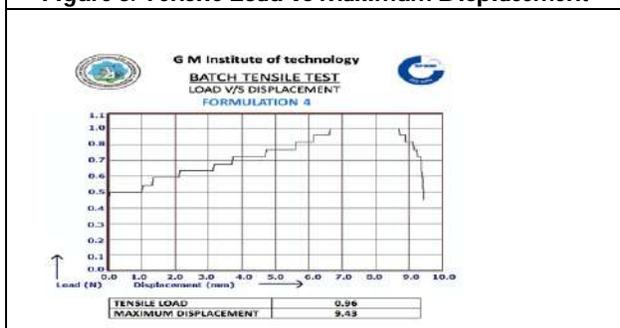
Figure 7. Tensile Load vs Maximum Displacement
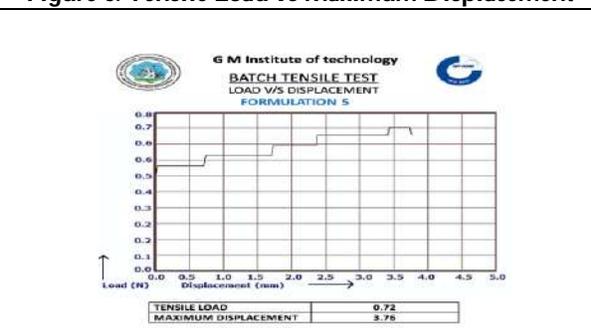
Figure 8. Tensile Load vs Maximum Displacement

Figure 9. Tensile Load vs Maximum Displacement
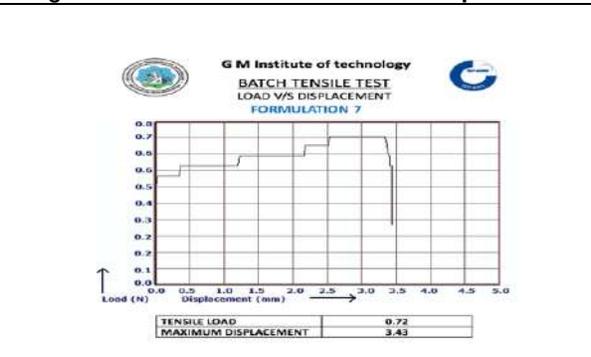
Figure 10. Tensile Load vs Maximum Displacement
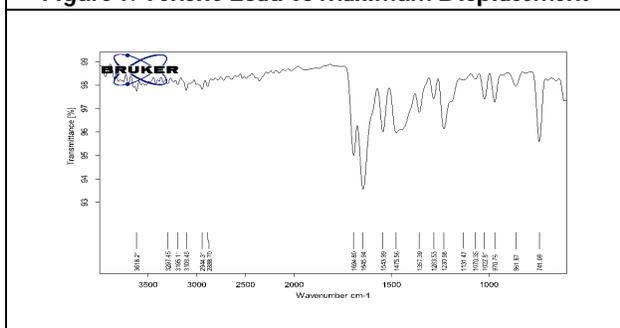
Figure 11: Caffeine FT-IR Spectrum
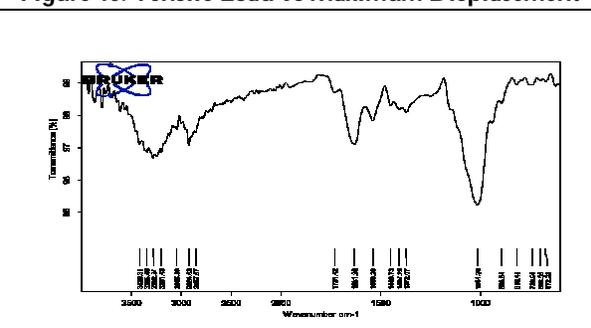
Figure 12: CMTKP FT-IR Spectrum
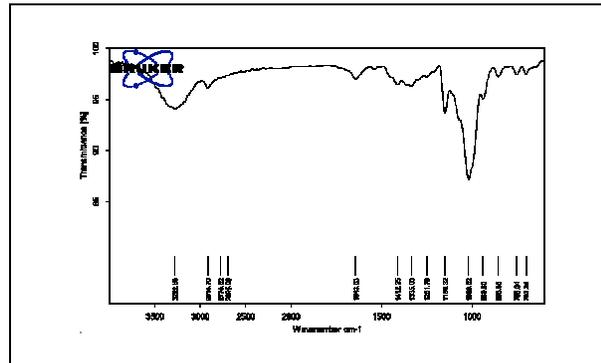
Figure 13: β-Cyclodextrin FT-IR Spectrum
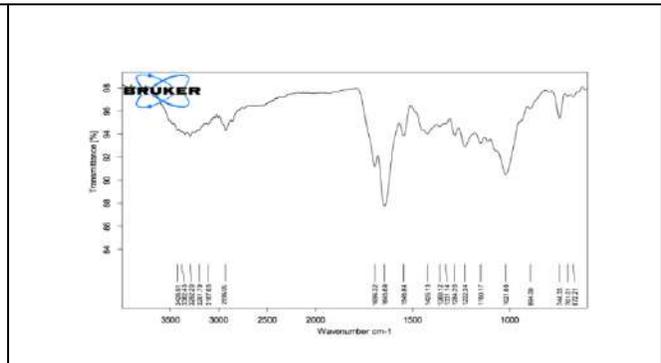
Figure 14: Formulation 1 FT-IR Spectrum
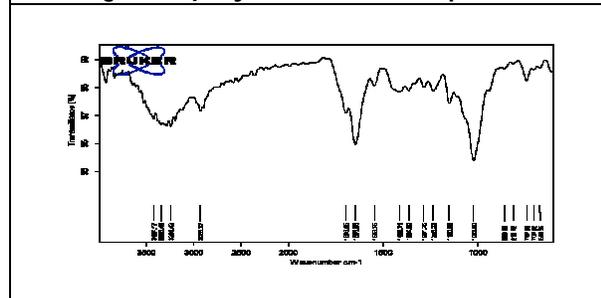
Figure 15: Formulation 4 FT-IR Spectrum
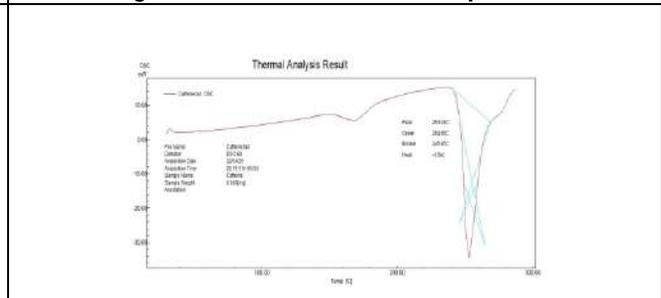
Figure 16: DSC Thermogram-Caffeine
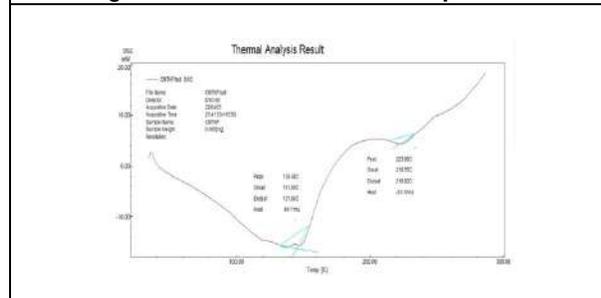
Figure 17:DSC Thermogram -CMTKP
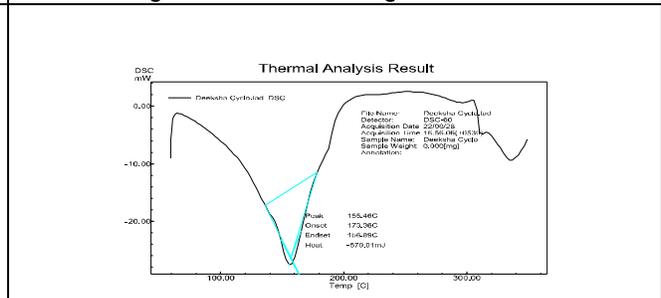
Figure18: DSC Thermogram β-Cyclodextrin
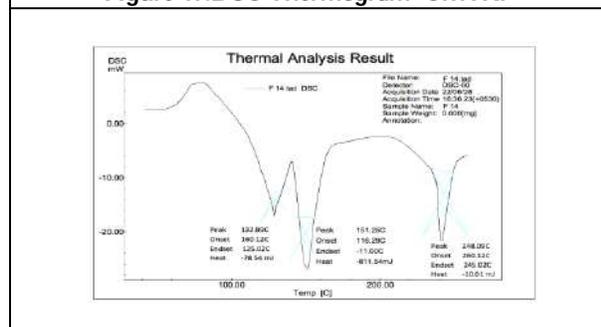
Figure 19: DSC Thermogram -Formulation 6

Figure 20: Melt in mouth caffeine oral film (whole patch) and (6 * 6) oral film

RESEARCH ARTICLE

A Study on (Q, L) –Anti Fuzzy Subsemiring of a Semiring

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ABSTRACT

In this paper, we introduce the concept of (Q, L)-Anti fuzzy subsemirings of a semiring. We also made an attempt to study the properties of (Q,L)- Anti fuzzy subsemirings of a semiring under homomorphism and anti-homomorphism.

Keywords: Fuzzy set, (Q,L)-Fuzzy subset, (Q,L)-Anti fuzzy subsemiring, (Q,L)-Fuzzy relation, Product of (Q,L)-Anti fuzzy subsets.

INTRODUCTION

There are many concepts of universal algebras generalizing an associative ring R.   Some of them in particular, near rings and several kinds of semirings have been proven very useful. An algebra R is said to be a semiring if (R, +) and (R, .) are semigroups satisfying distributive law. A semiring R is said to be additively commutative if a+b = b+a $\forall$ a, b € R. After the introduced of fuzzy sets by L.A. Zadeh [7], several researchers explored on the generalization of the notion of fuzzy set. Azriel Rosenfeld [2] defined a fuzzy group. Asok Kumer Ray [1] defined a product of fuzzy subgroups and fuzzy subgroups and Anti-fuzzy subgroups have introduced R. Biswas [14], S.Sampathu, S. Anita Shanthi and   A. Praveen Prakash[3] have introduced and defined a new algebraic structure is called (Q, L)-fuzzy subsemiring of a semiring. This time we introduce the concept of (Q, L)-Anti fuzzy subsemiring of a semiring and established some results.

Preliminaries
1.1 Definition
Let X be a non–empty set. A fuzzy subset A of X is a function A : X → [0, 1].

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1.2 Definition
Let R be a semiring and Q be a non empty set. A (Q,L) – Anti fuzzy subset A of R is said to be an (Q, L)- Anti fuzzy subsemiring of R if the following conditions are satisfied
(i) $A(x+y, q) \leq A(x, q) \vee A(y, q)$,
(ii) $A(xy, q) \leq A(x, q) \vee A(y, q)$, $\forall$ x & y € R and q € Q.

1.3 Definition
Let A , B be any two (Q,L)- Anti fuzzy subsets of sets G and H, respectively. The product of A and B, is defined as A×B={<((x, y), q),A×B((x, y),q)>/ $\forall$ x € G , y € H and q € Q}, where A×B((x, y),q) =A(x, q) v B(y, q).

1.4 Definition
Let R , R$'$ be any two semirings and Q be a non empty set. Let   f: R→R$'$ be any function. A be an (Q, L)-Anti fuzzy subsemiring in R, V be an (Q, L)-Anti fuzzy subsemiring in R$'$, defined by V(y, q)=inf A(x, q), $\forall$x € R, y € R$'$ and q € Q. Then A is called a pre-image of V under f and is denoted by f $^{-1}$ (V).

1.5 Definition
Let A be an (Q,L)-Anti fuzzy subset in a set S, the strongest (Q, L)-Anti fuzzy relation on S, that is an (Q,L)-Anti fuzzy relation V with respect to A given by V ((x, y), q) = A(x, q) v A(y, q), $\forall$ x ,y € S and q € Q.

1.6 Definition
Let X be non-empty set. A be a (Q,L)-Anti fuzzy subsemiring of a semiring R. Then A^0 is defined as $A^0(x, q)=A(x, q)/A(0,q)$, $\forall$ x € R, q € Q, where 0 is the identity element of R.

1.7 Definition
Let A be an (Q, L)-Anti fuzzy subset of X. For α € L, a Q-level subset of A is the set A_α ={ x∈X : A(x, q) ≤ α}.

Properties of (Q, L)-Anti fuzzy Subsemiring of a Semiring.

2.1 Theorem
If A , B are two (Q, L)- Anti fuzzy subsemiring of a semiring R, then their union AUB is an (Q, L) – Anti fuzzy subsemiring of R.

Proof
Let x ,y € R and q € Q, A={<(x, q),A(x, q)>/x € R and q € Q} and   B={<(x, q),B(x, q)>/x € R and q € Q}. Let C=AUB and C={<(x, q),C(x, q)>/ x € R and q € Q}. Now consider
(i)C(x+y,q)=A(x+y,q)∨B(x+y,q)≤{A(x,q)∨A(y,q)}∨{B(x,q)∨B(y,q)}≤ {A(x,q)∨B(x,q)}{A(y,q)∨B(y,q)}=C(x,q)∨C(y,q).
Therefore, C(x+y,q) ≤ C(x,q)∨C(y,q), $\forall$ x , y € R and q € Q.
(ii)C(xy,q)=A(xy,q)∨B(xy,q)≤{A(x,q)∨A(y,q)}∨{B(x,q)∨B(y,q)}≤ {A(x,q)∨B(x,q)}∨{A(y,q)∨B(y,q)}=C(x,q)∨C(y,q).
Therefore, C(xy, q) ≤ C(x,q)∨C(y,q), $\forall$ x ,y € R and q € Q. Hence proved the given statement.

2.2 Theorem
The union of a family of (Q, L) – Anti fuzzy subsemiring of a semiring R is an (Q, L) – Anti fuzzy subsemiring of R.

Proof
Let {A$_i$ }$_{i \, \epsilon \, I}$ be a family of (Q,L)- Anti fuzzy subsemiring of a semiring R. A = UA$_i$, Then for x, y € R and q € Q, we have
A(x+y, q)=Sup A(x+y, q) ≤ Sup{A$_i$(x, q)∨A$_i$(y, q)}=Sup (A$_i$ (x, q))∨ Sup(A$_i$ (y ,q))= A(x, q)∨A(y, q).
Therefore, A(x+y, q) ≤ A(x, q)∨A(y, q), $\forall$ x, y € R and q € Q. A(xy, q) =Sup A$_i$ (xy, q) ≤ Sup{ A$_i$(x, q)∨A$_i$(y, q) }=Sup (A$_i$ (x, q))∨Sup (A$_i$ (y, q)) = A(x, q) ∨ A(y, q).
Therefore, A(xy, q) ≤ A(x, q)∨ A(y, q), $\forall$ x , y € R and q € Q. Hence the union of a family of (Q, L)- Anti fuzzy subsemiring of a semiring R is a (Q,L) – Anti fuzzy subsemiring of R.

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2.3 Theorem

If A, B are (Q,L) – Anti fuzzy subsemiring of a semiring G and H , respectively, then A×B is an (Q,L) – Anti fuzzy subsemiring of G×H.

Proof

Let A , B are (Q,L)- Anti fuzzy subsemiring of a semiring G and H respectively. Let x_1, x_2 € G and y_1, y_2 € H. Then (x_1,y_1) and (x_2,y_2) € G×H and q € Q. Consider,

$A×B[(x_1,y_1)+(x_2,y_2),q]=A×B((x_1+x_2,y_1+y_2),q)=A(x_1+x_2,q) \vee B(y_1+y_2,q) \leq$
$\{A(x_1,q) \vee A(x_2,q)\} \vee \{B(y_1,q) \vee B(y_2,q)\}=\{A(x_1,q) \vee B(y_1,q)\} \vee \{A(x_2,q) \vee B(y_2,q)\}= A×B((x_1,y_1),q) \vee A×B((x_2,y_2),q).$
Therefore, $A×B[(x_1,y_1)+(x_2,y_2),q] \leq A×B((x_1,y_1),q) \vee A×B((x_2,y_2),q).$
$A×B[(x_1,y_1)(x_2,y_2),q]=A×B((x_1x_2,y_1y_2),q)=A(x_1x_2,q) \vee B(y_1y_2,q) \leq$
$\{A(x_1,q) \vee A(x_2,q)\} \vee \{B(y_1,q) \vee B(y_2,q)\}=\{A(x_1,q) \vee B(y_1,q)\} \vee \{A(x_2,q) \vee B(y_2,q)\}= A×B((x_1,y_1),q) \vee A×B((x_2, y_2), q).$
Therefore, $A×B[(x_1,y_1)(x_2,y_2), q] \leq A×B((x_1,y_1),q) \vee A×B((x_2,y_2),q).$
Hence A×B is an (Q, L) –Anti fuzzy subsemiring of G×H.

2.4 Theorem

Let A be an (Q,L) – Anti fuzzy subset of a semiring R and V be the strongest (Q,L) – Anti fuzzy relation of R. Then A is an (Q,L) – Anti fuzzy subsemiring of R iff V is an (Q,L) – Anti fuzzy subsemiring of R×R.

Proof

Suppose that A is an (Q, L) – Anti fuzzy subsemiring of a semiring R. Then for any $x=(x_1,x_2)$ and $y=(y_1,y_2)$ € R×R and q € Q. We have,

$V(x+y,q)=V[(x_1,x_2)+(y_1,y_2),q]=V((x_1+y_1,x_2+y_2),q)=A((x_1+y_1),q) \vee A((x_2+y_2),q) \leq$
$\{(A(x_1,q) \vee A(y_1,q)\} \vee \{A(x_2,q) \vee A(y_2,q)\}=\{A(x_1,q) \vee A(x_2,q)\} \vee \{A(y_1,q) \vee A(y_2,q)\}= V((x_1,x_2),q) \vee V((y_1,y_2),q)=V(x,q) \vee V(y,q).$
Therefore, $V(x+y,q) \leq V(x,q) \vee V(y,q)$, $\forall$ x, y € R×R. And,
$V(xy,q)=V[(x_1,x_2)(y_1,y_2),q]=V((x_1y_1,x_2y_2),q)=A(x_1y_1,q) \vee A(x_2y_2,q) \leq \{A(x_1,q) \vee$
$A(y_1,q)\} \vee \{A(x_2,q) \vee A(y_2,q)\}=\{A(x_1,q) \vee A(x_2,q)\} \vee \{A(y_1,q) \vee A(y_2,q)\}=V((x_1,x_2),q) \vee V((y_1,y_2),q)=V(x,q) \vee V(y,q).$
Therefore, V $(xy,q) \leq V (x,q) \vee V (y,q)$, $\forall$ x, y € R×R. This proves that V is an (Q, L)-Anti fuzzy subsemiring of R×R.
Conversely assume that V is an (Q, L)-Anti fuzzy subsemiring of R×R, then for any $x=(x_1,x_2)$ and $y=(y_1,y_2)$ are in R×R, Consider,
$A((x_1+y_1),q) \vee A((x_2+y_2),q)=V((x_1+y_1,x_2+y_2),q)=V[((x_1,x_2)+(y_1,y_2)),q]=V((x+y),q) \leq V(x,q) \vee V(y,q)=V((x_1,x_2),q) \vee V((y_1,y_2),q)=\{\{A(x_1,q) \vee A(x_2,q)\} \vee \{A(y_1,q) \vee A(y_2,q)\}\}$
If $A((x_1+y_1),q) \leq A((x_2+y_2),q),A(x_1,q) \leq A(x_2,q),A(y_1,q) \leq A(y_2,q)$, we get,
$A((x_1+y_1),q) \leq A(x_1,q) \vee A(y_1,q)$, $\forall$ x_1, y_1 € R. And, $A(x_1y_1,q) \vee A(x_2y_2,q)=V((x_1y_1,x_2y_2),q)=V[((x_1,x_2)(y_1,y_2),q)]=$
$V(xy,q \leq V(x,q) \vee V(y,q)=V((x_1,x_2),q) \vee V((y_1,y_2),q)=\{\{A(x_1,q) \vee A(x_2,q)\} \vee \{A(y_1,q) \vee A(y_2,q)\}\}.$
Therefore $A(x_1y_1,q) \leq A(x_2y_2,q),A(x_1,q) \leq A(x_2,q),A(y_1,q) \leq A(y_2,q)$. We get $A(x_1y_1,q) \leq A(x_1,q) \vee A(y_1,q)$, $\forall$ x_1, y_1 € R. Therefore A is an (Q, L)-Anti fuzzy subsemiring of R.

2.5 Theorem:

If A is an (Q,L) – Anti fuzzy subsemiring of a semiring R, then H = { x / x∈R: A(x ,q) =1} is either empty or is a subsemiring of R.

Proof

If no element satisfies this condition, then H is empty. If x ,y € H, then $A((x+y),q) \leq A(x,q) \vee A(y,q)=1 \vee 1=1$. Therefore, $A((x+y),q)=1$. And, $A(xy,q) \leq A(x,q) \vee A(y,q)= 1 \vee 1= 1$. Therefore, $A(xy,q)=1$. We get x+y , xy € H. Therefore, H is a subsemiring of R. Hence H is either empty or is a subsemiring of R.

2.6 Theorem

If A be an (Q,L) – Anti fuzzy subsemiring of a semiring R, then if $A((x+ y),q) =0$, then either $A(x,q) =0$ or $A(y,q) = 0$, f $\forall$ x, y € R and q € Q.

Proof

Let x , y € R and q € Q. By the definition $A((x+y),q) \leq A(x,q) \vee A(y,q)$, which implies that $0 \leq A(x,q) \vee A(y,q)$. Therefore, either $A(x,q) = 0$ or $A(y,q) = 0$.

2.7 Theorem

Let A be an (Q,L)-Anti fuzzy subsemiring of a semiring R. Then A^0 is an (Q, L)-Anti fuzzy subsemiring of a semiring R.

Proof

For any x € R and q € Q, we have

$A^0(x+y,q)=A(x+y,q)/A(0,q) \leq [1/A(0,q)]\{A(x,q) \vee A(y,q)\}=[A(x,q)/A(0,q)] \vee [A(y,q)/A(0,q)]=A^0(x,q) \vee A^0(y,q)$.

That is $A^0(x+y,q) \leq A^0(x,q) \vee A^0(y,q)$ for x, y € R and q € Q.

$A^0(xy,q)=A(xy,q)/A(0,q) \leq [1/A(0,q)]\{A(x,q) \vee A(y,q)\}= [A(x,q)/A(0,q)] \vee [A(y,q)/A(0,q)] = A^0(x,q) \vee A^0(y,q)$.

That is $A^0(xy,q) \leq A^0(x,q) \vee A^0(y,q)$ $\forall$ x, y € R and q € Q. Hence A^0 is an (Q, L)- Anti fuzzy subsemiring of a semiring R.

2.8 Theorem

Let A be an (Q,L) – Anti fuzzy subsemiring of a semiring R. A^+ be a fuzzy set in R defined by $A^+(x,q)=A(x,q)+1-A(0,q)$, $\forall$ x € R and q € Q , where 0 is the identity element. Then A^+ is an (Q, L)-Anti fuzzy subsemiring of a semiring R.

Proof

Let x , y € R and q € Q. We have,

$A^+(x+y,q)=A(x+y,q)+1-A(0,q) \leq \{A(x,q) \vee A(y,q)\}+1-A(0,q)=\{A(x,q)+1-A(0,q)\} \vee \{A(y,q)+1-A(0,q)\}=A^+(x,q) \vee A^+(y,q)$.

which implies that $A^+(x+y, q) \leq A^+(x, q) \vee A^+(y, q)$ for all x, y € R and   q € Q. $A^+(xy,q)=A(xy,q)+1-A(0,q) \leq \{A(x,q) \vee A(y,q)\}+1-A(0,q)=\{A(x,q)+1-A(0,q)\} \vee \{A(y, q)+1-A(0,q)\}= A^+(x, q) \vee A^+(y, q)$.

Therefore, $A^+(xy, q) \leq A^+(x, q) \vee A^+(y, q)$ $\forall$ x, y € R and q € Q. Hence A^+ is an (Q, L)-Anti fuzzy subsemiring of a semiring R.

2.9 Theorem

Let A be an (Q,L) – Anti fuzzy subsemiring of a semiring R, A^+ be a fuzzy set in R defined by $A^+(x,q)=A(x, q)+1-A(0,q)$, $\forall$ x € R and q € Q , where 0 is the identity element. Then there exists x € R such that $A^+(x, q)=1$ iff x=0.

Proof:

It is obviously.

2.10 Theorem

Let A be an (Q,L) – Anti fuzzy subsemiring of a semiring R, A^+ be a fuzzy set in R defined by $A^+(x,q)=A(x,q)+1-A(0,q)$, $\forall$ x € R and q € Q, where 0 is the identity element . Then $(A^+)^+=A^+$.

Proof

Let x, y € R and q € Q. We have, $(A^+)^+(x,q)=A^+(x,q)+1-A^+(0,q) = \{A(x,q)+1-A(0,q)\}+1-\{A(0,q)+1-A(0,q)\}= A(x,q)+1-A(0,q)=A^+(x,q)$.

Hence $(A^+)^+=A^+$.

In the following Theorem ∘ is the composition operation of functions:

2.11 Theorem

Let A be an (Q,L) – Anti fuzzy subsemiring of a semiring H and f is an isomorphism from a semiring R onto H. Then A∘f is an (Q,L) – Anti fuzzy subsemiring of R.

Proof

Let x , y in R. A be an (Q,L) –Anti fuzzy subsemiring of a semiring H and Q be a non-empty set. Then we have, (A∘f)((x+y),q)=A(f(x+y),q)=A(f(x,q)+f(y,q)≤A(f(x,q))∨A(f(y,q))≤ (A∘f)(x,q)∨(A∘f)(y,q), which implies that (A∘f)((x+y,q)) ≤ (A∘f)(x,q)∨(A∘f)(y,q). And (A∘f)(xy,q)=A(f(xy),q)=A(f(x,q)f(y,q))≤A(f(x,q))∨A(f(y,q))≤(A∘f)(x,q)∨(A∘f)(y,q),   which implies that (A∘f)(xy,q) ≤ (A∘f)(x,q)∨ (A∘f)(y,q).

Therefore (A∘f) is an (Q,L) – Anti fuzzy subsemiring of a semiring R.

2.12 Theorem

Let A be an (Q,L) – Anti fuzzy subsemiring of a semiring H and f is an anti-isomorphism from a semiring R onto H. Then A∘f is an (Q,L) – Anti fuzzy subsemiring of R.

Proof

Let x, y ∈ R and A be an (Q,L) – Anti fuzzy subsemiring of a semiring H and Q be a non-empty set. Then we have, (A∘f)((x+y),q)=A(f(x+y),q)=A(f(y,q)+f(x,q)) ≤A(f(x,q))∨A(f(y,q))≤ (A∘f)(x,q)∨ (A∘f)(y,q),
which implies that (A∘f)((x+y),q)≤(A∘f) (x,q)∨(A∘f)(y,q).
And (A∘f)(xy,q)=A(f(xy,q))=A(f(y,q)f(x,q)) ≤A(f(x,q))∨A(f(y,q)) ≤ (A∘f)(x,q)∨(A∘f) (y,q), which implies that (A∘f)(xy,q) ≤ (A∘f)(x,q) ∨(A∘f)(y,q). Therefore A∘f is an (Q,L) – Anti fuzzy subsemiring of a semiring R.

2.13 Theorem

Let R, R′ be any two semirings and Q be a non-empty set. The homomorphic image of an (Q,L) – Anti fuzzy subsemiring of R is an (Q,L) – Anti fuzzy subsemiring of R′.

Proof

Let R , R′ be any two semirings. Let f: R→R′ be a homomorphism. Let V=f(A), where A is an (Q, L)-Anti fuzzy subsemiring of R. We have to prove that V is an (Q, L)-Anti fuzzy subsemiring of R′. Consider, for f(x), f(y) ∈ R′, V(f(x)+f(y),q)=V(f(x+y),q) ≤A((x+y),q)≤A(x,q)∨A(y,q) which implies that V(f(x)+f(y),q≤V(f(x),q)∨V(f(y),q).
Again, V(f(x)f(y),q)=V(f(xy),q) ≤ A(xy,q) ≤A(x,q)∨A(y,q) which implies that
V(f(x)f(y),q) ≤V(f(x),q)∨V(f(y),q). Hence V is an (Q, L) - Anti fuzzy subsemiring of R′.

2.14 Theorem

Let R, R′ be any two semirings and Q be a non-empty set. The homomorphic preimage of an (Q,L) – Anti fuzzy subsemiring of R′ is an (Q,L) – Anti fuzzy subsemiring of R.

Proof

Let R, R′ be any two semirings. Let f:R→R′ be a homomorphism. Let V=f(A), where V is an (Q,L) -Anti fuzzy subsemiring of R′. We have to prove that A is an (Q,L)- Anti fuzzy subsemiring of R. Let x , y ∈ R and q ∈ Q. Then, A(x+y,q)=V(f(x+y),q) = V(f(x)+f(y),q) ≤V(f(x),q)∨V(f(y),q)=A(x,q)∨A(y,q) which implies that A(x+y,q) ≤A(x,q) ∨A(y,q). Again, A(xy,q)=V(f(xy,q))=V(f(x)f(y),q) ≤V(f(x),q)∨V(f(y),q)=A(x,q)∨A(y,q)
Therefore A(xy,q) ≤ A(x,q)∨A(y,q).
Hence A is an (Q,L) – Anti fuzzy subsemiring of R.

2.15 Theorem

Let R, R′ be any two semirings and Q be a non-empty set. The anti-homomorphic image of an (Q,L) – Anti fuzzy subsemiring of R is an (Q,L) – Anti fuzzy subsemiring of R′.

Proof

Let R , R′ be any two semirings. Let f:R→R′ be an anti-homomorphism. Let V=f(A), where A is an (Q,L)-Anti fuzzy subsemiring of R. We have to prove that V is an (Q,L)- Anti fuzzy subsemiring of R′.Consider, for f(x), f(y) ∈ R′, V(f(x)+f(y),q)=V(f(y+x),q) ≤A(y+x),q) ≤A(y,q)∨A(x,q)=A(x,q)∨A(y,q) which implies that V(f(x)+f(y),q) ≤V(f(x),q) ∨V(f(y),q).

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Again,   V(f(x)f(y),q)=V(f(yx),q)   ≤A(yx,q)   ≤A(y,q)∨A(x,q)=A(x,q)∨A(y,q),   which   implies   that   V(f(x)f(y),q) ≤V(f(x),q)∨V(f(y),q). Hence V is an (Q,L)-Anti fuzzy subsemiring of R′.

2.18 Theorem

Let R, R′ be any two semirings and Q be a non-empty set. The anti-homomorphic preimage of an (Q,L) – Anti fuzzy subsemiring of R′ is an (Q,L) – Anti fuzzy subsemiring of R.

Proof

Let R, R′ be any two semirings. Let f :R→ R′ be an anti-homomorphism. Let V=f(A), where V is an (Q,L) -Anti fuzzy subsemiring of R′. We have to prove that A is an (Q,L) -Anti fuzzy subsemiring of R. Let x , y € R and q € Q. Then A(x+y,q)=V(f(x+y),q)=V(f(y)+f(x),q)   ≤V(f(y),q)∨V(f(x),q)=V(f(x),q)∨V(f(y),q)= A(x,q) ∨A(y,q), which implies that A(x+y,q)≤A(x,q)∨A(y,q). Again, A(xy,q)=V(f(xy),q)=V(f(y)f(x),q)≤V(f(y),q)∨V(f(x),q)=V(f(x),q)∨V(f(y),q)=A(x,q)∨A(y,q) Therefore A(xy,q) ≤A(x,q)∨A(y,q).
Hence A is an (Q,L) -Anti fuzzy subsemiring of R.

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RESEARCH ARTICLE

Climate Change and its Impacts on Bay of Bengal Region

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ABSTRACT

Human extreme activities, including rapid urban and industrial development, and sometimes natural causes, are immediate reasons for climate changes. Moreover; due to the economic and population growth swift, the country's and the world's environmental conditions are deteriorating. Climate change is gaining attention due to its immediate and potential impact on the atmosphere as well as the human population. Moreover; coastal, freshwater ecosystems and agriculture are considered to be enormously at risk, due to this atypical weather conditions. Ocean warming, coastal erosion, drying of fresh water bodies, cyclones, unexpected river floods, and so forth are directly impacting the livelihood of fishing societies (aquaculture communities).The frequent climate changing on earth, is leading to the degradation of biodiversity and water bodies, desertification, the decrease of soil-resources, and other factors are declining the agricultural productivity. Besides that; local adaptation to climate change impacts is increasingly observed across the both agricultural and fishing communities. On the other hand, international organisations and Non-Profit Organisations (NGO's) all over the world are fighting for a sustainable environment. The methodology of this study is secondary data analysis, with the help of various sources. The present study mainly focuses on climate change and its impacts on the Bay of Bengal region, which includes India, Bangladesh, and Sri Lanka. The second objective of this study is to evaluate the vulnerability of climate change. Another aim of the study is, to analyse the development process and government policies related to the growth of the vulnerable communities in the community.

Keywords: Climate Change, Bay of Bengal, Livelihood Patterns, Sustainable Development Goals, Communities.

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INTRODUCTION

The term "environment is adopted from the French word environner; it means to encircle or to surround". Appropriate meaning of "environment" is as follows: "It is the sum total of water, air, and land and the interrelationships that exist among them with human beings, other living organisms, and materials". Apex Court of India has given the definition of "environment". It is said that "environment is a difficult word to define. Its common meaning relates to the environment, but obviously, that is a concept that is relatable to whatever object it is that is surrounded. Weather, atmosphere, and climate all have similar meanings in general, but when we examine them closely, we find that they have a different meaning. A polycentric and multifaceted problem affecting human existence, the environment has a wide range and the climate has a narrow range, but both are interdependent". According to the Cambridge dictionary, climate means "giving information regarding the weather conditions of a particular place for a long period of time and the weather means the conditions usually found in a particular place and period, for a short term, like temperature, humidity, rainfall, etc." [1]. According to the National Aeronautics and Space Administration (NASA), environmental changes are regular changes in daily temperatures as well as weather conditions. They have a rigorous effect on the earth's atmosphere. Before the industrial period, global temperatures increased slowly [2]. According to geographers, the environment is mainly divided into four spheres, such as the hydrosphere, lithosphere, biosphere, and atmosphere. Each of these four spheres is divided into several sub-spheres, and the above-mentioned spheres are interrelated and influence one another. Here, the atmosphere is divided into five sub-spheres, like "troposphere, stratosphere, mesosphere, thermosphere, and exosphere". All sub-spheres of the atmosphere are contained within air, and these sub-spheres extend from 0 kilometres to 1000 kilometres above the earth's surface. The atmosphere's sub-spheres shield the Earth from ultra-violet rays (UV-Rays) and other dangerous cosmic rays.

Toxic gases and other pollutants like "chlorofluorocarbons (CFC's), hydro fluorocarbons (HFC's), sulphur dioxide, carbon monoxide, nitrous oxide, methane" and other gases pollute the atmosphere. It is directly damaging the natural environment, including climate change. In general, the climate conditions of a country or a state depend on the following factors: latitudes, altitudes, and wind pressure systems, distance from the sea, ocean currents, etc. As per the latitude view point, the Bay of Bengal region countries are situated in the "Torrid Zone", which means they are located between the two temperate zones. Due to that, the climate conditions are changing frequently. From an altitude point of view, the coastal zones of the Bay of Bengal region, especially India, Bangladesh, and Sri Lanka, are equal to the sea bed, which is one of the major risks during the cyclones and monsoon season. While the wind pressure system has a strong influence on the climate, there are two types of winds, such as high-pressure winds and low-pressure winds, both of which move in a circle. The high Pressure winds moving towards low-pressure winds, it helps to cyclonic rainfall. However, ocean currents are acting an imperative role in typical environment conditions. Ocean currents mainly depend on the wind, water temperature, and salt content in the sea water, as well as sun and moon gravitational forces. Humidity increases or decreases near the coast due to ocean currents, temperatures, and rain falls. In the atmosphere, the climate is one of the factors. The climate is changing due to various reasons, and those climate change impacts are affecting the livelihood patterns among agricultural and fishing communities around this region. A typical weather change has been growing factor, as well as potential pressure on the world's population and environment. Climate change has been identified by the United Nations as one of the most important global challenges of our day, as its consequences are global in scope and unparalleled in scale [3]. From a recent report published by Harvard Business School in 2017, it reveals that "earth's average temperature has been increasing since the industrial revolution. Between 1880 and 2015, average global surface temperatures rose by 0.9°C.

In 2016, the Earth experienced its third consecutive hottest year since record keeping began. Global warming has been driven by factors such as atmospheric green house gases (GHGs), carbon monoxide, methane, nitrous oxide, etc. Green house gases (GHGs) emissions are caused by human activities. GHG's were 60% higher in 2014 than they were in 1990. As a result, the earth's climate has changed over time, owing to the greenhouse gases (GHGs) by the

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population. However; outcomes are probably to be rising of the sea levels, changing weather conditions, heath-related problems etc". Climate change may be referred to as "a change in average weather condition or time variation of weather within the context of a long-term average condition, which is caused by factors such as volcanic eruptions, biotic processes, global warming, etc" [4]. Above all the information brought out the causes of climate change, like ocean currents, wind pressure systems, green house gases, etc. The Inter Governmental Panel on Climate Change (IPCC) has "comes to a conclusion that global average temperature of the surface temperature has increased 0.6 (+/-) 0.2 degree centigrade in twentieth century. This may even go up to 1.4 to 5.8 degree centigrade increase for the current century. Warming will vary depending upon the region, which is associated with the changes in precipitation, sea levels are arising. Those changes would really effect on natural systems and humankind. This in turn has its effects on the ecosystems associated with it. The climatic change has high impact on the people, especially, who are living in cities and working in cities. But, it is a major concern for those who are living in the villages doing agriculture and allied sector jobs. Moreover; fishermen, who go out for fishing, and make a living on fishing, are affected directly by climate change. So any vulnerability to those who are economically disadvantaged would lose their livelihood and related resources" [5].

The "Intergovernmental Panel on Climate Change said that, extreme weather events, such as torrential rains and heat waves, are becoming more regular as a result of climate change, and floods are becoming more common as a result of global warming" [6]. Z. Wang and others told that, "the extreme ambience actions such as rising temperature, changing rainfall patterns, higher solar radiation, and other climate-related events are projected to have a greater impact on vegetation dynamics as a result of climate change" [7]. Moreover; "Vegetation is an important aspect of terrestrial ecosystems, as it plays a variety of roles in ecological cycles and represents ecosystem health" [8]. "Introduction of Natural science disciplines ranging from climatology to oceanography and from geophysics to biogeography has been involved in research on climate change, and its implications for sustainability. But, over the past few decades anthropologists have examining these same issues, from a rather different perspective. Even earlier, physical anthropologists and archaeologists had begun examining the role of mainly natural climate change in the bio-cultural evolution of humans in Africa and their subsequent dispersal to Eurasia, Australia, and the Americas. Climate change appears to have played a prominent role in the formation of various civilizations, of different regions over time, and the same climate change is one of the reason to collapse of major civilizations and indigenous societies" [9, 10]. The critical anthropology of climate change is "guided by an eco-social perspective and by political ecology theory, with its understanding of the politicized nature of human interaction with the environment. Moreover, environmental changes are the enormous Ecological, Socio-Economic challenges of our times" [11], it has been catching the attention of growing of its instant and possible impact on the atmosphere as well as the population. "Coastal, freshwater ecosystem to be very weak because, the environmental change process, like ocean temperate, increasing of sea bed levels, sea shore emissions, fresh water lakes and rivers evaporation, cyclones, drought conditions, etc. Which are directly effect on the lives and livelihood of both coastal and fresh water fishing societies (Aquaculture communities), and agricultural communities, like farmers and other agricultural allied sector people. The confined adjustment to environmental changes and its effects to be increasingly observes on those communities.

The earth's climate is regularly shifting, due to that the dreadful conditions of Biodiversity and Water Resources, Desertification, Decreasing of Soil Resources, Coastal Erosion, And Sedimentation, Depressing Agricultural Productivity etc" [11, 12]. As per the Lima and Bonetti, rising sea levels and melting glaciers pose a hazard to coastal towns and low-lying areas [13]. De Sario and others told that, "higher temperatures, intense weather, and rising sea levels not only endanger human health by impacting food, water, air, and the living environment, but they also endanger the environment" [14]. Panteli, Mancarella, highlighted that; climate change is also wreaking the loss of livelihood of the people, and damaging the road and rail network, it is a high expenditure to any society and their economy [15]. According to the Ahuja and others, environmental factors including rising temperatures and greenhouse gas emissions, have an impact on plant development and animals, it is pretence a major menace to vegetation, bio-diversity, and food security in the world [16, 17]. Mawdsley said that, "there is substantial interest in establishing of adaptive techniques to enable the adjustment of human civilization and conservation system, in response towards observed, likely consequences of environmental changes" [18]. Researchers Turner and others

describes that, "the extent to which vegetation degradation affects the ecological cycle as a result of climate change is a global issue that has received little attention, particularly in underdeveloped countries, with a focus on public health and social effects" [19]. Whereas; Shukla and other researchers are said that, Climate change, agricultural changes, and other disturbances all result in changes in plant patterns [20]. Moreover; "the natural and human disturbances that alter the composition and function of vegetated ecosystems have raised the burden on biodiversity globally" [21]. According to the Jetz and others, as a result, the interaction of climatic change with vegetation caused by land degradation has an impact on local climate and surface energy balance [22]. Human activities such as rapid-urbanization, mineral-mining, and de-forestation have had a substantial impact on ecosystem functioning [23]. As per the United Nations Human Settlements Programme "(UN-Habitat) affirms its support for the global intervention for human settlements to expand its support for climate resilience, emissions reduction, conservation planning outcomes in the world's habitats, and the formulation of policy recommendations on sustainable development for policymakers" [24]. The above all the information brings out, the marine and fresh water systems, and how they suffering with climate change and its impacts. Moreover; it is discussing the anthropological understanding of the climate change.

According to the United Nations Organisation's (U.N.O), "Sustainable Development Goals (SDGs) explains the climate change and its importance. In particular, goal number eleven explains the Sustainable Cities and Communities. Moreover, it explains access to green space, sustainable urbanization, access to safe, sustainable transport, and housing access for all. Disaster prevention, mitigation policy, air quality, waste management, and sustainable power resources, so forth. Goal number thirteen describes the Climate Action, taken by member countries in the U.N.O. It elaborates on climate resilience and adaptation, climate change education, and capacity building measures. Goal number fourteen explains that Life below water". Moreover; "there is a discussion about marine pollution, marine and coastal management, mitigation policy, and marine and coastal areas". However, SDG goal number fifteen said that "Life on Land". Under this heading, the UNO was discussing land conservation and restoration, protection of natural habitats, forests, protection of indigenous peoples' habitats, and others. Aside from the above SDG goals, goal number six also elaborates on "Clean Water and Sanitation", which includes drinking water access, sanitation access, integrated water management, and etc. The above factors are directly and indirectly linked among the environment changes and its collision only [25]. At present the Asian countries existing with the majority of typical weather conditions, those conditions are vulnerable, when compared to developed nations, underdeveloped and least developed countries, such as African countries. As per Bergman and others, "as a result of hastening climate change, increasing the frequency of extreme weather, and creating abnormally high surface, ocean, and air temperatures". Climate change is causing the widespread of anxiety, about the effects it will have on ecosystem [26]. According to Rui and others, "on the date of December 11, 1997, in Tokyo, Japan, parties to the United Nations Framework Convention on Climate Change signed the Kyoto Protocol. Three flexible strategies for achieving carbon reductions were introduced under the Protocol: cooperative implementation, emissions trading, and the Clean Development Mechanism (CDM). The CDM collaborates closely with developing countries and is aimed at helping them reduce emissions while also assisting them in achieving sustainable development" [27]. All the above information brings out the importance of sustainable development goals and their measures for controlling environmental changes along with its implications.

As per the international organisation, like Intergovernmental Panel on Climate Change (IPCC), "environmental / climate change refers to any change in climate eventually, either due to natural changes or as a result of human action". However, "it is possible to affect the boundaries of water bodies as well as the mortality of fishes and allied organisms based on the mobilisation of aquatic species". The area of water bodies they occupy might expand or shrink, as well as any distributional changes that will directly affect the nature and large quantity of fish. Fish progeny are especially sensitive to temperature, and several species of fish have been known to cross at a specific water temperature. Environmental changes are influencing the accessibility and mobilisation of fish and their distribution. All these conditions are directly impacting the fishing communities and their socio-economic aspects. "The fresh water lakes are fluctuating. It means sometimes the lakes are evaporated due to (EL-LINO) conditions, sometimes they are overflowing with sedimentation due to heavy rainfall conditions (LA-LINO)" [28]. Both

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conditions are severely damaging to the livelihood patterns of fishing communities and agricultural communities in and around the Bay of Bengal Region. Moreover, this may be the main cause of migration in the fishing and agricultural communities, and it also leads to socio-economic disturbances. The main two countries of this region, is India and Bangladesh. In India, mainly four states are sharing the boundary with the Bay of Bengal. They are: West Bengal, Odisha, Andhra Pradesh, and Tamil Nadu along with Union territory, such as Andaman Nicobar Islands. This east coastal zone has approximately 2500 sq. km of coastal line and also has many coastal plains and fertility lands. But in this region, every year either a cyclone or drought comes, severely damaging the above communities and livelihoods. The main reason for those natural calamities is climate change alone. The region's population, particularly in India, is estimated to be more than 25 crores. Cyclones can bring storm surges as well as salinity disturbances to farmland. The frequency of rainfall is either increasing or decreasing, and it is directly causing extra stress on the agriculture sector. However, "as the result of water levels of the sea bed is growing; it will submerge some important habitations and ecosystems like mangroves in the state of West Bengal and the Andaman and Nicobar islands, small islands near Sri Lanka". Bangladesh's economy is an example of one of the most vulnerable to bad climate conditions. It is a highly populated nation in the world that is suffering due to floods, cyclones, salinity intrusions, and droughts. Nearly 150 million people have a long record of suffering from climatic disasters every year. Over the last decade, 53 percent of Bangladesh's population has lived in drought-prone areas, and it is higher-than 47 percentage of Bangladesh's main-land are facing a famine risk [28].

As per Rajalakshmi and others (2021), noted that "in the last 45 years, the sea surface temperature (SST) has been raised by 0.2 to 0.3 degrees Celsius. It is assumed to rise in the future by 2.0 to 3.5 degrees Celsius by the end of the 21st century. As a result, the sea level is expected to rise by 37 cm by 2050. The Bay of Bengal region has witnessed an increase in the intensity of cyclones in the last twenty years. Moreover, floods and droughts have increased over the years, and they are a growing threat to both humans and the environment, including plants and species. Moreover; the phonological changes in marine species, especially in fishes and the intensity of coral bleaching, are other severe threats" [29]. According to E. Vivekanandan and others (2016), "climate change and its impacts on ocean productivity, habitats, and biological processes in the Bay of Bengal Large Marine Ecosystem (BoB-LME) are very high. Moreover, climate change is also affecting the inland and coastal aquaculture sectors in the countries around the Bay of Bengal region. However, the climate change impacts will also change the hydrology and availability of ground water sources. Climate change is causing physical harm to aquaculture facilities and the prevalence of already existing diseases in fish as well as humans, and it is more effectively spreading various types of new diseases into marine and animal life" [30]. Robin Haunschild and other researchers explained that "the shift in the statistical distribution of weather patterns over a prolonged period of time is referred to as a "climate change" (from decades to millions of years). Meanwhile, the observed century-scale rise in the average temperature of the earth's surface is referred to as climate change or global warming. Climate change is caused by a variety of factors, including variations in solar radiation, (changing parameters of the earth's orbit, variations in solar activity observed via sunspot number), drifting continents (see plate tectonics), volcanic eruptions (producing large amounts of sulphate-based aerosols), and possibly others, over long periods of time. Moreover; the climate change and its implications are getting a lot of attention recently in the natural sciences, as well as in the social and political sciences [31]". According to wester and others, "a climate change assessment report in the Hindu Kush Himalaya, even if global warming is limited to 1.5 degrees Celsius by 2100, the Himalayas will experience a 2 degree Celsius rise in temperature due to elevation-dependent warming, a phenomenon in which mountains experience rapid and extreme changes as temperature rises" [32]. As per the Hock and other researchers; "environmental temperate is linked to losses in snow, ice cover, glaciers, and permafrost, as well as altered precipitation patterns" [33]. Nepal is expected to lose around NRs 60 billion per year in 2017 pricing [34]. As per the International Institute for Environment and Development (IIED), the result of climate unpredictability and catastrophic weather occurrences, climate change increases water stress and scarcity, putting food security at risk [35].

According to Jayanta Basu (2020), "from the year of 1891 to 2018, the Bay of Bengal (BoB) region has experienced severe cyclonic storms. In 1891, the Bay of Bengal (BoB) region faced 41 severe cyclonic storms, and 21 cyclonic storms. In 2018, the BoB region was hit by 72 severe cyclonic storms and 55 ordinary cyclonic storms. Moreover, the

Assessment Report of Climate Change over the Indian Region, published by the Ministry of Earth Sciences, reveals that the BoB region has the highest number of cyclones in the May to November season every year. However; from 2000 to 2018, the Bay of Bengal region was hit by 22 cyclones, all are under categories four" [36]. As per the World Health Organisation (W.H.O), "nearly seven million pre-mature deaths are happening due to air pollution. Moreover, India as well as China is top ranking in the mortality due to the contamination of the air and other related pollutants" [37]. Allen, J. L., and others said that, "air pollution is causing cognitive impairment in the human population" [38].

According to the Kunwar, "the health, cleanliness, habitat, and hospitality of the environment, as well as livelihood, have all been harmed as a result of the effects of climate change. Some of the significant gaps and challenges in the efficient implementation of climate change adaptation and mitigation programmes include a lack of understanding of the impacts of climate change on species and ecosystems, a weak assessment and learning pool, and insufficient capacity" [39]. The IPCC said that; "climate change adaptation has become a priority alongside mitigation in global, national, and local policy agendas to handle this challenge, adaptation is defined by the IPCC AR5" [40]. During the adjusting a real or predicted typical environment conditions are having a little progress in the availability of adaptive solutions, there has been little progress in putting them into practise [41]. As per Thapa and others, in recent years, scientific efforts to understand the different aspects, like "Climate Change Adaptation (CCA)" contains the better significantly in conjunction with policy advances [42]. The Global Network Against Food Crises (GNAFC) Report-2021 told that, the severe climate change is a one of the reason to food insecurity, which is forced more than 23 million people in eight countries into food insecurity, in 2021, whereas; it is 15.7 million in 15 countries in 2020 [43]. According to A. Ely, "to address the context and causes of climate change, adaptation research and practise must broaden and be established in a broader framework, opening up to CCA options" [44]. Different places need to adapt because of how sensitive and vulnerable they are to environmental influences [45]. World Economic Forum's "The Global Risks Report-2022 describes the, world top-10 most severe risks on global scale over the next ten years, in that top-3 global risk are related to climate change only, those are '1-Climate Change Failure, 2-Extreme Weather, 3-Biodiversity loss" [46]. According to the Indian Meteorology Department (IMD), some of the important names of cyclones in and around the Bay of Bengal are as follows:

METHODOLOGY AND OBJECTIVES

The methodology of this study is mainly a secondary data analysis. The data is collected from the different sectors, like published reports, documents, statistical records, web-resources and annual reports of the fisheries department, Govt. of India. The main objectives of this study is gives the basic understanding on environment changes as well as its determinants. Other objective of the paper is to evaluate the vulnerability and implications of climate change. Present paper another goal has to analyse a development process and government policies related to the growth of the vulnerable communities within the society. On the other hand, the implications of atypical-climate changes around the Bay of Bengal region are divided into three categories: biological impacts, socio-cultural impacts, and ecological impacts.

Implications of the Climate Change
The Implications of environmental changes and global warming are divided into three types. Such as 1) Biological impacts 2) Socio – cultural impacts 3) Ecological impacts.

1.Biological Impacts
Climate change is causing to the "Valley Fever in drought conditions, Spreading of Vector Borne Diseases in Floods Conditions". Moreover; the climate change conditions has chance prevalence of the bacterial, fungal infections in drought prone areas. Air pollution is leads to "Cardio Vascular Diseases-(CVD Disease), Chronic Obstructive Pulmonary Disease-(COPD), and other respiration infections, lung cancer, depression and other Cognitive

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Impairments", in the humans. Not only that, Malnutrition and other nutritional deficiency related diseases are has to be prevalence due to the drought and other climatic fluctuations.

2.Ecological Impacts

Cyclones, Floods, and Droughts, are caused to agricultural Uncertainty. Moreover; declining of drinking water bodies, like rivers, ponds and lakes, declining of the ground water levels, are another impact of climate change. Besides that; fish productivity is stunted, availability of fishes in sea and rivers is hardened. Wild Fire or Inferno's, Desertification, Rising of sea levels, local Weather conditions are changed. Some of species are being forced out of their habitats; increasing of day and night temperatures are another examples of climate changes.

3.Socio – Cultural Impacts

Poverty, stagnation or perish of economic and human development and its continuity. Increasing the migrations from rural to urban and semi urban areas, population pressure on urban areas, unemployment & low wage scale, increasing of slums and lack of amenities are impacts of climate change. Increasing the demand for essential goods, hiking of goods and services prices, human trafficking, increasing of crime rate and so forth are another examples of socio-economical and cultural impacts of climate change.

Causes for global warming & climate change

De – forestation, Crop wastage firing, Chlorofluorocarbons (CFC's) gases, Carbon monoxide from industries and fertilizers, Rapid urbanization, Lack of sewage treatment facilities, Heavy usage of plastics, Population growth, Inferno or wild fires (Forests Burnings), Heavy industrialization, Rapid changes in migration and its patterns, and many more reasons are either directly or indirectly cause for damaging of climate change.

Govt Policies and Implementation

According to the Indian Forest Policy (1988), "India should maintain 33% of forest land in total land area, but the current situation (as of 2021) is only 24.62% of land covered by forests. But after 2000, the central and state governments in India started giving more importance to the reduction of global-warming and environmental-changes. With the purpose of, India has signed several international agreements, such as the Ramsar Convention Agreement, Kyoto Protocol, and Paris Agreement" and others. The Indian Govt. has also taken some of the measures like; "Barath –VI stage fuel efficiency measures, adding 5 to 10% of ethanol to petrol, encouraging the use of gas and electrical-based vehicles, promotion and distribution of the use of LED bulbs" etc. Governments were also promoting "renewable energy resources such as a national solar mission, a national wind energy mission, bio-gas electric generation, nuclear energy, and so on". Moreover, they are increasing plantation in waste lands around the country, and the government is giving subsidies to natural farming or organic farming, as well as subsidies for the purchase of agricultural machinery and pump sets, seeds, urea, etc. In aquaculture, governments are giving subsidies to cage farming for the fishing industry, and the government gives a subsidy for the purchase of boats, engines, and nets, etc. The government also provides "food grains to poor people at subsidised rates". Under the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), "the government of India provides jobs to unemployed people in their own villages. The governments are also running skill development programmes for urban residents and offering low-interest loans". For the prevention of pollution and protection of natural resources, the government of India has passed and is implementing the following acts: "Water (Prevention and Control of Pollution) Act of 1974; Air (Prevention and Control of Pollution) Act of 1981. The Public Liability Insurance Act 1981, the National Environment Tribunal Act 1995, and the National Environment Appellate Authority (NEAA) Act 1997. The Central Pollution Control Board Act of 1974, the Motor Vehicles Act of 1988, the Energy Conservation Act of 2001, the Wildlife (Protection) Act of 1972 and the (Amend) Act of 2002". Some other acts, like the Biological Diversity Act (2002), the Electricity Act (2003), the Forest Rights Act (2006), the New National Green Tribunal Act (2010),

Suggestions

- Improving engine efficiency's in support of well financially viable as well as environmental development, same time we need to concentrates on the issues of marine-safety along with fisher's community migrations.

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- Increase cold and ordinary storage facilities; encourage plantation in dry and wetlands areas.
- Concentrate the socio-economic development issues like, quality of life of fishing communities, strengthen planning for disasters and disaster preparedness, and improve access to basic services and decent housing.
- Endorse the different types of income generation resources from end to end with the help of consultative processes, like conducting awareness programmes to help them overcome poverty and encouraging them to make a minimum savings from their daily income. Preparedness for natural and environmental disasters, and so forth.
- promotes cage farming in aquaculture on the sea and river
- The government should give skill development training and allied activities to fishermen for their sustainable growth.
- Loan weaving is not a permanent solution for small-scale and marginal farmers; income generation, alternative crops, and alternative irrigation methods are giving relief and confidence in the future to the above farmers.
- Governments should focus their efforts on improving the socioeconomic conditions of families affected by climate change. Mainly, governments must provide basic support to fish workers and their families, along with small and marginal farmers and agricultural labourers and their families. It is the responsibility of governments to protect those who are struggling to manage their daily lives as a result of the effects of climate change and its disasters.
- Further research is necessary to comprehend the environmental changes and their impacts on aquaculture and agriculture. In addition, even more research is needed in other sectors related to global warming and climate change, as well as more funds needed for sustainable development and adaptation strategies.

CONCLUSION

One side Climate change driven migration causes congestion, primarily in semi-urban areas, and it will leads of wage pressure in an overcrowded labour market. It promotes precarious employment and creates opportunities for social insecurity. Such as human trafficking, prostitution, and other forms of child labour. So, People must understand climate change, its causes, and its consequences. Communities must help control the pollution and play an active role in restoring the environment. Meanwhile, Governments are needed to strictly enforce disaster risk management and mitigation plans. Governments must consider alternatives to farmer loans and fishing equipment loans, such as skill development programmes for agricultural and fishing communities. Because it will help accumulate the alternative livelihood of those communities. Finally, more research is required on climate change and allied sectors, with emic perspective.

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Table 1: Details of Major Cyclones in Bay of Bengal Region

Name of cyclone	Year
Cyclone Leila, Cyclone Jal	2010
Cyclone Thane	2011
Cyclone Nilam	2012
Cyclone Phailan	2013
Cyclone Hudud	2014
Cyclone Komen	2015
Cyclone Nada, Varadah, Kyant, Ronu	2016
Cyclone Mora, Ockhi	2017
Cyclone Titli, Cyclone Gaja, Cyclone Pethai, Cyclone Pabbuk	2018
Cyclone Fani, Bulbul	2019
Cyclone Amphan, Cyclone Nivar,	2020
Cyclone Yaas, Gulaab, Jawad	2021
Source: IMD, India [46].	

RESEARCH ARTICLE

Circular Economy of a No Waste Tree "*Cocos nucifera* (L.) *(Arecaceae)*": A New Sunrise for the Coconut Sector in India

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ABSTRACT

India is the leading producer of coconuts in the world. India's coconut based food products essentially cater to the strong domestic market. However, its non-food coconut residue products such as coir and coconut shell activated carbon have been in great demand worldwide for a very long time. As the global demand for coconut and its products is set to increase, concurrently coconut residues availability will also increase. India is a pioneer in the coconut circular economy due to its long-standing export of coir and activated carbon. It has to encompass the new uses of coconut residue in many areas like reinforcement and stabilization of soil, adsorbent for oil spill and pesticide residues, plant growing medium and other industrial uses. It may have to reduce the export of the low-value raw-residue products and increase the high-value added coconut residue products. Such initiatives will not only revive the coconut sector in traditional States like Kerala but also will lead to more employment opportunities in emerging States like Odisha, West Bengal, Maharashtra, Gujarat and non-traditional States like Bihar, Tripura Chhattisgarh.

Keywords: Circular economy, coconut husks, coconut residues, activated carbon, coir pith, geo-textiles

INTRODUCTION

Every year, 2nd September is celebrated as World Coconut Day since 2009. The International Coconut Community (ICC), an intergovernmental organization of coconut producing countries under the aegis of the United Nations Economic and Social Commission for Asia and the Pacific (UN-ESCAP) has been taking the initiatives to celebrate the World Coconut Day. India, as an active and key member of the ICC, takes keen interest to celebrate the World Coconut Day in various parts of the country as it is a leading producer of coconut in the world. In 2022, the theme of

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the World Coconut Day was "Growing coconut for a better future and life". The global demand for coconut based food products is set to increase leading to multi-fold growth in its residues. There is an urgent need to effectively recycle these residues in a befitting mode than allowing them to decay leading to environmental challenges. India being a pioneer in coconut circular economy is suitably positioned to enlarge the scope of the utility of the coconut residues based on the long-standing research activities undertaken in this regard.

Coconut circular economy

United Nations Industrial Development Organization (UNIDO) states that 'Circular economy is an alternative to the traditional linear economic model where resources are kept in use for as long as possible, maximum value is extracted from them, and waste is relocated from the end of the supply chain to the beginning, giving the used materials a new life'. This paper is primarily focused on reviewing the efforts made by various Indian scholars to recycle the coconut residues resulting in the application of circular economy principles.

Objectives

1. To bring out the status of coconut cultivation and production in different States of India
2. To outline the changing composition of India's coconut and coir products exports
3. To identify the practices of using various coconut residues particularly India's pioneering efforts in coir usage leading to coconut circular economy
4. To delineate the various studies and initiatives undertaken in India for making use of a range of coconut residues

MATERIALS AND METHODS

This paper to a large extent has been based on the secondary data and also review of the reports and research publications on the subject. The secondary data were mostly from the reports of the India's Coconut Development Board and Coir Board. The websites of these organizations were accessed for obtaining official data on coconuts in different states, coconut products and their exports. With regard to the reports and research publications, the focus was mostly on the research undertaken by various scholars in India and it was specifically centered on recycling and usage of coconut residues in diverse sectors.

Coconut production

In 2020, the world coconut production was 65,671 million nuts and India was the leading coconut producing country. India (30.93%), Philippines (22.07%), Indonesia (21.31%), Sri Lanka (4.25%), Vietnam (2.55%), Papua New Guinea (2.26%) and Thailand (0.90%) were the major producers of coconuts in this year. Traditionally, Kerala, Karnataka, Tamil Nadu and Andhra Pradesh are the leading States in area under coconut cultivation as shown in Table 1. Though there are many other States that have coconut, Odisha, West Bengal, Maharashtra, Gujarat and Assam are the emerging States in coconut cultivation. The four southern and coastal States of India, Kerala, Tamil Nadu, Karnataka and Andhra Pradesh contributed to about 90% of India's coconut production from 2015-16 to 2019-20 as show in Table 2. Kerala had been the top state accounting for close to one-third of India's coconut production. In these five years, Tamil Nadu was the second leading state for three years and Karnataka had occupied this position in 2016-17 and 2017-18. Though Andhra Pradesh continued to be the fourth leading state, its contribution was hovering around 5-7 per cent only. The two leading producers of coconut, Kerala and Karnataka, however had lower productivity in terms of Nuts/ha at 9175 and 6892 respectively compared to that of All India (9345) in 2019-20. Kerala had better productivity than All India only in 2018-19. Though Karnataka had better productivity in 2016-17 (13,181 Nuts/ha) and 2017-18 (12,102 Nuts/Ha) than All India, its productivity has dropped considerably in 2018-19 and 2019-20 thus contributing to the decline in case of All India too. Among the leading producers only Andhra Pradesh and Tamil Nadu had consistently better productivity than All India as indicated in Table 3.

India's major coconut products

Many coconut products are used in India since a long time. In 1889, a list of 83 different products which included several shell articles, based on the coconut palm products exhibited at the Colonial and Indian Exhibition in the 1880s, was available [1]. The Coconut Development Board of India has listed 25 coconut products. They are (a) Kernel based coconut products (b) Coconut Inflorescence based food products (c) Coconut Water based products (d) Coconut convenience food products and most importantly (e) Coconut Shell based products such as Coconut Shell Powder, Coconut Shell Charcoal and Activated Carbon. The Coir Board of India lists coconut coir based products exported from India such as curled coir, coir fiber, coir rugs, coir pith, coir rope, coir other sorts, coir yarn, geo-textiles, handloom mats, handloom matting, power loom mats, power loom matting, rubberized coir and tufted mats. Non-food products of coconut such as fiber processed from coconut husk that is used as growing culture media or geo-textiles in the horticultural and civil engineering sectors respectively and a premium product of Activated Carbon made from coconut shell are mentioned as examples of rise of non-traditional coconut products [2]. It is worth noting that India is considered to be a leader in the processing and export of coconut fibers by many scholars. They opined that coconut water, virgin coconut oil and sugar obtained from the sap collected on the coconut flower, are high potential development products.

Coconut residues and uses

The coconut palm is highly valued as a 'no-waste tree' as its once considered wastes have also been put into use and turned up as income generating industries. Coir dust also known as coir pith, the major by-product of coir production and once considered a pollutant, has got so many applications and contrarily is sought to conserve the environment. The coir pith's use as substitute for peat as a medium for plants (Suharto, 1998) is expected to result in environmental stability [3]. The production, harvesting and processing of coconuts earlier used to result in substantial residues like coconut fronds, leaves, trunk, shell, coir, pith and husks. DP Clear Tech (2017) identified that 25 million tones of coconut wastes were generated in South East Asia and Asia Pacific alone every year and typical coconut waste averaged around 50% of the total coconut production mass [4]. It estimated the typical composition of total coconut waste as Coir Dust (3-4%), Shell (12%), Husks (~35-40%) and Usable Products (44-50%). Obeng *et al* (2020) conducted a study in Ghana and found out that 62–65% of the whole coconut fruit was generated as wastes in the form of husks and shells [5]. A study conducted in Philippines found out that the coconut husks had 35 per cent fiber and 65 per cent dust or peat or pith [6]. Another study in Thailand indicated that husk consisted of 30% fiber and 70% pith having extremely high lignin and phenolic content [7]. It is observed that due to this high lignin content, the coir produced out of coconut husk, has a good resistance to soiling and dampness [8].

While listing out the strengths of the coir sector and industry, the 2025 Vision document of India's Coir Board (2019) has mentioned that the lignin content in coir is 46% compared to 39% for the best timber like teakwood and hence coir is more durable and more resistant to insect/termite [9]. An article on coconut byproducts published in 1949 itself mentioned that 'Cocopeat has been found to be a desirable material for mulching, useful in propagating seeds and cuttings and cocopeat containing short coconut fibers, can be used as a growing medium without other ingredients. It was also suggested by this article that instead of 'coir dust', it was better to use 'cocopeat' for this valuable material as 'dust' to most people implied an undesirable quality [10]. In a brief correspondence to the Current Science entitled, 'Coconut coir: not just a beautiful doormat', Mahendru (2013) lists out various uses of the coir [11]. They are plant nutrient, including nitrogen-fixing bacteria, removal of potentially toxic industrial effluents using the coir pith in the form of biochar, substituting some traditional construction materials like particleboards by coconut coir and as a good corrosion inhibitor for acid induced corrosion of aluminum. As per a recent study by Kumar et al (2021), even coconut flower cover fiber can be used as a viable alternative or a substitute for non-biodegradable materials of similar properties. This study concluded that coconut flower cover fiber-reinforced polymer composite is a conductive option for industrial purposes especially in the automobile sector [12].

Pioneering Indian coir industry

Coir, a natural fiber obtained from coconut's mesocarp tissue is considered as an important by-product of coconut-husks. The Coir Board of India estimated that world coir fiber production was around 250,000 tones. The first coir

factory in India was started in 1854 by an Irish man named James Darragh, at Kulachal and Alappuzha, Kerala [13]. Kerala's various natural resources and ecological setting like long coast, brackish backwaters and lagoons were cited as the enabling factors to undertake retting (traditional process) for the production of coir. World trade of the coir from the Southern India has a very long history dating back at least five centuries [14]. Though India, the largest exporter of coir and coir products has a long coastline, growth of coir industry is restricted to a few states and not more than 28 percent of the coconut husks were used in the coir industry [15]. In 2014, the world production of coir fiber was estimated by the Food and Agriculture Organization of the United Nations (FAO) to be at around 1.13 million tons and India was the country producing most of the coir and its production alone accounted for about 5,44,000 tons [16]. However, the Coir Board (2016) reported that though about one-fourth of the world's 55 million coconuts were produced by India, and only 15% of the husk was used for recovery of coir fibers. As per the Coir Board (2016), a 10 ounce (300 g) coconut husk yields about 3 ounce (80 g) of fiber, one third of which is bristle fiber (fiber of at least 8 inches or 20 cms long). According to Coir Board (2016), during the process of extraction of coir fiber from husk, about one third of it was obtained as fiber and two third of it was termed earlier as coir waste. The spongy material that binds the coir fiber in the husk is known as the coir pith or coir dust and it constituted about 50-70 percent of the husk [17]. The Coir Board's Vision 2025 documents stated that coconuts have a 40-50 days' cycle of yield right through the year. This document considers that coir provides the best opportunity as long-term sustainable solution, in view of the continuous supply of raw material due to the short cycle for coconut yield. It estimated that nearly 14,99,200 MT of coir pith had been produced in India during the year 2018-19 out of which 5,66,661 MT of coir pith had been exported. Of the remaining, an estimated quantity of 40,000 MTs of pith had been utilized within the country leaving a surplus of 8,92,539 MTs of coir pith [18].

Limited diversity in coconut products exports

India's coconut products (excluding coir based products) in the last few years have been dominated by coconut shell activated carbon as shown in Table 4. India seems to have got a head start in this product compared to other coconut producing countries. Traditionally, India has not been able to export coconut oil as other major countries dominate the coconut oil market. Apart from that India has its own large domestic market which absorbs most of its coconut products. Considering that coconut shell activated carbon has found many industrial applications, India needs to further strengthen this product by preventing the loss of coconut shells to other lesser valued uses.   Apart from creating the awareness on the relevance of the coconut shells for the export markets and thereby ensuring their availability to processing industry, enabling the latter by upgrading the technology and also facilitating its export could do wonders in strengthening this product's exports. It could be seen that our coconut products export basket is lacking diversity and identifying suitable products to overcome it expeditiously is important. Though there are diverse opinions on the saturation for the virgin coconut oil, it could be one such product. *Neera* obtained from the coconut inflorescence and coconut water are being considered as health drinks and they can be potential export products apart from the sugar of the sap and honey.

Detrimental changes in coir products export composition

Over a period of time from 1998-99 to 2020-21, there have been substantial changes in the composition of the coir products exports from India. In 1998-99, coir fiber (0.31%), coir pith (0.86%), coir yarn (16.52%), handloom mats (50.00%), and tufted mats (0.70%) constituted India's coir products exports. Around 2009-10, major changes in this composition have taken place as coir fiber (12.12%), coir pith (15.36%), coir yarn (16.52%), handloom mats (31.62%) and tufted mats (31.53%) were among the coir products exported. The Table 5 shows the major coir products exported during the period 2016-17 to 2020-21. The year 2020-21 presents a totally contrasting picture as coir fiber (16.64%), coir pith (50.80%), coir yarn (0.77%), handloom mats (6.53%) and tufted mats (21.35%) had a different shares than what they had at the start of the 21st century. Though tufted mats' share has come down drastically they could still command a major share in the export basket. On the other hand, handloom mats' shares have drastically declined and the raw products like coir fiber and coir pith have come to occupy pre-eminent positions. Such changes of exporting raw products are not desirable as they fetch lower income to the country. They also enable the importing countries to produce high value added products and become strong competitors to India's products.

Coconut coir for composting and manure

Gopal, Gupta and Thomas (2016) discussed about the coconut circular economy aiming to reintroduce wastes from a system back into it through inputs in a different form. They suggested recycling the abundant biomass of coconut based farming system particularly for vermi-composting the coconut leaves with other agro-wastes. They elucidated on its potential to return the all important organic carbon and critical microbiota to soil [19]. These authors in an earlier publication presented their findings on the production of vermiwash from actively composting coconut leaf litter+cow dung substrate, its chemical, biochemical and microbiological properties, and its potential as a bio-liquid to increase crop growth and yield accompanied with soil, microbial, enzyme and nutrient properties [20]. The feasibility of co-composting coir pith with solid poultry manure was tested with and without lime and rock phosphate amendment by Thomas et al (2013). They found out that the composting process facilitated by poultry manure amendment brought about bioconversion of coir pith to a final product in 45 days. The final product was stated to possess physico-chemical characteristics required for quality organic manure [21].

Agro/Industrial/Geo-textiles applications of coir

Due to high lignin content and also because it is the hardest among the natural fibers, the coir is considered by Pillai and Vasudev (2001) as much more advantageous in different applications for erosion control, reinforcement and stabilization of soil. They suggested that the coir converted into coir yarn and later to woven mesh matting can be used for controlling soil erosion and conditioning the soil. They found out that the coir non-woven is also used for soil erosion control and conditioning the soil by more ground cover and soil retention. They pointed out that non woven coir has also been used in manufacture of basket liners, mulching mats, grow sticks, cultivation mats for plants, roof green applications, portable lawn or instant lawn and many more applications [22]. Coir Board (2016) stated that geo textiles produced from the coir are blankets that are laid on bare soil to control erosion and promote the growth of protective ground covers [17]. It was estimated by Rajan and Abraham in 2007 that around five million tons of coir was available globally and bio-softened coir fibers were found to be spinnable and could be blended with natural fibers for producing furnishing fabrics, textiles and many other things [23]. These authors citing various tests conducted by German Bundesanstalt for Material Testing indicated that coir has taken 15 times longer time than cotton and seven times longer than jute to degrade. They felt that these durability and the elongation properties of the coir had made it a potentially suitable engineering material to be used in reinforcement, ground improvement, and erosion control. Vishnudas *et al* (2012) conducted an experiment in highland of Kerala, India.

They found out that slopes treated with the geotextiles (coir) and pineapple crop had the highest moisture retention capacity. They concluded that geotextile on sloped land increased moisture availability in soil. Thus, the geotextiles are also being promoted in prevention of soil erosion [24]. In an effort to produce flame retardant textiles, Teli (2018) applied the acidic coconut shell extract in neutral and alkaline conditions on jute fabric in different concentrations. The resultant fabric showed good flame retardant properties. Further, the treated fabric showed antibacterial property against both gram-positive and gram-negative bacteria [25]. Another study by Teli and Pandit (2018) concluded that coconut shell extract treated fabric had flame retardance up to four washes and had antibacterial property that was significantly high even after five washes. They hence recommended that cellulosic fabric could be used for various applications such as making low-cost home furnishing products like sofa cover, curtains, products for interior design in public halls, theatre, protective materials for making tents, etc [26]. A study conducted by Bharath *et al* (2019) has found out that the hybrid laminates of coconut leaf sheath with extreme glass fibers plies as skin layer may be suited in manufacturing car doors, car interiors, dash boards, headliners, decking, parcel shelves, pallets, spare tyre covers, spare-wheel pan, seat backs, etc [27].

Coir in civil engineering applications

Peter et al (2016) made an effort to study how coir waste can be effectively utilized in combination with soft soil to improve subgrade characteristics. They identified that soft soil became a problematic subgrade for pavements due to its low bearing capacity and strength. Various properties like grain size distribution, moisture-density relations, California bearing ratio (CBR) and elastic modulus were studied individually and for soil blended with coir waste. The test results showed that stabilization with coir waste had a significant effect on the compaction, elastic modulus

as well as CBR characteristics [28]. Since the coconut fiber contains certain amount of cellulose, a study was made by Panda, Suchismita and Giri (2013) to utilize this naturally and abundantly available material in preparation of Stone Matrix Asphalt (SMA) mixes to explore the utilization of a natural fiber for paving purpose. It was observed by them that only a marginal 0.3% coconut fiber addition brought significant improvement in the engineering properties of SMA mixes [29]. A study conducted by Gunasekaran *et al* (2017), attempted an application of coconut shell aggregate concrete (CSAC) into an element like concrete pipe. They claimed that test results and performance of coconut shell aggregate concrete (CSAC) pipes encouraged the use of coconut shell as an aggregate for the replacement of conventional coarse aggregate in reinforced concrete pipes production. They felt that these pipes can be used for drainage and irrigation, cross drains/culverts carrying medium traffic [30]. The permeability properties of lightweight self-consolidating concrete containing coconut shell aggregate (CSA) had been investigated by Palanisamy *et al* (2020). Based on this experimental investigation, it was concluded that it was practicable to use CSA as aggregate to produce light weight concrete with satisfactory performance [31].

Coir pith and coconut shell activated carbon as absorbents
The study conducted by Parameswaran, Ravindranath and Sarma (2019) suggested that acetylated coir pith could be beneficial in oil adsorption and potentially provided a low cost environmentally friend adsorbent for oil spill. They considered that for mopping up oil spills in water bodies to save the marine lives from toxic environments, acetylated coir pith can be useful [32]. A review of about 175 publications since 2010 by James and Yadav (2021) has highlighted the potential and use of different parts of coconut palms such as shell, husk, coir, copra, sawdust, tree barks and roots as absorbents for removal of pollutants in water. They expressed the hope that 'valorization of coconut parts for facile remediation of water pollution is a path towards a green, circular economy' [33]. The detrimental consequences of pesticide residues in water were considered by Kodali *et al* (2021) as key concerns to be addressed. They undertook a study and reported the adsorptive removal of an organophosphorus pesticide monocrotophos onto Activated Coconut Charcoal (AcCoC) as the adsorbent. Their study demonstrated an efficient solid-phase extraction of a toxic organophosphorus pesticide, monocrotophos using activated coconut charcoal as an adsorbent. They concluded that the super adsorbent proved its capacity to detoxify monocrotophos in samples of farm water from agricultural soils [34]. Another study conducted by Kulkarni *et al* (2013), focused on using coconut shell activated carbon as an absorbent to overcome the phenolic pollution because of its good adsorption ability and low cost. They cited the experience of many researchers where the coconut shell activated carbon had been tried for removal of chromium and other heavy metals with reasonable success [35].

Coconut fiber/peat/pith based bio-fuel
The draft National Coir Policy (2019) of India mentioned that the coconut husks were used widely as an alternate fuel in brick kiln units as high prices were offered. It was considered that, due to this, the fiber extraction units in many States were facing problem in procuring coconut husks needed by them. Therefore, the State governments of Tamil Nadu and Karnataka were reported to have issued orders banning the use of coconut husks as a fuel in brick and similar other units. This draft policy (2019) suggested that other coconut producing States should also follow the initiatives taken by the Governments of Tamil Nadu and Karnataka. In case of Mumbai, one of the largest cities in India, it was reported that tender coconut shell garbage was being used as a fuel in the form of briquettes in crematoriums. There were problems in disposing of the empty coconut shells of 3-4 lakhs of tender coconuts reaching the city daily [36]. It was reported by Kotak (2018) that a few in Mumbai intended to do make coco peat from the coconut shells to use as a substitute for soil in nurseries which was being followed in Chennai and Pune. It was claimed that one could save a lot of water because coco peats can absorb and retain water for seven days [37].

Coir pith /cocopeat as a plant growing medium
Coir substrate used as a growing media for horticultural applications is obtained from the mesocarp (external husk) of a coconut. A substrate, having a combination of 75% sawdust and +25% coconut residue, was found to have the high potential as a raw material in oyster mushroom cultivation [38]. Trichoderma coir pith cake (TCPC) was developed using a simple and low cost technology. The production of coir pith cake containing appropriate microbial bio-agents in the coconut growing areas was expected to help in plant and soil health management [39].

Coconut shell charcoal

Coconut shell powder, shell charcoal and activated carbon are some of the industrial products of the coconut shells. Coconut shell oil used for medicinal preparations and shell based handicrafts and utility products are other uses of coconut shell [40]. Coconut shells are also used as moulds for making the palm jaggery [41]. The coconut shell charcoal seems to have gained commercial importance even during the war of 1914-18 and again in the years immediately preceding the war of 1939-44. The use of 'activated carbon' as a means of defense against poisonous gases in warfare was reported during the war of 1914-18. It is claimed that coconut shells among other shells provided products for this purpose. Data on export of coconut shell charcoal from Ceylon (present Sri Lanka) during the period 1933-41 are also available. The countries that imported it during this period were UK, France, Holland, Italy and Romania [42].

CONCLUSION AND RECOMMENDATIONS

India, a pioneer in making use of coconut residues, is the top most country in production of coconuts and also in export of coir pith. To sustain and improve the coconut based livelihoods for the significant number of small farmers and women involved in processing of coir, both the Union and State Governments have been undertaking continuous efforts through the Coconut Development Board, Coir Board and Horticulture Boards. The various research institutions and agricultural universities under the auspices of both Union and State Governments have been encouraging the scientific community to undertake researches on use of coconut and its residues. Apart from the traditional uses of coconut residues such as coir mattress, door mat, curled coir, coir fiber, coir rugs, coir pith, coir rope, coir yarn, handloom mats, handloom matting, power loom mats, power loom matting, rubberized coir and tufted mats, many other novel applications have been invented by the Indian researchers. Coconut Shell Powder, Coconut Shell Charcoal and Activated Carbon are some of the emerging industrial products of coconut residues. Use of coconut coir fiber in growing culture media, geo-textiles to prevent soil erosion and for reinforcement and stabilization of soil, use of coir pith as environmentally friend adsorbent for oil spill, utility of coir for improvement in engineering properties of Stone Matrix Asphalt (SMA) mixes used for paving and coconut shell aggregate concrete (CSAC) pipes for drainage and irrigation are a few notable coconut residues applications that are getting noticed.

Considering the increasing global demand for coconut and its products in future, coconut production has to be increased substantially by India. In addition to intensification of the coconut cultivation in the traditional states such as Kerala, Tamil Nadu, Karnataka and Andhra Pradesh, consolidating in emerging states such as Odisha, West Bengal, Maharashtra, Gujarat and Assam, expansion in non-traditional states of India such as Bihar, Chhattisgarh and Tripura has become essential. Such efforts will enable India not only to cement its position as the top producer of coconuts but also ensure that it achieves the highest productivity so that it can tap the rising global market demands for the coconut and bye-products. These open up further opportunities for adding value through effective utilization of coconut residues. Creating awareness on the new applications of the coconut residues among the coconut sector stakeholders is becoming essential. This will ensure the increased availability of coconut husks for India's pioneering coir industry leading to is re-emergence and also fledgling coconut shell based industry.

Moreover, it is crucial to build the capabilities to make use of the coconut residues for manufacturing higher value products such as coconut shell powder, coconut shell charcoal and activated carbon. Transfer of technology and further facilitation of small scale industries in all coconut producing states in this context becomes indispensable. These are vital for India to increase the proportion of these high value-added products and reduce the proportion of low value raw products such as coir pith and coir fiber in its export composition. For instance, decreasing the export of coir pith and coir fiber particularly to a select few countries which import bulk of India's coir pith is expected to ensure coir pith's availability to domestic small scale industries that can focus on value addition, achieve higher employment and income.

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Table 1: Area under coconut production in major states of India: 2015-16 to 2019-20 (''000 Hectares)

States	2015-16	2016-17	2017-18	2018-19	2019-20
Kerala	770.62 (36.90%)	770.79 (37.02%)	807.13 (38.49%)	760.95 (35.38%)	760.78 (35.01%)
Karnataka	526.38 (25.20%)	513.85(24.68%)	518.39 (24.72%)	619.78 (28.82%)	624.03 (28.71%)
Tamil Nadu	459.74 (22.01%)	461.06 (22.14%)	441.49 (21.06%)	436.94(20.31%)	437.57 (20.13%)
Andhra Pradesh	103.95(4.98%)	115.21 (5.53%)	99.51 (4.75%)	111.82(5.20%)	111.38(5.12%)
Odisha	50.91 (2.44%)	50.91 (2.45%)	50.91 (2.43%)	46.67 (2.17%)	51.71 (2.38%)
West Bengal	29.51(1.41%)	29.63 (1.42%)	30.25 (1.44%)	30.82 (1.43%)	31.30 (1.44%)
Maharashtra	27.75 (1.33%)	20.90(1.00%)	26.97(1.29%)	27.18 (1.26%)	29.95(1.38%)
Gujarat	22.81(1.09%)	24.44(1.17%)	24.94(1.19%)	26.91 (1.25%)	27.40 (1.26%)
Assam	19.73(0.94%)	20.60(0.99%)	19.92(0.95%)	20.61(0.96%)	20.75(0.95%)
All India	2088.47(100%)	2082.11(100%)	2096.72(100%)	2150.89(100%)	2173.28(100%)

Source: Coconut Development Board

Table.2: Coconut production in major states of India: 2015-16 to 2019-20 (Million nuts)

	2015-16	2016-17	2017-18	2018-19	2019-20
Kerala	7429.39(33.51%)	7448.65(31.16%)	8452.05(35.52 %)	7683.55(36.09%)	6980.3(34.37%)
Tamil Nadu	6171.06(27.84%)	6570.63(27.49%)	6020.41(25.30%)	5370.39(25.23%)	5373.21(26.46%)
Karnataka	5128.84(23.14%)	6773.05(28.33%)	6273.79(26.36%)	4947.74(23.24%)	4300.69(21.18%)
Andhra Pradesh	1427.46(6.44)	1377.53(5.76%)	1396.89(5.87%)	1567.6(7.36%)	1555.82(7.66%)
Maharashtra	271.24(1.22%)	198.85 (0.83%)	127.92(0.54%)	208.93(0.98%)	523.66(2.58%)
West Bengal	373.58(1.69%)	374.56(1.57%)	377.65(1.59%)	384.17(1.80%)	389.16(1.92%)
Odisha	328.38(1.48%)	341.68(1.43%)	341.71(1.44%)	286.2 (1.34%)	354.57(1.75%)
Gujarat	312.68 (1.41%)	336.65(1.41%)	241.16(1.01%)	259.57(1.22%)	264.88(1.30%)
Assam	132.59(0.60%)	153.27(0.64%)	168.21(0.71%)	182.78(0.86%)	159.87(0.79%)
All India	22167.45(100%)	23904.1(100%)	23798.23(100%)	21288.24(100%)	20308.7(100%)

Source: Coconut Development Board

Table.3: Coconut productivity in major states of India (Nuts/Ha): 2015-16 to 2019-20

	2015-16	2016-17	2017-18	2018-19	2019-20
Maharashtra	9775	9514	4743	7687	17485
Andhra Pradesh	13732	11957	14038	14019	13969
West Bengal	12658	12641	12484	12467	12433
Tamil Nadu	13423	14251	13637	12291	12280
Gujarat	13706	13775	9670	9646	9667
Kerala	9641	9664	10472	10097	9175
Nagaland	8091	5681	8000	8477	8482
Assam	6720	7440	8444	8868	7704
Karnataka	9744	13181	12102	7983	6892
Odisha	6451	6711	6712	6132	6857
All India	10614	11481	11350	9897	9345

Source: Coconut Development Board

Table.4: Export of major coconut products from India 2016-17 to 2020-21 (Value in Crores)

	2016-17	2017-18	2018-19	2019-20	2020-21
Activated Carbon	815.07 (39.53%)	951.27(53.92%)	1344.11(65.72%)	1184.6(67.22%)	1514.27(65.99%)
Shell Charcoal	88.08 (4.27%)	79.28 (4.49%)	54.14 (2.65%)	34.62(1.96%)	32.11(1.40%)
Fresh Endocarp	13.54 (0.66%)	8.62(0.49%)	17.62(0.86%)	9.03(0.51%)	51.72(2.25%)

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Other Endocarp	9.46(0.46%)	14.24(0.81%)	17.12(0.84%)	16.44(0.93%)	26.03(1.13%)
Dried Endocarp	5.38(0.26%)	2.1 (0.12%)	2.6 (0.13%)	6.56 (0.37%)	16.62 (0.72%)
Other coconut products	1128.51(54.74%)	701.54(39.76%)	604.69 (29.56%)	509.75 (28.93%)	652.5(28.43%)
Total	2061.70(100%)	1764.31(100%)	2045.36(100%)	1762.17(100%)	2294.81(100%)

Source: Coconut Development Board

Table.5: Export of major coir products from India 2016-17 to 2020-21 (Value in Rs. Lakhs)

	2016-17	2017-18	2018-19	2019-20	2020-21
Curled Coir	2419.3(1.06%)	2316.26 (0.91%)	3137.02 (1.15%)	2681.57 (0.97%)	2422.22(0.64%)
Coir Fiber	53913.63(23.63%)	70177.88(27.71%)	60164.11(22.05%)	49842.56(18.07%)	62890.57(16.64%)
Coir Pith	90539.11 (39.68%)	101846.8 (40.22%)	123208.5(45.16%)	134962.9(48.94%)	191974.1(50.80%)
Coir Rugs	271.92(0.12%)	269.58(0.11%)	243.96(0.09%)	483.82(0.18%)	427.9(0.11%)
Coir Yarn	2948.32(1.29%)	2457.66(0.97%)	2642.23(0.97%)	2301.22(0.83%)	2919.3(0.77%)
Geo-Textiles	4481.04(1.96%)	3996.59(1.58%)	5972.56(2.19%)	6389.45(2.32%)	7059.05(1.87%)
Handloom Mats	21316.31(9.34%)	18613.96(7.35%)	21911.04(8.03%)	19630.08(7.12%)	24662.1(6.53%)
Handloom Matting	1535.25(0.67%)	1394.79(0.55%)	1436.08(0.53%)	1366.41(0.50%)	1712(0.45%)
Tufted Mats	48442.83(21.23%)	49591.41(19.58%)	52225.03(19.14%)	56344.14(20.43%)	80690.82(21.35%)
Coir Other Sorts	416.59(0.18%)	498.29(0.20%)	361.58(0.13%)	476.93(0.17%)	1200.96(0.32%)
Others	1880.52(0.82%)	2064.6 (0.82%)	1502.48 (0.55%)	1311.03(0.48%)	1938.92(0.51%)
Total	228164.8 (100%)	253227.8 (100%)	272804.6 (100%)	275790.2(100%)	377897.9(100%)

Source: Coir Board

RESEARCH ARTICLE

Heat Transfer Analysis of MHD Casson Fluid Flow Over an Unsteady Vertical Permeable Porous Plate Under the Influence of Heat Source and Thermal Radiation with Hall Current Effect

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ABSTRACT

The unstable free convection flow of a Casson fluid in the occurrence of an infinite vertical porous dish and a bouncy force was reviewed in this work. The flow field is controlled by nonlinear combined partial differential equations of momentum and energy, which are converted into an ordinary differential equation system. The perturbation technique was used to solve the flow's leading equations to get non-dimensional velocity and temperature grounds. We also calculated the Nusselt number and estimated the skin friction variation. Graphical representations of the temperature and velocity outlines for various constraint values were also included in the revision. For various values of these relevant parameters, typical results for the velocity and temperature profiles, as well as the skin-friction coefficient and local Nusselt number, are presented to demonstrate the tendency of the solutions.

Keywords: Thermal conductivity, free convection, Casson fluid parameter, Hall current, Heat absorption.

INTRODUCTION

This research paper analyses the unsteady free flow of a Casson fluid past an oscillating vertical plate with constant wall temperature. The Casson fluid model is used to distinguish the non-Newtonian fluid behaviour. By employing nondimensional variables, the governing partial differential equations, correlated with momentum and energy equations are transmuted into linear ordinary differential equations. In recent decades, Newtonian fluids described

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by Navier-Stokes equations are widely studied in the literature and the Newtonian flows fascinate many researchers to scrutinize and study their behaviours for many years. The Steady and unsteady fluid dynamics were examined for different cases of operations to model and imitate many engineering applications. The unstable allowed current of a Casson heated previous a wavering vertical plate by unbroken wall temperature exists explored in this paper. By employing non-dimensional variables, the governing partial differential equations, correlated with momentum and energy equations are transmuted into linear ordinary differential equations. To simulate and mock some engineering suggestions, several properties of the steady and unstable fluid dynamics were examined using mathematical models. Now this methodology, the M. Abd El-Aziz *et al.*[1]. scrutinised the education has too clearly established the temperature and velocity outlines for different morals of the parameters entering the problem. Spending the perturbation technique, the combined non-linear partial differential comparisons of energy, motion that resistor of the movement arena are transmuted possessed by an accredited of ordinary differential equations. Underneath thermal radiation, a series solution for melting heat transfer (HT) appearances of hybrid Casson fluids. This research paper deals with Current energy and gluey degeneracy are involved in the melting heat transmission appearances of Casson fluid. Also, the magneto hydrodynamic flow concluded non-parallel porous walls container stand construed as a grouping concerning the traditional Jeffery Hamel movement extra of unique injection/suction is questioned now this paper. A parametric learning is likewise executed to prove the special effects of constraints on the fluid current were examined by Emran Khoshrouye Ghiasi *et al.* [2-4].The non-Darcy magnetic hydro dynamic (MHD) flow of a Casson fluid over a nonlinearly distending sheet in a permeable medium was investigated by Bhim Sen Kala *et al.*[5].

Salim Hamrelaine *et al.*[6]. have given incompressible viscous fluid flow between non-parallel walls in references. The momentum equation is converted to a non-dimensional ordinary differential equation using similarity variables. Ahmed S. Rashed *et al.*[7]. investigated a passionately moving vertical plate exposed to a heat source and a magnetic ground was examined alongside as per the Newtonian steady state movement of fluids by electrical transmission components. Under the effects of diverse convection, thermal energy and chemical response, A study presented by Sawan Kumar Rawat *et al.*[8]. is, one such example. Ch. Krishna Sagar *et al.* [9]. promise to investigate how heat and mass transfer, the heat radiation, and Hall current interact to mix incompressible, Casson convective, and conductive fluids on a vertical inclined plate. Rahul P. Mehta *et al.*[10]. investigated the use of the implicit limited alteration technique to solve nonlinear equations which differ over energy and time based to the relevant principal and border limits. This study takes into account the heat and mass transmission appearances of the nonlinear, unsteady, radioactive MHD edge layer slip current of a chemically reacting fluid past an infinite vertical porous plate inspected by Venkateswarlu *et al.*[11]. Vijayaragavan *et al.*[12,13] have scrutinize the Dufour inference on instable MHD flow past a semi-infinite vertical permeable moving plate in the occurrence of thermal energy, heat concentration and first order homogeneous chemical reaction are conveyed. The prevailing equations are converted into a non-linear ordinary differential equation and cracked systematically by using perturbation technique.

Nabil Tawfik Eldabe *et al.*[14] discussed the effects of Hall currents on the trembling flow of an incompressible non-Newtonian fluid minding the Casson model through a permeable medium. The unsteady free flow of a Casson fluid past an oscillating vertical plate with constant wall temperature was studied and described by Asma Khalid *et al.*[15]. The effect of inclined Lorentz force, thermal radiation and Newtonian heating on the Falkner-Skan boundary value problem (FBVP) in Nano fluids combined with the Casson rheological model. Using the similarity variables, the governing partial differential equations (PDEs) are transformed into the system ordinary differential equations, and are solved through the homotopy analysis method, which was supported by the findings of Emran Khoshrouye Ghiasi *et al.*[16]. The systematic study of the convective current of a viscoelastic electrically conducting fluid within an inclined network bounding a porous regime with Hall and induced magnetic field effects have been examined by Jitendra Kumar Singh *et al.*[17]. A moving vertical flat plate limits the unstable allowable convection current of a Casson fluid in a rotational structure with convective margin conditions. CH. Baby Rani *et al.*[18]. examined the prevailing equations of the flow that were cracked systematically using the perturbation technique. Pushpalatha *et al.*[19]. have investigated the effects of various governing parameters like Casson parameter, magnetic parameter, thermal transmission parameter, chemical response parameter and thermal radiation parameter on velocity and

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temperature outlines and these effects have been existing through graphs. The stable Magneto hydrodynamic adjustments on chemical reaction concepts, with heat and mass transfer, are thoroughly debated and dominant by Baba Galadima Agaie *et al.*[20]. The collective possessions of buoy-ancy forced, gravity incline, heat cause, thermal radiation, chemical response, and Hall current on the heat and mass transfer of Newtonian liquid over a extending area endangered to a non-linear extending velocity was delivered by Lawal *et al.*[21]. The Soret and Dufour effects on the flow field were considered in justification of bodily relevance. The multiple natured flow equations are converted to a set of PDEs using a proper parallel variable has been made by research community Muhammad Hamid *et al.*[22]. This study is focus to designate the dual solutions of the Newtonian and non-Newtonian fluids past on vertical permeable porous plate with impacts various parameters. The set of governing PDE's transformed into ODE's with suitable dimensionless variables.

Mathematical Analysis

Heat transfer affects an infinite vertical porous plate with an incompressible Casson fluid flowing across it in an unstable slip flow. The Cartesian coordinates such as $x^*, y^* \ and \ z^*$ were used to express the geometry flow and Casson fluid physical coordinate system. So that, the x^* axis runs vertically up the plate, the y^* axis parallels the plate plane and points into the fluid region, and the z^* axis is normal to the plate x^*, y^* -axis (see FIGURE 1). A powerful transverse magnetic field is applied in a direction parallel to the y^* -axis, and an electric current flows normally as a result of the magnetic and electric fields, causing the fluid to move transversely. The velocity will have two components as a result of the Hall current inducing secondary flow. Furthermore, the applied magnetic field is assumed to be insignificantly similar to the current induced magnetic field, resulting in a few magnetic Reynolds numbers. From the reported equations of M. Abd El-Aziz et al (2017), this research observed the non-Newtonian model equation with two cases such as $\pi > \pi_c$ and $\pi < \pi_c$. Based on the reported equation, this research modified the equation using Boussines q approximation and the assumptions, which can be used to define fluid problem of Hall current. The governing equations are derived as follows, $\dfrac{\partial v^*}{\partial y^*} = 0$,   (1)

$$\frac{\partial u^*}{\partial t^*} + v^* \frac{\partial u^*}{\partial y^*} = -\frac{1}{\rho}\frac{\partial p^*}{\partial x^*} + v\left(1+\frac{1}{\xi}\right)\frac{\partial^2 u^*}{\partial y^{*2}} - \frac{\sigma B_0^2}{\rho\left(1+m^2\right)}\left(u^* - U_\infty^* + mw^*\right) + g\beta(T^* - T_\infty^*) - v\frac{u^*}{k_1^*} \qquad (2)$$

$$\frac{\partial w^*}{\partial t^*} + v^* \frac{\partial w^*}{\partial y^*} = v\left(1+\frac{1}{\xi}\right)\frac{\partial^2 w^*}{\partial y^{*2}} + \frac{\sigma B_0^2}{\rho\left(1+m^2\right)}\left[m\left(u^* - U_\infty^*\right) - w^*\right] - v\frac{w^*}{k_1^*} \qquad (3)$$

$$\frac{\partial T^*}{\partial t^*} + v^* \frac{\partial T^*}{\partial y^*} = \frac{k}{\rho C_p}\frac{\partial^2 T^*}{\partial y^{*2}} - \frac{Q_0}{\rho C_p}\left(T^* - T_\infty^*\right) - \frac{1}{\rho C_p}\frac{\partial q_r^*}{\partial y^*} \qquad (4)$$

where t^* denotes the dimension of time, The acceleration due to gravity is denoted by g, T^* denotes the Fluid temperature in all dimensions near the plate. T_∞^* denotes the temperature of free stream, The thermal extension factor is characterized by β, μ denotes the fluid viscosity, ρ is the weight, k represents the thermal conductivity and the kinematic viscosity is $v = \mu\big/\rho$, ξ represents the Casson fluid variable, Q_0 is the specific heat of the fluid

at constant pressure and c_p is the fluid's specific heat at constant pressure. At $y^* = 0$, these assumptions define the proper boundary conditions for velocity with slip flow and temperature fields,

$$u^* = u^*_{slip} = \chi\left(1+\frac{1}{\xi}\right)\frac{\partial u^*}{\partial y^*}, \quad w^* = w^*_{slip} = \chi\left(1+\frac{1}{\xi}\right)\frac{\partial w^*}{\partial y^*}, \quad T^* = T^*_w + \in\left(T^*_w - T^*_\infty\right)\exp\left(i\omega^* t^*\right), \tag{5}$$

as $y^* \to \infty$; $u^* \to U^*_\infty = U_0\left[1 + \in \exp\left(i\omega^* t^*\right)\right]$, $w^* \to 0$, $T^* \to T^*_\infty$,

Whereas the T^*_w-dimensional wall temperature, At most the U^*_∞-dimensional free stream velocity , ω^* is said to be as oscillation of dimensional frequency, U_0-constant and χ -velocity slip. For $\chi = 0$, the no-slip can be restored. The velocity of suction of the plate, a relation to equation (1), is neither constant nor a function of time only, the non-zero constant and mean,

$$v^* = -V_0\left[1 + \in A\exp\left(i\omega^* t^*\right)\right], \tag{6}$$

where V_0 represent the velocity of mean suction, the real positive constant is said as A ,both $\in$, $\in A$ are not greater than one. The negative value of velocity of suction is negative towards the plate. Outer boundary layer, By (2) yields,

$$-\frac{1}{\rho}\frac{\partial p^*}{\partial x^*} = \frac{dU^*_\infty}{dt^*} \tag{7}$$

Therefore,

$$\frac{\partial u^*}{\partial t^*} + v^*\frac{\partial u^*}{\partial y^*} = \frac{dU^*_\infty}{dt^*} + v\left(1+\frac{1}{\xi}\right)\frac{\partial^2 u^*}{\partial y^{*2}} - \frac{\sigma B_0^2}{\rho\left(1+m^2\right)}\left(u^* - U^*_\infty + mw^*\right) + g\beta(T^* - T^*_\infty) - v\frac{u^*}{k_1^*} \tag{8}$$

Merged equations (3) and (8), with modified term complex variable = q^* became (9) and

$$q^* = u^* + iw^* \tag{9}$$

we have

$$\frac{\partial q^*}{\partial t^*} + v^*\frac{\partial q^*}{\partial y^*} = v\left(1+\frac{1}{\xi}\right)\frac{\partial^2 q^*}{\partial y^{*2}} - \frac{\sigma B_0^2\left(1-im\right)}{\rho\left(1+m^2\right)}\left(q^* - U^*_\infty\right) + g\beta(T^* - T^*_\infty) + \frac{dU^*_\infty}{dt^*} - \frac{vq^*}{k_1^*} \tag{10}$$

The framed final equation (10) defines the kinetic energy (E) equation of selected fluid system,

$$\frac{\partial T^*}{\partial t^*} + v^*\frac{\partial T^*}{\partial y^*} = \frac{k}{\rho C_p}\frac{\partial^2 T^*}{\partial y^{*2}} - \frac{Q_0}{\rho C_p}\left(T^* - T^*_\infty\right) - \frac{1}{\rho C_p}\frac{\partial q_r^*}{\partial y^*} \tag{11}$$

then the problem's relevant boundary conditions are as follows: at $y^* = 0$;

$$q^*_{slip} = \chi\left(1+\frac{1}{\xi}\right)\frac{\partial q^*}{\partial y^*}, \quad T^* = T^*_w + \in\left(T^*_w - T^*_\infty\right)\exp\left(i\omega^* t^*\right),$$

as $y^* \to \infty$; $q^* \to U^*_\infty = U_0\left[1 + \in \exp\left(i\omega^* t^*\right)\right]$, $T^* \to T^*_\infty$, $\tag{12}$

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$$q = \frac{q^*}{U_0}, \; v = \frac{v^*}{V_0}, \; y = \frac{y^* V_0}{v}, \; U_\infty = \frac{U_\infty^*}{U_0}, \; t = \frac{V_0^2 t^*}{v}, \; \theta = \frac{T^* - T_\infty^*}{T_\omega^* - T_\infty^*}, \; \omega = \frac{\omega^* v}{V_0^2},$$

$$Gr = \frac{g \beta v (T_\omega^* - T_\infty^*)}{U_0 V_0^2}, \; M = \frac{\sigma B_0^2 v}{\rho V_0^2}, \; \Pr = \frac{v \rho C_p}{k}, \; Q_H = \frac{Q_0 v}{\rho C_p V_0^2}, \; R = \frac{4\sigma^* T_\infty^3}{k \, k^*},$$

$$T^{*4} \cong 4T_\infty^3 T^* - 3T_\infty^4, \; k = \frac{k_1^* V_0^2}{v^2}, \; q_r^* = \frac{-4\sigma^*}{3k^*} \frac{\partial T^{*4}}{\partial y^*}$$

(13)

As per the reported Casson fluids mathematical models (13), we have derived the velocity model (14) and temperature model equations (15) without any dimensions. The modified non-dimensional equations were slightly adjusted using T^{*4}, k and q_r^*, which are framed as follows,

$$\frac{\partial q}{\partial t} - \left[1 + \in A \exp(i\omega t) \right] \frac{\partial q}{\partial y} = \left(1 + \frac{1}{\xi} \right) \frac{\partial^2 q}{\partial y^2} + \frac{dU_\infty}{dt} + Gr\theta + \frac{M(1-im)}{(1+m^2)} (U_\infty - q) - \frac{q}{k}$$

(14)

$$\frac{\partial \theta}{\partial t} - \left[1 + \in A \exp(i\omega t) \right] \frac{\partial \theta}{\partial y} = \frac{1}{P_r} \left(1 + \frac{4R}{3} \right) \frac{\partial^2 \theta}{\partial y^2} - Q_H \theta$$

(15)

'M' stands for magnetic field parameter, Gr represents the Grashof number, Pr denotes Prandtl number, Q_H is the parameter for heat absorption. The limit conditions dimensionless form (11) converts

At $y = 0$; $q_{slip} = \delta \left(1 + \frac{1}{\xi} \right) \frac{\partial q}{\partial y}$, $\theta = 1 + \in \exp(i\omega t)$,

as $y \rightarrow \infty$; $q \rightarrow U_\infty = 1 + \in \exp(i\omega t)$, $\theta = 0$. (16)

In equation (14), $\delta = \dfrac{(\chi V_0)}{v}$ denotes the slip parameter. But, they cannot be applied for closed form and to be modified the ordinary differential equations (ODE) without dimensions $\left(x^*, y^*, z^* \right)$. This can be explained in terms of analytical solutions using the temperature (θ) and velocity (q).

$$q = f_0(y) + \in \exp(i\omega t) f_1(y) + O\left(\in^2 \right)$$

(17)

$$\theta = g_0(y) + \in \exp(i\omega t) g_1(y) + O\left(\in^2 \right)$$

(18)

We get by substituting Eq. (17) in (14).

$$\in \exp(i\omega t) \left[f_1'' + \frac{1}{a} f_1' - \left(\frac{i\omega}{a} + \frac{M(1-im)}{a(1+m^2)} + \frac{1}{ak} \right) f_1 + \frac{A}{a} f_0' + \frac{Gr}{a} g_1 + \frac{M(1-im)}{a(1+m^2)} + \frac{i\omega}{a} \right] = -f_0''$$

$$-\frac{1}{a} f_0' - \frac{Gr}{a} g_0 - \frac{M(1-im)}{a(1+m^2)} + \left[\frac{1}{ak} + \frac{M(1-im)}{a(1+m^2)} \right] f_0$$

(19)

In Eq. (19), we get by $a = \left(1 + \dfrac{1}{\xi}\right)$ equating the coefficient terms both (harmonic and non-harmonic) while neglecting the higher order harmonic terms $O\left(\in^2\right)$.

$$f_1^{''} + \frac{1}{a} f_1^{'} - \frac{1}{a}\left(i\omega + \frac{M(1-im)}{(1+m^2)} + \frac{1}{k}\right)f_1 = -\frac{1}{a}\left(i\omega + \frac{M(1-im)}{(1+m^2)} + \frac{1}{k}\right) - \frac{A}{a} f_0^{'} - \frac{Gr}{a} g_1 \tag{20}$$

and

$$f_0^{''} + \frac{1}{a} f_0^{'} - \left(\frac{M(1-im)}{a(1+m^2)} + \frac{1}{ak}\right)f_0 = -\frac{Gr}{a} g_0 - \frac{M(1-im)}{a(1+m^2)} \tag{21}$$

Also, when we substitute equation (18) into (15), we have

$$\in \exp\left(i\omega t\right)\left[-\frac{1}{\Pr} g_1^{''} - \frac{1}{\Pr}\frac{4R}{3} g_1^{''} - g_1^{'} + (i\omega)g_1 + Q_H g_1 - A g_0^{'}\right] = -\frac{1}{\Pr} g_0^{''}$$

$$+\frac{1}{\Pr}\frac{4R}{3} g_0^{''} + g_0^{'} - Q_H g_0 \tag{22}$$

Like eq.19, Eq. (22), was modified using $O\left(\in^2\right)$ and equation becomes

$$\left(1 + \frac{4R}{3}\right)g_1^{''} + \Pr g_1^{'} - \Pr\left(Q_H + i\omega\right)g_1 = -\Pr A g_0^{'} \quad \text{and} \tag{23}$$

$$\left(1 + \frac{4R}{3}\right)g_0^{''} + \Pr g_0^{'} - Q_H \Pr g_0 = 0 \tag{24}$$

The subsidiary equation is $\left(1 + \dfrac{4R}{3}\right)m^2 + \Pr m - Q_H \Pr = 0.$

Starting, we solve equation (24) analytically. The result is

$$g_0(y) = C_1 \exp\left(\frac{1}{2\left(1 + \dfrac{4R}{3}\right)}\left(-\Pr + \sqrt{\Pr^2 + 4\left(1 + \frac{4R}{3}\right)\Pr Q_H}\right)y\right) + C_2 \exp\left(m_1 y\right) \tag{25}$$

In Eq., enter the following boundary conditions: (25)　$\begin{array}{ll} g_0 = 1 & at\ y = 0 \\ g_0 = 0 & as\ y \to \infty \end{array}$ \tag{26}

gives　$g_0(y) = \exp\left(m_1 y\right)$ \tag{27}

Next, we solve Eq. (23)　$\left(1 + \dfrac{4R}{3}\right)g_1^{''} + \Pr g_1^{'} - \Pr\left(Q_H + i\omega\right)g_1 = -\Pr A g_0^{'}$

The characteristic (auxiliary) equation is $\left(1 + \dfrac{4R}{3}\right)m^2 + \Pr m - \Pr\left(Q_H + i\omega\right) = 0$.

$$C.F = C_1 \exp\left(\frac{1}{2\left(1+\frac{4R}{3}\right)}\left(-\Pr+ \sqrt{\Pr^2+4\left(1+\frac{4R}{3}\right)(Q_H+i\omega)\Pr}\right)y \right) + C_3 \exp(m_2 y)$$

$$g_1(y) = C.F + P.I$$

$$P.I = B_1 \exp(m_1 y) \cdot \quad g_1(y) = C_1 \exp\left(\frac{1}{2\left(1+\frac{4R}{3}\right)}\left(-\Pr+ \sqrt{\Pr^2+4\left(1+\frac{4R}{3}\right)(Q_H+i\omega)\Pr}\right)y \right) + C_3 \exp(m_2 y) \tag{28}$$

$$+ B_1 \exp(m_1 y)$$

The border conditions are
$$g_1 = 1 \quad at \ y = 0$$
$$g_1 = 0 \quad as \ y \to \infty \tag{29}$$

Substituting the border conditions (29) into (30), we get $g_1(y) = C_3 \exp(m_2 y) + D_1 \exp(m_1 y)$ $\qquad$ (30)

Next, we consider Eq. (21)

$$f_0'' + \frac{1}{a} f_0' - \left(\frac{M(1-im)}{a(1+m^2)} + \frac{1}{ak} \right) f_0 = -\frac{Gr}{a} g_0 - \frac{M(1-im)}{a(1+m^2)} \text{, The} \qquad \text{characteristic} \qquad \text{equation} \qquad \text{is}$$

$$m^2 + \frac{1}{a} m - \left(\frac{M(1-im)}{a(1+m^2)} + \frac{1}{ak} \right) = 0 ,$$

$$C.F = C_1 \exp\left(\frac{1}{2}\left(-\frac{1}{a} + \sqrt{\frac{1}{a^2} + 4\left(\frac{1}{ak} + \frac{M(1-im)}{a(1+m^2)}\right)} \right)y \right) + C_4 \exp(m_3 y) ,$$

$$P.I_1 = D_2 \exp(m_1 y) , \quad P.I_2 = \frac{\dfrac{M(1-im)}{a(1+m^2)}}{\left(\dfrac{M(1-im)}{a(1+m^2)} + \dfrac{1}{ak} \right)} = A_1$$

$$f_0(y) = C.F + P.I_1 + P.I_2$$

$$f_0(y) = C_1 \exp\left(\frac{1}{2}\left(-\frac{1}{a} + \sqrt{\frac{1}{a^2} + 4\left(\frac{1}{ak} + \frac{M(1-im)}{a(1+m^2)}\right)} \right)y \right) + C_4 \exp(m_3 y) \tag{31}$$

$$+ D_2 \exp(m_1 y) + A_1$$

The boundary conditions are
$$f_0 = \delta a f_0' \quad at \ y = 0$$
$$f_0 = 1 \quad as \ y \to \infty \tag{32}$$

Replacing the border settings (32) into equation (31) gives

$$f_0(y) = C_4 \exp(m_3 y) + D_2 \exp(m_1 y) + \frac{\dfrac{M(1-im)}{a(1+m^2)}}{\left(\dfrac{M(1-im)}{a(1+m^2)} + \dfrac{1}{ak} \right)} \tag{33}$$

Lastly, we solve Eq. (20)

$$f_1'' + \frac{1}{a} f_1' - \frac{1}{a}\left(i\omega + \frac{M(1-im)}{(1+m^2)} + \frac{1}{k} \right) f_1 = -\frac{1}{a}\left(i\omega + \frac{M(1-im)}{(1+m^2)} + \frac{1}{k} \right) - \frac{A}{a} f_0' - \frac{Gr}{a} g_1$$

The normal comparison is $m^2 + \frac{1}{a}m - \frac{1}{a}\left(i\omega + \frac{M(1-im)}{(1+m^2)} + \frac{1}{k} \right) = 0$

$$C.F = C_1 \exp\left(\frac{1}{2}\left(-\frac{1}{a} + \sqrt{\frac{1}{a^2} + \frac{4}{a}\left(i\omega + \frac{1}{k} + \frac{M(1-im)}{(1+m^2)} \right)} \right) y \right) + C_5 \exp(m_4 y)$$

$$P.I_1 = \frac{\left(i\omega + \frac{M(1-im)}{(1+m^2)} \right)}{\left(i\omega + \frac{1}{k} + \frac{M(1-im)}{(1+m^2)} \right)} = A_2, P.I_2 = D_3 \exp(m_1 y), P.I_3 = D_4 \exp(m_2 y),$$

$P.I_4 = D_5 \exp(m_3 y)$, $f_1(y) = C.F + P.I_1 + P.I_2 + P.I_3 + P.I_4$

$$f_1(y) = C_1 \exp\left(\frac{1}{2}\left(-\frac{1}{a} + \sqrt{\frac{1}{a^2} + \frac{4}{a}\left(i\omega + \frac{1}{k} + \frac{M(1-im)}{(1+m^2)} \right)} \right) y \right) + C_5 \exp(m_4 y)$$

$$+ D_3 \exp(m_1 y) + D_4 \exp(m_2 y) + D_5 \exp(m_3 y) + A_2$$

(34)

The border settings are
$$\begin{aligned} f_1 &= \delta a f_1' \quad at \ y = 0 \\ f_1 &= 1 \quad\quad as \ y \to \infty \end{aligned}$$

(35)

The Eq. (34) is substitute by (35), we get

$$f_1(y) = C_5 \exp(m_4 y) + D_3 \exp(m_1 y) + D_4 \exp(m_2 y) + D_5 \exp(m_3 y) + A_2$$

(36)

In Equations, replace the above explanations (27), (30), (33) and (36). (17) Plus (18), we obtain the following ending form of temperature and velocity deliveries in the border layer:

$$q(y,t) = C_4 \exp(m_3 y) + D_2 \exp(m_1 y) + A_1$$
$$+ \in \exp(i\omega t)\left[C_5 \exp(m_4 y) + D_3 \exp(m_1 y) + D_4 \exp(m_2 y) + D_5 \exp(m_3 y) + A_2 \right]$$

(37)

$$\theta(y,t) = \exp(m_1 y) + \in \exp(i\omega t)\left[C_3 \exp(m_2 y) + D_1 \exp(m_1 y) \right]$$

(38)

RESULTS AND DISCUSSION

Using perturbation study, Hall current on Casson fluid convective slip flow completed near a vertical porous plate through variable pressures and heat sink were reviewed. The two dimensional plots were drawn between the selected parameters such as u, w and θ. Likewise, τ_x - axial friction of skin factor, τ_z - transverse skin factor, Nu, M, Hall parameter, slip parameter δ, Q_H, Gr, Pr and time t for both session of Casson non-Newtonian and Newtonian fluids were used to define the fluid changes with respect of velocity and temperature.

The initiation of $\text{Pr} = 1$, $Q_H = 0.2$, $Gr = 5$, $m = 2$, $M = 1$, $R = 0.7$, $K = 0.3$, $\delta = 0.2$,

$A = 0.5$, $\varepsilon = 0.1$, $t = 1$, $i = 0.4$, $w = \pi/3$, $\xi = 1$ on the velocity and temperature profile can be questioned from Fig.2-21 and on Axial and transverse skin friction number in fig. 22-24. Figure 2 exhibits M on the axial velocity u. The morals M - magnetic parameter is not decreasing from 2 to 6, near is the clear decrease the velocity u, i.e. When magnetic parameter is getting high, the axial flow is strongly initiated M. Such impact on u can be explained by the fact that applying a magnetic field to an electrically conducting fluid produces Lorentz force, which eventually resists fluid gesture in the flow arena. Towards the axial movement is contrast, the sources M is extended, a major progress in the transverse velocity, the Figure 3 is exposed by the Hall effect w. Fig. 4 attened the impression of m - Hall parameter arranged outlines of the axial velocity of Casson and Newtonian fluids, pursirezed an elaborated as Hall parameter morals m outcomes due to decrease of axial flow velocity u. This is because decreases effective conductivity decreases effective conductivity $\left(\dfrac{\sigma}{1 + m^2} \right)$ has increased and as shown in Figure.5 the magnetic inspection decreases after that, which increases w due to the effect. The effect of the velocity slip factor δ happens the transverse w and axial velocities u are migrated in Figures 6 and 7 respectively. It is perfect such that the transverse (w) and the values of δ is increasing due to the axial velocities (u) are increasing. It was assessed because slip constraint tends to decrease resistance forces, growing fluid velocity. Effect of the increasing the absorption of heat factor morals Q_H on transverse (w) and axial velocities (u) is denoted in Fig. 8 and 9. It is recognisable that an increase the values of Q_H as result of the boundary layer thickness is not elaborated. When temperature has been absorbed, the buoyancy force decreases, resulting in a decrease in flow rate and velocity values. Figures 10 and 11 displays the Grash of numbers superior properties on the axial and transverse velocities. An increase now causes the buoyancy effects and decreases the density of the fluid, subsequent in new tempted flows. As a result, as the value of Gr increases, so do the crosswise and axial velocities of the fluid.

Actually $Gr > 0$ parallels to plate freezing, which has been specialised in engineering applications such as nuclear reactors and electronic components. Sets of the Casson fluid stricture were denoted in Figures 12 and 13 ξ is initialized on the transverse and axial velocities. It is detected since those numbers are the result of Casson extended factor ξ is increasing the both velocity mechanisms importantly close the plate while the condition is totally overturned narratively on the plate. These figures also show that when the Casson parameter is $\xi \to \infty$ (large enough), the non-Newtonian behaviour of the fluid disappears, and it one performs like a Newtonian fluid. Casson liquid has a greater momentum margin coating depth than Newtonian fluid, as illustrated in figures 12 and 13. This is because the fluid's provides increase the Casson factor and decrease ensuing in a wider velocity boundary layer. The encouragement of Pr - Prandtl number in the axial and slanting velocities are graceful by the figure of 14 and 15. That the Pr increases, the transverse and axial velocities u and w decrease in significant lowering in the width of the motivation border stratum. This performance is initiated by the fluid high viscosity, which causes it to move slowly as Pr increase. Figure 16 depicts the effect of dimensionless time on transverse velocities, As dimensionless time increases, transverse velocity increases. Figures 17–19 illustration the variances in temperature transfer against for changed principles of the Prandtl number, absorption of heat parameter and time t. As illustrated figure 17, the temperature decreases as profiles growth. Physically, this behaviour is caused by the state that as the Prandtl number rises, the thermal conductivity of the fluid falls and the viscosity rises, resulting in a decrease in the depth of the thermal border coat.

According to Fig. 18 shows that the current border layer fatness decreases as the heat concentration Q_H increases. This is normal as heat stands naturally engaged by the fluid and decreasing the temperature. Fig. 19 exposes that the temperature θ is reduced with growing dimension of time t. As shown in Figure 20, the thickness of the thermal

border layer decreases as temperature θ is rises. Fig. 21, It is demonstrated that as the perturbation parameter ε increases, so does the thickness of the thermal boundary layer.

CONCLUSION

In this research is concludes the investigations of an unsteady heat transfer done a vertical permeable porous plate with Casson fluid flow and influence of the Hall Current. The nonlinear velocity and temperature leading equations are solved systematically expending the perturbation technique. The following are the study's findings: The Axial velocity profiles are decreases for when we have increasing value of the Magnetic parameter M and the Q_H -heat absorption parameter, $\Pr$ -Prandtl number and the situation remains opposed inclination for increasing value of the Casson fluid parameter ξ, the Grashof parameter Gr. The transverse velocity outlines are decreases for the increasing Q_H, ξ, $\Pr$ and it is opposite tendency for increasing value of the M, Gr, and the dimensionless time t. The temperature profiles are enhanced for the given increasing value of $\Pr$, Q_H and the thermal radiation R. Also, the graph stated that the opposite tendency for increasing value of the dimensionless time t and the perturbation parameter ε.

Conflicts of Interests

The authors of the paper declare that there is no conflict of interest regarding the publication of this article and there were no external funding sources for this study.

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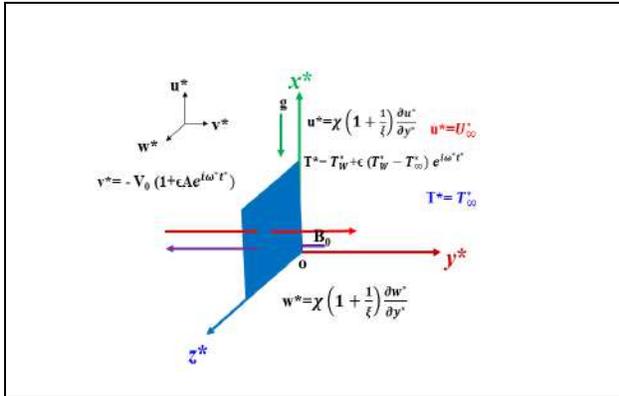
Figure.1: Flow geometry and physical coordinate system
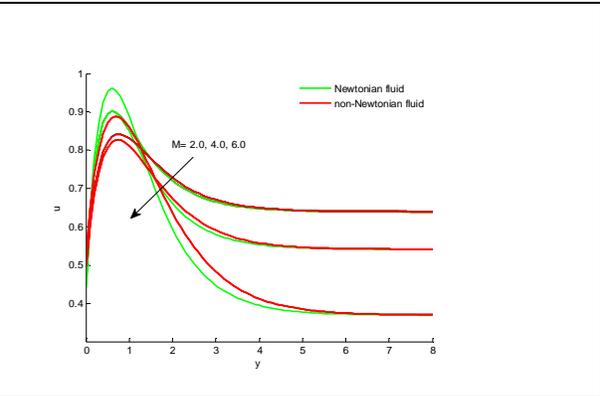
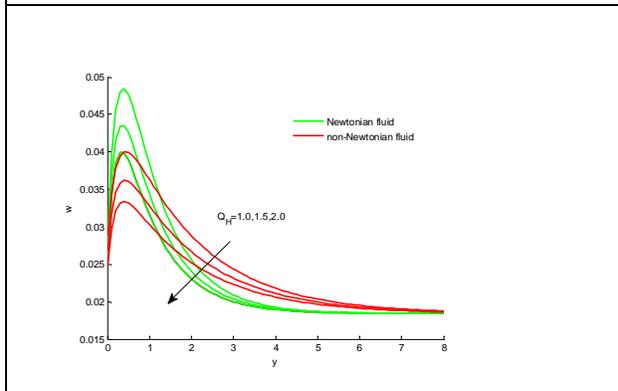**Figure.2: Axial Velocity Outline for M and ξ alternate Morals**
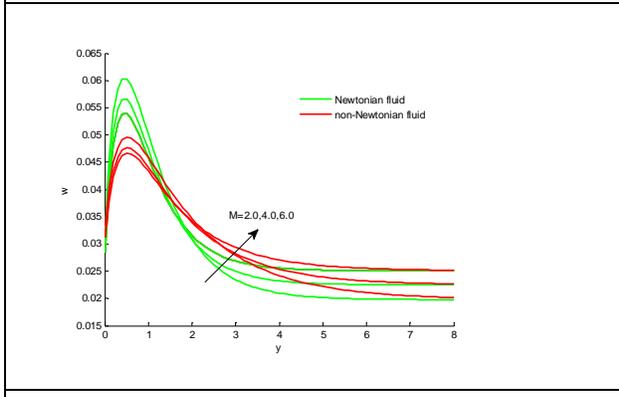
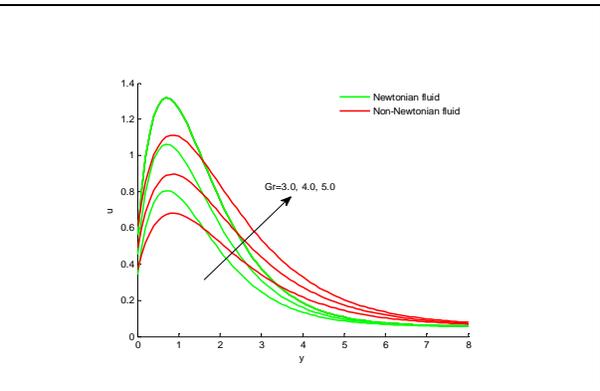**Figure.3:Transverse Velocity Outline for M and ξ alternate Morals**
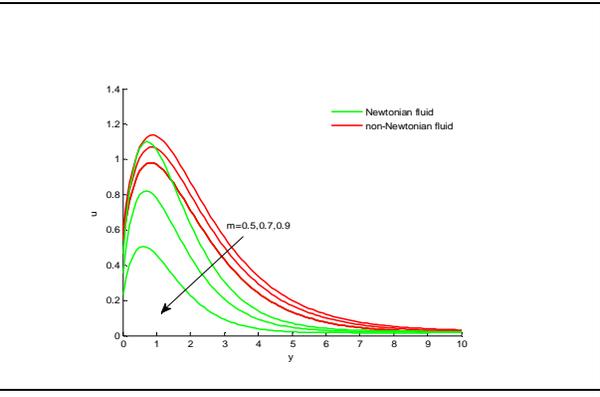
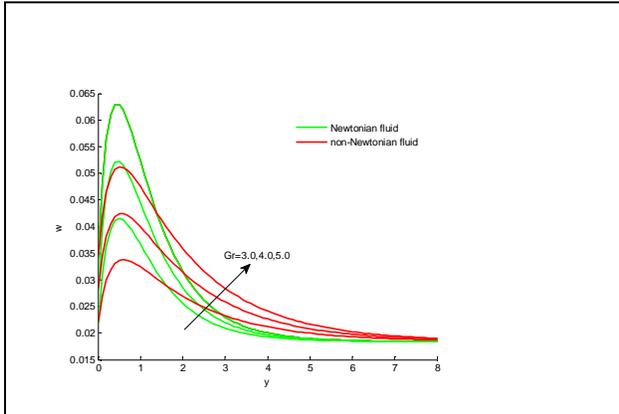**Figure.4: Axial Velocity Outline for m and ξ alternate Morals**

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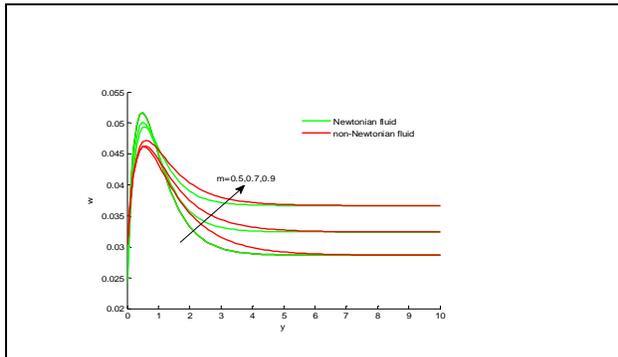
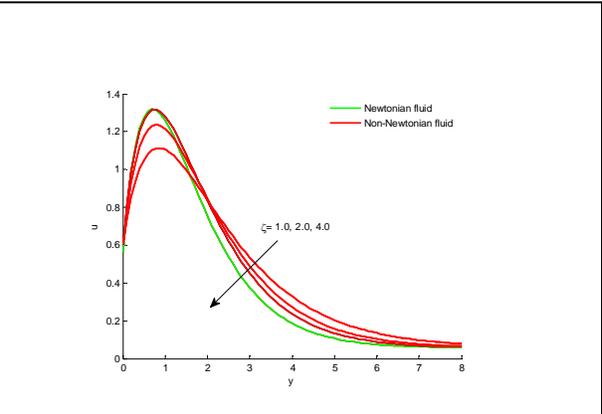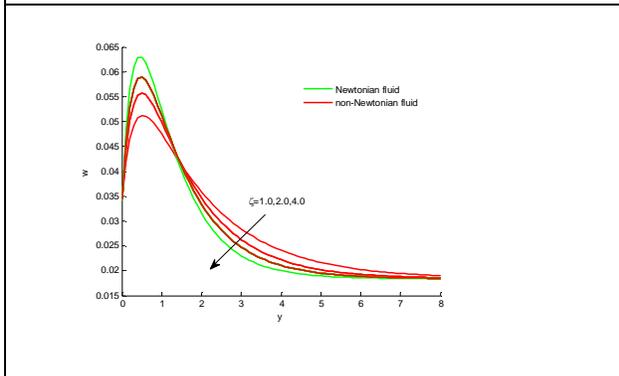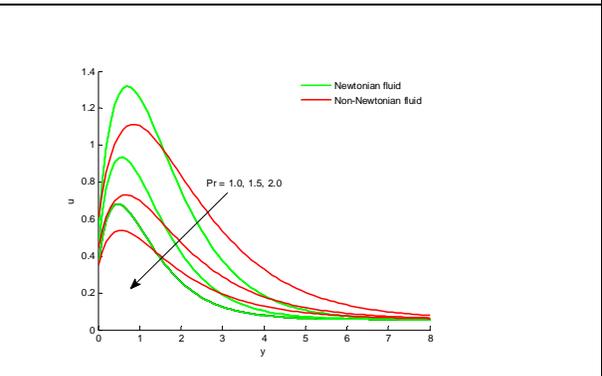**Figure.5: Transverse Velocity Outline for** m **and** ξ **alternate Morals**
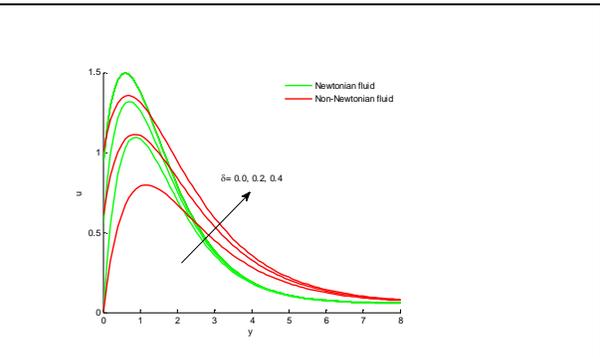
Figure.6: Axial Velocity Outline for δ **and** ξ **alternate Morals**
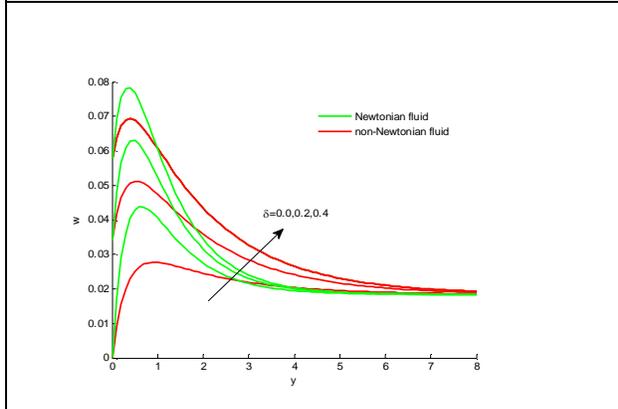
Figure.7: Transverse Velocity Outline for δ **and** ξ **alternate Morals**
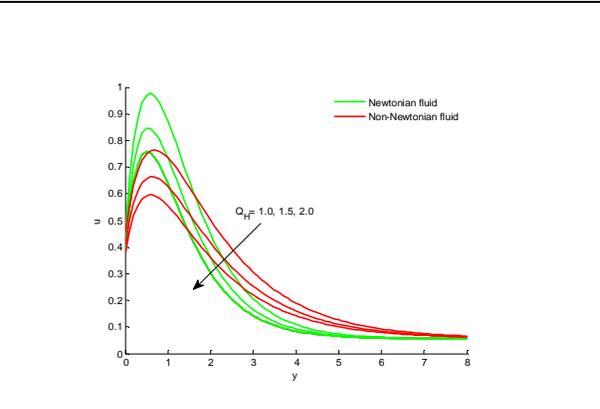
Figure.8: Axial Velocity Outline for Q_H **and** ξ **alternate Morals**

Figure.9: Transverse Velocity Outline for Q_H **and** ξ **alternate Morals**

Figure.10: Axial Velocity Outline for Gr **and** ξ **alternate Morals**

Figure.11: Transverse Velocity Outline for Gr and ξ alternate Morals

Figure.12: Axial Velocity Outline for ξ alternate Morals

Figure.13: Transverse Velocity Outline for ξ alternate Morals

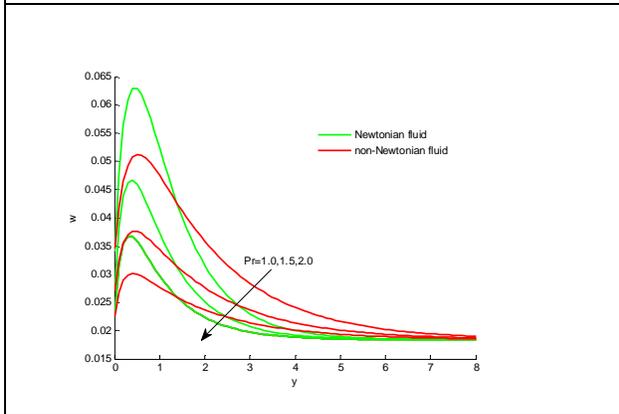**Figure.14: Axial Velocity outline for $\Pr$ and ξ alternate Morals**

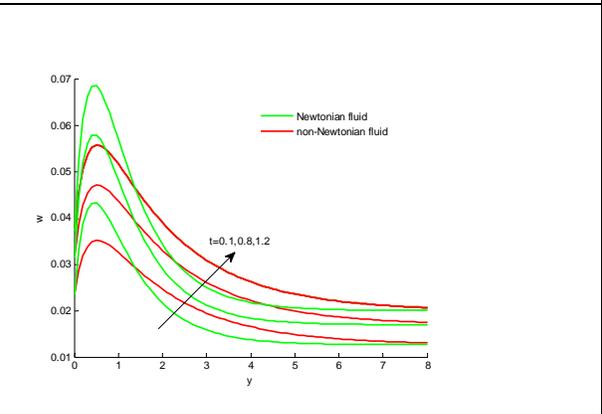**Figure.15: Transverse Velocity Outline for $\Pr$ and ξ alternate Morals**

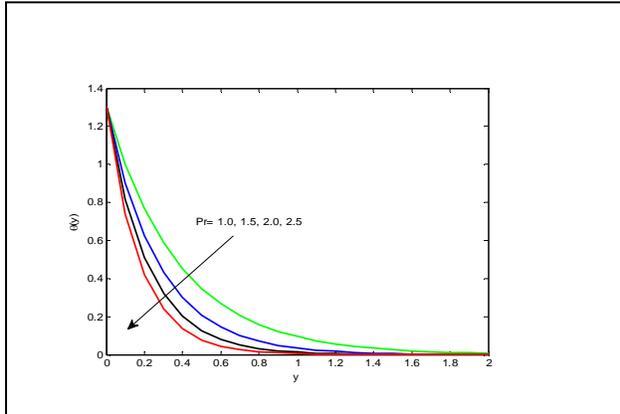**Figure.16: Transverse Velocity Outline for t and ξ alternate Morals**

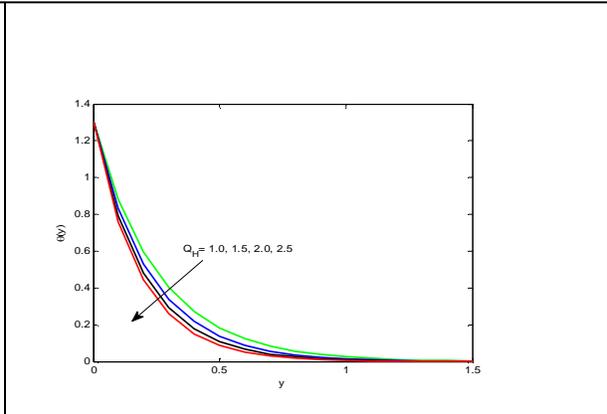**Figure.17: Temperature outline for altered morals of the Prandtl number** $\Pr$

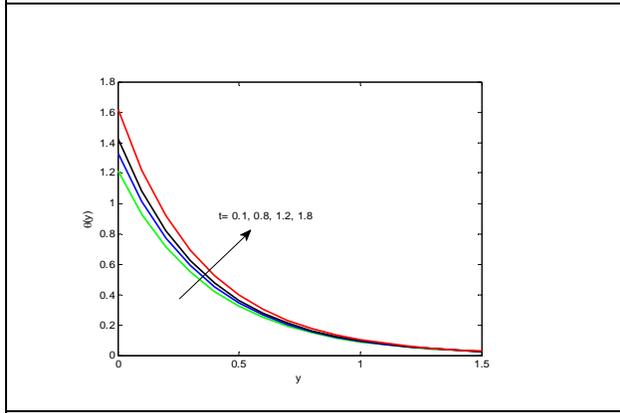**Figure.18: Temperature outline for altered morals of the heat absorption parameter** Q_H

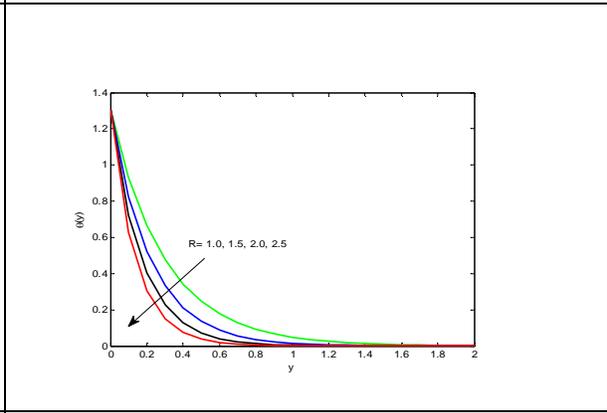**Figure. 19: Temperature outline for altered morals of the dimensionless time** t
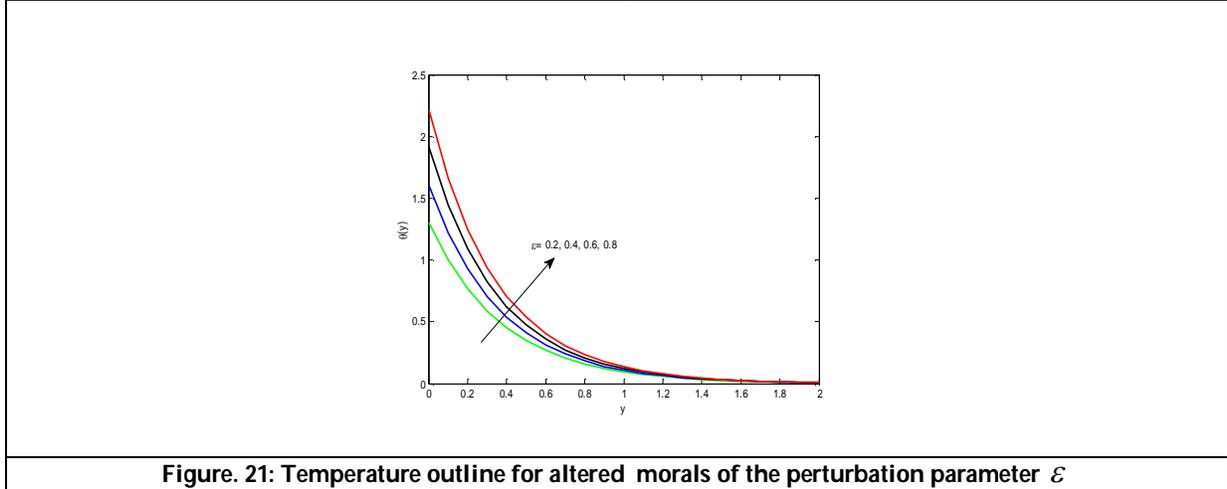

Figure. 20: Temperature outline for altered morals of R

Figure. 21: Temperature outline for altered morals of the perturbation parameter ε

RESEARCH ARTICLE

A Survey on usefulness of Quill as a Web Tool for English Language Enhancement

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ABSTRACT

Technology integrated teaching – learning has become an eminent part of today's Education. Web Tools are useful to create interactive and powerful learning environment for the students. Web Tools supports collaborative learning for the students. In the present research paper Researcher conducted research to know the usefulness of one of the Web Tools that is Quill (www.quill.org). Quill provides grammar-based activities in each lesson. Quill was implemented on students of P P Savani University. In the present research Investigator prepared and implemented Questionnaire on the 80 students to know their opinion about Quill, on the basis of their experience. Through this research Researcher came to know the Usefulness of Quill as a Web Tool for English Language Enhancement.

Keywords: Web Tools, English Language Enhancement, Quill

INTRODUCTION

The swift and constant increase of Electrical Communication is having power to influence existing education throughout the world in both positive and negative way dramatically. It has provided ease to the teachers and students to seek information from anywhere with the use of internet. One can have access to any content, just by one click, on his/her monitor. Moreover courses designed by best teacher of one country become available for the students who live in some other country (Chapman and Mahlck, 2004). Technology has provided facility through which students of one country are able to attend the session delivered by teacher in another country. Students who wanted to learn autonomously and seeking knowledge, for those students Technology is very useful for career development. It plays an important role in their development.

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Technology has the potential to improve education system in upcoming future. It will help to create world as a platform where everyone can show their competence (Schmitz, Prescott and Hunt 1996). It is the age of information in which education integrated technology has become an intermediate for learners. Through technology education is being departed to the farthest corner of the world. This is how students can work effectively, enrich their knowledge and can reach to the new dimension of learning. It increases reasoning, problem solving and lifelong learning skills, which are the requirements of the present world. Technologies are also useful for language learning. This kind of learning is called Technology Assisted Language Learning (TALL). It is an umbrella term which includes Audio – Visual Aids, Computer Assisted Language Learning (CALL), Mobile Assisted Language Learning (MALL), Web Based Learning and many more. These all involved in the process of language learning. The TALL is represented by the use of technology to encourage educational learning that includes word processing, presentation package, guided drill and practice, stimulation, problem solving, language games and internet for language learning process(Levy, 1997). One of the branches of TALL is Web Tools which are used for language learning. Specifically more emphasis is given to the Web 2.0 Tools.

Web Tools

Web Tools are providing new opportunities for learning, earning and living. Web Tools have opened doors of knowledge through which students can have access to the information which were difficult to have 20 years before. It is the world of Globalization and where communication and collaboration are possible irrespective of time and place (Solomon and Schrum, 2007). People of the world are using Web Tools regularly and this number is still increasing. Many of them are using Web Tools for teaching – learning language. Web 2.0 Tools are used to two way interaction, where in user can share the information and others can also initiate in editing and updating those information. The basic difference between Web 1.0 and 2.0 Tool related to sharing of information. In Web 1.0 only the content creator was able to make modifications in the content (Cormode and Krishnamurthy, 2008). Because of this majority of viewers were only consumers of the content, which can called one way process of sharing information. But in Web 2.0 Tools participant can create content and allowed to make changes, give response, interact and design the content, which is called two ways process of communication.

Web 2.0 Tools

Web 2.0 Tools are useful for teaching and learning in the classroom. It has competence to enhance, compliment and add new collaborative element to the teaching – learning process. There are many Web 2.0 Tools like Blogs, Podcast, Wikis, YouTube, Nice Net, Quill and many more. These Web 2.0 Tools provides different kinds of unique and powerful information sharing platform for cognitive level of learning process. Web 2.0 Tools have provided space for the students where in anyone can participate to seek knowledge (Parker and Chao, 2007). Quill is one of the Web 2.0 Tools through this kind of teaching –learning process takes place. It is task based and self-learning Web Tool for the students. Quill is a Web Tool that is used for personalized and interactive lessons for the students. Quill was inspired by Laura Gibbs who was an English professor at the University of Oklahoma. She used to make her students to do proofreading by reading an essay of two pages which were containing eighty grammatical errors. The same way Quill provides activities like sentence writing and proofreading for learners. It focuses on grammar. Quill provides grammar based activities in each lesson. It does not allow learners to memorize grammar rules instead of students learn thorough trial and error. Students are supposed to understand the examples given and then they have to correct sentences on their own. After doing this students use to get immediate feedback of their attempts. Quill also provides function of proofreading which are filled with grammatical errors. In this proofreading students' job is to identify errors and fix each error. After doing so quill highlights students' own errors and provides a report on particular subject area (www.quill.org). Quill use to give immediate feedback of lesson and provides encouragement to the students so that they can repeat assignment until they achieve perfection.

Quill's mission is to make anactive learning environment by presenting learners with issues to comprehend and permitting them to find solutions. In this environment, learners assume responsibility of their own education. Quill is an online Web based Tool that gives customized, interactive written work lessons for learners. Over the coming years, Quill will move beyond sentence composing and editing, into different kinds of other written work activities.

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In the present paper entitled *"A Survey on Usefulness of Quill Web Tool for English Language Enhancement"*, Researcher has conducted survey on the students of P P Savani University who used Quill for language enhancement. Through this survey Researcher wanted to know usefulness of Quill for English Language learning.

Objective of the Study
➢ To develop and implement questionnaire for students to know usefulness of Quill.
➢ To know students' opinion about the use of Quill.
➢ To study usefulness of Quill to learn English Grammar.
➢ To know students experience regarding use of Quill to learning English language.

Methodology of the Study
Research Methodology contains Research Design, Population, Samples, Tools for Data Collection, Procedure of Data Collection and Procedure of Data Analysis. These steps provide the outline of whole research that how Researcher has conducted the research. By reading Research Methodology one can easily get the whole idea of conducted research.

Design of the Study
Present study was Survey type in nature. Specifically, it was Normative Survey type.Survey research is useful for documenting existing community conditions, characteristics of a population, and community opinion. In this research Researcher tried to know opinion of students regarding use of Quill for language enhancement.

Population of the Study
All the students of P P Savani University were considered as population for the present research.

Sample of the Study
From the total population students who used Quill web tool during their studies were considered as sample for the present Research. There were 80 students who responded to the questionnaire. All these students were considered as samples for the present study.

Delimitation of the Study
Present study has been delimited to the students of the first year of P P Savani University, who used Quill Web Tool during academic year 2021-22 in the H P P Savani University.

Tools of Data Collection
Questionnaire
For achieving the objective of the present study, the Researcher has prepared a questionnaire. In this questionnaire researcher has used different kinds of questions. Questionnaire contained questions related to the use of Quill to learn English language. There were both open ended and close ended types of questions. There were 19 close ended questions and 1 open ended question. From the questionnaire Researcher wanted to know students' opinion about the use of Quill to learn English language. Questions in the questionnaire were related to students' experience about the use of Quill Web Toll, skills that students learned, future use of Quill to learn language and functioning of Quill in learning process. These kinds of questions were considered basic things which teacher should know. Keeping in mind these things questions were prepared by the Researcher.

Procedure of the Study
Procedure of Data Collection is useful to give information about how research was conducted and which procedure was used to collect the data. From this one can easily get the idea about Researcher's process of collecting data. The process of data collection has been divided into three phases. They are mentioned below:

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Phase 1: Development and Drafting Questionnaire
Phase 2: Development of Google Form for Data collection
Phase 3: Implementation of Questionnaire on Students
Phase 4: Data Collection of the Questionnaire

Data Analysis

Questionnaire contained 20 questions related Quill and its' usage. From these questions 19 were close-ended question and 1 was open-ended question. These questions were analysed quantitatively and qualitatively. Close-ended questions were analysed quantitatively using frequency and percentage and open-ended questions were analysed qualitatively using content analysis. First close-ended questions were analysed. Above mentioned table indicated that there were 80 students who responded to the Questionnaire. This table contained responses related to the grammar topic/s that students learnt through Quill. For this question 58, 62, 72, 41 and 36 students who responded for Tenses, Prepositions, Articles, Conjunctions and other respectively for this question. In percentage it is 72.50, 77.50, 90.00, 51.25 and 45.00 respectively for the same. From Table 2 was based on easiness of Quill for English Language Learning. From this table it was found out that there were 74 students who responded Yes and 6 students who responded No for this question. In percentage it is 92.50 and 7.5 respectively for Yes and No. Table 3 shows the analysis of the data based on the Learning through Quill to comprehend English Grammar. For this question 69 students responded as Yes and 11 students responded as No. which indicated that most of the most of the students were in the favour of Quill to learn English Grammar. In percentage data is 86.25 and 13.75 respectively for Yes and No. Above mentioned table 4 is about the practical approach provided by Quill for English Language learning. For this question 71 (88.75%) students responded that Yes Quill provided practical approach. There were 9 (11.25) students who responded that No Quill did not provided practical approach for English Language Learning.

This table 5 is about the emphasised language skills in Quill. From this table it was found put that there were only 3 students who mentioned Listening Skills, no student mentioned Speaking Skill, 24 students mentioned Reading Skills and 53 students mentioned Writing Skills. Table 6 is about the use of Quill to understand concept of English grammar for longer time. Students were made to responses of this question on five-point scale from Strongly Agree to Strongly Disagree. For this question 37 students responded Strongly Agree, 25 students responded Agree, 13 students were Not Sure, 3 Students were Disagree and 2 Students were Strongly Disagree. In percentage these responses were 46.25, 31.25, 16.25, 3.75 and 2.50 respectively for Strongly Agree, Agree, Not Sure, Disagree and Strongly Disagree. This table 7 is based on Quill to comprehend Topics more clearly. For this question 23 students responded Strongly Agree, 37 Students responded Agree, 12 students responded Not Sure, 4 students responded Disagree and 2 students responded Strongly Disagree. In percentage responses were 28.75, 48.75, 15.00, 5.00 and 2.50 respectively for Strongly Agree, Agree, Not Sure, Disagree and Strongly Disagree. Above mentioned table 8 is based on the information related to Explanation of grammatical terms with examples through Quill. From this table it is found out that there were 34 students responded Strongly Agree, 29 Students responded Agree, 12 students responded Not Sure, 3 students responded Disagree and 2 students responded Strongly Disagree. In percentage responses were 42.50, 36.25, 15.00, 3.75 and 2.50 respectively for Strongly Agree, Agree, Not Sure, Disagree and Strongly Disagree.

Through this table 9 Researcher wanted to know active involvement of students in the tasks provided through Quill. From this table it was found out that there were 29 (36.25), 34 (42.50), 16 (20.00), 1 (1.25) and 0 (0) students who responded respectively for Strongly Agree, Agree, Not Sure, Disagree and Strongly Disagree in terms of students active involvement in the tasks. Above mentioned table 10 is about removing burden of remembering English grammar rules. From this table it is found out that there were 36 students responded Strongly Agree, 31 Students responded Agree, 9 students responded Not Sure, 3 students responded Disagree and 1 student responded Strongly Disagree. In percentage responses were 45.00, 38.75, 11.25, 3.75 and 1.25 respectively for Strongly Agree, Agree, Not Sure, Disagree and Strongly Disagree. This table 11 is about the use of different kinds of activities provided by Quill for English language leaning. For this question 42 students responded Strongly Agree, 29 Students responded Agree, 8 students responded Not Sure, 1 student responded Disagree and no student responded Strongly Disagree. In

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percentage responses were 52.50, 36.25, 10.00, 1.25 and 0.00 respectively for Strongly Agree, Agree, Not Sure, Disagree and Strongly Disagree. Above mentioned table 12 is about students' increase of interest to learn English grammar. For this question responses of students were collected. From the responses it was found out that 23 students responded Strongly Agree, 37 Students responded Agree, 12 students responded Not Sure, 5student responded Disagree and 3 students responded Strongly Disagree. In percentage responses were 28.75, 48.25, 15.00, 6.25 and 3.75 respectively for Strongly Agree, Agree, Not Sure, Disagree and Strongly Disagree.

This table 13 is to know how many students enjoyed learning with the use of Quill. From this table it is found out that there were 37 (48.75), 28 (35.00), 11 (13.75), 2 (2.50) and 0 (0) students who responded respectively for Strongly Agree, Agree, Not Sure, Disagree and Strongly Disagree about their enjoyable experience of learning through Quill. Above mentioned table 14 is based on the corrections provided by the Quill, if any, after attempting tasks. For this question 63 students responded Strongly Agree, 14 Students responded Agree, 3 students responded Not Sure, no student responded Disagree and no student responded Strongly Disagree. In percentage responses were 78.75, 17.50, 3.75, 0.00 and 0.00 respectively for Strongly Agree, Agree, Not Sure, Disagree and Strongly Disagree. Table 15 is about the Combination of theory, examples and activities made learning interesting for each topic through Quill. For this question 39 students responded Strongly Agree, 32 Students responded Agree, 7 students responded Not Sure, 1 student responded Disagree and 1 student responded Strongly Disagree. In percentage responses were 48.75, 40.00, 8.75, 1.25 and 1.25 respectively for Strongly Agree, Agree, Not Sure, Disagree and Strongly Disagree. This table 16 is related to the use of Quill earlier than this for English language learning. From the responses of the students it was found out that only 3 students had used Quill before than this to learn English language. There were 77 students out of 80 who had not used Quill before than this to learn English language. In percentage it is 3.75 and 96.25 respectively for Yes and No. Above mentioned table is related to usefulness of Quill in future. For this question 76 students responded Yes indicating usefulness of Quill in future. There were 4 students who responded No about the use of Quill in future. In percentage it is 95.00 and 5.00 respectively for Yes and No. Table 18 is related to suggesting friends to use Quill to learn English language. For this question 76 students responded Yes that they will suggest their friends to use Quill to learn English language.

There were 4 students who responded No about suggesting friends to use Quill to learn English language. In percentage it is 95.00 and 5.00 respectively for Yes and No. This table 19 is related to making students to use Quill to learn English language. For this question 76 students responded Yes indicating making other students to use Quill to learn English language. There were 4 students who responded No about making other students to use Quill to learn English language. In percentage it is 95.00 and 5.00 respectively for Yes and No. There were close-ended questions which were analysed quantitatively using frequency and percentage. There was 1 open ended question in the Questionnaire which was analysed using content analysis. This question was related to students' experience regarding use of Quill in few words. This question was analysed quantitatively. After analysis of this question it was found out that most of the students were having positive responses regarding experience of Quill to learn English Language. Further it was found out that there were many students who wanted to continue to use Quill so that they can improve their Grammar skills. Some students responded that tasks and activities helped them to identify their common errors that they come across when they were using Quill. Further students mentioned that it was practical way of learning for them.

Major Findings
Researcher analysed the data collected rough Questionnaire. From the analysis of the data Researcher came across many findings regarding Quill and its' usefulness for English language enhancement. These findings are mentioned as below:
➢ Majority of the students mentioned that they learnt Tenses, Prepositions, Articles and Conjunctions through Quill.
➢ Majority of the students mentioned that it was easy for them to learn English through Quill.
➢ Majority of the students mentioned that Quill was useful to comprehend English Grammar topics and their points.

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➢ Majority of the students mentioned that Quill had provided practical approach for English language learning.
➢ Majority of the students mentioned that Quill is useful to improve Reading and Writing Skills.
➢ Majority of the students were Strongly Agree and Agree regarding use of Quill to understand concept of grammar for longer time.
➢ Majority of the students were Strongly Agree and Agree regarding comprehending topics more clearly.
➢ Majority of the students were Strongly Agree and Agree regarding use of Quill to learn grammatical points with examples.
➢ Majority of the students were Strongly Agree and Agree about their active involvement in the tasks provided through Quill.
➢ Majority of the students were Strongly Agree and Agree in terms of reducing burden of remembering grammar rules.
➢ Majority of the students were Strongly Agree and Agree about different kinds of activities were provided by Quill for English Language Learning.
➢ Majority of the students were Strongly Agree and Agree about increasing interest of learning Grammar through Quill.
➢ Majority of the students were Strongly Agree and Agree regarding their experience of learning through Quill.
➢ Majority of the students were Strongly Agree and Agree about corrections provided by Quill after completing the tasks.
➢ Majority of the students were Strongly Agree and Agree regarding combination of theory, examples and activities made our learning interesting for each topic.
➢ Majority of the students were not having experience of Quill before this.
➢ Majority of students mentioned that Quill will useful for them in future.
➢ Majority of the students mentioned that they will suggest their friends to use Quill
➢ Majority of the students mentioned that they will make their students to use Quill to learn English language.
➢ Majority of the students were having positive experiences and they mentioned that they enjoyed this way for learning English language.

CONCLUSION

In the world of the technology, where people are becoming techno-savvy and relaying on technology. So these technologies can be used for teaching – learning purpose. There are various kinds of technologies which are available to encourage education. From all those technologies Web 2.0 based learning is one of them. Web 2.0 Tools can take education to the new platform. There are specific Web 2.0 Tools which are used for particular types of learning. From all those Web 2.0 Tools Quill is a Web 2.0 Tool which is used to improve English Grammar. Instead of learning English Grammar through memorizing rules, Quill provides practical way of learning grammar, though which English Language learning is not a difficult task. Quill has provided new way of learning English Grammar to the students and has removed fear for the same.

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Table.1: Grammar topic/s that students learnt though Quill

Total Students	Tenses	Prepositions	Articles	Conjunctions	Other
80	58	62	72	41	36
Percentage	72.50	77.50	90.00	51.25	45.00

Table.2:Easy to use Quill

Total Students	Yes	No
80	74	6
Percentage	92.50	7.50

Table.3:Learning through Quill to comprehend English Grammar

Total Students	Yes	No
80	69	11
Percentage	86.25	13.75

Table.4: Practical approach provided through Quill for English Language learning

Total Students	Yes	No
80	71	9
Percentage	88.75	11.25

Table.5: Language Skill/s emphasised in Quill

Total Students	Listening	Speaking	Reading	Writing
80	3	0	24	53
Percentage	3.75	0	30.00	66.25

Table.6:Quill is useful to understand concepts of English grammar for longer time

Total Students	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
80	37	25	13	3	2
Percentage	46.25	31.25	16.25	3.75	2.50

Table.7: Quill to comprehend Topics more clearly

Total Students	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
80	23	37	12	4	2
Percentage	28.75	48.75	15.00	5.00	2.50

Table.8: Explanation of grammatical terms with examples through Quill

Total Students	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
80	34	29	12	3	2
Percentage	42.50	36.25	15.00	3.75	2.50

Table.9:Active involvement of students in the tasks provided Quill

Total Students	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
80	29	34	16	1	0
Percentage	36.25	42.50	20.00	1.25	0.00

Table.10: Removing the burden of remembering English Grammar rules

Total Students	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
80	36	31	9	3	1
Percentage	45.00	38.75	11.25	3.75	1.25

Table.11: Different kinds of activities provided by Quill for English Language learning

Total Students	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
80	42	29	8	1	0
Percentage	52.50	36.25	10.00	1.25	0.00

Table.12:Increase of interest to learn English grammar

Total Students	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
80	23	37	12	5	3
Percentage	28.75	48.25	15.00	6.25	3.75

Table.13:Enjoyable experience of learning through Quill

Total Students	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
80	37	28	11	2	0
Percentage	48.75	35.00	13.75	2.50	0.00

Table.14: Immediate correction provided through Quill

Total Students	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
80	63	14	3	0	0
Percentage	78.75	17.50	3.75	0.00	0.00

Table.15:Combination of theory, examples and activities made learning interesting

Total Students	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
80	39	32	7	1	1
Percentage	48.75	40.00	8.75	1.25	1.25

Table.16: Use of Quill before this to learn English Language

Total Students	Yes	No
80	3	77
Percentage	3.75	96.25

Table.17: Usefulness of Quill in future

Total Students	Yes	No
80	76	4
Percentage	95.00	5.00

Table.18: Suggesting friends to use Quill to learn English language

Total Students	Yes	No
80	76	4
Percentage	95.00	5.00

Table 19:Making students to use Quill to learn English language

Total Students	Yes	No
80	76	4
Percentage	95.00	5.00

RESEARCH ARTICLE

Phenological Analysis in Relation to Physiological and Yield Attributes of *Triticum aestivum* L. (Wheat) under Late Planting Condition

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ABSTRACT

The aim of the present study was to identify the heat-tolerant genotype to understand the phenological adjustment under late planting condition in wheat and to evaluate the physiological and yield attributes. Present study was conducted in the pot house of Baba Mastnath University, Rohtak complete randomized design (CRD) with three replications under three sowing condition (viz., normal sown, late sown and very late sown) during winter season of mid-November to April, 2020-21 and 2021-22 with ten selected wheat genotypes *viz*.C-306, HD-3086, NSGW-27, DBW-90, WH-1124, DBW-90, NSGW-9, WH-730, NSGW-1, Raj-3765 and WH-1105.In controlled conditions, genotypes were sown at optimum planting date, while for heat-stressed experiment sowing date was delayed. The data were subjected to one factor and two factor analyses the following statistically analyses using online OPSTAT software. The results revealed that sowing at various sowing conditions observed the maximum yield parameters viz., biomass/plant, grain yield, test-weight of wheat over sowing at optimum, late and very late sown condition. The study was found to be non-significant with days to heading (DH) and days to an thesis (DA) at different heat environment. The genotypes (C-306, HD-3086 and NSGW-27) significantly showed the highest mean value of yield related parameters compared with other genotypes (NSGW-1, RAJ-3765 and WH-1105) under different sowing environment conditions. The present study is concluded that genotypes would be used for future cultivation under heat-affected areas.

Keywords: Wheat, Phenology, Yield attribute, late sown, Genotype

INTRODUCTION

In India, the impact of climate change may be seen in the form of short period of winters and the start of summer much earlier than usual. Due to the close proximity to equator and late seedling of wheat (due to late rice harvesting), the wheat crop (*Triticum aestivum* L.) is exposed to extreme heat stress during the grain filling stage, resulting in terminal heat stress and reduction of yield parameters. Recent studies have been conducted to examine the long-term influence of climatic variability on wheat output and propose adaptation techniques to mitigate its detrimental effects in India. Annual production of wheat 106.21 Mt and productivity of 3160 kg/ha during 2019-20 its occupies the 33.61 Mha area that reported by IIWBR, (2020).Global warming is a serious problem faced by the agriculture sector and mitigating its adverse effects is becoming a challenge while the incoming long wave radiations being directly onto the earth surface (Lakhran *et al.*, 2020). Rainfall and temperature inconsistency circumstantially have a significant impact on the success of agriculture sectors. Various biotic and abiotic stresses, high temperature is a common occurrence that creates a serious risk to crop production (Balla, 2019). India increased from 23.832 million tonnes in 1971 to 108.75 million tonnes in 2021 growing at an average annual rate of 3.42% and many research done by Bana *et al.*, (2022) that high yielding and medium early maturing wheat varieties are widely sown in India in 2020-2021, its production for India was 108.75 million tonnes (Bana *et al.*, 2022).

The wheat growing season in arid and semi-arid region of India are the great challenge in agriculture sectors under heat stress environments (Sabagh*et al.*, 2019). Late planting condition for wheat crop usually is delayed when toria, potato, pigeon pea, sugarcane, cotton and rice are grown before wheat. According to Refay (2011) sowing period is an important role in wheat cultivation, its sowing phase is delayed from 21st November to 21st December and ahead this is said to be a late planting conditions. The ideal range of temperature varies from 12 to 22°C for growing spring wheat cultivar at anthesis and grain filling period (Farooq, 2011). Reproductive stage and grain filling period coincides with increasing trends of temperature and drought environments in March and April, which responsible for decline growth and grain yield in the late planting conditions (Barutçular *et al.*, 2017; Hossain *et al.*, 2018). In the case of delayed sowing of wheat facing heat stress such as flowering and filling of grain declines the grains number in kernals, a significantly reduction of 16 percent yield as compared to normal sown (Agalodiya *et al.*, 2011; Hussain *et al.*, 2018). The developing grains are active sites for the synthesis of metabolites and macromolecules including starch and proteins both are essential for plant growth and development (Verma *et al.*, 2018). The crop sown in January compared to one sown in November resulting in reduces 62 percent yield (Thapa *et al.*, 2020). The terminal heat stress at anthesis and grain filling stages speed up maturity and significantly reduce grain size, weight (1.5mg per day) can occur for every 1°C above 15-20 °C (Tewari and Tripathy, 2012).Prasad *et al.*, (2008) resulted that decrease the time to flowering, grain set, and physiological maturity when wheat was exposed to high temperature (20-24°C), which eventually reducing grain yield. Genotypes with shorter vegetative periods and longer reproductive periods thrived well in existing environmental condition (Upadhyaya and Bhandari, 2022). In the current environmental conditions, genotypes with shorter vegetative periods and longer reproductive periods prospered (Upadhyaya and Bhandari, 2022).

This late-sown crop substantially needs higher number of irrigations because to the low temperature during early establishment and higher temperature at the reproductive stage (Bana *et al.*, 2018). Temperatures exceeding 30 °C at the reproductive stage negatively impact on the rate and duration of grain filling and eventually such terminal heat stress significantly reduce wheat yield (Suryavanshi *et al.*, 2016). In contrast, early sown wheat reduces the risk of high temperature and consequently produces more yields (Dubey *et al.*, 2019; Pathania *et al.*, 2018). Heat stress effect in each phenological stage, which consistent to the physiological accumulation of heat stress in each growth stage, beginning from tillering, through stem elongation, to heading and grain filling stage of wheat (Solanki *et al.*, 2017). Drought and high temperature induced earlier mobilization of non-structural reserve carbohydrates from stem and leaf sheaths, which provided a greater proportion of grain dry weight at maturity (Ram *et al.*, 2018). Heat stress as well as combined effect of drought and high temperature, plants show different morphological, physiological, biochemical, and molecular adaptations that result in stress tolerance under heat stress (Sarkar *et al.*, 2021; Mishra *et*

al., 2021) or combined heat and drought stress (Zahra *et al.*, 2021). The phenology parameters of wheat related with growth and yield parameters determines adaptation to different thermal environments, an understanding of the genes underlying developmental variation (Hyles *et al.*, 2020). Adjusting sowing dates and changing cultivars could also be a useful intended or unintended climate change adjustments, especially for crops (Waha *et al.*, 2013). The tested genotypes of wheat showed a significantly variations based on yield attributes viz. C-306, HD-3086 (maximum yielding), NSGW-27, DBW-90 (heat-tolerant) and RAJ-3765 and WH-1105 (minimum yielding). The phenological alteration was assessed to investigate the relation of yield parameters with growth and weight of grain under different sowing time conditions.

MATERIALS AND METHOD

Experimental site, plant material, raising of crop

The research was carried out for two rabi seasons of 2020-2021 and 2021-2022 at the pot house of Baba Mastnath University, Rohtak under pot house environment conditions. Ten wheat (*Triticum aestivum* L.) genotypes viz., C-306, DBW-90, HD-3086, NSGW-27, NSGW-9, NSGW-1, RAJ-3765, WH-1105, WH-1124 and WH-730 genotypes were procured from   Department of Genetics and Plant Breeding, Chaudhary Charan Singh Haryana Agricultural University, Hisar (Haryana) recommended for timely, late and very late sown irrigated environment. Seed were grown in earthen pots filled with 10 kg farm soil. Then the seeds of wheat were surface sterilized by 1 % (w/v) solution of mercuric chloride (HgCl$_2$) for 5 min to avoid contamination before using them for experiment. Sowing was completed when pots were maintain field capacity and watered thrice times in a week to maintain water content in the soil.

Experimental design and treatments

The experiment was laid out in a complete randomized design (CRD) with three pots for each genotype with three replications. Five seeds were sown in each pot under different sowing time. In late sown conditions, sowing was delayed by one month from the normal sowing conditions and for very late sowing conditions, sowing was delayed by one month from the late sowing. The total numbers of treatment were thirty, while the numbers of experimental units were ninty.

Observation recorded

The research formulated for wheat genotype under different sowing time with irrigated conditions. The research were observed on phenological adaptations in relation to yield parameters viz., days to heading (DH), days to anthesis (DA), days to maturity (DM) and yields (biomass/plant, grain yield/plant and test weight), separately on each pot and average was taken out. Plants tagged at the days to heading for observation recorded. The number of days to heading was calculated from sowing to 75% of spike emergence in the pot. From each pot, three plants were randomly selected for calculated to number of days (DA) from sowing time to 75% appearance of anthesis, when the opening of bud during the flowering period. The number of days was calculated from the date of sowing to the date on which the 75% ear heads losses green colour for days to maturity. The cell membrane stability (%) was calculated by the method of Ibrahim and Quick, (2001). The sample for flag leaf, randomly three plants from each replication of each pot was collected from an thesis period till maturity period at interval of seven days. The method adopted by Ram et al, (2017) was used for calculate the relative water content. The biomass was calculated in three randomly selected in each pot, averaged and calculated as plants were cut from the base of stem at maturity and weight was taken using spring balance in kilograms. The spikes were threshed and the number of grains were calculated and average taken out. The randomly selected grain for weight, clean and filled 1000 grains was measured in grams from each replication using electronic balance and average was recorded. Crop was threshed and to record for grain yield.

Statistically analysis

The data was analyzed by one-way and two-way analysis of variance for the complete randomized design (CRD) using OPSTAT software available on www.http// hau.ernet.in home page (Sheoran *et al.*, 1998) where each

observation was three times replicated and CD at 1% was calculated. The data was observed while each value of experiment recorded even as mean ± S.E. at significant different at 0.05 and mean value of three sets of experiment independently.

RESULTS AND DISCUSSION

Temperature play a crucial role in all stages of wheat growth and development such as   heading, an thesis and physiological maturity therefore it effect on other parameters important for development and rate of water supply, but may varies with phenological stages and species and cultivar of plant reported by Wahid *et al.,* (2007). The mean±S.E. of different wheat genotypes showed different responses and phenological, physiological and yield related attributes were analysed under various sowing environments.

Phenological
Days to heading observed that mean value ranged from 82.7-92.5 under normal sown, the mean value was ranged from 72.3-90.5 and from 62.7-73.5 during late and very late sown environments respectively.The results of statistically for days to anthesis indicated in Table 1. Average days to anthesis for genotypes ranged from 90.0 to 102.8 (timely sown), 83.0to 92.9 (late sown) and 66.9 to 78.2 (very late sown). Days to maturity observed between 130.3-138.6, 105.0-118.0 and 91.0-102.6 under normal sown, late sown and very late sown environments respectively. Late planting condition resulted in a reduction in average days to physiological maturity from 134.6 to 95.7 whereas mean reduction in genotype for days to physiological maturity from 119.7 to 108.8 in Table 2. Similar trends were observed by Lakhran *et al.* (2020) that a significantly influenced the yield attributes of wheat under different sowing time along with the application of bioregulators. The results showed reduction in days to heading and days to maturity in late sown over timely sown but greater reduction was observed in heat sensitive parent WH711 as compared to heat tolerant parent WH1021 studied by Sangwan *et al.* (2019). Jena *et al.* (2017) observed that days to heading and days to maturity were accelerated under heat stress environments, noticed similar finding with this present study. Nahar *et al.* (2010) and Saxena*et al.* (2016) also studied in reduction of maturity period of wheat cultivars during the high temperature condition, which was also reported in this study. The early heading occurs, the grain filling period will be comparatively longer (Upadhyaya and Bhandari, 2022).

Physiological
Relative water content (RWC) and membrane stability index act as a good indicator for various abiotic stress such as drought and high temperature in plants, as well as measure of turgor pressure in leaf (Pour-Aboughadareh*et al.,* 2017).Sharma *et al.,* (2016) reported that a significant reduction in relative water content during drought stress in barley. A significantly reduction in relative water content during different time of sowing viz., normal, late and very late in genotypes of wheat indicated presently Table 4. Genotype C-306 (92.2±1.953, 78.0±0.448 and 72.4±1.161) followed by HD-3086 (86.5±1.513, 78.2±0.361 and 77.5±1.513) and NSGW-27 (82.6±1.961, 80.2±0.361 and 78.2±0.657) observed more RWC during normal, late and very late sown environments respectively. Whereas wheat genotypes RAJ-3765 and WH-1105 had low RWC than other genotypes in wheat plant. Membrane stability index (%) of genotype RAJ-3765 of wheat was (61.5±1.249, 49.9±0.953 and 46.8±0.000) and WH-1105 (60.2 ± 0.120, 49.6 ± 0.953 and 45.2 ± 0.809) showed less membrane stability index (%) under normal, late and very late sown environments, genotype C-306 showed the highest membrane stability index (%) (74.1±1.097, 69.2±1.337 and 57.7±0.536) followed by HD-3086 (72.6 ±1.513, 61.6±1.521 and 56.2±0.536) and NSGW-27 (71.4±1.041, 61.1±0.505 and 55.0±0.176). Efeoglu and Terziglu (2007) reported that high temperatures at seedling growth decreased cell membrane stability in wheat. Khan *et al.,* (2015) examined the effect of high temperature stress on six wheat cultivars and reported that high temperature significantly affected total proline, soluble protein content, membrane stability index (MSI), yield and various yield components.

Yields

Genotype C-306 produced the highest biomass/plant (45.3, 33.9 and 26.3) followed by HD-3086 (43.9, 32.4 and 24.5) and NSGW-27 (43.6, 31.6 and 21.9) whereas RAJ-3765 (34.6, 23.6 and 13.5) and WH-1105 (30.4, 24.6 and 11.5) produced the lowest biomass/plant seen Table 2 in normal, late and very late sown condition respectively. Genotype C-306 had highest biomass followed by HD-3086 and NSGW-27 whereas, RAJ-3765 and WH-1105 had minimum biomass in all tested genotypes. During very late sown environments, the genotype of wheat C-306, HD-3086 and NSGW-27 showed less reduction in yield related parameters as compared to NSGW-1, RAJ-3765 and WH-1105. Similar finding was observed in other yield related parameters like grain yield and thousand grain weight. Heat tolerant genotype C-306 and HD-3086 of wheat was indicated in Table 3(20.0 ± 0.473, 11.7 ± 0.000 and10.6 ± 0.208) and (19.3 ± 0.240, 11.0 ± 0.208 and9.8 ± 0.000) respectively during normal, late and very late sown environments which showed significantly percent reduction in grain yield was 47% and 50.7% respectively in genotype. Grain yield of genotype RAJ-3765 (heat susceptible) of wheat was (13.4 ± 0.328, 10.5 ± 0.000 and 4.9 ± 0.058)and WH-1105 (12.8 ± 0.208, 10.0 ± 0.058 and 4.3 ± 0.058) under normal, late and very late sown environments, which noticed percent reduction in grain yield was 63.4% and 66.4% in RAJ-3765 and WH-1105 genotype respectively.

The highest value for 1000 grain weight was found under normal sown (55.3g) whereas lowest value (21.5g) was found under very late sown condition showed in Table 3. The 1000 grain weight was found in C-306 (67.1 ± 0.985, 61.9 ± 1.577 and 42.6 ± 0.177) and HD-3086 (65.6 ± 0.296, 60.6 ± 1.513 and 36.7 ± 0.625) which showed percent reduction 36% and 44% in C-306 and HD-3086 respectively.1000 grain weight in heat susceptible observed in NSGW-1 (43.5 ± 0.058, 38.4 ± 0.066 and 14.3 ± 0.033) and WH-1105 (41.8 ± 0.067, 32.2 ± 0.328 and 13.0 ± 0.033) under normal, late and very late sown condition respectively and percent reduction in 1000 grain weight was 68% and 68.9%. Early sown (>20 °C) 3 crop faces high soil temperature obstruct seed germination, resulting in the reduction of grain yield (Barutçular *et al.,* 2017; Sabagh *et al.,* 2019). Ram *et al.,* (2017) reported that greater reduction in grain yield in both tolerant and susceptible cultivar under the combined effect of heat stress and drought. Wheat sown at 20ºC of mean temperature along with foliar spray of salicylic acid 200 ppm at ear emergence and tillering stages for alteration the conflicting effects of heat stress reported by Lakhran *et al.* (2020).

CONCLUSION

Phenology plays an important role in stress tolerance by improving physiological processes and; Finally improving grain yield in summer environments. The current study demonstrates that genotypes that are heat-tollerant exhibit late maturation, high water content, and maximum membrane stability. Under various sowing environmental conditions, genotypes C-306, HD-3086, and NSGW-27 displayed the highest mean values of days to maturity, membrane stability index, relative water content, and yield-related parameters (biomass per plant, grain yield, and test weight), whereas NSGW-1, RAJ-3765, and WH-1105 were found to be minimal in comparison to the other tested genotypes. Based on the aforementioned investigation, we hypothesised that genotypes C-306, HD-3086, and NSGW-27 would be employed for cultivation in high temperatures effected environment as well as late-sowing conditions.

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Conflict of interest

The authors do not have any conflict of interest

Data from other sources

Not applicable.

Consent to publish

All authors agree to publish the paper in Journal of Environmental Biology.

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Table.1:Assessment of wheat genotype under different high temperature stress condition for days to heading and days to anthesis

Genotypes	Days to Heading			Days to Anthesis		
	NS	LS	VLS	NS	LS	VLS
C-306	92.5±1.603	86.7±0.947	73.5±0.043	102.8±1.867	86.7±0.947	78.2±0.610
DBW-90	90.5±1.130	90.5±1.130	66.9±0.557	99.3±1.809	83.0±2.099	72.1±0.150
HD-3086	91.5±0.286	84.3±1.579	70.5±0.514	101.8±1.484	92.9±2.176	75.7±0.433
NSGW-1	84.1±1.269	76.6±1.076	63.8±0.830	92.4±0.914	83.2±1.256	69.0±0.539
NSGW-27	91.1±1.802	82.4±0.901	72.5±0.755	100.4±0.261	90.0±0.094	77.7±1.577
NSGW-9	88.0±1.786	78.7±0.860	66.5±0.900	96.3±0.602	85.3±1.643	71.7±0.783
RAJ-3765	83.9±0.655	72.9±1.138	63.0±0.295	91.2±0.570	79.5±0.165	67.2±0.979
WH-1105	82.7±1.506	72.3±0.339	62.7±0.587	90.0±1.452	78.9±1.643	66.9±0.035
WH-1124	86.2±0.987	78.1±1.748	64.5±0.420	92.4±0.866	84.7±1.719	68.7±0.951
WH-730	86.5±0.315	78.4±1.102	67.5±1.546	94.8±2.368	85.0±0.265	71.5±0.967
Factor one way						
C.D.	3.728	3.780	2.231	4.096	4.255	2.445
SE(m)	1.255	1.272	0.751	1.379	1.432	0.823
SE(d)	1.775	1.799	1.062	1.950	2.026	1.164
Factor two way	**C.D.**	**SE(d)**	**SE(m)**	**C.D.**	**SE(d)**	**SE(m)**
Treatment (T)	1.004	0.5	0.354	2.034	1.014	0.717
Genotypes (G)	1.832	0.914	0.646	1.114	0.556	0.393
Interaction (T×G)	N/A	1.583	1.938	N/A	1.757	1.242

Observation were taking in triplicate (each genotype) ± standard error at significant different at 0.05

Table.2:Assessment of wheat genotype under different high temperature stress condition for days to anthesis and biomass/plant

Genotypes	Days to Maturity			Biomass/Plant		
	NS	LS	VLS	NS	LS	VLS
C-306	138.6±1.443	117.8±1.901	102.6±1.655	45.3±0.176	33.9±0.177	26.3±0.058
DBW-90	135.4±0.281	113.0±1.905	96.0±1.199	42.5±1.041	31.6±0.416	20.2±0.058
HD-3086	138.0±3.016	118.0±0.307	100.1±0.259	43.9±0.625	32.4±0.153	24.5±0.176
NSGW-1	132.7±1.450	110.7±2.247	93.0±1.016	37.8±0.120	23.6±0.058	14.6±0.120
NSGW-27	136.9±1.139	116.1±1.390	98.0±1.377	43.6±0.152	31.6±0.208	21.9±0.058
NSGW-9	135.0±0.562	112.2±1.518	95.0±1.285	39.7±0.058	27.8±0.033	19.4±0.328

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RAJ-3765	131.0±1.090	107.4±0.671	92.7±2.074	34.6±0.777	23.6±0.569	13.5±0.058
WH-1105	130.3±2.373	105.0±1.967	91.0±0.900	30.4±0.361	24.6±0.265	11.5±0.058
WH-1124	134.1±0.978	111.0±0.404	94.0±1.252	39.6±0.745	26.8±0.416	16.3±0.058
WH-730	134.1±1.605	111.8±1.745	94.7±0.245	41.0±0.889	26.8±0.058	17.3±0.265

Factor one way						
C.D.	4.728	4.617	3.707	1.923	1.344	0.824
SE(m)	1.592	1.554	1.248	0.647	0.452	0.277
SE(d)	2.251	2.198	1.765	0.916	0.640	0.392
Factor two way	**C.D.**	**SE(d)**	**SE(m)**	**C.D.**	**SE(d)**	**SE(m)**
Treatment (T)	1.321	0.659	0.466	0.433	0.216	0.153
Genotypes (G)	2.411	1.202	0.85	0.791	0.345	0.279
Interaction (T×G)	4.176	2.082	1.473	1.371	0.683	0.483

Observation were taking in triplicate (each genotype) ± standard error at significant different at 0.05

Table.3:Assessment of wheat genotype under different high temperature stress condition for grain yield and 1000 grain wt.

Genotypes	Grain Yield			1000 Grain Wt.		
	NS	LS	VLS	NS	LS	VLS
C-306	20.0±0.473	11.7±0.000	10.6±0.208	67.1±0.985	61.9±1.577	42.6±0.177
DBW-90	18.5±0.208	11.0±0.120	7.9±0.058	59.4±1.009	54.2±0.089	24.4±0.361
HD-3086	19.3±0.240	11.0±0.208	9.8±0.000	65.6±0.296	60.6±1.513	36.7±0.625
NSGW-1	13.4±0.208	10.5±0.240	5.1±0.058	43.5±0.058	38.4±0.066	14.3±0.033
NSGW-27	19.0±0.208	11.3±0.208	8.6±0.000	52.3±1.009	51.6±0.713	20.3±0.088
NSGW-9	15.7±0.328	10.8±0.265	6.1±0.088	51.7±0.089	49.6±0.649	20.1±0.328
RAJ-3765	13.4±0.328	10.5±0.000	4.9±0.058	43.0±0.569	38.6±0.953	13.8±0.328
WH-1105	12.8±0.208	10.0±0.058	4.3±0.058	41.8±0.067	32.2±0.328	13.4±0.033
WH-1124	13.5±0.088	10.7±0.265	5.2±0.120	46.4±0.713	48.4±0.264	16.4±0.058
WH-730	14.1±0.240	10.9±0.088	5.2±0.058	51.5±1.073	48.1±0.385	12.6±0.296
Factor one way						
C.D.	0.806	0.523	0.269	2.120	2.477	0.875
SE(m)	0.271	0.176	0.091	0.714	0.834	0.295
SE(d)	0.384	0.249	0.128	1.009	1.179	0.417
Factor two way	**C.D.**	**SE(d)**	**SE(m)**	**C.D.**	**SE(d)**	**SE(m)**
Treatment (T)	0.174	0.087	0.061	0.582	0.29	0.205
Genotypes (G)	0.317	0.158	0.112	1.063	0.53	0.375
Interaction (T×G)	0.55	0.274	0.194	1.842	0.918	0.649

Observation were taking in triplicate (each genotype) ± standard error at significant different at 0.05

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Table.4:Assessment of wheat genotype under different high temperature stress condition for relative water content (%) and membrane stability index (%)

Genotypes	Relative Water Content (%)			Membrane Stability Index (%)		
	NS	LS	VLS	NS	LS	VLS
C-306	92.2±1.953	78.0±0.448	72.4±1.161	74.1±1.097	69.2±1.337	57.7±0.536
DBW-90	80.9±1.513	75.8±0.087	77.5±0.088	69.3±1.633	58.0±0.857	53.4±0.145
HD-3086	86.5±1.513	78.2±0.361	77.5±1.513	72.6±1.513	61.6±1.521	56.2±0.536
NSGW-1	73.2±1.753	68.8±0.241	67.7±0.921	64.8±0.657	50.9±1.185	48.6±0.889
NSGW-27	82.6±1.961	80.2±0.361	78.2±0.657	71.4±1.041	61.1±0.505	55.0±0.176
NSGW-9	82.0±1.721	72.3±0.865	70.3±0.921	68.1±1.665	58.1±0.416	53.8±0.985
RAJ-3765	71.8±1.249	67.3±0.777	65.5±1.545	61.5±1.249	49.9±0.953	46.8±0.000
WH-1105	69.3±1.249	66.7±1.721	64.3±0.061	60.2±0.120	49.6±0.953	45.2±0.809
WH-1124	75.4±0.889	69.5±0.208	68.3±0.833	62.4±1.017	52.2±0.361	49.9±0.176
WH-730	79.4±1.994	74.4±1.281	67.3±0.593	65.9±0.296	55.3±0.058	51.7±1.249
Factor one way						
C.D.	4.530	2.400	2.851	3.406	2.758	2.022
SE(m)	1.525	0.808	0.960	1.147	0.928	0.681
SE(d)	2.157	1.142	1.357	1.621	1.313	0.963
Factor two way	C.D.	SE(d)	SE(m)	C.D.	SE(d)	SE(m)
Treatment (T)	1.022	0.510	0.361	0.841	0.419	0.297
Genotypes (G)	1.867	0.931	0.658	1.536	0.766	0.542
Interaction (T×G)	3.233	1.612	1.140	2.660	1.327	0.938

Observation were taking in triplicate (each genotype) ± standard error at significant different at 0.05

RESEARCH ARTICLE

Phytochemical Screening and Fluorescence Analysis of 4 *Curcuma* Species: *Curcuma aromatica* Salisb., *Curcuma caesia* Roxb., *Curcuma longa* L. and *Curcuma zedoaria* Roscoe the Zingiberaceae Rhizomes

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ABSTRACT

Green plants play a key role in medicinal and aromatic compounds that have improved human health care by synthesizing and preserving a variety of biochemical products that are used as raw materials for drug development. The varieties of turmeric use prepare many Ayurveda medicines. *Curcuma* rhizomes are used as dry powder form an essential source of food additives, spice and condiments. It is used as carminative, stimulant, treat inflammation, burns, leucorrhea, bronchial complaints, digestive disorders, various pathological conditions including cancer and insect bites in traditional medicine. Their chemical active ingredients, which have distinct physiological effects on the human body, are what give them their medical worth. In this study, four species of *Curcuma* will have their phytochemicals and fluorescence analyze (*Curcuma aromatic* Salisb., *Curcuma caesia* Roxb., *Curcuma longa* L. and *Curcuma zedoaria* Roscoe). The phychemical analysis reveals that aqueous extracts contain substances such as sugars, proteins, lipids, alkaloids, glycosides, phenolic compounds, saponins, steroids, and terpenes. The fluorescence feature is a crucial factor in the pharmacognostic assessment of unprocessed medicines. It is crucial in determining the quality and purity of drug-related raw materials. The results of this study can be used to identify genuine samples and spot adulterants in turmeric powders.

Keywords: *Curcuma*, Turmeric, *Zingiberaceae*, Medicinal, Rhizome, Phytochemical

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INTRODUCTION

Curcuma aromaticav Salisb. is an erect, perennial endangered medicinal herb with slender tuber roots. It is called as 'Kasthurimanjal' in Tamil, belongs to the family Zingiberaceae [1]. *Curcuma caesia* Roxb. is an erect medicinal herb listed as an endangered species belongs to the family Zingiberaceae. It is 'Karumanjal' in Tamil. The rhizome has been utilized for both therapeutic and spiritual purposes for ages [2].It is a good herbal remedy for lung ailments and possesses anti-cancer properties. Topical application of rhizome paste may offer comfort for sore, aching joints. The perennial rhizomatous herb Curcuma longa L., also known as "Manjal" in Tamil, is a member of the Zingiberaceae family [3]. The *d*ried rhizome powder is golden spiceand very versatile condiment helps with digestion. It is a powerful super food that can help in at fighting and potentially reversing several ailments arthritis pain, treat burns, boost immunities and cancer treatment. It is applied externally to treat infections, skin eruptions, sprains, bruises, and bruising [4]. *Curcuma zedoaria* Roscoe is large perennial shrub called as "Kichilikizhangu" in Tamil, belongs to the family Zingiberaceae. The plant is traditionally used to cure ulcers, menstrual abnormalities, inflammation, pain, and other skin conditions including wounds [5]. Phytochemicals are classified into primary and secondary constituents. The carbohydrates, proteins and fatsare primary constituents most abundant in plants.Proteinsare an essential compound of the protoplasts. Fats are energy storage reserve material as non-volatile oils.Thealkaloids, glycosides, phenolic compounds, steroids and terpenes are secondary constituents. Alkaloids are nitrogenous waste productsoccur as salts of organic acids. Glycosides are complex organic molecules may serve to regulate the acidity and alkalinity of plant cells. Flavonoids are polyphenol compounds, widely distributed in plants. Tannins are naturally occurring polyphenols protect plants from bacteria or fungi infections and predation. The preliminary tests used to determine the presence of phytochemical occurin rhizome extracts rely on the visual observation of color change or the formation of a precipitate after the addition of particular reagents [6]. A photon released from an excited state of a molecule is what causes fluorescence. A normal molecule in the ground state can easily induce them by exposing it to light, but because the excited state's duration is often very brief, the molecule returns to the ground state by dissipating the excitation energy as heat, fluorescence or both [7]. UV chamber is an instrument has an appropriate source of light. Thelignin, chlorophylls, vitamins and many phenolic compounds displays auto fluorescence. These products when irradiated with light of a specific spectral region. They emit radiation of longer wavelength. Few phytochemicals exhibit noticeable fluorescence in daylight. Many natural compounds glow when exposed to ultra violet light. This fluorescence is not observable in daylight. If a chemical doesn't naturally fluoresce, it can frequently be transformed by the use of various reagents into a fluorescent derivative or a breakdown product [8].

MATERIALS AND METHODS

Plants collection
The rhizomes of *Curcuma aromatic* Salisb., *Curcuma caesia* Roxb., *Curcuma longa* L. and *Curcuma zedoaria* Roscoe were bought at the market, Chennai, India. Through reading the literature, the plant materials were located [9].

Preparation of extract
The rhizomes cleaned, shade dried, powdered and extracted with distilled water in the ratio (1:5) using electric blender and filtered. The filtrate used for phytochemical analysis.

Phytochemical screening
Tannic acid test for alkaloids, Sodium-bi-carbonate test for carboxylic acid, Alkaline test for Coumarins and Flavonoids, Copper acetate test for Diterpenoids, Sudan-III testfor Fats, Concentrated Hydrochloric acid (HCl) test for Glycosides, Ferric chloride ($FeCl_3$) test for Phenolic compounds, dilute Hydrochloric acid test for Phlobatannins, Welker's Biuret's test for Proteins, Fehling's test for Reducing sugars, Acetone test for Resins, Foam's test for Saponins, Lead acetate test for Tannins, Salkowski's test for Steroids and Triterpenoids [10-16].

Fluorescence analysis

The dried rhizome fine powders treated with distilled water, Sodium hydroxide (NaOH), Ferric chloride ($FeCl_3$), Glacial acetic acid (GAA), Hydrochloric acid (HCl), Sulphuric acid (H_2SO_4) and Nitric acid (HNO_3).The fluorescence characteristics observed under dim, day, visible and ultra violet lights according to the method [17].

RESULTS AND DISCUSSION

Plants naturally contain phytochemicals. They play a key role in the preservation of human health and the medicinal properties of plants [18]. Starch is rich in underground rhizomes. Saponins and glycosides exert therapeutically significant effects. Theyhave detergent properties led to their use in shampoos, facial cleansers, cosmetic creams and adjuvants in development of vaccines. Phenolic and flavonoids possess radical scavenging activity, anti-carcinogenic, anti-inflammatory and anti-peroxidation effects. Numerous biological and pharmacological functions can be attributed to flavonoids [19]. Phlobatannins have wound healing properties, anti-inflammatory, analgesic and curative properties against diseases. Tannins act as anti-diarrhoea and anti-haemorrhagic agents. Therhizome extractof *C. aromatica* shows eleven phytochemicals reducing sugars, resin, fats, proteins, alkaloids, diterpenoids, tannins, coumarins, flavonoids, phenolic compounds and phytosterols. *C. caesia*extract shows nine phytochemicals resin, fats, proteins, alkaloids, diterpenoids, tannins, coumarins, flavonoids and phlobatannins. *C. longa* extract showseleven phytochemicals resin, fats, proteins, alkaloids, diterpenoids, tannins, coumarins, flavonoids, glycosides, phenolic compounds and tritereinoids. *C. zedoaria* extract shows ten phytochemicals reducing sugars, resin, fats, proteins, alkaloids, diterpenoids, tannins, coumarins, flavonoids and tritereinoids. Reducing sugars present in *C. aromatic* and *C. zedoaria.* The resin, fats, proteins, alkaloids, diterpenoids, tannins, coumarins and flavonoids are present in four *Curcuma species*. Glycosides present in only in *C. longa*. Phenols present in both *C. aromatic* and *C. longa*. Phlobatannins present only in *C.caesia.* Saponins and Carboxylic acid are absent in all four *Curcuma species*. Steroids present only in *C. aromatic* shown in Figure (1) and Table (1).

C. aromatic rhizome used in traditional medicinal applications [20, 21], antibiotic, antiseptic, bronchitis, leucoderma, as tonic, carminative [22]. It cures cancer, intestinal problems, common colds, stomach infections, kidney fibrosis and bronchitis. It is used externally forscabies, sprains, snakebite, skin eruption and infections [23, 24]. Therhizome extract used for curing indigestion, rheumatism and dysentery. The alkaloids, phytosterols, glycosides, phenols, flavonoids, diterpenes have high healing potential. *C. aromatica* rhizome has excellent medicinal properties used as tonic, carminative, externally in combinations with astringents, bitters, appetizer, sprains and snakebite. It helps wrinkles, digestion, rheumatism, dysentery, hair growth and reduces inflammation. *C. caesia* has high healing potential used traditionally to treat leucoderma, hemorrhoids, leprosy, asthma, bronchitis, menstrual disorders, vomiting, tumors, fever, wounds, diabetes, cancer, psoriasis, jaundice, allergic eruptions, piles, anti-helmentic, aphrodisiac, gonorrheal discharges, epileptic, menstrual disorders inflammation and blood purifying activity. It is used as a brain and heart tonic, a carminative, a digestive stimulant, a treatment for cough, bronchitis, ulcers, a variety of skin conditions, piles, tumors, tuberculosis glands of the neck, spleen disorders, epileptic seizures, allergic eruptions, a smooth muscle relaxant, a laxative and it has anti-bacterial, anti-fungal, and anti-oxidant properties. Tribal tribes utilize it to treat pneumonia, fever, and asthma in adults as well as cough and colds in kids [25].

Local people use rhizome paste to cosmetics, relief from painful rheumatism; alleviate toothaches, treating various skin diseases, snake and scorpion bites [26]. *C. longa* rhizome is commonly used for cleaning foul ulcers and makes a good dressing for wound. I*nternally used to treating jaundice, nosebleeds, hemorrhages, painful menstruation and chest pain.* It enhances digestion, revs up the circulatory system and gallbladder, stops bleeding and dissolves clots. It is extensively used in traditional medicine as carminative, antiseptic, digestive aid, appetizer, tonic, laxative, anthelmintic, blood purifier, anticancer, antipyretic, anti-vadha, anti-diabetic, anti-inflammatory, liver diseases, stomach ulcer, abdominal swelling, eye disorders, insect bites and sprain. Its potent antibiotic properties are used to treat a variety of conditions, including fever, gastroenteritis, dysentery, infections, chest congestion, cough, hypertension, rheumatoid arthritis, jaundice, urinary tract infections, skin conditions, diabetic wounds, menstrual

discomfort, and issues with the liver and gallbladder [28]. *C. zedoaria* rhizome acts as very strong antioxidant, carminative, digestive stimulant, antiseptic, relieve flatulence, colic, anti-hyperlipidemic, immunomodulatory, anti-thrombotic, anti-helminthic, cardiovascular, immunosuppressive, anti-microbial, anti-cancer, anti-inflammatory, analgesic, anti-parasitic, hepatoprotective and neuroprotective and diuretic [29]. Medicinally used for cough, bronchitis, asthma, skin diseases, wound and spleen disorder, hematologic, circulation abnormalities, aphrodisiac, promote menstruation, strengthen the uterus muscles, flatulence and various infections. It has been used for a long time to treat several kinds of chronic pain including joint pain [30]. It regulates body temperature in cases of fever. It has also been used to clean and purify the blood and detoxifies the body. The fresh juice used to cure many skin diseases, anthelmintic and anti-parasitic. It decoction is used as an effective eye wash. Fluorescence color is specific for each phytochemical compound. The alkaloids fluorescent in ultra violet light and possess the characteristic absorption spectra. The rhizome powders treated with Concentrated Sulphuric acid exhibit in brown, which indicated the presence of steroids and terpenoids. Powder treated with Ferric chloride exhibited a range of dark green and dark brown respectively, which indicated the presence of phenols and tannins. Powder treated with Sodium hydroxide exhibit a yellowish brown indicated the presence of flavonoids. The presence of flavonoids may be the cause of the orange fluorescence. The presence of glycosides may be the cause of the blue-green fluorescence [31] shown in the Table (2-3).

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Table:1.Phytochemical Screening of *Curcuma*rhizomes

S. No.	Phytochemicals	*C. aromatica*	*C.caesia*	*C. longa*	*C.zedoaria*
1.	Fats	+	+	+	+
2.	Proteins	+	+	+	-
3.	Reducing sugars	+	+	+	+
4.	Resins	+	+	-	-
5.	Alkaloids	+	+	+	+
6.	Carboxylic acid	-	-	-	-
7.	Coumarins	+	-	-	+
8.	Diterpenes	-	+	+	+
9.	Flavonoids	+	+	+	+
10.	Glycosides	-	+	+	-
11.	Phenolic compounds	+	-	+	-
12.	Phlobatannins	-	+	+	-
13.	Saponins	-	-	-	-
14.	Steroids	+	+	+	-
15.	Tannins	+	-	+	+
16.	Triterpenoids	-	-	+	+

Table: 2. Fluorescence Analysis of *Curcuma* rhizomes observe in Dim and Sun lights

Reagent	Colour observe in Dim light			
	C. aromatica	*C. caesia*	*C. longa*	*C. zedoaria*
Powder	Yellow	Cream white	Deep yellow	White
Powder + Dis. water	Yellow	Pale yellow	Yellow	Cream white
Powder + FeCl$_3$	Brown	Yellow	Deep brown	Brown
Powder + NaOH		Golden brown	Deep brown	
Powder + GAA	Yellow	Yellow	Fluorescence yellow	Cream white
Powder + 1N HCl		Golden brown	Deep brown	
Powder + HCl	Brown	Deep brown	Deep brown	Brown
Powder + HNO$_3$	Brown	Brown	Brown	Yellow
Powder + H$_2$SO$_4$	Brown	Pale brown	Brown	Brown
Reagent	Colour observe in Sun light			

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	C. aromatica	*C. caesia*	*C. longa*	*C. zedoaria*
Powder	Golden yellow	White	Deep yellow	Dull white
Powder + Dis. water	Golden yellow	Pale cream	Yellow	Cream white
Powder + FeCl$_3$	Deep brown	Fluorescence yellow	Deep brown	Brown
Powder + NaOH		Dull white	Deep brown	
Powder + GAA	Golden yellow	Pale brown	Fluorescence yellow	Cream white
Powder + 1N HCl		Golden brown	Deep brown	
Powder + HCl	Deep brown	Golden yellow	Deep brown	Brown
Powder + HNO$_3$	Reddish brown	Deep brown	Brown	Golden yellow
Powder + H$_2$SO$_4$	Golden yellow	Deep brown	Golden brown	Brown

Table:3. Fluorescence Analysis of *Curcuma* rhizomes observe in Visible and UV lights

Reagent	Colour observe in Visible light			
Dry powder	*C. aromatica*	*C. caesia*	*C. longa*	*C. zedoaria*
Powder + Dis.water	Pale yellow	Cream white	Yellow	Dull white
Powder + FeCl$_3$	Pale yellow	Cream white	Yellow	Cream white
Powder + NaOH	Brown	Fluorescence yellow	Deep brown	Brown
Powder + GAA		Pale brown	Deep brown	
Powder + 1N HCl	Pale yellow	Cream white	Fluorescence yellow	Cream white
Powder + HCl		Pale yellow	Golden brown	
Powder + HNO$_3$	Deep brown	Deep brown	Black	Brown
Powder + H$_2$SO$_4$	Yellowish brown	Brown	Brown	Yellow
	Deep brown	Golden yellow	Brown	Brown
Reagent	Colour observe in Ultra violet (UV) light			
	C. aromatica	*C. caesia*	*C. longa*	*C. zedoaria*
Dry powder	Fluorescence green	Pale blue	Blue	Dull green
Powder + Dis. water	Fluorescence green	Pale blue	Blue	Dull green
Powder + FeCl$_3$	Brown	Fluorescence yellow	Deep brown	Brown
Powder + NaOH		Deep blue	Deep brown	
Powder + GAA	Fluorescence green	Deep blue	Fluorescence blue	Dull green
Powder + 1N HCl		Yellow	Golden brown	
Powder + HCl	Bluish black	Deep blue	Black	Brown
Powder + HNO$_3$	Fluorescence brown	Deep blue	Brown	Fluorescence green
Powder + H$_2$SO$_4$	Bluish black	Deep blue	Brown	Brown

Phytochemicals	*C. aromatica*	*C. caesia*	*C. longa*	*C. zedoaria*
Fats				
Proteins				
Reducing sugars				

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Resins				
Alkaloids				
Carboxylic acid				
Glycosides				
Phenolic compounds				
Coumarins				
Flavonoids				
Phlobatannins				
Tannins				
Saponins				
Steroids and Triterpenoids				
Diterpenes				

RESEARCH ARTICLE

Effectiveness of Nurse Tailored Interventions on Pain and Discomfort among Patients undergone Coronary Angiogram

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ABSTRACT

Cardiac catheterization is largely recognized as the most effective diagnostic and treatment method for coronary heart problems. In order to enhance patient outcomes, increase safety, and lower the complications, Nurses are essential to the delivery of care following cardiac catheterization procedures as well as in engaging safe protocol and producing evidence-based treatment. The objectives of the study are to determine the effectiveness of Nurse tailored interventions on pain and discomfort among patients who undergone coronary angiogram and to associate the post test findings with selected demographic and clinical variables. The pre-experimental design one-group pre and post test was used. Purposive sampling was employed to choose 60 samples. The data were collected by using Verbal Descriptor Scale and Kolcaba General Comfort Questionnaire. A considerable improvement was seen in the post-intervention findings, which indicated a drop in the pain score from 8.07 to 2.40 and an enhancement in the comfort score from 40.73 to 100.53. After receiving a nurse-tailored intervention, patients who were male, from urban areas, and who were unemployed or self-employed reported less pain, which in turn led to greater comfort. This study concluded that moving around and using an ice pack decreases pain intensity and increases physiological comfort, hence decreasing patients' apprehension about undergoing coronary angiography.

Keywords: Coronary Angiogram, Catheterization, Discomfort, Pain.

Samuel Prabakar Panchanathan *et al.,*

INTRODUCTION

Globally, cardiovascular diseases (CVDs) are the leading cause of death, accounting for an estimated 31 % of all deaths each year [1]. Several procedures, including chest X-ray, exercise stress test, echocardiography, cardiac catheterization, and EKG, are used to diagnose and treat heart disorders [2]. It's indeed impossible to neglect the coronary angiogram's complication rates. Implementing a systematic pre- and post-angiogram approach will enhance patient evaluation, service quality, and can help to prevent errors [3]. According to the Global Burden of Disease study, the age-standardized CVD mortality rate in India is higher than the global average of 235 per 100,000 people, at 272 per 100,000 people. A few variables that should cause significant concern are the rapid spread of the CVD pandemic in India, the early age at which illness first manifests in the population, and the high case fatality rate [4]. The current gold standard method for evaluating coronary arteries before cardiac valve surgery is conventional coronary angiography (CAG). Despite the fact that CAG is a generally safe treatment, it is nevertheless an intrusive process with risks and problems. The non-invasive procedure known as coronary computed tomography angiography (CCTA) has rapidly gained popularity as a superior and alluring method for defining coronary anatomy [5]. The most common discomfort following femoral penetration was low back pain, while pain at the puncture site predominated in individuals undergoing cardiac catheterization using radial and femoral access. Patients who had femoral artery surgeries were found to have more complaints of lower back pain and general malaise [6].

Patients may have discomfort and vascular issues as a result of their extended immobility after coronary angiography. Although their efficacy is debatable, techniques such as therapeutic patient positioning, elevating the head of the bed, early ambulation, and the application of a weight to the catheter insertion site are recommended to reduce complications during coronary angiography. It is possible to reduce back pain, groin pain, urinary retention, and overall patient discomfort without aggravating vascular complications such as hematoma, haemorrhage, thrombosis, or bruising by adjusting the patient's position, elevating the head of the bed, and encouraging early mobilisation after angiography. They can also make it simpler for patients to fulfil their needs, such as eating, drinking, and using the restroom, hence reducing the workload of the clinical professionals and the amount of time patients spend in the hospital [7].The purpose of nursing care is to promote comfort and pain relief without increasing vascular side effects following coronary angiography, which imposes a unique obligation on nurses due to the prevalence of cardiovascular illness and the importance of diagnostic procedures in reducing mortality. The study's objectives are to investigate the efficacy of Nurse-tailored interventions on pain and discomfort in coronary angiography patients and to correlate post-test results with chosen sociodemographic and clinical characteristics.

MATERIALS AND METHODS

Research Approach
A quantitative one group pretest post test design study was conducted in the Cardiology department, Rajiv Gandhi Government General Hospital Chennai, India

Sample Criteria
60 Patients who have undergone coronary angiogram were selected using Purposive sampling technique based on the inclusion criteria as follows (a)Patients between the age group of 25-65 years,(b)Both male and female patients available at the time of study,(c)Patients who are hemo-dynamically stable & (d) Patients who are willing to participate in this study.

Data Collection Procedure
The researcher acquired permission from the appropriate authorities. The importance of the research was discussed in depth, and the patient's written consent was obtained. Pre-test was conducted by verbal Descriptor Scale and Comfort Questionnaire. After conducting the pre-test, the nurse tailored interventions was given to the patients who

have undergone coronary angiogram. The duration of the ice pack application was 20 minutes and positioning for 3 hours at three different angles, and the post-test was conducted by using the same tool.

Ethical approval

The study was developed and presented to the Madras Medical College's ethics committee, which approved the research vide Reference No: EC. Reg. No. ECR/270/Inst./TN/2013/RR-16,17.3.2021.

Data Analysis

Demographic variables in categories were reported in frequencies and percentages using descriptive statistics. The mean and standard deviation of standardized questionnaires were provided. The Chi-square test was used to investigate the relationship between demographic factors and standardized questionnaires. Karl Pearson Correlation Coefficients were used in inferential statistics to calculate the correlation, and a P value of < 0.05 was used to determine its statistical significance.

RESULTS AND DISCUSSION

Among the 60 patients participated in the study the Demographic characteristics of patients who have undergone coronary angiogram reveal that, 5% of them were in the 25–35-year age range. 25% of them were of 36-45 years, 31.67% of them were of 46-55 years. 38.33% of them were of 56-65 years. 60% of them were males, 40% of them were females. 91.67% of them were married 8.33% of them were unmarried .51.67% of them had no formal education, 33.33% of them studied primary level education, 15% of them were of higher secondary level of education is nearly 38. 33 % of them are unemployed, 35 % of them are self- employed and 26.67% of them are private employees. 71.67% of them are Hindus and 8.33% of them are Muslims and 20% of them are Christians, 63.33 % of them are from urban and 36.67 % of them are from rural area. Participants had an average pre-test pain level of 8.07 and a mean post-test pain score of 2.40, making the mean change in pain 5.67 [Table 1]. This difference in pain scores is significant and statistically significant. (P= 0.001) [Figure 1]. Participants had a 40.73 comfort score on the pretest and a 100.53 comfort score on the follow-up test, for a mean difference of 59.80 comfort scores [Table 2]. This difference is substantial and statistically significant. Statistical significance was determined using the paired't' test for students. (P=0.001) [Figure 2]. There had been an association between the posttest level of pain score with patient's demographic and clinical variables such as sex (6.46), occupation (8.37), area of residence (5.83). In those male patients, urban area patients, and unemployed/ self -employed patients experienced reduced level of pain after nurse tailored intervention.

 There was a moderate correlation between pain score and comfort score which indicates if the pain is reduced the patients comfort level increases(r=0.48, P=0.001***) [Table 3]. There has been a significant association between the posttest level of comfort score and patient's demographic and clinical variables such as sex (4.44), occupation (8.59), and area of residence (5.81) .In that male patients, urban area patient and unemployed / self-employed patients experienced increased level of comfort after nurse tailored intervention. A randomized controlled experiment on position shift followed by early ambulation after trans-femoral coronary angiography yielded comparable results. The findings of this study indicated that position adjustment followed by early ambulation after coronary angiography via femoral route reduces the intensity of back pain and improves comfort [8]. 20 minutes of ice application reduced discomfort at the femoral site after sheath removal, according to a study investigating the effect of an ice bag on local vascular issues and low back pain in patients undergoing Percutaneous Coronary Intervention [9]. The decrease of discomfort at the vascular access site is significantly impacted by the use of ice following cardiac catheterization [10].

CONCLUSION

The study, findings shown that posture adjustments after post cardiac catheterization has significant favorable effects on patient outcomes by reducing the intensity of back pain and increasing patient comfort level. According to the presented protocol, changing the patient's position to prevent back pain is safe and practicable and permits early ambulation. Furthermore, it eliminates any potential patient antagonism towards coronary angiograms. Further, this positioning saves nurses' time from having to explain complete bed rest, prescribe analgesics, and massage the patient's back to reduce pain. Implementing the use of ice packs has improved patient comfort and reduced discomfort during coronary angiography. It is inexpensive and simple to use; nurses could probably carry out this application.

Conflicts of Interest
There are no conflicts of interest.

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Table.1 : Comparison of Pretest and Posttest Mean Pain Score

No. of patients	Pretest		Posttest		Mean Difference	Student's paired t-test
	Mean	SD	Mean	SD		
60	8.07	0.90	2.40	0.59	5.67	t=43.77P=0.001 *** DF=59,Significant

Table.2 : Comparison of Pre Test And Post Test Mean Comfort Score

No. of patients	Pretest		Posttest		Mean Difference	Student's paired t-test
	Mean	SD	Mean	SD		
60	40.73	5.59	100.53	4.18	59.80	t=62.90P=0.001 *** DF=59,Significant

Table.3 : Correlation Between Mean Pain Reduction Score And Comfort Gain Score

Correlation between	Mean gain score Mean ±SD	Karl Pearson Correlation coefficients	Interpretation
Pain reduction score Vs	5.67±1.02	r=0.48	Moderate
Comfort gain score	59.80±7.36	P=0.001***	correlation

Figure.1: Pre Test And Post Test Level of Pain Score

Figure2: Pre Test and Post Test Level of Comfort Score

RESEARCH ARTICLE
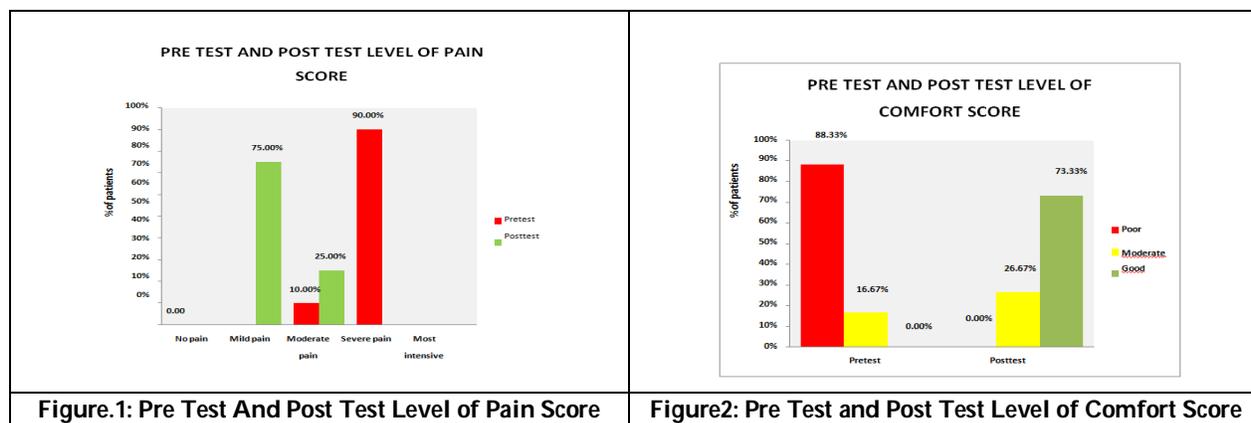
Comparative Phytochemical Composition of *Pauropsylla* Induced Galls Vs Normal Leaves in *Alstonia scholaris* (L.) R.Br. and *Ficus racemosa* L.

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ABSTRACT

Plant galls are pathologically developed abnormal growth on plant tissue, which produced by external organisms. Galls can be considered as extended phenotypes as the inducers has the ability to alter host plant morphology, biochemistry and physiology. The chemical composition in gall tissue differs markedly from those of surrounding normal plant tissue. The present study is on two *Pauropsylla* induced galls on the leaves of plants *Alstonia scholaris* (L.) R. Br. and *Ficus racemosa* L. Qualitative phytochemical analysis and Gas Chromatography-Mass Spectrometry (GC-MS) analysis were carried out in these plants. GC-MS analysis reported, more than 50 compounds in methanolic extract of normal leaf and gall of both *A. scholaris* and *F. racemosa.* Comparative study of phytochemicals in healthy leaves and galls revealed the difference in phytochemical constitution due to gall formation. The uniqueness of compounds was high in galls. The galls of *A. scholaris* include 41 unique compounds, whereas in the case of the gall of *F. racemosa*, 36 unique compounds were identified. When compared to normal leaves, the phytochemicals in galls show a great deal of variety; this may be because insects alter them to aid in their own growth and development, or it may be because the indirect defence of host plant to fight parasitic attack.

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INTRODUCTION

Secondary metabolites may function in different physiological processes of plants like defence, stress response and attraction of pollinators. The composition of it in each plant is different according to their living environmental condition, genotype and developmental stage [1,2]. Hence the secondary metabolic composition may vary in plants, when attacked by phytophagous organisms that form galls [3]. Accordingly, phytochemicals showed much variation in the gall tissue from that of normal plant tissue. This modification is due to alteration of metabolic pathways by the gall inducing parasites and this can be considered as an adaptive manipulation for the survival of the inducer [4]. The attack by gall inducers triggers differences in biochemistry either directly or through indirect defence of the plant. The parasite may down regulate the genes that synthesizes the phytochemicals that are involved in defence, so that the parasites get control over their hosts. In turn the host plant may up regulate some genes involved in defence activity, thereby the host may overcome the stress response produced by the parasite [2,5]. The gall inducing parasites not only alter the biochemistry of the host but also modify physiology and thereby the morphology, that can be directly seen as extended structures. The parasitic organism may reduce photosynthetic ability of host plants for increasing the surface area of the host cell. So that it can store more nutrients, thereby benefiting the development of the parasite. The nutritive tissue having cells with enriched cytoplasm, fragmented vacuoles and numerous cell organelles, which contains abundant soluble sugars, which is used by the inducer [4,6].

Galls may be developed in plant parts such as leaf, stem, root, bud or in flowers by different gall inducers such as bacteria, fungi, nematodes, insects [6,7]. Insect belongs to six orders were found to produce galls [8-10], in which, order *Hemiptera* includes four super families [11], in the family Psyllidae of super family Psylloidea, there are about 350 gall inducing species [12]. The genus *Pauropsylla*, of Psyllidae includes two species *Pauropsylla tuberculata* Crawford, from galls on the plant *Alstonia scholaris* (L.) R. Br. (Family: Apocynaceae) and *Pauropsylla depressa* Crawford, produce galls on the plant *Ficus racemosa* L. (Family: Moraceae). Galls on *A. scholaris* are produced on the adaxial surface of the leaf and they open to the abaxial surface (Figure 1 and Figure 2). They are sometimes scattered and isolated or may be formed in agglomerated clusters[13]. The galls in *F. racemosa* are epiphyllous, Fleshy, globose unilocular or multilocular agglomerate clusters(Figure 3 and Figure 4). Galls are projected to the adaxial surface [13]. The both plants selected in this study have reported therapeutic properties. The different parts of *A. scholaris* and *F. racemosa* are known for many medicinal properties like antibacterial, antifungal, anti-inflammatory, antioxidant, antidiabetic activities etc.[14,15]. The present study aims to characterize the differential phytochemical profile that will be produced through the co-association between gall inducing parasite and host. Hence in future thorough understanding of the modification of biochemistry during gall induction will be useful for more applications of galls of these plants in therapeutic fields.

MATERIALS AND METHODS

Collection and documentation of biological materials

The normal leaves (NL), galls (GA) and galled leaves (GL) of *A. scholaris* and *F.racemosa* were collected from different regions of Kerala, India. The gall tissues were separated from the galled leaves immediately after collection. Flowering twigs were also collected for authentication by means of pertinent taxonomic literature. Voucher specimens of all collections prepared as herbarium following standard methods and were deposited in herbarium of Government Victoria College, Palakkad, Kerala, with accession numbers GVCP-SV 768 and GVCP- SV 769 for *A. scholaris* and *F.racemosa* respectively.

Extract preparation

The separated galls, the rest portion of leaves *i.e.,* gall leaves and normal leaves of *A. scholaris* and *F.racemosa* were thoroughly washed, shade dried and were powdered and stored at room temperature for future use. The powdered plant tissue was extracted by using 25g tissue in 500ml solvent such as aqueous, methanol, hexane and allowed to evaporate the solvent in a hot air oven at a temperature below the melting point of each solvent. The extracts were used for further analysis and screening [15].

Qualitative phytochemical analysis

The normal leaf, gall and gall leaf (the remaining portion of leaf after galls were excised) of *A. scholaris* and *F. racemosa* in various extracts *i.e.,* water, methanol and hexane were subjected to qualitative phytochemical analysis to detect the presence of various phytochemical constituents such as alkaloids, flavonoids, phenols, saponins, quinones, coumarins, cardiac glycosides, tannins, steroids and triterpenoids as per standard protocols [16,17].

GC-MS

The gall and normal leaf extract of *A. scholaris* and *F. racemosa* were subjected to detailed Gas chromatography analysis along with Mass Spectrum at Advanced Instrumentation Research Facility (AIRF), Jawaharlal Nehru University, New Delhi. The analysis was performed using the GC-MS equipment by Shimadzu QP-2010 Plus with Thermal Desorption System TD 20. About 1µl of methanolic extracts of *A. scholaris* and *F. racemosa* was injected into the machine using the micro syringe and the scanning was done for 45 minutes. The injector and detector temperatures were maintained at 260ºC, and the operation temperature at 50-280 ºC. The column temperature was programmed at 50-120ºC, with 4ºC increase per min which was maintained for 1 min. Then it was programmed at 120-300ºC, with 6ºC increase per min and held on for 3min, with retention time (Rt) 60 min. Column oven temperature was 50.0 ^{0}C, injection temperature was 260.00^{0}C and injection in split mode. Pressure was kept at 69.0 k Pa. Total flow was 16.3 ml/min and column flow were maintained at 1.21 ml/min. The identification of the compounds and structure determination were based on the comparison of mass spectra and their fragmentation profiles using published data, Wiley, NIST library search.

RESULTS AND DISCUSSION

Phytochemical analysis

The normal leaf, gall and gall leaf of both plants were showed the presence of different phytochemical compounds. Aqueous, methanol and hexane extracts of gall of *A. scholaris* found the presence of alkaloids, flavonoids, phenols, cardiac glycosides, steroids and terpenoids. Quinones were found to be totally absent in *A. scholaris* extracts. The results are shown in Table 1. Likewise, *F. racemosa* gall has showed the presence of alkaloids, phenols and cardiac glycosides in all three solvent extracts. Flavonoids were present in aqueous and methanol extracts of gall. Quinones gave positive results in methanol and aqueous extract of gall. The results are shown in Table 2.

GC-MS analysis

The GC-MS analysis of the methanolic extract of the normal leaf of *A. scholaris* produced 54 peaks, whereas the gall yielded 63 peaks. The resulted chromatogram of a normal leaf is shown in Figure 5, while those of galls are presented in Figure 6. Table 3 (supplementary data) lists compounds having an area percentage 1 above in *A. scholaris* with their molecular formula and area percentage. In the case of *F. racemosa*, GC-MS analysis of the normal leaf and gall produced 53 and 57 peaks, respectively. The resultant chromatogram for the normal leaf of *F. racemosa* is shown in Figure 7 and that of galls in Figure 8. Table 4 (supplementary data) contains a list of the phytochemicals having an area percentage of 1 above in *F. racemosa*. In *A. scholaris* 32 compounds were exclusively found in normal leaf and 41 compounds were exclusive to gall. For *F. racemosa*, the normal leaf and gall contain 32 and 36 unique compounds respectively. The uniqueness of the compounds was higher in the galls of both plants. A few compounds that were found to be common to normal leaf and gall of both plants. 21 compounds were common in galls and healthy leaves of *F. racemosa* and in case of *A. scholaris* 22 common compounds were present. The area percentages

for the common compounds are expressed differently on different samples. The area percentage of some of the compounds showed increase from normal leaf to gall. The number of common compounds were fewer compared to unique compounds in both plants.

A triterpenoid named Lup-20(29)-en-3-ol, acetate, (3. beta.)- is expressed in higher area percentage in both *A. scholaris* normal leaf and *A. scholaris* gall is with unknown biological activity. Methyl Commate B is the compound with highest area percentage in both normal leaf and gall of *F. racemosa*, which has known antimicrobial and anti-inflammatory activities [18,19]. 1,3,4,5-Tetrahydroxy-Cyclohexanecarboxylicacid is the compounds with second highest area percentage in both gall of *A. scholaris* and *F. racemosa* is with reported antimicrobial, antioxidant, analgesic and anti-inflammatory activities[20]. The defensive properties of some of the substances discovered were well recognised. The galls and leaves of both plants contain N-hexadecanoic acid, which has nematicide, insecticide, and cytotoxic properties[21,22]. Stigmasterol (present in gall and normal leaf of both plants), Lupeol (gall and normal leaf of *A. scholaris*) and Phytyl Palmitate (normal leaf of *A. scholaris*)were found to be possess cytotoxic activity[22-26]. Insectifuge irritant action was reported for the 9-Octadecenoic Acid (Z) present in *A. scholaris* gall [27,28]. *F. racemosa* normal leaves contain 1-Heptacosanol, which has nematicidal activity[29,30]. The normal leaf of *F. racemosa* contains betulin, which has antineoplastic activity [27,31]. Though in lower concentrations than in normal leaves, betulin was also identified in the *F. racemosa* gall. The majority of the chemicals found to have antibacterial, antioxidative, and anti-inflammatory properties. The biological activity of substances with an area of more than 1% in normal leaf and gall of both plants is displayed in Table 5(supplementary data).

Gandhidasan and colleagues discovered higher phytochemical contents, lower nitrogen levels and higher levels of phenolic compounds in galls than in ungalled plant tissue[32] and the phenolic content of host plants was reported to be connected with the resistance of gall insects[33,34]. The results of the current study were in agreement with the past studies that discovered galls had a higher concentration of phytochemicals than normal leaves. Scientific works on different solvent extracts of leaves, flowers, stem, bark and root of *A. scholaris* found various active phytochemicals [17,35,36]. Chen and colleagues identified Alstorisine A, alkaloid from galls and gall leaves of *A. scholaris,* but not discovered in healthy leaves[37]. Their work indicates changes in main components and presence of new trace compositions during gall development and our results also go with their findings and found distinctiveness in chemical composition between galls and normal leaves. Hamdiani and colleagues identified the presence of four alkaloids compounds, having antibacterial activity from *A. scholaris* leaves, in which Sarpagan-16-carboxylic acid, 17-hydroxy-, methyl ester was found as the major alkaloidal compound. The present study found Sarpagan-16-carboxylic acid, 17-hydroxy-, methyl ester found not only in leaves but also in the galls of the plant [38].The GC-MS analysis Performed by Goyal and Shinde on *A. scholaris* leaf revealed presence of 35 and 29 compounds respectively in methanol and hexane extracts[39]. The present GC-MS analysis *A. scholaris* normal leaf were identified 54 compounds in which 22 compounds having an area percentage of above 1 is with a good deal of biological activities and in case of galls, 63 compounds were present in which 16 compounds are having higher area percentage and we found that they possessed various physiological and biological activities, which may help in defence responses of plants. In galls of *A. scholaris*12.6% phenolic compounds, 38% terpenoids, 1.5% steroids, 4.7% hydrocarbon derivatives, 4.7% glycosides and 12.6% fatty acid derivative compounds are present.

Jun and colleagues identified more than hundred volatile compounds from the leaves and fruits of *Ficus carica*[40]. Jeongs and Lachance detected the presence of sterols like sitosterol, campesterol, stigmasterol and fucosterol from different parts of *F.carica* [41]. The present work identified 5 different sterols in normal leaf and 4 from the *F. racemosa* galls. Previous works on the plant revealed the presence of tannins, flavonoids, saponins and reducing sugars also [42-44]. The galls were found to be rich in lignin and phenolic chemicals, according to research by Ushir and colleagues[45]. In *Ficus microcarpa*, 12 distinct phenolic compounds were discovered by GC-MS analysis [46]. In the current investigation, 6 different phenolic compounds were observed in normal leaves and 4 in the *F. racemosa* galls. According to Ao and colleagues, the antioxidant and antibacterial properties of plant are caused by the high concentration of phenolic chemicals present in it[46]. The present GC-MS analysis of *F. racemosa* normal leaf were yielded 53 compounds in which 15 compounds having an area percentage of above 1 is with a good deal of

biological activities and in case of galls, 57 compounds were present in which 11 compounds are having higher area percentage. In the galls of *F. racemosa*, we detected 7% of phenolics compounds, 17.5% terpenoids, 33% fatty acid derived compounds and 5% hydrocarbon derivatives. Phytochemical compounds detected through the present study were also found to possess various biological activities such as antimicrobial, anti-inflammatory, anticancer, antioxidant activities etc.

A thorough literature search revealed that the *A. scholaris* gall contains chemicals that are insecticidal and larvicidal. Gamma. -Dehydro-ar-himachalene with larvicidal activity[47], N, N-Bis (2-Hydroxyethyl) Dodecanamide with insecticidal activity[48], 1H-Cycloprop[e]azulen-7-ol, decahydro-1,1,7-trimethyl-4-methylene- found to possess both larvicidal and insecticidal activity [49] and 9-Octadecenoic Acid (Z)- was also reported to have insectifuge irritant activity [27,28]. These four compounds were discovered to be exclusive to *A. scholaris* galls. Similar to this, *F. racemosa* galls contain a unique compound called 1-Octadecanol that has been shown to have antilarval activity in addition to anti-bacterial and antifungal activity [50]. All these compounds in the plant galls may be produced in response to herbivore attack and this may be the reason for the uniqueness of these compounds to galls. Induced production of these compounds may help the plant to get resistance from further attack by herbivores but in some cases the parasite may develop an obstruction to the plant resistance so that they may overcome the resistance.

1-Dodecanol, another substance exclusive to gall, is recognised to have functions as an insect attractant and pheromone [27]. Both the normal leaf as well as the gall of *A. scholaris* have a pheromone named 2-Methoxy-4 Vinyl Phenol, which has been shown to have antioxidant, antimicrobial, cytotoxic, and anti-inflammatory properties [27,51,52]. A thorough assessment of the functions of phytochemical components in both plants revealed that gall as well as regular leaves possessed phytochemicals that had an adverse effect on pests like insects, nematodes, and some other organisms. For instance, it was discovered that n-Hexadecanoic Acid, which is present in both plant galls and healthy leaves, exhibits nematicidal and pesticidal activity in addition to antioxidant, antibacterial, antifungal, and cytotoxic activity [21,22] and the compound is expressed in higher area percentage in all samples. Hexadecanoic acid methyl ester, which is found in the galls of *A. scholaris* and the galls and normal leaves of *F. racemosa*, has been reported to exhibit nematicidal and pesticidal activity together with several other activities [20].

The normal leaf extract of *F. racemosa* contains more compounds having nematicidal, insecticidal, and larvicidal activity. This included Eicosane, having larvicidal, antibacterial, antifungal and cytotoxic activity[53], n-Nonadecanol-1 is with nematicidal and anti- inflammatory activities[54], 1-Heptacosanol having nematicidal, anticancer, antioxidant and antimicrobial activities[29,30]. A compound with insecticidal and herbivore deterrent properties found in the normal leaves of *A. scholaris* is 1, 6-Cyclodecadiene, 1-methyl-5-methylene-8-(1-methylethyl) [55]. It is possible that these substances may already present in healthy leaf tissue and hence the plant is resistant to gall induction. In the case of galls, these compounds may be produced in response to stimulation from the parasite organism. These substances may assist the plant to get defence from herbivore attack or may control the herbivore within the plant, preventing gall formation. When a parasite attacks, the host may get stressed and produce alterations in their physiology and biochemistry to fight the condition. This might result in a distinct secondary metabolite composition in galls compared to normal leaves [33]. Further thorough research is required to understand the biochemical and molecular mechanisms behind the development of the galls and to confirm the underlying reasons of the distinct phytochemical profiles exhibited in galls.

In conclusion, the qualitative phytochemical assessment revealed that the phytochemical composition of gall differs greatly from that of gall leaves and healthy leaves. More than 50 chemicals were discovered in the methanolic extract of normal leaf and gall of both *A. scholaris* and *F. racemosa* through GC-MS analysis. The phytochemical profile of galls and normal leaves varied, and the number of unique compounds in galls was higher than in normal leaves. This may be thought to be the result of an alteration induced by insects that occurred during the development of the gall. Most of the compounds that have been identified has significant biological activities, a few of which are associated with the interaction between plants and insects. Further research is necessary to find out the underlining mechanism behind the differential profile of phytochemicals in galls compared to normal leaves. In future,

characterization and bioactivity study of phytoconstituents that are unique to galls may sheds light on compounds having important therapeutic activities.

ACKNOWLEDGEMENT

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Table 1: Results of Qualitative Phytochemical Analysis on Different Extracts of *A.scholaris*

| Compound | Test | *Alstonia scholaris* | | | | | | | | |
| | | Water | | | Hexane | | | Methanol | | |
		NL	GA	GL	NL	GA	GL	NL	GA	GL
Alkaloids	Dragendorf's test	-	-	-	-	-	-	-	-	-
	Hager's test	+	+	+	-	+	-	-	-	-
	Wagner's test	-	-	-	-	-	-	+	+	+
Phenol	Ferric chloride test	+	+	+	-	+	-	+	+	+
Flavonoid	Ferric chloride test	-	-	-	-	+	-	-	-	-
	Lead acetate test	+	+	+	+	+	+	-	+	-
	NaOH test	-	-	-	+	+	+	-	-	-
Saponin	Froth test	+	+	+	-	-	-	-	-	-
Quinones	HCl test	-	-	-	-	-	-	-	-	-
Coumarins	Ferric chloride test	+	+	+	-	-	-	-	-	-
Cardiac glycosides	Kellerkillani test	+	+	+	+	+	+	-	+	-
Steroids & terpenoids	Libberman's test	+	+	+	-	+	-	+	+	+
	Salkowski test	+	+	+	+	+	-	+	+	+
Tannin	Potassium dichromate	-	-	-	-	-	-	+	-	+
	Lead acetate test	+	+	+	+	-	-	+	+	+

Samples examined were; NL: Normal leaves, GA: galls, GL: gall leaf of *A. scholar*

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Table 2: Results of Qualitative Phytochemical Analysis on   Different Extracts of *F. racemosa.*

Compound	Test	*Ficus racemosa*								
		Water			Hexane			Methanol		
		NL	GA	GL	NL	GA	GL	NL	GA	GL
Alkaloids	Dragendorf's test	-	-	-	-	-	-	-	-	-
	Hager's test	+	+	+	+	+	+	+	+	+
	Wagner's test	+	+	+	-	-	-	+	+	+
Phenol	Ferric chloride test	-	+	-	-	+	-	+	+	-
Flavonoid	Ferric chloride test	-	+	-	-	+	-	-	+	-
	Lead acetate test	+	+	+	-	-	-	-	+	-
	NaOH test	+	+	+	-	-	-	-	+	-
Saponin	Froth test	-	+	-	-	-	-	-	-	-
Quinones	HCl test	-	+	-	-	-	-	-	+	-
Coumarins	Ferric chloride test	-	-	-	+	+	+	-	-	-
Cardiac glycosides	Kellerkillani test	-	+	-	-	+	-	-	+	-
Steroids & terpenoids	Libberman's test	+	+	+	+	+	-	-	-	-
	Salkowski test	-	-	-	+	+	+	-	+	-
Tannin	Potassium dichromate	-	-	-	-	-	-	+	+	-
	Lead acetate test	+	+	+	-	-	-	-	+	-

Samples examined were NL: Normal Leaves, GA: Galls, GL: Gall Leaf of *F. racemosa*

Table 3: Results of Quantitative Phytochemical Analysis on Methanolic Extracts of *A. scholaris*

Name of compound	Molecular Formula	Area percentage in *A. scholaris*	
		Normal leaf	Gall
2-Furanmethanol, Tetrahydro-. Alpha.,.Alpha.,5-Trimethyl-5-(4-Methyl-3-Cyclohexen-1-Yl)-	$C_{15}H_{26}O$	3.99	-
2H-Pyran-3-Ol, Tetrahydro-2,2,6-Trimethyl-6-(4-Methyl-3-Cyclohexen-1-Yl)-, [3S-[3alpha,6alpha(R*)]]-	$C_{15}H_{26}O$	1.19	-
Mome Inositol	$C_7H_{14}O_6$	1.50	
Neophytadiene	$C_{20}H_{38}$	5.69	4.84
n-Hexadecanoic acid	$C_{16}H_{32}O_2$	3.97	0.48
9,12-Octadecadienoic Acid, Methyl Ester	$C_{19}H_{34}O_2$	2.49	4.43
(Z,Z)-6,9-Cis-3,4-Epoxy-Nonadecadiene	$C_{19}H_{34}O$	3.81	-
Hexadecanoic Acid, 2-Hydroxy-1 (Hydroxymethyl)Ethyl Ester	$C_{19}H_{38}O_4$	2.79	-0.71
9-Octadecenoic Acid (Z)-, 2,3-Dihydroxypropyl Ester	$C_{21}H_{40}O_4$	2.45	0.47
Squalene	$C_{30}H_{50}$	3.24	4.61
gamma-Tocopherol	$C_{28}H_{48}O_2$	1.97	0.70
Vitamin E	$C_{29}H_{50}O_2$	3.27	1.11
Ergost-5-En-3-Ol, (3.Beta.,24r)-	$C_{28}H_{48}O$	2.51	1.46
Stigmasterol	$C_{29}H_{48}O$	2.79	2.43
Gamma-Sitosterol	$C_{29}H_{50}O$	2.73	3.16
Cycloeucalenyl Acetate	$C_{32}H_{52}O_2$	3.46	-
9,19-Cyclolanost-24-En-3-Ol, (3.Beta.)-	$C_{30}H_{50}O$	4.53	2.22
Lupeol	$C_{30}H_{50}O$	2.66	6.27
Olean-12-En-3-Ol, Acetate, (3.Beta.)-	$C_{31}H_{52}O$	4.51	2.95

9,19-Cyclolanostan-3-ol, 24-methylene-, (3.beta.)-	$C_{31}H_{52}O$	1.12	-
Lup-20(29)-En-3-OI, Acetate, (3.Beta.)-	$C_{32}H_{52}O_2$	23.13	23.51
Phytyl Palmitate	$C_{36}H_{70}O_2$	1.57	-
Catechol	$C_6H_6O_2$	-	1.13
1,3,4,5-Tetrahydroxy-Cyclohexanecarboxylic Acid	$C_{15}H_{24}O$	-	11.12
	$C_{18}H_{34}O_2$	-	1.05
9-Octadecenoic Acid (Z)-	$C_{30}H_{50}O_2$	-	3.00
Betulin	$C_{30}H_{48}O$	-	2.91
Lup-20(29)-en-3-one			

Each value corresponds to area percentage of the compounds in each sample

Table 4: Results of Quantitative Phytochemical Analysis on Methanolic Extracts of *F. racemosa*.

Name of compound	Molecular Formula	Area percentage in *F. racemosa*	
		Normal leaf	**Gall**
1,3,4,5-Tetrahydroxy-Cyclohexanecarboxylic Acid	$C_7H_{12}O_6$	10.45	15.50
Neophytadiene	$C_{20}H_{38}$	4.02	0.61
N-Hexadecanoic Acid	$C_{16}H_{32}O_2$	6.79	5.98
2-Hexadecen-1-OI, 3,7,11,15-Tetramethyl-, (R-(R*,R*-(E)))-	$C_{20}H_{40}O$	3.27	-
9,12-Octadecadienoic Acid (Z,Z)-	$C_{18}H_{32}O_2$	1.77	-
1-Hexacosanol	$C_{26}H_{54}O$	1.01	-
1-Heptacosanol	$C_{27}H_{56}O$	1.97	-
Ergost-5-En-3-OI, (3.Beta.,24r)-	$C_{28}H_{48}O$	1.64	0.76
Stigmasterol	$C_{29}H_{48}O$	3.06	1.36
.Gamma.-Sitosterol	$C_{29}H_{50}O$	14.77	5.18
Methyl Commate D	$C_{31}H_{50}O_4$	2.37	1.51
Olean-12-En-3-OI, Acetate, (3.Beta.)-	$C_{32}H_{52}O_2$	4.79	7.02
Methyl Commate B	$C_{31}H_{50}O_3$	21.62	0.89
Lup-20(29)-En-3-OI, Acetate, (3.Beta.)-	$C_{32}H_{52}O_2$	4.99	8.33
Betulin	$C_{30}H_{50}O_2$	4.04	1.80
1,2,3-Propanetriol	$C_3H_8O_3$	-	1.09
4H-Pyran-4-One, 2,3-Dihydro-3,5-Dihydroxy-6-Methyl-	$C_6H_8O_4$	-	2.05
(Z,Z)-6,9-Cis-3,4-Epoxy-Nonadecadiene	$C_{19}H_{34}O$	-	4.23
Ethyl (9z,12z)-9,12-Octadecadienoate	$C_{20}H_{36}O_2$	-	1.92

Each value corresponds to area percentage of the compounds in each sample

Table 5: Biological Activity of Compounds

Name of compound	Biological activity
2-Furanmethanol, Tetrahydro-.Alpha.,.Alpha.,5-Trimethyl-5-(4-Methyl-3-Cyclohexen-1-Yl)-	Anti-hyperalgesic and anti-edematous activities[56]
Mome Inositol	Anti-cirrhotic, anti-neuropathic, cholesterolytic and lipotropic activities[57]
2H-Pyran-3-OI, Tetrahydro-2,2,6-Trimethyl-6-(4-Methyl-3-Cyclohexen-1-Yl)-, [3S-[3alpha,6alpha(R*)]]-	Antifungal activities[58]
Neophytadiene	Analgesic, antipyretic, anti-inflammatory, antimicrobial and

	antioxidant activities[25,27]
N-Hexadecanoic Acid	Antioxidant, hypocholesterolemic,pesticide, nematicide, antiandrogenic,hemolytic,5-Alpha reductase inhibitor, antipsychotic, antibacterial, antifungal and cytotoxic activities[21,22]
9,12-Octadecadienoic Acid, Methyl Ester	Antifungal and antioxidant activity[59]
Hexadecanoic Acid, 2-Hydroxy-1-(Hydroxymethyl)Ethyl Ester	Hemolytic and antioxidant activity[18,22]
9-Octadecenoic Acid (Z)-, 2,3-Dihydroxypropyl Ester	Antioxidant and anti- inflammatory activities[60]
Squalene	Antibacterial, antioxidant, anti-tumour, immunostimulant, lipoxygenase-inhibitor and chemo-preventive activity[24-26,53]
Gamma.-Tocopherol	Antioxidant, cardioprotective, anticancer, anti-inflammatory and hypocholesterolemic activities[24,61]
Vitamin E	Antioxidant, cytoprotective, anti-aging, analgesic, antidiabetic, antidermatitic, antileukemia, anticancer, vasodilator, hepatoprotective, hypocholesterolemic, antibronchitic, anticoronary, anti-alzheimer's,immunostimulant, anti-inflammatory, antiulcerogenic and antispasmodic activities[18,24,25]
	Antimicrobial, anticarcinogenic, antiangiogenic, hypocholesterolemic and antioxidant activities[18]
Ergost-5-En-3-OI, (3. Beta.,24r)-	Anti-angiogenic, anticancer, anti-inflammatory, antioxidant, antidiabetic, cytotoxic and antimicrobial activities[22,24-26]
Stigmasterol	Antioxidant, antimicrobial, antidiabetic, antiasthma, diuretic, hypolipidemic and prophylactic activities[24-26]
.Gamma.-Sitosterol	Antibacterial and antifungal activities[62]
Cycloeucalenyl Acetate	Antibacterial, antimycotic and anti-free radical activities[63]
9,19-Cyclolanost-24-En-3-OI, (3.Beta.)-	Cytotoxic and anti-inflammatory activities[24-26]
Lupeol	Antidyslipidemic activity[64]
Olean-12-En-3-OI, Acetate, (3. Beta.)-	Antibacterial activity and anti-HIV compound used to prevent

	the HIV virus[18]
9,19-Cyclolanostan-3-OI, 24-Methylene-, (3. Beta.)-	Data deficient
Lup-20(29)-En-3-OI, Acetate, (3.Beta.)-	Antimicrobial and cytotoxic activity[23]
Phytyl Palmitate	Antimicrobial, antioxidant, anti-inflammatory and analgesic activities[65,66]
Catechol	Antimicrobial, anti-inflammatory, antioxidant and analgesic activities[20]
1,3,4,5-Tetrahydroxy-Cyclohexanecarboxylic Acid	Antibacterial, antioxidant, allergenic, anemiagenic, antiandrogenic, anti-inflammatory, cancer preventive, choleretic, hypocholesterolemic, insectifuge irritant activities[27,28]
9-Octadecenoic Acid (Z)- Cis-9-Hexadecenal Betulin	Antimicrobial activity[20] Antiviral, analgesic, anti-carcinomic, anti-flu, cytotoxic, anti-inflammatory and antineoplastic activities[27,31] Trypanocidal activity[67]
Lup-20(29)-En-3-One	Antioxidant, anti-inflammatory, anticancer neuroprotective, antinociceptive, antioxidant, antimicrobial and diuretic activities[61]
2-Hexadecen-1-OI, 3,7,11,15-Tetramethyl-, (R- (R*, R*-(E)))-	Antioxidant, antiproliferative, anti-inflammatory and antiarthritic activities[24,25]
9,12-Octadecadienoic Acid (Z, Z)- 1-Hexacosanol	Antileishmanial activity[24] Nematicidal, anticancer, antioxidant and antimicrobial activities[29,30]
1-Heptacosanol Methyl Commate D	Antimicrobial and anti-inflammatory activities[19] Antimicrobial and anti-inflammatory activities[18,19]
Methyl Commate B	Antimicrobial, anti-inflammatory, antiproliferative, anticancer and antioxidant activities[20,68]
4H-Pyran-4-One, 2,3-Dihydro-3,5-Dihydroxy-6-Methyl-	Antibacterial activity[69]
(Z,Z)-6,9-Cis-3,4-Epoxy-Nonadecadiene Ethyl (9z,12z)-9,12-Octadecadienoate	Anti-inflammatory activity[27]

Samples examined were NL: Normal Leaves, GA: Galls, GL: Gall Leaf of *F. racemosa'*

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Figure 1: Habit of *A. scholaris*

Figure 2: *A. scholaris* leaves with galls

Figure 3: Habit of *F. racemosa*

Figure 4: *F. racemosa* leaves with galls
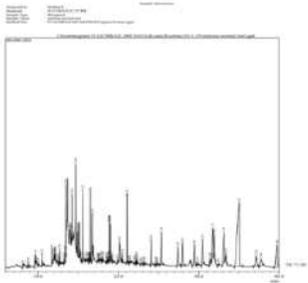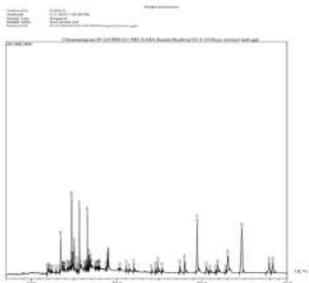
Figure 5: A. GC-MS chromatogram of normal leaf of *A. scholaris*

Figure 6: GC-MS chromatogram of *A. scholaris* leaf galls
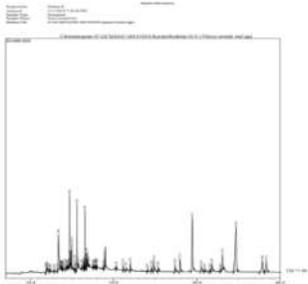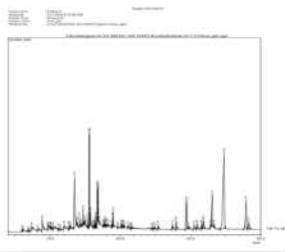
Figure 7: GC-MS chromatogram of *F. racemosa* normal leaf

Figure 8: GC-MS chromatogram of *F. racemosa* leaf galls

REVIEW ARTICLE

Analytical Method Development and Validation of Rivaroxaban: A Concise Review

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ABSTRACT

This review study suggests a technique applying RP-HPLC for the development and validation of rivaroxaban in bulk and medicinal dose forms. Rivaroxaban, an anti-clotting medication, inhibits the growth of blood clots by acting on Factor Xa. This study examines various RP-HPLC techniques that are now available for determining rivaroxaban in tablets (Xarelto 10,15,20 mg). There have been a number of techniques discussed for the estimation of this medicine, including RP-HPLC, ultra-performance liquid chromatography (UPLC), and UV. RP-HPLC is an essential requirement for quantitative analysis of pharmaceuticals' active ingredients and related formulations. The development of various sophisticated analytical methods was extensively reviewed for rivaroxaban based on a literature survey. The goal of this study was to create awareness and knowledge of a quick, stable, and economical system of method development and validation.

Keywords: HPLC, Rivaroxaban, UV, HPTLC, UPLC, Validation, ICH guidelines.

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INTRODUCTION

Analytical Method Development

When there are no formal methods available, innovative techniques are created to analyze novel products. Current pharmacopoeial or non-pharmacopoeial products are being analyzed using cutting-edge methods to save costs and time while enhancing precision and durability. These processes are created and validated by trial runs. Different methods are proposed and developed to replace the current practice in comparative laboratory results with all recognized benefits and drawbacks [1].

Why analytical method development is done

Drug analysis is the process of finding, identifying, and detecting drugs in mixtures such as dosage forms and bodily samples. To ensure that drug products are produced consistently, analytical methods are employed to provide data on potency, impurity, bioavailability, stability, and the impact of production parameters during the manufacturing method and drug development [2]. Method development frequently leads to method validation as a byproduct. There are many different ways to construct a method. At one extreme, it can include making only minor adjustments to an existing method in order to adapt it to a new application there is a lot of labor involved, and there are some questions about whether the method will initially be successful. It entails working on several different concepts concurrently before choosing one [3]. Any technique that has been carefully devised includes validation. Prior to putting any intellectual framework for drug assessment into practice, an appropriate protocol must be developed.

Method Validation

By conducting laboratory tests, it is possible to determine whether an analytical technique's performance parameters satisfy the requirements for the planned assistance in the evaluation. Any new or improved approach needs to be validated to show that it can deliver consistent and dependable results when utilized by various operators within the same or different facilities with the same machinery. A key element of any solid analytical procedure, the findings of method validation can be used to evaluate the quality, dependability, and repeatability of analytical findings. The method validation methodology involves equipment being within specification, operational, and properly calibrated. The word "validation" comes from the Latin word Validus, which signifies "strong," and it describes anything that has been shown to be truthful, advantageous, and up to par. Method validation is the process of proving that a created analytical technique is suitable for its intended usage. Any analytical procedure must include validation. The process of creating an analytical objective and confirming that the technique in question meets the performance requirements of the application is known as method validation.

The following are typical parameters of validation that the FDA, USP, and ICH recommend:
1. Specificity or Selectivity
2. Linearity and Range
3. Accuracy (%Recovery)
4. Precision

- Method precision (Repeatability)
- Intermediate precision (Reproducibility)
5. Solution stability
6. LOD
7. LOQ
8. Robustness
9. System suitability

Specificity

Specificity is the capacity to make a conclusive assessment of the analyte in the existence of accurate assessment components. Typical types include impurities, degradants, matrix, as well as other components. A supporting

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analytical approach may make up for a single analytical study's lack of specificity (s). The following conclusions flow from this definition

Identification
To confirm an analyte's identity.

Purity Tests
To make sure that almost all analytical techniques used, such as testing for related chemicals, heavy metals, residual solvents, and so on, accurately declare the degree of impurity in an analyte.

Assay (content or potency)
To produce a precise result that enables a statement about the concentration or efficacy of the analyte found in the sample to be made [4]. The capacity of an analytical method to reliably identify an analyte in the existence of distractions, such as synthetic intermediates, inactive ingredients, substituents, and recognized (or likely) disintegration products contained in the sample matrix, is referred to as selectivity.

Linearity and range
The ability of an analytical procedure to generate a response inversely proportional to the concentration of analyte (amount) in the sample is known as linearity. For the purpose of expressing linearity, the uncertainty limit surrounding the linear regression's slope is commonly utilized [5]. Linearity is the ability of an analytical method to yield test results proportionally to the amount of analyte in the sample (within a specified range).The ICH demands a minimum of 5 concentrations. The distance between the higher and lower values that can be estimated analytically with accuracy, repeatability, and linearity is the range of the approach.

Accuracy (%Recovery)
The level of accuracy indicates how closely calculated numbers match actual values. Practical accuracy shows the difference between the computed mean value and the real value. The accuracy of a procedure is expressed by the level of agreement between the value recognized as a conventional actual value or an authorized reference value and the value discovered. The recoveries of specified, increased quantities of an analyte through the test is a common method to state it.

Precision (Repeatability)
The degree of dispersion between a collection of information obtained from a series sample of the same population under preset conditions is expressed by the precision of a statistical approach. The three types of accuracy that can be taken into account are repeatability, intermediate precision, and repeatability. The ability of an analytical method to be replicated or reproduced under normal circumstances is known as precision. Ruggedness, another name for intermediate precision, expresses variability within a laboratory, such as on different days, with different analyzers, or with different pieces of equipment. Repeatability is the variation that a single analyst experiences on a single computer. It does not distinguish between changes brought on by the tool or system or by the sample preparation technique. Repeatability is assessed during validation by employing the analytical procedure to examine numerous replicates of an assays composite sample.

Then, precision is expressed using the relative standard deviation:

%RSD = $\frac{SD}{Mean}$ ×100

The below diagram shows the accuracy and precision

Solution stability

The stability of test samples is assessed during validation under typical settings, under normal storage conditions, and regularly in the instruments to evaluate whether extra storage conditions, such as refrigeration or light protection, are required.

Limit of Detection (LOD)

The smallest amount of analyte in the sample that can be detected by a certain method but is too little to be utilized as a whole as a valid value is known as the limit of detection (LOD). The signal-to-noise (S/N) ratio (3:1), which is frequently provided as the concentration of analyte in the sample, maybe the basis for the LOD in analytical equipment that exhibits baseline noise. Based on the slope and response standard deviation (S) of the calibration curve, the LOD calculation algorithm is developed [6].

$$LOD = \frac{3.3\sigma}{S}$$

Where σ= Standard deviation
S = Slope of curve

Limit of Quantification (LOQ)

The limit of quantification (LOQ) of a specific analytical technique is the smallest amount of analyte contained in a sample that can be statistically recognized with enough precision and accuracy. For analytical techniques like HPLC that display baseline noise, the LOQ is often determined from an analysis of the S/N ratio (10:1) and is typically verified by injecting standards that produce this S/N ratio as well as an accepted % RSD.

$$LOQ = \frac{10\sigma}{S}$$

Where σ= Standard deviation of area
S = Slope of the curve.

Robustness

Robustness, a measure of resilience, evaluates a system's reaction to unanticipated events. Robustness, which describes a method's dependability in normal use (such as a change in pH, the composition of the mobile phase, temperature, and instrument settings), is the capacity of an analytical method to remain unaffected by minor but significant changes in control parameters.

System Suitability

In liquid chromatographic procedures, evaluating a system's suitability is routine practice. They are used to confirm that the detection sensitivity, resolution, and repeatability of the chromatographic system are adequate for the analysis. The tests are predicated on the notion that the analytical techniques, electronics, instruments, and research samples are all components of a broader system that may be assessed. Peak resolution, the number of hypothetical plates, peak tailing, and capacity were assessed as indicators of the success of the employed approach [7].SST is generally used to test the column effectiveness, resolution, and repeatability of chromatographic systems in order to confirm their suitability for a particular analysis. According to the Ich and the US Pharmacopeia, SST is a prerequisite for all HPLC analytical procedures (ICH). The foundation of SST is the assumption that the instruments, electronics, analytical techniques, and test samples are all components of a larger system that may be evaluated. The majority of pharma analyses, such as active substance assays, impurity evaluation, and dissolution testing (trying to measure the dissolution rate for a particular form of dosage), use chromatographic systems that must first meet a set of predetermined acceptance criteria before testing can begin (SST limits) [8].

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System Suitability Parameters

The following is a diagram of the system suitability criteria that are typically approved by regulatory bodies and independent auditors:

a) Peak retention time,
b) Peak tailing,
c) Capacity factor (k′),
d) Plate numbers,
e) Resolution between peaks

Retention time

The length of time it takes for the solvent to elute from the column is known as the retention time. The amount of mobile phase needed to elute a chemical from the chromatography column is known as the retention volume. Vm is the void volume, KD is the distribution coefficient, and Vs is the volume of the stationary phase. The total amount of the liquid phase in the chromatographic column is known as the dead volume or void volume.

Void Volume can be calculated as the following equation

$$V_O = f \times \pi \times r^2 \times L$$

where: r = radius of column[cm]

Π = constant, ratio of circumference to diameter of a circle

L = length of column [cm]

f = fraction of column volume that is not taken up by stationary phase but available for mobile phase; the default value for f = 0.7 (for Hypersil)

Capacity factor (k)

The theory of HPLC retention focused on the adsorption from solutions can assist in establishing the links between the thermodynamic parameters, such as the free Gibbs energy (G) or the adsorption equilibrium constant (K), and the measured retention values (VR, tR, and k'). The ratio of the dead volume to the decreased retention volume called the capacity factor.

$$K = \frac{V_r - V_o}{V_o}$$

Theoretical Plate Count

A (theoretical) gauge of the HPLC column's effectiveness is plate count. There is equilibrium between both the stationary phase and the mobile phase in HPLC chromatography. The separation happens as molecules are transferred back and forth along the length of the column from the mobile phase to the stationary phase and back to the mobile phase during the elution process [9].

$$N = 16 \left(\frac{t_r}{W} \right)^2$$

Where t_r: retention time, and

W: peak width

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Resolution

Resolution (R) is defined as the ratio of the baseline mean peak width to the distance between the two peak maxima:

$$\alpha = \frac{(t_r)_A - (t_r)_O}{(t_r)_B - (t_r)_O}$$

$$R = \frac{\sqrt{N}\,(t_r)_B - (t_r)_A}{2(t_r)_B + (t_r)_A}$$

Drug Profile
Rivaroxaban

Biologically active substance (S)-5-chloro-N-[2-oxo-3-[4-(3-oxomorpholin-4-yl) phenyl] (S)-5-chloro-N-[2-oxo-3-[4-(oxazolidin-5-yl] RIV contains methyl thiophene-2-carboxamide, an oral anticoagulant. Blood clots can be prevented from forming or dispersed using coagulation factors. Clots may prevent blood from reaching the heart muscle or the brain. A heart attack or stroke may arise from them. a powerful factor Xa direct antagonist used to safeguard adults from venous thromboembolism after complete hip or knee replacement surgeries.[10]. Rivaroxaban, an anti-clotting drug, inhibits the formation of blood clots by acting at a critical stage in the blood clotting process. By directly interacting with factor Xa's catalytic pocket, it stops the strengthening of the extrinsic and intrinsic pathways of the clotting cascade, preventing thrombus formation.

CONCLUSION

This review compiled the specific methodologies for developing and validating rivaroxaban by various sophisticated analytical tools. The methodologies published in literature until recently were tabulated and the steps for new method development and validation protocols were discussed. This extensive literature screening will provide insight knowledge for the researchers to easily apply and modify the published methodologies depending based on their intended studies.

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Table 1: Classification of analytical methods

Measurement signal	Analytical method
Chromatographic techniques	
Electrical	Gas chromatography (Thermal conductivity detector)
Increase in electrical current	Gas chromatography (Flame ionization detector)
Decrease in electrical current	Gas chromatography (Flame capture detector)
Electromagnetic radiation absorbed	Liquid chromatography (Ultraviolet Light detector, Diode array detector)
Electrical	Ion chromatography
Spectrophotometric method	
Emission radiation	Emission spectroscopy (X-ray, UV, Visible), Fluorescence and phosphorescence (X-ray, UV, Visible), radiochemistry.
Absorption of radiation	Spectrophotometry (X-ray, UV, Visible, IR)NMR and Electron spin resonance spectroscopy.
Scattering of radiation	Turbidimetry, Nephelometry, Raman spectroscopy
Refraction of radiation	Refractometry, Interferometry
Diffraction of Light	X-ray and Electron diffraction
Rotation of radiation	Polarimetry, Optical rotatory dispersion
Mass to charge ratio	Mass spectroscopy
Electrochemical techniques	
Electrical potential	Potentiometry
Electrical current	Polarography, Amperometry
Electrical resistance	Conductometry
Miscellaneous techniques	
Rate of reaction	Kinetic method
Thermal properties	DTA and DSC
Classical methods	
Mass	Gravimetric Analysis
Volume	Volumetric Analysis

Table 2:Limits for system suitability parameters are displayed in

Parameter name	Limit/acceptance criteria
Tailing factor(T)	NMT 2
Resolution	NLT 2
Relative standard deviation (RSD)	RSD<2%
USP Plate Count	NLT 2500
Capacity factor	<1
Separation or Relative retention	>1

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Table 3: The development of the UV analytical method and the validation of rivaroxaban

Method	Brief description	Reference
UV	Solvent: DMSO, Detection wavelength: 270nm	11
UV	Solvent: acetonitrile: water (50:50) Detection wavelength:248nm	12

Table 4:The HPLC analytical method development and validated for rivaroxaban

Method	Mobile phase	Column used	Flow rate	Wavelength-th(nm)	Reference no
RP-HPLC	ACN: Water (55:45v/v)	PhenomenexLuna5 μmC18 100 A0 Column (250 × 4.6 mm)	1.2ml/min	249	13
RP-HPLC	Acetonitrile: K H_2 PO_4(40:60 v/v)	Nova-Pak C8 (4 μm,150mm×3.9mm)Waters.	1ml/min	270	14
RP-HPLC	ACN :0.1 % GAA (70:30v/v)	Enable C_{18}-G (250,4.6 mm× 5 μm)	1.0 ml/min	250	15
RP-HPLC	Methanol: Acetonitrile (50:50 v/v).	Phenomenex C_{18} (250, × 4.6 mm, 5 μm), 100A° particle size of column	1 ml/min	250	16
RP-HPLC	(0.02M)MonobasicK$H_2$$PO_4$: Acetonitrile: Methanol)	Zorbax SB C_{18} (250 mm × 4.6 mm, 3.5 μ)	1ml/min	247	17
RP-HPLC	10% orthophosphoric acid pH 4: CAN (40:60%v/v)	Peerless C-18 column (4.6 mm × 250 mm, 5μ)	1ml/min	249	18
RP-HPLC	Buffer (0.05 M pH 4): Methanol (30:70 v/v)	BDS Hypersil C-18 (250 mm × 4.6 mm,5 μ) thermo scientific	1ml/min	220	19
RP-HPLC	ACN: K$H_2$$PO_4$ buffer (pH 3 adjusted with orthophosphoric acid) (40:60 v/v)	HIBAR-5 μ C18 column (250 mm × 4.6 mm)	1ml/min	248	20
HPLC	ACN:Water (55:45 v/v)	C_{18}column(Phenomenex 250 mm × 4.6 mm, 5 μm)	1.2ml/ min	251	21
HPLC	Methanol: 0.1 M sodium acetate (40:60v/v)	ACE-Ciano column (250 mm × 4.6 mm 5μm particle size)	1ml/min	247	22
HPLC	: 0.1% OPA: ACN (60: 40 V/V)	Phenomenex C8 100A (250 X 4.6mm id, 5 μm particle size)	1ml/min	280	23
HPLC	Methanol: Water (90:10 v/v)	C18 column (250 x 4.6 mm; 5μm)	1ml/min	249	24
HPLC	Methanol: water: DMSO (50:45:5,v/v/v)	phenomenexluna C8 (5μm x 250mm x 4.6mm)	1ml/min	252	25
HPLC	ACN and water (70:30)	C18 column (150 mm x 4.6 mm), maintained at 40 ºC	0.7ml/ min	249	26
HPLC	Monobasic potassium phosphate at pH 2.9 and ACN (70:30 v/v)	Thermo ODS Hypersil C18 (250, 4.6mm x, 5μm)	1ml/min	249	27

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Table 5:The HPTLC development and validation of the of rivaroxaban

Method	Brief description	References
HPTLC	Stationary phase: precoated silica gel aluminium plate 60F254 (10×10cm) Mobile phase: toluene: methanol (7:3v/v) Detection wavelength:250nm	28
HPTLC	Stationary phase: RR-18 silica gel 60 F254S HPTLC plates Mobile phase: ethanol: water (7:3v/v) Detection wavelength: 253nm	29
HPTLC	Stationary phase: pre-coated silica gel 60F254 Mobile phase:toluene: ethylacetate: methanol (6:3:1, % v/v/v) Detection wave length:284nm	30

Table 6: The UPLC Method development and validation of rivaroxaban

Method	Brief description	References
UPLC	Column: Acquity UPLC BEH HSS T3 100- mm, 2.1-mm, and 1.8-μm Flow rate:0.45ml/min Temperature:25°c Retention time:<12min Detection wavelength:248	31

Figure.1: Linearity and range	Figure.2: Precision (Repeatability)

Figure.3: Capacity factor (k) Calculation of peak tailing (T)=(x+y)/2x	**Figure.4: Peak Resolution Measurement of selectivity and resolution values measured from a chromatogram containing two peaks.**

RESEARCH ARTICLE
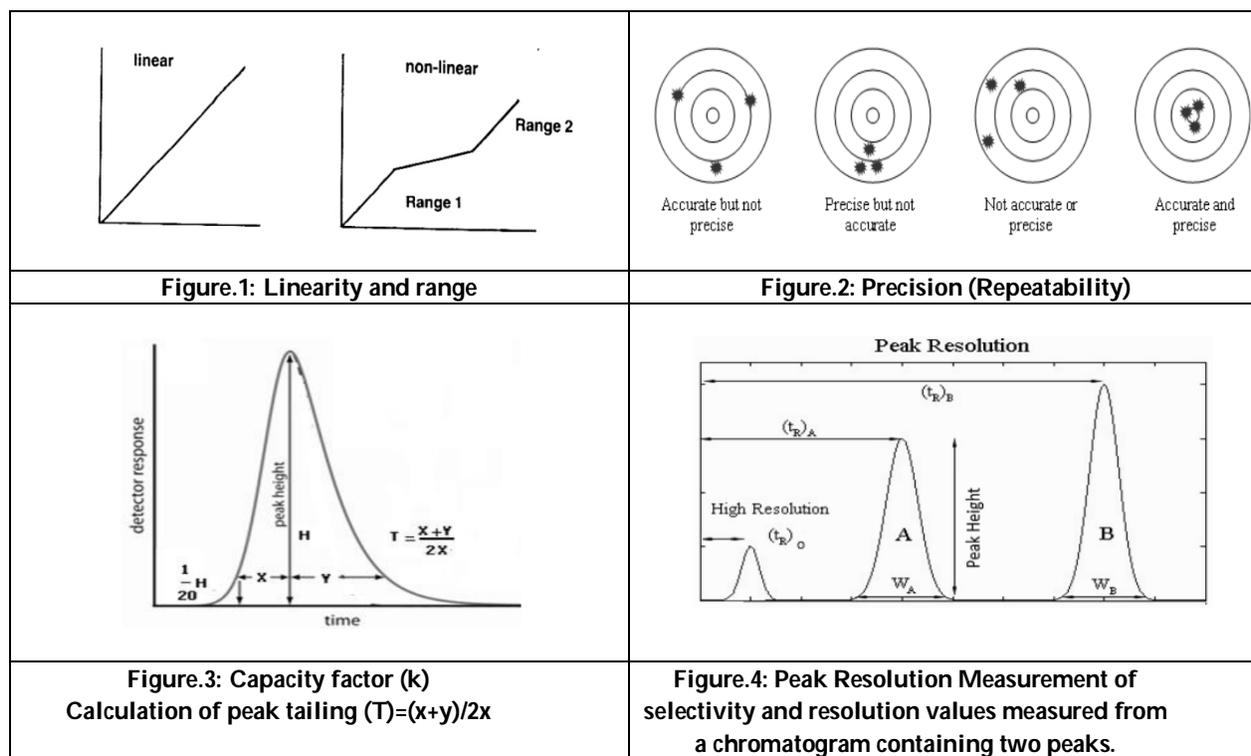
Framework for an Interactive Tool to Screen Specific Learning Disability in Primary School Children using Machine Learning

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ABSTRACT

Specific Learning disabilities is a medical disorder that includes difficulties in reading, spellings, following instructions, understanding, comprehending, writing. 10% of Primary school children have difficulties in learning varying from negligible to significant. Students with SLD suffer Less self-esteem. Diagnosing their difficulties and assisting them has become a tedious job. This article outlines web based framework to diagnose SLD using machine learning .To easy the process and make the diagnosis automated a web based frame work is proposed. "My lab" app designed to check their learning ability .This Web app is designed based on GLAD "Grade level assessment Device" which is an assessment tool to acess the students learning difficulties. "My Lab" is used to determine the learning difficulties in language processing-Dyslexia, arithmetic -dyscalculia and dysgraphia writing difficulties. The app collects the data as voice clipping, images, quiz score and based on glad scoring data set are generated and using CNN and ML algorithms like SVM,KNN and classifies students as negligible , mild or significant SLD.

INTRODUCTION

In recent years, specific learning disabilities have been considered to represent a diverse set of diseases that influence the learning and capabilities of a person [1]. Early SLD detection and intervention were identified as essential in the reduction and improvement of the cumulative detrimental effects [2]. Here is an overview of SLD with its key characteristics [3].

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- It shows substantial problems in gaining and utilising abilities in reading, understanding, writing, mathematics or mathematical thinking [3].
- It is basically observed as a neurodevelopmental issue [1].
- It is a lifelong state with specific impairments which manifest in a person's lifetime different manifestations.
- It is not caused by inadequate education, cultural, linguistic differences, or poor motivation, but these factors might influence the severity and effects of learning disability.
- It cannot be considered as Low intellectual capacity, sensory impairment, neurological or motor disorders, or severe emotional disruption.

The terms "disability" and disorder are being used interchangeably in Literature, in an educational context the term "disabled" is used often possible for eligibility to receive accommodation and special arrangements from various educational Boards. SLD is also referred to as a Specific Learning Disability [4].

Back Ground

The primary objective to determine whether a kid has an SLD is to give adequate, helpful and corrective programmes so that the child can operate in his or her environment efficiently. Approximately 5 to 15% of school-age children have learning disabilities. 80% of people with learning problems are believed to suffer from reading difficulty (commonly referred to as dyslexia). SLD is important for early identification since it impacts all fields of functioning, intellectual, emotional or social comportments [3].

SLD can be broadly classified as Dyslexia, Dysgraphia, and Dyscalculia

Dyslexia is an expression referring to reading difficulties. Dyslexia people have problems linking letters to sound they perceive on a age. Students with dyslexia find it difficult to read fluently and need more effort to read compared to their peers [3] Learning difficulties begin even before learning to read, when kids find it difficult to divide words into syllables and recognise words that rhyme. Kindergarten-age children may not be able to recognise and write letters as well as their peers. Kids with Dyslexia might also have trouble with spellings .

Dysgraphia

Neurological disorder effecting written expression that impairs writing ability and fine motor skills. Children find it difficult in all aspects of writing such as legibility , text size, spacing between letters and words ,expression. around 5 to 20 percent of all children have some type of writing deficit like dysgraphia.[3] [5]. Dyscalculia refers to a wide range of challenges In mathematics' including deficits in understanding the meaning of numbers and trouble using mathematical principles to solve problems. Children with dysgraphia face problems like Understanding the size and connection of numbers,Counting methods , lack of proficiency in recognising numbers, finds it impossible to mentally add single digit numbers, working memory capacity limitations etc. [6]
SLD can be scaled based on the severity.

Mild: Certain learning challenges in one or two academic areas but may be compensated.

Significant: Certain learning challenges in one or two academic areas but may be compensated.

Severe: Severe learning problems affecting multiple academic areas and needing continuous specialised education [3].

Literature review

There are studies in this field, to integrate technology in diagnosing and assisting children with SLD Table no.1. Current study focusses on developing a ML model using web app "My learnab"- My learning ability web based application to collect data based on Glad "Grade level assessment Device". Early diagnosis of SLD can help children to cope better, so this model is primarily aimed for students of age group 6 to 10 years (1st standard to 4th Standard).

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System Architecture

The architecture of a system is a conceptual description of the design, content, structure, and behaviour. The current frame work architecture consist of three levels in the development this prognosis tool, [15] the overall architectures is given below fig 1.This mainly consists of three levels in the first level a web app interactive app is developed based on GLAD assessment tool. In the second level acquired data from the app is pre-processed and in final stage ML model is applied for classification of students abilities as negligible mild and significant, and the results are evaluated [16]. Level 1: This phase is the user interface, where the app navigation screen first checks the authentication of the user for new users first need to register and a help guide is provided along with a disclaimer. If user a registered user then it checks for admin login or parent/teacher (who wants to take the assessment of the child).For assessment first step is to enter all the necessary data of the child. Then user can choose the assessment module Dyslexia , dyscalculia or dysgraphia,. Based on the age and class the child is studying respective quizzes are displayed. The user interface activity is depicted in the fig 2. Admin module of the app provides facility for the admin to update worksheets.

Dyslexia

This module has various testing activities as shown below for comprehension, identifying objects etc.And   spellings are tested by dictating the age specific words   [17]. Text is displayed on the screen child has to read it and then it is accessed [18] [19]. fig.4. Dycalculia is a math quiz module, where various arithmatic parameters are tested few samples are given below [20]. It inclueds identifying numbers, matching numbers with quantities, comparing quantities , based on their age, concepts on addition, subtraction, multiplication are also tested.

Dyagraphia

Students are given words or few lines of test based on their age and class , they have to write and scan the text.[2] Then image is scanned and based on the parameters such as writing size, alignment, skewness in writing, insufficient space in between words, broken links between letters, inconsistent height between letters with and without an extension, ambiguous letters, unstable track [21] [22] . Values for the above features are extracted as per BHK Method (Beknopte Beoordelings methode voor Kinderhand). And tabulated for processing and analysis as given in table II.

Level 2 :Identifying and handling the missing values the app is designed in such a way that the child will be able to proceed only after completing each and every question, this allows to reduce missing values. Based on the Score sheet of Glad the categorical values are evaluated based on point scale. Based on the scoring specification of GLAD feature extraction is done. Dividing the dataset is the next stage in machine learning data pre-processing. Each Machine Learning model dataset must be divided into two independent sets - a Training data and test data [23].

Level 3: Final stage is the predicting stage where NLP is used to evaluate audio responses as per the GLAD grading. Similarly the images are converted to text using OCR [24]. then and CNN with appropriate ML algorithms such as KNN, SVM [25] are applied for classifying children as negligible or mild or significant learning difficulties in the specific areas as dyslexia, dysgraphia and dyscalculia [22].

CONCLUSIONS AND FUTURE WORK

This work aims to provide a framework that helps in Screening SLD in preprimary school children through a Web app "My Lab". This framework integrating web application for test assessment which uses machine learning algorithms for assessing the severity of learning difficulty in English, Math and Handwriting difficulties can be extended for diagnosis. The app is designed in a colorful and interactive manner to make it more interesting for kids. It also has multimodal mechanisms to support student interaction. Admin login option gives scope of adding more assessment modules for diagnosis and assessment. This app can be enhanced for vernacular Indian languages in futur

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Table.1: Comparative study on various SLD Apps

Title / Application Name	Comparison of various apps for supporting SLD		
	Main findings	Methodology	Limitations
DYS-I-CAN [7]	a smartphone application that supports dyslexic people with real world reading and writing problems.This example will display and read text like alphabets and numbers. Furthermore, a machine learning method is required to improve the educational efficacy of a dyslexic youngster.	Neural Machine Translation algorithm	This application mainly helps in Learning ,does not diagnose the learning difficulties of the child . Scope: English ,math , Communication
Kalcal :[8]	This is an Iranian mobile app that works with Persian-language devices. The Wechsler Test and the most recent updates to Persian mathematics textbooks for students in grades 7 through 12 were taken into consideration when designing and implementing the research approach for mobile applications.	Wechsler test	Difficulties in math in persian language. Scope: Dyscalculia
Pudubu : [9]	To distinguish between dyslexic and non-dyslexicYoung children, a various tests of	Machine learning, CNN,SVM	Pudubu is mainly developed inview of Sinhalelanguage . Scope:

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	pronunciation is used in dyslexia screening. A single Sinhala letter is shown as the initial stage, and the difficulty level is steadily increased up to two-letter words. Children with letter dysgraphia are screened and given two Sinhala letters to write with a comparable amount of tries. CNN built the model to determine whether or not the written letters of children were right using 5000 photos of non-dysgraphic youngsters between the ages of six and seven. Dot Counting and Number Comparison are two tests used for dyscalculia assessment.		Dyslexia,Dyscalculia,Letter dysgraphia
ALEXZA :[10]	The present system is interactive and user-centric since it takes into account the user's preferred methods of learning. This system's layered architecture, which includes layers for the learning management system, application server, presentation, adaption, and database, enables many functionality. .	Optical Character Recognition, Text-to-Speech with Voice Controls and Navigations, Machine Learning, Smart AI Assist.	Alexza is mainly helps in reading. Scope: Reading difficulties
Mobile App to Support People with Dyslexia and Dysgraphia.[11]	This research was done to find out the students diagnosed with dysgraphia by using an expert system which uses Forward Chaining. This system recognises the speech pronunciation and compare with a ML model using voice data sets.	Speech recognition, Image processing ML	Scope: Dyslexia and dysgraphia

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Adaptive e-Learning System.[12]	A multi-layered architecture includes the display layer, adaptation layer, learning system management layer, application server layer and database layer. The adaptation layer gives a more intelligent and adaptive system functioning - the major aim of this study.	Multi-Layer Architecture involving presentation , adaptation, LMS,Application server layer and DB	More generic system
Multiplatform Games for Dyslexia Identification in Preschoolers[13]	A series of online games were designed to develop multiplayer versions for mobile platforms and the Web in one effort. They are also intended for their target users to be both suitably demanding and entertaining and effective for assisiting reading and language processing skills	RIA(Rich internet application)LAMP HTML 5	This mainly focuses on Dyslexia and games to help English learning.
Dyslexia Baca [14]	This mobile app is developed for young children to identify and distingush letters. Dyslexia Baca' is a multi-sensor based Malay-speech learning ecosystem. In terms of substance and attitude, Baca is nicely designed, Multimedia goods and general stuff such as fascinating and easy to use, attractive	ADDIE ,text graphics , animation and videos	It mainly focus on identifying similar alphabets and memorizing them. This app is for children of age group 6-8years
Framework for Intervention and Assistance in University Students with Dyslexia[15]	It provides a learning management system for university students with learning difficulties, it includes cognitive assessment give provides a platform for assisting	Multilevel architecture . 1)Tools for assessment and intervention 2)get Reading Profiles and personal details 3)get an adaptive engine that selects and provides	It is aimed for university students with reading and cognitive isuues.

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	tasks in specific cognitive deflicts.	analysis and recommendations for learning 4)developing an interactive model	

Table. 2: Features for handwriting analysis

S. No	Feature	Parameter
1.	Alignment.	P1
2.	Skewed writing.	P2
3.	Insufficient spacing between the words.	P3
4.	i dots and t bars	P4
5.	Irregular size of the letters.	P5
6.	Reverse alphabets/ atypical letters	P6
7.	Ambiguous letters.	P7
8.	Striking of words / traced letters.	P8
9.	Unstable track	P9
10.		P10
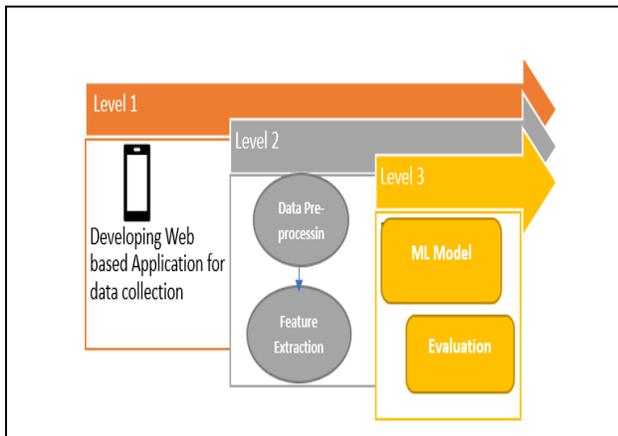
Fig.1: Overall system architecture
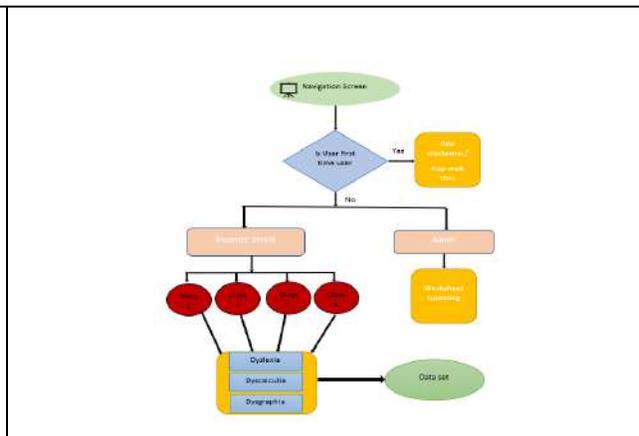
Fig.2: Unser interface activity diagram
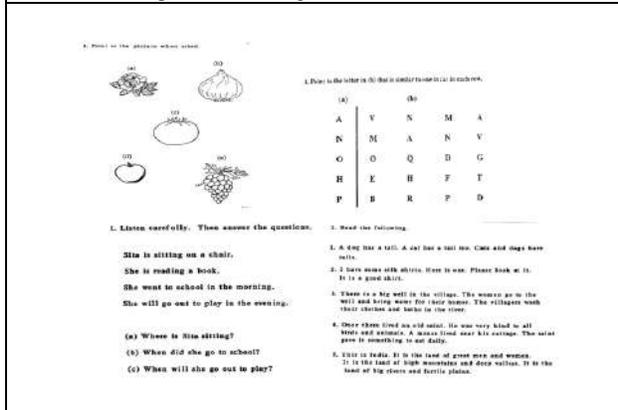
Fig.3: Sample Worksheets for dyslexia
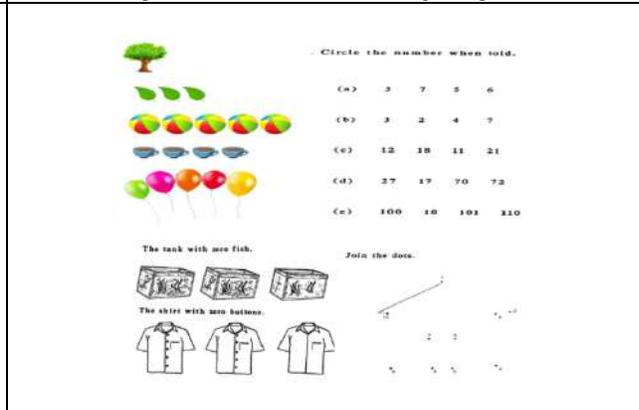
Fig.4: Sample Dyscalculia worksheets

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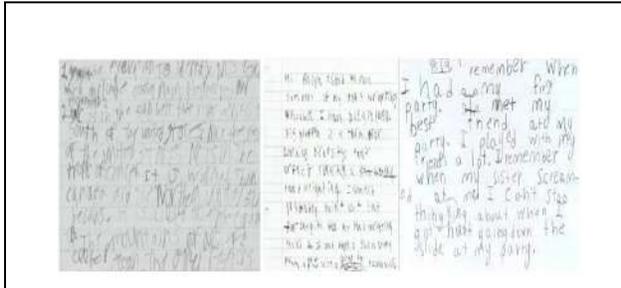
Fig. 5: Writing Samples
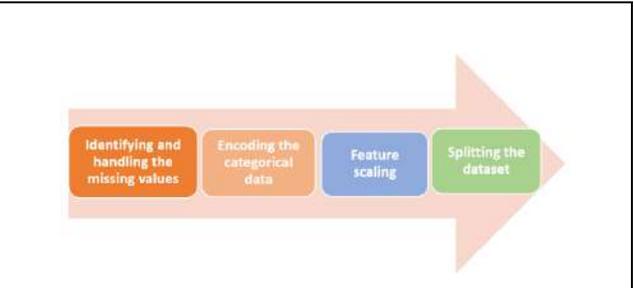
Fig. 6: level 2 Process diagram
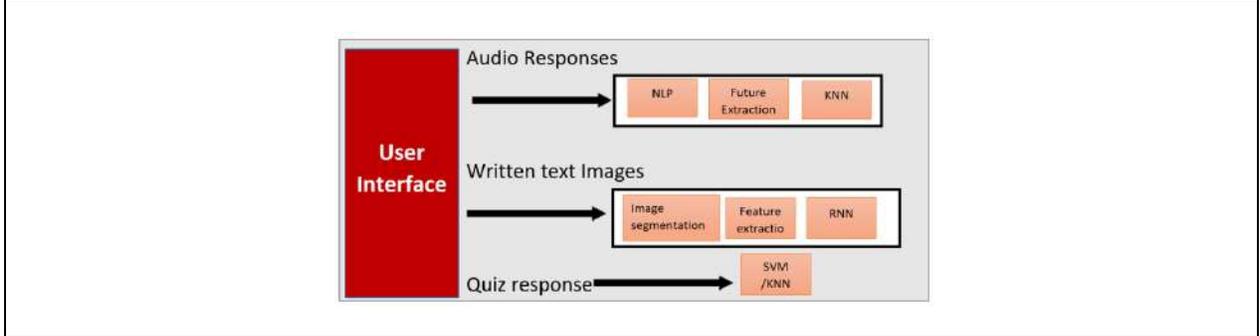
Fig. 7: Level 3 architecture.

RESEARCH ARTICLE

A Study on Home based Occupational Therapy Functional Training for Senile Population

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ABSTRACT

To provide Home based occupational therapy training for people with senile age group. To make independent in BADL for people with senile age group. To enhance functional skills for people with senile age group. This study consists of 40 people with senile age group were randomly selected based on the criteria. All the participants were assessed Basic activities of daily living by Barthel index (BI) and they were administrated with Home based occupational therapy training program for 12weeks duration. The assessment was taken on the initial day. Afterwards, the training program were initiated for 50 minutes per session for 5 session per week. 1st and 2nd observational values were taken at the end of 6th and 12th week and followed by adaptive devices were provided among the participant who all are dependent in basic living activities. A total of 40 individuals were participated in this study, with mean value of the age is 69.5. The results were analysed after the training of 12 weeks shows initial assessment were taken on the first day, than the 1st observational values and 2nd observational values for people with senile age group were administrated with home based BADL training. The mean value of initial Assessment is 33.35 and SD is 15.2037. The Score variance of 1st assessment is 15.2027 and 'Z' test value is 39.779. The mean value of 1st observation score is 58.45 and SD is 28.210. The Score variance of 1st observation is 29.012 and 'Z' test value is 85.0484. The mean Value of 2nd observation is 79.58 and SD is 39.640. The Score variance of 2nd observation is 40.110 and 'Z' test value is 88.5406. This study showed that, the 30% of people with senile age group were effectively managed with their basic daily living

Activities and the remaining 70% of the senile populations were managed their activity with Adaptive devices.

Keywords: Basic activities of daily living (BADL), Barthel index (BI), Senile Population and Occupational Therapy (OT)

INTRODUCTION

The main aim of the study to obtain maximum level of functional independent in Basic activities of daily living for people with senile age group, Basic living activities play a major role in patient with senile population. Today, most of the senile populations are suffer from Basic living activities instead of other activities. In United States 80.5% are suffered from Basic living activities. Based on the report of (UNFBA), 2017 In India there are 12 million senile populations are suffered from basic living activities. Hence, the Functional status of this population is closely related with emotional, physical and cognitive Health. Aging is a normal developmental process the study of basic biological and psychological aspects of the aging process is necessary, In geriatrics populations, special consideration for their functional Independence is more essential to cope up with Basic living activity for elderly populations with Age group between 60-100.The Age related changes often occur in cluster and the person's abilities to adapt and to solve problems are therefore to their limit. Ageing problem in old age people, make them difficulty to perform their activities of daily living, Hence, this study may be helpful for senile populations and they may not able be able to cope up with their day-to day living activities.

Need for the Study
Geriatric population are unable to perform their Basic living activity, due to their age factor, this study may create awareness among people with senile age group and to make them independent in their basic living skills.

METHODOLOGY

Study Setting
Home set up and NGO's

Inclusion criteria
Both male and female with age group between 60-80 senile populations were selected.
Lack of BADL among older adults and who are able to co-operative the treatment session were selected for this study.

Exclusion criteria
- Chronic illness of people with older adults,
- Cardiac complains with senile population
- Less than 60 years of people with older adults
- Non co-operative older adults
- Cognitive impairment of people with older adults

Sample and Study Design
Observational Study with Simple random sample technique was selected for this study.

Procedure

This study consists of 40 people with senile populations were randomly selected based on the criteria. All the participants were assessed Basic activities of daily living by Barthel index (BI). All the participants were administrated home based occupational therapy training program for 12weeks duration. The assessment was taken on the initial day. Afterwards, home based occupational therapy training program were given for 50 minutes per session for 5 sessions per week. 1st and 2nd trial was taken, at the end of 6th and 12th week.

Training Programme and Protocol

Basic skills	Training activities	Minutes
Open session	-----	5
Feeding	Hand grip Activities Peg Board Activities Coordination Activities Weight Shifting Activities	10
Bathing	Ball Activities One leg standing Activities Self-Care Activities	10
Grooming	Fine motor Activities Peg board Activities Hand grip Activities	10
Dressing	Fine Motor Activities Self-Care Activities Coordination Activities	10
End Session	----------	5

Adaptive Device

Badal	Adaptive devices
Bathing	Long handled Sponge, Bath mitt
Grooming	Long handle comb, Long handle brush, Long handle razor
Feeding	Universal cuff, Built up handle spoon, Long handled straws/Length straws, Cup Adaptors
Dressing	Shoe horn, Button Hook, Velcro Reaches, Collasible Dressing stick

RESULTS AND DATA ANALYSIS

A total of 40 individuals were participated in this study, with mean value of the age is 69.5.The results were analysed after the training of 12 weeks program. The initial assessment were taken on the first day, than the 1st observational values and 2nd observational values for people with senile age group were administrated with home based BADL training. The mean value of initial Assessment is 33.35 and SD is 15.2037 .The Score variance of 1st assessment is 15.2027 and 'Z' test value is 39.779. The mean value of 1st observational score is 58.45 and SD is 28.210. The Score variance of 1st observational is 29.012 and 'Z' test value is 85.0484. The mean Value of 2nd observational is 79.58 and SD is 39.640 .The Score variance of 2nd observational is 40.110 and 'Z' test value is 88.5406.

DISCUSSION

In this study, 40 individual were participated, among these 29 females and 11 males. The main purpose of this study was to retrain basic activities of daily living in senile population. Before starting this training program, Proper permission were obtained from the Research supervisor and the head of the department , In the division of PMR,

Director of trust (NGOS) geriatric Home. All participants were assessed and trained by Barthel index, which is valid and reliable outcome measure to evaluate the basic activities of daily living. This study was started on 24th may 2022. The Initial Assessment were also done on the same day, during the Assessment we have faced little bit difficulties such as they were are non-co-operative, emotionally disturbed also showed Aggressive behaviour during this training programme. Based on exclusion criteria Exclude non Co-operative older Adults due to then Age process and acceptance. Chronic illness of people with older adults Cardiac complaint older adults excluded. Cardiovascular problems are more common in older adults. Heart rate increases during training programme. In future study may inclusion cardiac complaint older adults. Mood swings Happen in cognitively impaired older adults. So, difficult to understand so excluded this type of sample. People Aged between 60 to 80 years were included in this study, BADL dependent older Adults and co-operative with training session were included in this study. Before taking the Assessment screening older adult's blood pressure.40 Participate were included in the training session based on the inclusion criteria. The initial assessment was taken on the first day of the session. Training program Were followed by during 12 weeks of duration. 1st and 2ndtrial were taken, at the end of 6Th week and 12th week. Training program was based on the ability to enhance in Basic activities of daily living such as bathing, grooming, feeding, and dressing. A training protocol used for these activities. After following a training programme retraining and enhance the basic activities skills after, training with adaptive devices. Among individual provide a adaptive devices those who are unable to cope up with their Basic activities of daily living in senile populations. Some peoples do not accept the adaptive devices. Hence this study is useful for senile populations.

CONCULSION

This study showed that, the 30% of people with senile age group were effectively managed with their basic daily living Activities and the remaining 70% of the senile populations were managed their activity with Adaptive devices. Occupational Therapy Rehabilitation plays an important role in improving the function of the older adults

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Table 1: Shows, Mean and SD of first assessment and Ist & IInd observational values of BI Scores for people with senile age group

First Assessment	Mean Values	SD
	33.35	15.2037
Ist Observational Values	58.45	28.210
IInd Observational Values	79.58	39.640

Figure.1: Initial Assessment	**Figure.2: Fine Motor Training**	**Figure.3: Co-Ordination Training**
Figure.4: Reacher	**Figure.5: Training Materials Used For This Study**	
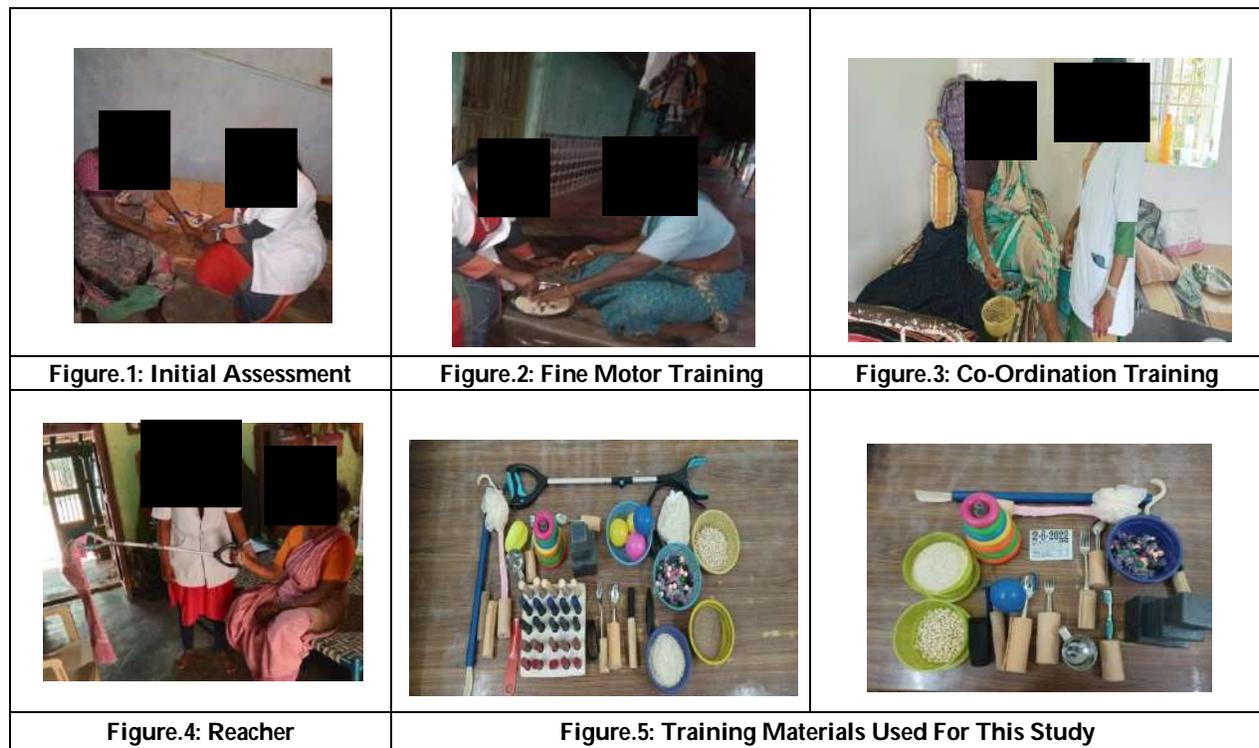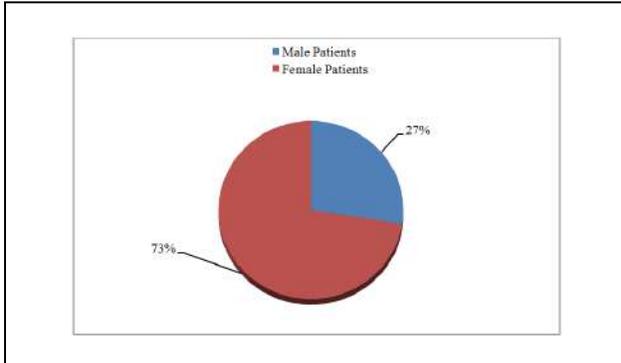
Graph: 1 Shows, Male Vs Female people with senile age group participated in this study
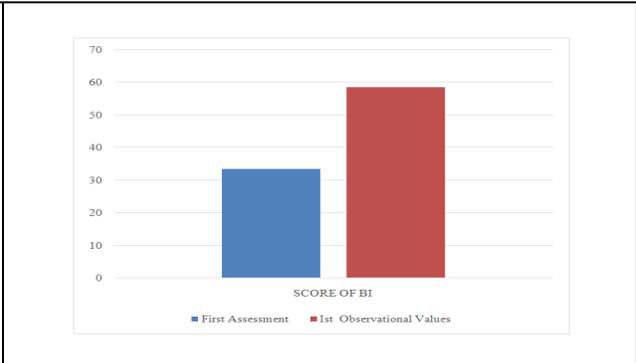
Graph: 2 Shows, Mean and SD of first assessment and Ist Observational values of BI Scores for people with senile age group.
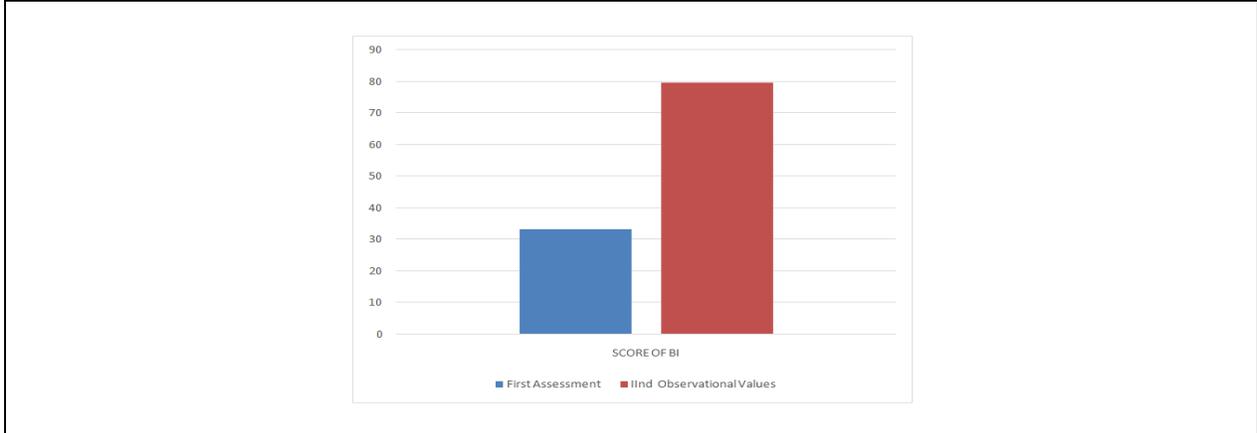
Graph: 3 Shows, Mean and SD of first assessment and IInd Observational values of BI Scores for people with senile age group.

RESEARCH ARTICLE

Comparative Analysis of Classification Techniques using Feature Selection Methods for Stroke Prediction

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ABSTRACT

A Stroke is a medical emergency that necessitates quick medical attention. Early detection can reduce brain damage and other complications. This research work focuses on predicting the stroke using filter method and wrapper method for feature selection. Machine learning techniques such as Random Forest, Logistic Regression, Decision Tree, Support Vector Machine and K-Nearest Neighbours are used for classification. The performance of the results is compared using metrics such as accuracy, precision, recall, F1-score.

Keywords: Stroke Prediction, Machine Learning, Random Forest, Logistic Regression, Decision Tree, Support Vector Machine, K-Nearest Neighbours, Filter method, Wrapper method.

INTRODUCTION

Stroke is the world's second leading cause of death. When blood flow to a portion of the brain is interrupted or when a blood vessel in the brain bursts, a stroke occurs. Brain cells quickly die without blood to deliver oxygen and nutrition, as well as to remove waste materials. A stroke can result in paralysis, speech impairment, memory and reasoning loss, coma, or death, depending on which part of the brain is affected [1][2].
There are two types of stroke:

• An ischemic stroke happens when blood clots or other particles obstruct the blood vessels that provide blood to the brain. Plaque, which is made up of fatty deposits, can clog blood vessels and cause blockages.

• When a blood vessel in the brain bursts, it causes a hemorrhagic stroke. Blood builds up around the brain, damages brain tissue [1].

According to the World Stroke Organization's Facts and Figures on Stroke, the disease stroke has already reached epidemic proportions. In their lifetime, one out of every four adults over the age of 25 will have a stroke [3].

REVIEW OF LITERATURE

On the Cardiovascular Health Study (CHS) dataset, the article [4] compares different approaches with the suggested strategy for stroke prediction. A decision tree algorithm is used for feature selection, the dimension is reduced using the component analysis algorithm and Back propagation neural network is used for classification [5]. In the article [6], the data from a recent cohort of 0.5 million Chinese people is used generate stroke risk scores. ML techniques with GBT providing the best discrimination and calibration performance is used to improve risk prediction over traditional Cox model.

DATASET DESCRIPTION
The Stroke prediction dataset used in this research is download from kaggle dataset [7] The data contains 5110 observations with 12 attributes. A brief description of the attributes in the dataset are as follows:
id: It refers to an individual's distinct identity (Integer Value).
gender: It denotes the patient's gender (Male, female, other).
age: It relates to the person's age(Integer).
hypertension: The patient's blood pressure is high (1, 0)
heart_disease: It reveals whether or not the patient has heart disease (1, 0).
ever_married: It determines whether or not the patient is married (Yes, No)
work_type: It gives different categories for work (Children, Govt_job, Never_worked, Private, Self-employed)
Residence_type: It indicates the patient's residence type (Urban, Rural)
avg_glucose_level: Gives the average glucose level value in blood Floating point number
bmi : It displays the patient's BMI (Body Mass Index) (Floating point number)
smoking_status: It reveals the patient's smoking status (formerly smoked, never smoked, smokes, unknown)
stroke: Output feature which indicates whether the patient is at risk of stroke (1, 0) .The snapshot of the dataset used in the research is shown in the Fig.1:

PRE PROCESSING
The process of converting raw data into an understandable format is known as data pre-processing. The quality of the data should be checked before applying machine learning or data mining algorithms Hence, it is an important step in data mining [8]. The practice of removing incorrect, incomplete, and inaccurate data from datasets, as well as replacing missing information, is known as data cleaning. There are a few methods for cleansing data. The attribute's mean value can be used to replace the missing value. When data is provided in numeric form instead of categorical to a model for training and testing, machine learning algorithms perform significantly better in terms of accuracy and other performance metrics. As a result, before fitting and evaluating a model, categorical data must be converted into integers. The gender, ever married, work type, residence type, and smoking status parameters in the dataset utilised in this study contain categorical data. Label Encoding is used to convert these data into numbers [9]. Synthetic Minority Over-sampling Technique (SMOTE) is an over-sampling method that uses "synthetic" instances rather than replacement over-sampling to over-sample the minority class. [10].

FEATURE SELECTION
Feature selection is the process of choosing a subset of relevant features (variables, predictors) for use in model creation in machine learning and statistics. It is also known as variable selection, attribute selection, or variable subset selection.

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The significance of feature selection is summarises below:
• It minimises the complexity of a model and makes the machine learning algorithm to train faster.
• Choosing the correct subset enhances the accuracy of a model.
• It decreases overfitting [11] [12].
Filter methods, wrapper methods, hybrid methods, and embedding methods are the four main types of feature selection methods. [13].

Filter Methods
The filter methods for selecting a subset of correct features are independent of any learning algorithm and rely on inherent and statistical qualities of the features. Weight is allocated to each feature in these methods based on its degree of relevance to class labels; correlation criteria and information theory-based criteria are typically employed for weighting features. [14] [15] [16] [17].

Feature Selection using Chi-Square Test
The Chi-squared feature evaluation simply shows how important each of the original features are. The user can then choose which characteristics to keep and which to reject based on this information. The Chi-squared test statistic between the feature and the target class is used to determine the relevance of a feature in Chi-squared feature selection [17] [18].

Wrapper Method

The wrapper methods work in a similar way to the filter methods, but instead of using an independent measure for subset evaluation, they employ a predefined classification algorithm. When compared to filter methods, wrapper approaches produce superior results, but they are more computationally expensive when the number of features is very large [17].

Recursive Feature Elimination (RFE)
This technique does a greedy search for a subset of features, starting with all features in the training dataset and successfully deleting features until the required amount of features remains. The model's core contains a machine learning algorithm for ranking features by relevance, eliminating the least important features, and re-fitting the model. This procedure is done until only a certain amount of features are left [19] [20]. These two feature selection methods are used in this research work.

MACHINE LEARNING TECHNIQUES
The process of classifying ideas and objects involves recognizing, comprehending, and arranging them into predetermined groups or "sub-populations." Machine learning programs classify future datasets into categories using pre-categorized training datasets and a range of algorithms. In machine learning, classification algorithms use input training data to predict whether following data will fall into one of the established categories. [21] [22]. Classification problems with two class labels, such as "true and false" or "yes and no," are referred to as binary classification [23]. In binary classification tasks like these, one class could be the normal state, while another could be the abnormal state. In this research work, Binary classification is used for predicting whether the person will be affected by stroke or not.

Random Forest

Random Forests (RF) are made up of a variety of decision trees. By combining the bootstrap aggregating approach and randomness in the selection of data nodes during the creation of a decision tree, it improves the classification performance of a single tree classifier [24] [25].The building of numerous "simple" decision trees in the training stage and the majority vote (mode) across them in the classification stage are the essential principles underlying the random forest approach [26].

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Logistic Regression

Under the Supervised Learning approach, one of the most prominent Machine Learning algorithms is logistic regression. The categorization problems are solved using logistic regression. Maximum likelihood estimation is used in this classic statistical procedure for binary outcomes. It's completely parametric. Model hyperparameters do not need to be set. The coefficients are adjusted to account for the features' interdependence. Inference, estimation, interpretation, and prediction are all possible with it [27] [28] [29].

Decision Tree

Decision Trees (DT) are classification trees that arrange items according to their feature values. Each node in a decision tree represents a feature in an instance to be classified, and each branch indicates a value that the node can adopt. Instances are classified and organised based on their feature values starting at the root node [26]. In decision tree learning, which is used in data mining and machine learning, a decision tree is a prediction model that turns observations about an object into inferences about the item's target value. Such tree models are referred to as classification trees or regression trees [27]. In decision tree classifiers, post-pruning procedures are often used to evaluate the performance of decision trees after they have been trained [30].

Support Vector Machine

Support Vector Machine (SVM) models are similar to multilayer perceptron neural networks in that they use support vectors. The concept of a margin—either side of a hyperplane that separates two data classes—is central to SVMs. It has been demonstrated that increasing the margin and therefore generating the biggest possible space between the separating hyperplane and the instances on either side of it reduces the expected generalisation error [26].

K-Nearest Neighbours

The K-Nearest Neighbor (KNN) algorithm [31, 32] assumes that instances of each class are usually surrounded by instances of the same class. As a result, a collection of training instances in the feature space and a scalar k are supplied to it. A particular unlabeled instance is classified by assigning the label that appears the most often among the k training examples closest to it. The Euclidean distance is the most commonly utilised for this purpose, according to many different measurements that are used for the distance between instances.

PERFORMANCE METRICS

The metrics used for measuring the performance of the classification algorithms used in this research are given below:

Confusion Matrix

It is the most straightforward technique to assess the performance of a classification issue with two or more types of output. As shown below, a confusion matrix is a table having two dimensions: "Actual" and "Predicted," as well as "True Positives (TP)", "True Negatives (TN)", "False Positives (FP)", and "False Negatives (FN)" on both dimensions. Explanation of the terms associated with confusion matrix are as follows –
• True Positives (TP) occur when a data point's actual and predicted classes are both 1.
• True Negatives (TN) are when the actual and predicted classes of a data point are both 0.
• False Positives (FP) occur when the actual class of a data point is 0 and the predicted class is 1.
• False Negatives (FN) occur when the actual class   of a data point is 1 and the predicted class is 0. [33] [34] [35].
The confusion matrix which contains the TP, TN, FP and FN is shown in the Figure 4.

Classification Accuracy

It is the most widely used metric for evaluating classification algorithms' performance. It's the ratio of correct predictions to all predictions. The following formula can be used to calculate it using a confusion matrix.

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$$\text{Accuracy} = \frac{TP+TN}{TP+FP+FN+TN} \qquad (1)$$

Precision
Precision refers to the percentage of correctly classified classes among all positive classifications as a measure of exactness.

$$Precision = \frac{TP}{TP+FP} \qquad (2)$$

Recall
Recall is a measure of completeness that compares the number of successfully classified classes to the number of correctly forecasted classes.

$$Recall = \frac{TP}{TP+FN} \qquad (3)$$

Score
The F1 Score [30] is the Harmonic Mean of precision and recall. The F1 Score ranges from 0 to 1. It indicates how precise and robust your classifier is (the number of instances it correctly classifies) (it does not miss a significant number of instances).

With high precision but poor recall, you can get an extremely accurate answer, but you'll miss a lot of hard-to-classify situations. Our model's performance improves as the F1 Score rises. It can be mathematically stated as:

$$F1 = 2 * \frac{1}{\frac{1}{precision}+\frac{1}{recall}} \qquad (4)$$

AUC-ROC Score
The Receiver Operator Characteristic (ROC) curve is a binary classification issue evaluation metric. It's a probability curve that displays the TPR against the FPR at different threshold levels, thereby separating the'signal' from the 'noise.' The Area under the Curve (AUC) is a summary of the ROC curve that measures a classifier's ability to distinguish between classes.

RESULTS AND DISCUSSION

The performance of machine learning classification approaches with 50% of the input features obtained by trial and error utilising two feature selection techniques is investigated in this study effort. The following are the results of the two feature selection techniques:
• Age, hypertension, heart disease, ever married, and avg glucose level are the five best features obtained using SelectKBest (Chi square statistics).
• Gender, age, avg glucose level, bmi, and smoking status are the five best features obtained using Recursive Feature Elimination (RFE).

As a sample, the graphical representation of No Stroke vs Stroke by Age attribute is displayed in the figure 5. The risk of experiencing a stroke increased as patient's age advanced. The steps in the proposed model are represented in Fig.6's flowchart. The dataset used in this study, 'healthcare-dataset-stroke-data.csv,' has been loaded. After that, the dataset is preprocessed, which involves looking for missing values and replacing them with relevant information. For machine learning classifications, the category input is translated into numerical values. When observations in one class are much more or lower than those in the other classes, this is known as Imbalanced Data Distribution. Because the purpose of Machine Learning algorithms is to enhance accuracy by minimizing error, they do not consider class distribution. One of the most widely used oversampling approaches to overcome the imbalance

problem is SMOTE (synthetic minority oversampling technique). Its goal is to achieve a more balanced distribution of classes by replicating minority class examples at random. Following pre-processing, feature selection techniques are used to pick the top five features from the dataset. On the reduced features, classification methods are applied and the accuracy is measured. The dataset is then divided into two halves, with the first 80 percent used to train the model and the second 20 percent used to validate it.

Performance of Logistic Regression model with feature selection techniques
The performance of Logistic Regression model using Chi Square Statistics and Recursive Feature Elimination feature selection techniques are compared and the results are shown in the Table 1. The metric values obtained proves that the performance of Logistic regression technique using Recursive Feature Elimination gives better results when compared to Chi Square statistics.

Performance of Support Vector Machines model with feature selection techniques
The Comparison of result obtained using Support vector machine with two difference feature selections are depicted in Table 2 and the shows that the recursive Feature Elimination gives better result.

Performance of K-Nearest Neighbours model with feature selection techniques
Table 3 shows how the performance of stroke prediction using K-Nearest Neighbours and two feature selection strategies is measured in terms of metrics. The obtained by using Chi Square statistics gives better accuracy than the other feature selection techniques.

Performance of Decision Tree model with feature selection techniques
Table 4 shows how the performance of Decision Tree's stroke prediction utilizing the two feature selection strategies is measured in terms of metrics. The result obtained using Recursive feature Elimination gives better accuracy.

Performance of Random Forest model with feature selection techniques
Table 5 shows how the performance of the Random Forest stroke prediction utilising the two feature selection strategies is measured in terms of metrics. The result obtained using Recursive Feature Elimination with Random Forest gives significant increase in the accuracy than using Chi Square statistics. The performance of the Random Forest, Logistic Regression, Decision Tree, Support Vector Machine classification algorithms gives better accuracy using RFE than Chi Square statistic feature selection. The   K-Nearest Neighbours algorithm gives better result with Chi square statistic. The accuracy obtained by the Random Forest classification using Recursive Feature Elimination technique is 99.02% which is better than all other classifications algorithms. The graphical representation of accuracy obtained by using classification techniques with two feature selection methods are shown in the figure 6 and figure 7. This reveals that the performance of Radom Forest technique gives higher accuracy when using RFE as Feature Selection method than the other Classification algorithms used in this research work.

CONCLUSION

In this article, Recursive Feature Elimination and Chi Square statistical feature selection techniques were used, followed by Random Forest, Logistic Regression, Decision Tree, Support Vector Machine, and K-Nearest Neighbours classification were applied for predicting stroke. Among the two feature selection algorithms tested, RFE with Random Forest Technique produced superior results with accuracy of 99.02% than the other models. Future work will be focused on investigating the performance of hybrid Feature selection and Feature extraction methods for better prediction of results in classification.

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Table 1. Results of Logistic Regression with Feature Selection Techniques

Metrics	Feature Selection techniques	
	Chi Square Statistics	Recursive Feature Elimination
Accuracy	76.55	**77.68**
Precision	0.75	**0.75**
Recall	0.79	**0.82**
ROC_AUC	0.76	**0.77**
F1 Score	0.77	**0.78**

Table 2. Results Of Support Vector Machines With Feature Selection Techniques

Metrics	Feature Selection techniques	
	Chi Square Statistics	Recursive Feature Elimination
Accuracy	75.93	**76.65**
Precision	0.74	**0.75**
Recall	0.77	**0.79**
ROC_AUC	0.75	**0.76**
F1 Score	0.76	**0.77**

Table 3. Results of K-Nearest Neighbours with Feature Selection Techniques

Metrics	Feature Selection techniques	
	Chi Square Statistics	Recursive Feature Elimination
Accuracy	**93.83**	93.16
Precision	**0.89**	0.87
Recall	**1.00**	1.00
ROC_AUC	**0.93**	0.93
F1 Score	**0.94**	0.93

Table 4. Results of Decision Tree with Feature Selection Techniques

Metrics	Feature Selection techniques	
	Chi Square Statistics	Recursive Feature Elimination
Accuracy	97.32	**97.63**
Precision	0.94	**0.95**
Recall	1.00	**1.00**
ROC_AUC	0.97	**0.97**
F1 Score	0.97	**0.97**

Table 5. Results of Random Forest with Feature Selection Techniques

Metrics	Feature Selection techniques	
	Chi Square Statistics	Recursive Feature Elimination
Accuracy	97.48	**99.02**
Precision	0.95	**0.98**
Recall	1.00	**1.00**
ROC_AUC	0.97	**0.99**
F1 Score	0.97	**0.99**

Fig.1 Stroke Prediction Dataset

Fig 2. Filter Method for Feature Selection
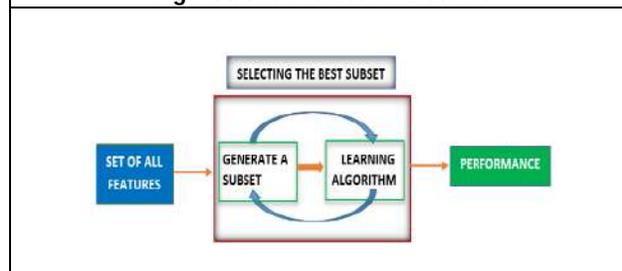
Fig 3. Wrapper Method for Feature Selection
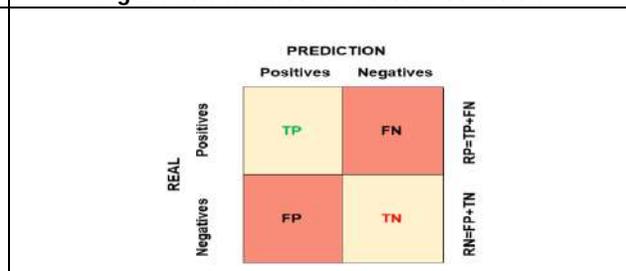
1)   **Fig. 4 The Confusion Matrix in Testing a Predictor**
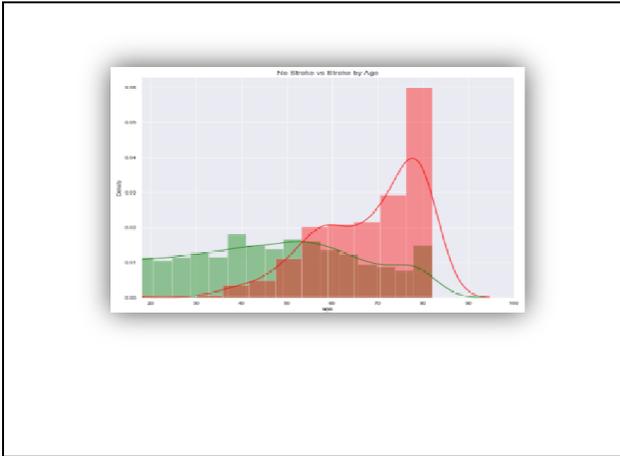
Fig. 5 No Stroke Vs Stroke by Age
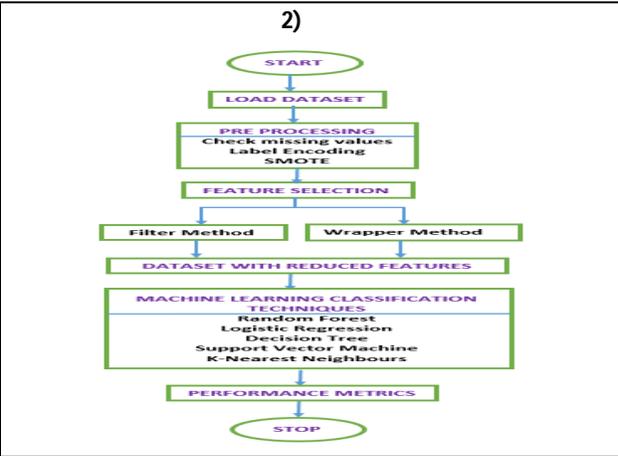
Fig. 6 Flow Diagram of the Proposed Model
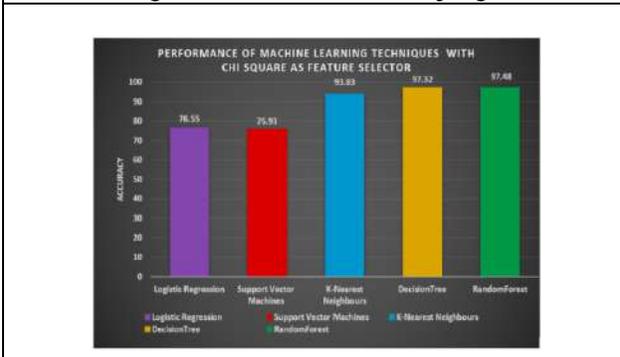
Fig. 7 Performance of Machine Learning Techniques with Chi Square Feature Selector
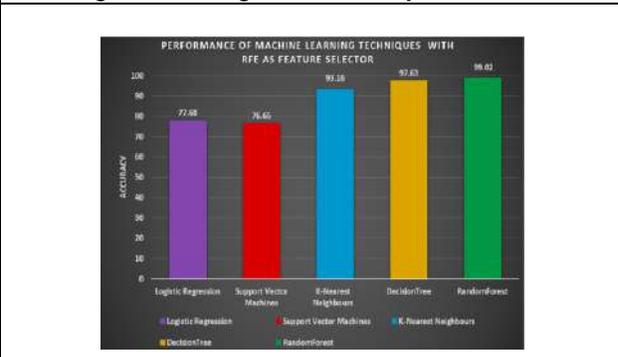
Fig. 8 Performance of Machine Learning Techniques with RFE

RESEARCH ARTICLE

A Student Reflection on Web 2.0 Tools in Promoting Learning Autonomy in Undergraduate Programs: Enhancing Autonomy Based Language Teaching in Indian Scenario

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ABSTRACT

The present paper explores links between learner autonomy and web2.O tools. It describes the impact of learner autonomy on course outcomes, pedagogical research, and practice in English for a Specific Purpose. The process of learning by self is closely related to the learner's perception outside the classroom. All the major findings of this paper, indicate that apart from the geographical and socio-economic background impact on learners' autonomy in the language learning process is significant. The Paper concludes on the note that language learning is not independent of the learner's autonomy, and not only the teacher but the learners are also responsible for their own autonomy.

Keywords: language learning, learner's autonomy, geographical, Paper concludes

Index Terms- Web 2.0 tools, Digital Pedagogy, Reflexive Learning

INTRODUCTION

New technology has become a part of the social fabric and an indispensable part of everybody's lives. The use of computers, laptops, and mobile phones has become almost ubiquitous. Furthermore, social networking websites, smartphones, latest apps have taken precedence over anything else in the lives of today's youth. (Aşıksoy,

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2018)(Basal, 2014). Therefore, when technology has garnered a special place for itself, why not leverage it for the purpose of education as well? Other reasons for applying technology to education as stated by many experts include increased motivation, improvement in self-concept, more student-centered learning and engagement in the learning process, and learner autonomy, which results in better understanding and better recall. There is certainly an increase in the studies on the impact of technology on education, but the issue of integrating technology in literature classes remains unaddressed in India. Online education is now regularly available even in rural places thanks to the Internet's expansion outside of urban areas. The internet is being used to transmit subject information at the primary and secondary levels. The number of systematic, well-designed empirical evaluative studies of the effects of technology use in literature is hardly found in the scholarly literature. The instructional design of technology has been proposed as having as its foundation constructivism's philosophy of learning. According to this notion, pupils are not merely passive consumers of information. The pedagogy of web-based learning and constructivism theory have many similarities (Baytekin; 2021), (Behjat; 2012), (Bustamante; 2012).

The objective of the Study
Current State

The study of literature (in the form of short stories, plays, prose and poetry) is used in the first year as compulsory language classes in selected government and private universities of Rajasthan, India as a basis for increasing language acquisition skills. To maintain literature's privileged place in language studies, it has become challenging the teachers to adopt new pedagogic approaches to achieve the above-mentioned aim. But there is a general perception in higher education that technology has little to contribute to the study of literature. The authors tried to combine the teaching of literature with technology to enrich the language learning process. Thus, this study aimed to redress the balance by introducing technological tools to teach literature followed by the assessment of the students by comparing the results the of pre-test and post-test. The perception of the students towards the use of technology-enhanced needed learning was collected through a questionnaire and semi-structured interviews with the subjects.

The first objective was to use technology as a complement to traditional teaching and learning methods in literature and language classrooms. The second was to monitor the impact of technology on the outcome of learning literature and language. Finally, the objective was to identify learners' behaviors, motivation, and attitudes towards technology-enhanced classes.

Subjects of the study

The subjects for this study were the second-semester B.Tech. (Bachelor of Technology), B Sc. (Bachelor of Sciences) and B.A. (Bachelor of Arts) students of state and Private Universities, Jaipur. Institutes are established in one of the most socially, economically, and educationally challenging areas of the district with the aim to uplift the literacy standard of the areas in the vicinity of the university. The students, thus, have a rudimentary knowledge of the English language. Furthermore, teaching literature to them poses a great challenge for the teachers. Despite making lots of efforts, the students don't show the expected improvement. Hailing from the marginalized strata of society, the students invariably find this subject a hard nut to crack. Course contents (plays, poetry, etc. from the literary giants), teaching materials, and perhaps the traditional method of teaching demotivate them and evoke the emotion of fear for the subject. Most of the students feel intimidated; have inhibitions which lead to poor performance in class. Demotivation can negatively influence the learner's attitudes and behaviors, degrade classroom group dynamics and teacher's motivation and result in long-term and widespread negative learning outcomes (Coskun, A., & Marlowe, Z;2015). Therefore, inspired by the advice, observations, and results of the studies by ELT experts' researchers have decided to adopt a new pedagogic approach in the class i.e. to use technology as a complement to the traditional teaching method. After the exhaustive literature survey, it has been found that technology has the potential to address a variety of students' learning styles and academic needs simultaneously and seamlessly. Contemporary researchers have proposed that in integrating computers in higher education, positive attitudes toward computers and high computer self-efficacy, and lower computer anxiety levels could be important factors in helping students learn computer skills and use computers in education. Hong suggested, "Students who are going to participate in courses that require the use of the Internet would benefit if offered technology literacy courses prior to

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enrolling in courses that require its use" (Hidayati; 2016). Emphasizing the importance of computer competence in the students, Lam said, "If this aspect is not addressed properly, students will be quickly overwhelmed and frustrated by the complexity of computer and Internet usage (Lam, Y., & Lawrence, G; 2002)." Keeping Hong's and Fox's advice in the mind, the researcher undertook the project in the second semester as by that time the subjects had learned the computer efficacy skills, and this justified the reason for selecting technical and non-technical students for this study.

METHODS AND MATERIALS

Methodology and data collection

To get the most accurate data possible, the researchers used three different devices. Initially, a Computer Self Efficacy (CSE) scale was used. It was employed to keep an eye on the students' computer proficiency. (Hafner, C. A., & Miller, L; 2011)The second tool was a language competency test, which was used to gauge the student's level of proficiency both before and after the project as a post-test. The effectiveness of technical instruments was then examined by comparing the outcomes of the two tests. Finally, a questionnaire was given to the individuals, and an interview was done to gather quantitative and qualitative data on their attitudes regarding using technology in the English classroom. The survey collected data on the opinions and suggestions of students regarding the usage of technology in the English classroom. The study was conducted in four phases. The language proficiency of the subjects was assessed at the outset of the course through reading and writing language proficiency tests. The subjects were, then, introduced to technology for the purpose of teaching and learning literature and language in the second phase. They were administered a post-test after the completion of the course. In the fourth phase of the project, A t-test was used to compare the outcomes of the pre-test and post-test. The subjects' feedback was solicited through an interview and a questionnaire in the last phase of the study. The scores of the questionnaire were statistically analyzed.

Findings
Awareness of Web 2.O tools (Pre-test analysis)

The acceptability of the data on the use of web2.0 tools can be expressed in terms of the acceptability rate. Out of the surveyed students, about 56.7 percent the students had an experience of using technology by their teachers in class, however, the number has increased after the pandemic situation in India. As per figure, 1The lowest awareness about the use of web2.O tools was among colleges where Hindi is the medium of instruction, in such colleges, it was found that instructors rarely used technology as an aid in such classes, while the foremost acceptability of web2.0 technology was in colleges where the medium of instruction was English. Students at such colleges were very much aware ofthe benefits of technology integration in teaching. In the interaction with students, it was found out that after the pandemic of Covid 19, there has been a shift in the use of web2.O technology among their classes. Because Data received from respondents reveals that the use of digital tools in teaching has increased significantly at all levels in undergraduate courses, however, their outcome impact is very nominal than expected. (Figure 2).

In pretest mode, all students were asked how many tools they are aware of which can be categorized into web2.0. Many students termed, Google, and YouTube were the two names that majority of the students were aware. The analysis of data showed that almost 73.86 percent of students were not aware of the LMS tools. It also stated that only 36% of the colleges and universities in the Jaipur region had LMS software to monitor the progress of students. In the survey, it was found by the authors that students could never check their progress in the course before the final exam because most of the institutions focused only on structured mode of assessments mainly the end semester examinations. The pretest survey also revealed that students were never briefed about the course assessment methods, program outcomes and the part of technology to be used for the competition of the course. A t-test; Table:1, on gender differences was also conducted. A T-test revealed that female learners were more comfortable with coping with technology in all courses. Although, it has its own limitation because the questions were qualitative, and it was done in the presence of classroom instructors. Table 1 presents those female learners who are enrolled in technology

programs who have a better understanding of the use of Web2.0 tools as compared to non-technology-driven programs. Further, respondents were asked about their access to digital tools and the results were quite surprising. Most students admitted that they feel comfortable using web2.O tools on their smartphones as compared to the access in their colleges or universities. (Figure:3). Figure 4, shows, that researchers have also found that there is a big digital divideamong colleges and universities as per their establishments. Technology has increased the divide among students which has also become a factor of social injustice. Students in private universities had a better orientation towards the use of web2.o tools while students in government and local colleges were suffering to cope with technology. Discussion with the students revealed that students coming from Hindi medium backgrounds had very little idea about the use of web 2.o tools in their learning outcomes. Further, they admitted that throughout their course outline they never thought technology can be integrated in literature classes.

Acceptability of web2.0 tools (post-test)
Through a series of experiments and interactions, the data were gathered. As previously mentioned, Table 2's pre-test, which was carried out at the start of the project, served as the first test. The post-test was the last test, and it was used to evaluate the study's overall efficacy. Questions about the ease, familiarity, and effectiveness of the learning outcomes of the technology-enabled classes were included in the post-test. Both experimental group and control group students took part in the test. Using the t-test, the efficacy of web 2.0 tools was compared and examined. Table III in the analysis of replies indicated a p-value of less than 0.05. The post-test results for the experimental and control groups were significantly different, according to the obtained p-value. The analysis of the post-test results for the control and experimental groups is presented in Table 1 below. The post-test results from both the experimental group and the control group had a mean score of nine. When the scores of the post-test performance of the experimental group and the control group were compared, it was possible to see how effective the usage of technology and web 2.0 tools was. The parameters utilized in this study were effective, as evidenced by the signified value being below.005. The post-test values for the experimental group are noticeably higher than the pre-test values. The use of web 2.0 tools in the classroom has therefore been found to be more productive for students learning second languages.

Social media and acceptability as a learning medium for learner autonomy
Most students admitted that the use of web2.0 tools provides them with a virtual environment where they can express their concerns in an effective manner. Students admitted that they get plenty of resources and feel less burdened in a virtual community. Course instructors also admitted that it gives them an opportunity to apply a variety of pedagogical methods and individualized attention to learners in their classroom. Interviews of learners further revealed that integration of technology in their classroom has enhanced their autonomy and motivation toward language and literature classes. Motivation access was measured on scales of exogenous motivation and endogenous; both the components were measured on a 5-point Likert scale. The score of the survey ranged from 1.68 to 4.2 with an average of 3.7 (SD=0.46), which revealed the learner's high orientation to adopt web2.0 tools. The result also showed that learners were motivational to integrate web2.o tools significantly more endogenously (M=4.58, SD= 0.46) than exogenously (M= 3.37, SD = 0.837), t (670) = 18.00, p < 0.01. Students were asked to rate the factors which, Figure 5, motivate them for using web2.0 in their course, so a few factors which emerged after an interview with them were engagement, social interaction, conceptual understanding, critical thinking, collaborative learning, and enhancement in individual knowledge

CONCLUSION

Web 2.0 tools enhance the learning activities outside of the classroom to promote student autonomy in addition to facilitating productive activities in foreign language schools. Making friends with people from other countries, listening to western music, reading the English news, and conversing with their peers in English are just a few of the non-instructional activities that students cited in the study's student response. To sum up, it is encouraged that the employment of web2.0 tools in classroom instruction always increases student autonomy.

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Table-1 Learners			
Domain	Male	Female	Total
Literature	35 (29.16)	85 (70.83)	120
Arts	42 (53.16)	37 (46.83)	79
Engineering	156 (46.7)	178 (53.29)	334
Sciences	56 (39.1)	87 (60.83)	143
Total	311 (46)	365 (53.9)	676

Table II: Paired Sample T-Test Values of Post-Test- Experiment Group and Control Group

Group	Mean	Std. Deviation	Sig. (2 -tailed)
Experiment post test and control post-test	9.0333	1.8223	.000

Table III: Pre-Test And Post-Test Values of the Experimental Group

Group	Mean	Std. Deviation	Sig. (2 -tailed)
Experiment PRE-TEST test and experimental post-test	-8.9833	1.1273	.000

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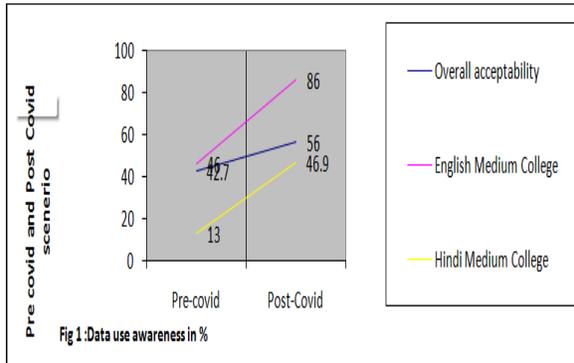
Fig. 1: Data use Awareness in %
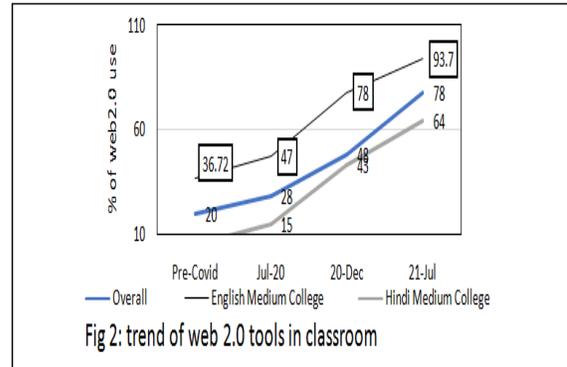
Fig. 2: Trend of web 2.0 Tools in Classroom
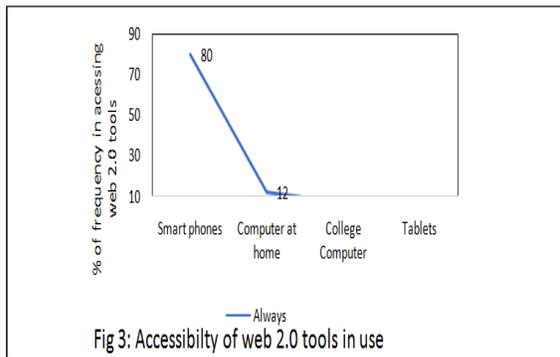
Fig. 3: Accessibility of web 2.0 tools in use
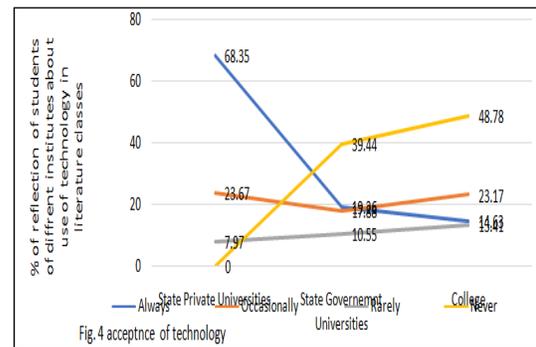
Fig. 4: Acceptnce of Technology
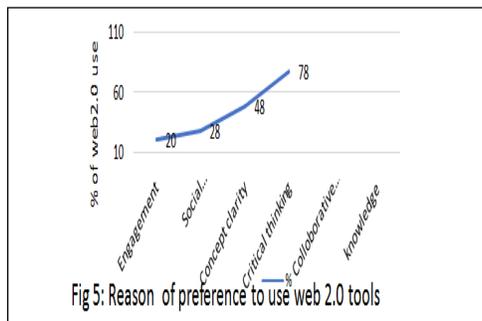
Fig. 5: Reason of Preference to use web 2.0 tools

RESEARCH ARTICLE

An Assessment of the Services of University Libraries in the Context of Changing Information Scenario with Special Reference to Moradabad and Meerut

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ABSTRACT

The research article looks at how several university libraries in north India are doing in terms of resources and services. The automation status of four chosen libraries of the universities has been taken into consideration. This study mainly focuses on a broad spectrum of factors like goals of the university library, the state of the print and electronic resource collections, library membership, staff availability, library hours, services provided, e-resources subscription and ICT infrastructure facility in the library.

Keywords: University Library, Library Resources and Services, ICT, Collection Development, Automation and Infrastructure of the University Library.

INTRODUCTION

University libraries are essential to meeting the multifaceted needs of students, researchers, and university faculty in the higher education system. By offering the greatest amount of service possible with the resources at their disposal, university libraries work to better serve their patrons. Libraries should set up facilities and resources that can serve as adaptable preparatory programmes that can adequately prepare any student for graduation or further education.

The library should be a hub for pursuing higher education, offering a wealth of materials, facilities to the students. A library should include reliable information resources to offer routes for holistic development and academic access for the students.

DESCRIPTION OF UNIVERSITIES
IFTM University
In 2010, the Institute of Foreign Trade and Management, presently known as IFTM University, was founded. It's located in the Moradabad, Uttar Pradesh. The University's current vice chancellor is Dr. M. P. Pandey. In accordance with IFTM University Act No. 24 of 2010, the UP government granted IFTM as University status. It is acknowledged under the UGC Act's 2(f) and 12(B). It has received a "B" rating from NAAC. The university provides a wide range of UG and P G courses. The institution is committed to fostering excellence via academic success, research, innovation, interaction, and teamwork as well as personality development and leadership skills. The IFTM University offers programmes that are career-oriented at all levels, including: degrees in a variety of fields, including law, pharmacy, management, engineering, polytechnic, Sciences, Social Sciences and the Agriculture, at the undergraduate, graduate, and doctoral levels.

Teerthanker Mahaveer University
The Teerthanker Mahaveer University was founded under the Uttar Pradesh government's "Act" (No. 30) of 2008 and has been recognised by the University Grants Commission (UGC) since its creation in 2008 via letter No. F. the October 2008 document 9-31/2008(CPP-1). The TMU University offers programmes that are career-oriented at all levels, including at the undergraduate, graduate, and doctoral levels.

Chaudhary Charan Singh University
In order to meet the needs of higher education in western Uttar Pradesh, Chaudhary Charan Singh University (formerly known as Meerut University) was founded in 1965. In 1991, the university commemorated its silver jubilee. Currently, it is one of the top educational institutions in the nation, with a 222-acre campus that is large, lovely, and pollution-free, complete with expansive playgrounds, experimental fields, a botanical garden, a rose garden, and a life-size monument of the late Prime Minister Ch. Charan Singh has a gym, an indoor stadium, a well-stocked library, dorms for both boys and girls, an administrative building with a large auditorium, a guest house, a community centre, a medical centre, professor and staff housing, a canteen, a bank, and a post office. Currently, the campus has five faculties running 35 courses that are self-financed or career-oriented and 22 UGC-sponsored courses. There are 109 colleges and one constituent college among the 252 professional colleges/institutions that are associated with Chaudhary Charan Singh University.

Swami Vivekanand Subharti University
As a provider of values-based education and a research-focused institution, Swami Vivekanand Subharti University (SVSU) offers equitable chances to people from all walks of life without letting geographic boundaries act as impediments. Through integrated programmes of teaching, research, and selfless service, the university, which enrolls students from all over the world, helps individuals and communities. In accordance with Swami Vivekanand Subharti Vishwavidhaylaya, Uttar Pradesh Adhiniyam, 2008 (U.P. Act No. 29 of 2008), which was approved by the legislature of Uttar Pradesh and given the honourable Governor of Uttar Pradesh's assent in September 2008, Subharti University (SVSU) was created. The Mahayana Theravada Buddhist Religious and Charitable Trust, Meerut, which is famous for providing outstanding service in the areas of education, healthcare, and social welfare, currently oversees the operation of the University.

LITERATURE REVIEW

Otulugbu (2017) in this survey, institution of City College guy students were asked about their awareness of and use of online information sources. Three hundred pupils were given questionnaires as part of a purposeful sampling.

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The results demonstrate that while 97.9% of the students were generally aware of online information sources, very few of them were aware of the specific online resources that the university made available. Additionally, only a few of the students were content with the online information sources that were provided. According to this survey, university libraries should do a better job of raising awareness of the various online resources available to students. Saturday, *et al.* (2017) investigates that library infrastructure is predictor of turnover intention of academic librarian in Nigeria. The study used retest of the measuring instrument Cronbach"s alpha reliability coefficient and face validity for the reliability. The study finds that library infrastructure in academic libraries including internet facility, power supply, library building, smoke detector, fire extinguishers, fire alarm, were at different level of dilapidation which affected services. Further the study shows that inadequacy of unavailability of library infrastructure increase turnover intentions of academic librarians. Khan J. (2016) the survey approach was used to carry out the investigation. Undergraduate, graduate, and research students from different IIT Delhi departments participated in the study. There were about 180 undergraduate, graduate, and research students across many disciplines. A random sample of 150 undergraduate, graduate, and research students was selected from among them while they studied in units. Libraries are now faced with a new difficulty as a result of information technology (IT). The impact of technology on library services has been significant. Singh, & Arora, (2015) describes the role of selected university libraries in Haryana, India in higher education and research of Engineering, Science and Technology. This paper comprehensively studies the functioning, the resources and services of these libraries. The collection development, library membership, staff position, working hours, services offered and e-resources subscribed by these libraries are also discussed. Lakshmi kant, & Jyoti, (2014) discusses the significance of ICT to the libraries to achieve or manage of information, effective services and extension of boundaries from the four-walls to the globe. The study states that ICT is very essential to offer access to books in every possible form and format. And it helps everyone to see resources via internet. Kumari & Talawar, (2011) describes the reference sources collection in 7 university libraries in Karnataka. Among them Mangalore University Library possess more number of reference sources compare to geographical sources of information and directories. The study finds that there is a need to strengthen the information sources like maps and atlases, gazetteers, indexing, abstracting and statistical sources etc.

OBJECTIVES

The specific objectives of the study is

1. To examine the objectives of the four selected university library.
2. To examine the current status of the resources in the four selected university library.
3. To find out the status of e resources in the four selected university library.
4. To determine the types of services provided by the libraries to its users.
5. To find out the ITC infrastructure facilities provided in the four selected university library.

SCOPE AND LIMITATIONS

Four university libraries in north India has been the only ones included in the study. The current analysis is limited to universities established by an Indian Parliament Act and run by state governments. The following universities are chosen for the study: IFTM University, Moradabad, Teerthanker Mahaveer University, Moradabad, Chaudhary Charan Singh University, Meerut, and Swami Vivekanand Subharti University, Meerut. Therefore, connected universities' schools and departments are not included in the current study.

METHODOLOGY

By physically visiting each of the universities chosen for the current study, a questionnaire has been used to collect the pertinent data. Data was acquired over a significant period of the 2020–2021 academic sessions from the librarians of particular university libraries. In addition to the questionnaire tool, telephone interviews and other methods were used as needed to support the validity of data collection.

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ANALYSIS AND INTERPRETATIONS

The basic frequency counting approach is used to present and analyze the data gathered by questionnaires, interviews, and telephone scheduling. Note: 1= to a great extent, 2= to moderate extent, 3=to a little extent, NR= Not respond. It can be observed from the table 2; the four selected university libraries have the common objectives — "To develop research Activities", "Taking lead to provide service for promoting policy of social inclusion regarding equity of provision", "to enhance higher education for students" rating the scale "*To a great extent*" and can be seen is no response by CCSU. At the same time the table 2 shows that "To enhance higher education for students", To enlightened student career and "To build skills among the students" as common objectives of all four selected university libraries rating scale for —moderate extent and can be seen is no response by SVSU. We can observe that the overall performance of the each and every library is up to the mark. Table 3 explains the library staff available in these university libraries. The table 3 shows details about the TMU staff, that there is 23 professional staff and 5 non-professional staff in TMU, total 28 staffs is there in the library. The table 3 also shows that there is 11 professionals' staff and 03 non-professional staff in IFTMU total 14 staffs is there in the library. Further the table shows details about the CCSU staff, that there is 11 professional staff and 01 non-professional staff in CCSU total 12 staffs is there in the library. The table 3 shows details about the SVSU staff, that there is 18 professional staff and 14 non-professional staff in SVSU total 32 staffs is there in the library.

Table 4 describes library membership holders in the library, the table 4 shows that faculty membership holds is maximum i.e, 400 in the IFTMU followed by 300 in TMU, 250 in SVSU and 250 in CCSU. The research scholar's membership is maximum in the TMU i.e, 250 followed by 200 in the IFTMU and 200 in the CCSU & the lowest 150 membership holds is in the SVSU. The student membership is maximum in TMU i.e, 10500 followed by 8000 in the CCSU, 7000 in IFTMU and 7000 membership holds is in the SVSU. Library membership holds of technical & non-teaching staffs are maximum in numbers i.e. 500 in the TMU, followed by 250 in the IFTM and 200 in the SVSU & 150 in the CCSU. Table 5 describes the opening & closing time of the University libraries. IFTMU library opens at 9:30 am to 09:00 pm and is as same timings in working days and exam days but on national holidays and during vacation library will be kept opened from 10 am to 5 pm. Followed by CCSU library opens at 08.00 am to 01:00 pm in the evening, Saturdays library will be kept opened from 08:00 am to 05:00 pm, this timing is as same in the working days and exam days. The table also shows that TMU library opens at 9:50 am to 07:00 pm and is as same timings in working days and exam days but on national holiday and during vacation library will be kept opened from 09:00 am to 05.00 pm in the evening. And further SVSU library opens at 8:00 am to 11:00 pm and is as same timings in working days and exam days but on national holiday and during vacation library will be kept opened from 08:00 am to 05.00 pm in the evening. Table 6 shows that TMU library has the largest number of print collections i.e., 243000 followed by CCSU library with 161664 and SVSU library with 155652 and IFTMU library has the lowest number of 101500 total collections. Table 6 also shows that collections of journals in the university libraries. CCSU library has the largest number of 31988Journal collections, followed by IFTMU library with 2605, TMU library with 1500 and SVSU library has the lowest number of 500 total collections.

All selected university libraries provide the service of Indian journals. Table 7 gives the detail information of E-resources of the entire four university libraries covered under the present study. The table observes that the presence of largest number 69487 of E-resources collection in CCSU library, followed by TMU library with 47300, SVSU library 4700 and IFTMU library has the least number of 2054 total E- Resource collections. Table 9 gives details of E-resources subscriptions in all the four university libraries covered under the present study. Table 9 shows that SVMU library has the highest number of E-resource subscription i.e., 06 followed by IFTMU library with 05, TMU library with 5 and CCSU library has the lowest number of E-resource subscription i.e., 04. The table 9 shows that Springer, EBSCO, Science Direct (Elsevier) online resources are subscribed by all the four university libraries. Whereas Taylor & Francis, J-Gate subscribed by IFTMU, TMU and SVSU, UGC Info Net subscribed by CCSU and SVSU. Table 10 describes the availability of Infrastructural facility for library automation purpose. The table 10 shows that TMU library has the highest number of ICT Infrastructure facilities i.e., 248 followed by IFTMU library with 108, SVSU library with 116 and CCSU library has the lowest number of ICT Infrastructure Facilities i. e., 111. The table

11depicts different functions carried out in the library. The table 11 states that the all university libraries follow the Open Access mode for accessing the resources of the library by their users. Card catalogue is not use in all university libraries. Instead the users prefer to use OPAC. The table 11 shows that all the university libraries follow DDC as Classification scheme for classification of library resources. Besides it can be observed that using Accession register or check list for Stock verification process adopted in all university libraries. The all university libraries use the formalities of weeding out of old books once in a year. All selected university library maintain shelf list for accessing resources. Table 12 shows that information regarding status of library automation in selected four university libraries. The table 12 shows that selected university libraries are partially automated. In IFTMU has automated Acquisition, Technical and Circulation sections. TMU has automated Technical section and Circulation section. CCSU has automated only Technical and Circulation section. IFTMU, TMU and SVSU use KOHA software for automation whereas CCSU use SOUL software for automation in the library. The table 12 shows the selected university libraries use Dspace as Digital software, along with this IFTMU, TMU and SVSU also use e-prints as Digital software in the library. All the selected university libraries use E—Z proxy for remote accessing.

FINDINGS AND SUGGESTIONS

1. This survey finds that most of the university has qualified staff.
2. According to the study, in order to provide quality service, a library should have a full-time professional staff with positions like librarian, deputy librarian, assistant librarian, and library assistant. Staff shall effectively carry out their responsibilities in accordance with the hierarchy.
3. Suggestion: The university libraries' collection of Indian and foreign journals is crucial for users including researchers, faculty members, and students. Additionally, to raise and expand the standard of research and advancements.
4. The majority of the significant physical infrastructure components, including the kiosk, fax machine, television, LCD projector, multimedia kit, CCTV cameras, and laser printers, are utilized by the universities indicated in the report. But the use of these components in maximum possible number will leave some more positive effect on a large number of population.
5. Recommendation: An academic library's infrastructure can be used to predict its plans for staff turnover. The library is dedicated to giving its users the best service possible given the state of IT development today. To adequately serve the user population, a university library must be outfitted with devices such a kiosk, fax machine, television, LCD projector, multimedia kit, CCTV cameras, and laser printers.

CONCLUSION

According to the study's findings, university libraries should seriously consider building infrastructure in the rapidly evolving digital world. They should also expand their purchases of information sources including international and Indian journals to meet users' current research needs. The best service offered to the user community is library services, for which the library has completely committed its professional personnel. By assessing and gaining access to the usability of library resources, library professionals will deliver high-quality service.

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Table 1: University Libraries

S.No	Name of the university	Abbreviation	Website Address	Year
1.	IFTM University	IFTMU	https://www.iftmuniversity.ac.in/	2010
2.	Teerthanker Mahaveer University	TMU	https://www.tmu.ac.in/	2008
3.	Chaudhary Charan Singh University	CCSU	https://www.ccsuniversity.ac.in/ccsum/index.php	1965
4.	Swami Vivekanand Subharti University	SVSU	https://www.subharti.org/	2008

Table 2: Main Objectives Of The University Library

S.No	Objectives	IFTMU	CCSU	TMU	SVSU
1.	To develop research Activities	1	1	1	1
2.	Creating knowledge with individuals and groups	1	NR	1	1
3.	To build skills among the students	2	2	2	NR
4.	To support learning	1	1	1	1
5.	To enlightened student career	2	2	2	2
6.	To enhance higher education for students	2	2	2	2
7.	Taking lead to provide service for promoting policy of social inclusion regarding equity of provision	1	1	1	1

Table 3: Staff In The University Libraries

S.No	Position	Name of the University Library			
		IFTMU	CCSU	TMU	SVSU
	University Librarian/ Librarian in charge	1	-	1	1
	Deputy Librarian	1	1	1	-
	Assistant Librarian	1	7	5	3
	Library Assistant	7	1	16	5
	Library Project Assistant / Apprentice	-	1	-	9
	Non professionals	4	1	5	14
	Total	14	11	28	32

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Table 4: Library Membership

S.No	Category of Members	Name of the University Library			
		IFTMU	CCSU	TMU	SVSU
1.	Students	7000	8000	10500	7000
2.	Research Scholar	200	200	250	150
3.	Faculty	400	250	300	250
4.	Non-Teaching/Tech. Staff	250	150	500	200
	Total	7850	8600	11550	7600

Table 5: Working Hour's of the Library

Period	Timings			
Working Days	IFTMU	CCSU	TMU	SVSU
Exam days	9:30 am to 9:00 pm	8:00am to 01:00pm	9:50 am to 7:00 pm	8:00 am to 11:pm
On national Holiday / During vacation	10:00am to 5:00pm	08:00 am to 5:00 pm	09:00am to 5:00pm	08:00am to 05:00pm

Table 6: Print Resources Collections Status

S.No	Types of Information Resources	Name of the University Library			
		IFTMU	CCSU	TMU	SVSU
	Book collections				
1.	Text books	96000	161664	243000	155652
	Reference book collections	5000	-	-	-
	Book Bank collection (SC & ST)	5000	-	-	-
	Total	101500	161664	243000	155652
	Journals collections				
2.	Indian journals	90	106	-	500
	Foreign journals	15	82	1500	-
	Back volumes of journals	2500	31800		-
	Total	2605	31988	1500	-
	Reference collections				
3.	Thesis and dissertations	250	14650	95000	-
	Dictionaries	10	-	-	-
	Encyclopedias	5	-	-	-
	Government publications	-	-	-	-
	Indexes & abstracts	-	-		-
	Reports	500	-	-	-
	Gazetteers	-	-	-	-
	Biographical sources	-	-	-	-
	Bibliographical sources	-	-	-	-
	Year books & almanacs	-	-	-	-
	Monographs	-	-	-	-
	Maps / Atlases	-	-	-	-
	Handbooks & manuals	-	-	-	-
	Manuscripts	-	-	-	-
	Total	765	14650	95000	01

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Table 7: E-Resources Collections

S.No	Types of E- Resources	Name of the University Library			
		IFTMU	CCSU	TMU	SVSU
1.	E-Books	1000	67000	38800	2500
2.	E- Journals	50	312	8500	2200
3.	Electronic database	4	2175	-	-
4.	CDs, DVDs	1000	-	-	-
5.	Others	-	-	-	-
	Total	2054	69487	47300	4700

Table 8: Services Offered by the University Libraries

S. No	Services provided	Name of the University Library			
		IFTMU	CCSU	TMU	SVSU
1.	Current Awareness Services	Y	Y	Y	Y
2.	Selective Dissemination of Information	Y	Y	Y	Y
3.	Inter Library Loan	Y	Y	Y	Y
4.	Bibliographic Services	Y	Y	Y	Y
5.	Photocopy Service	Y	Y	Y	Y
6.	Document Delivery Services	Y	Y	Y	Y
7.	Reference Service	Y	Y	Y	Y
8.	Circulation Service	Y	Y	Y	Y
9.	Registration and Membership	Y	Y	Y	Y
10.	Book Bank Service	Y	Y	Y	Y
11.	OPAC/Web OPAC	Y	Y	Y	Y
12.	Departmental Library	Y	Y	Y	Y

Note: Y= Yes and N = No, The table 8 describes four university libraries are providing all the necessary services which is given in the table.

Table 9: E-Resources Subscribed In The University Libraries

Online resources	IFTMU	CCSU	TMU	SVSU
Springer	YES	YES	YES	YES
EBSCO	YES	YES	YES	YES
ACM Digital Library	-	-	-	-
ASME	-	-	-	-
Emerald	-	-	-	-
Taylor & Francis	YES	-	YES	YES
ASTM Journals & Standards	-	-	-	-
Science Direct(Elsevier)	YES	YES	YES	YES
UGC Info Net	-	YES	-	YES
ASCE	-	-	-	-
J-Gate	YES	-	YES	YES
Nature	-	-	-	-
American Chemical Society	-	-	-	-
American Physical Society	-	-	-	-
American Institutes of Physics	-	-	-	-
ISID	-	-	-	-
Total	5	4	5	6

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Table 10: Infrastructure for Library Automation

S. No	ITEMS	Name of the University Library			
		IFTMU	CCSU	TMU	SVSU
1.	No. of computer	40	100	200	100
2.	UPS	40	7	4	2
3.	Scanner	2	-	-	-
4.	Kiosk	-	-	-	-
5.	Fax	1	-	-	-
6.	Xerox machine	1	-	2	1
7.	LED TV	-	-	-	-
8.	LCD projector	1	2	2	1
9.	Server	1	-	-	-
10.	Multimedia kit	-	-	-	-
11.	CCTV cameras	10	-	20	10
12.	Barcode scanners	4	-	10	-
13.	Printers	4	-	-	2
14.	Laser Printers	2	2	10	2
15.	Ink-jet printer	2	-	-	-
	Total	108	111	248	116

Table 11 : Various Functions Of The Library

S. No	Task	Name of the University Library			
		IFTMU	CCSU	TMU	SVSU
1.	Access mode	Open Access	Open Access	Open Access	Open Access
2.	Card catalogue	NO	NO	NO	NO
3.	Classification scheme	DDC	DDC	DDC	DDC
4.	Stock verification	Accession register or Using check list	Accession register or Using check list	Accession register or Using check list	Accession register or Using check list
5.	Weeding out policy	Done / Once in a year	Done / Once in a year	Done / Once in a year	Done / Once in a year
6.	Self-list	Done	Done	Done	Done
7.	Technical Processing	within four months	within four months	within four months	within four months
8.	Method for issuing books	online	Online	Online	online

Table 12: Status of Library Automation

S. No	Task	Name of the University Library			
		IFTMU	CCSU	TMU	SVSU
1.	Status of library automation	Partially Automated	Partially Automated	Partially Automated	Partially Automated
2.	Operations	Acquisition	Circulation	Technical	Acquisition
		Technical	Circulation	Circulation	Circulation

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		Technical	Technical	Circulation	Circulation
3.	Software for automation	KOHA	SOUL	KOHA	KOHA
4.	Software for remote accessing	Yes	Yes	Yes	Yes
5.	Digital software	D-Space	-	D-Space	D-Space

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RESEARCH ARTICLE

Comparison of Rooting Hormone Concentrations in a Local Resource for Vegetative Propagation of Oriental Cypress (*Platycladus orientalis*)

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ABSTRACT

Exotic but environmentally friendly species, when mixed with endemic species, can improve the scenic quality of the urban environment. The purpose of this research was to establish what concentration of ANAA is optimal for boosting the early growth of cypress cuttings. Five levels of ANAA were prepared and applied to one hundred fifty (150) cuttings of cypress cuttings and planted in a propagation bed for six (6) months using Completely Randomized Design. Treatments were replicated three times, with 10 experimental cuttings per replication. The parameters assessed included the number of roots produced, root length, and survival rate. Results showed that the average root length of Oriental Cypress cuttings varies significantly when applied with ANAA hormone, with T4 (20ml of ANAA/liter of water) obtaining the longest average root length of 4.76 cm and the highest survival rate at 82%, 180 days after planting. The number of roots produced, however, did not differ significantly. The variation in growth performance, particularly in attaining longer roots and survival of cypress cuttings, could be attributed to the appropriate level of ANAA hormone applied to the experimental cuttings. So, 20 ml of ANAA per liter of water worked well for the first stage of growth for Oriental cypress cuttings.

Keywords: Vegetative propagation, Alpha Naphthalene Acetic Acid, Oriental Cypress, Initial Growth, and Rooting hormone

Jerry B. Acero

INTRODUCTION

Due to the current situation of the country's forest resources, major efforts to bring back the country's lost forest cover are required. Immediate forest rehabilitation is necessary to improve the vegetation on millions of acres of open, deforested land and in expanding urban areas. The unchecked cutting down of trees for their timber is the most common cause of deforestation. However, the growth of cities and the introduction of farming in lowland areas have also had a negative impact on the natural forests that are still standing (Ahmad, 2006; Shively *et al.*, 2001). The Philippines is one of many developing nations that are at the forefront of a new field known as urban forestry. Based on this concept, city residents take charge of their environment by caring for trees and forests as an integral part of their neighborhoods and by becoming aware that good urban forestry enhances the quality of life in cities. This field studies the relationship between the expansion of urban populations and the growth of forest vegetation. Some city greening programs combine native species with non-native ones when they landscape urban areas like parks and lawns. This is done as part of an effort to diversify the vegetation in urban areas to reduce the effects of pollution (Nowak et al., 2008) and to enhance the aesthetic appeal of natural settings. Recent developments in landscaping, on the other hand, have shown that combining endemic species with invasive species that aren't harmful to the environment can result in a better overall composition and an improvement in the urban area's scenic quality. This quest, however, has been complicated by the arduous task of propagating these fascinating exotic species, as many of them are unable to produce seeds because of differences in the climatic conditions in different locations (De Silva, 2003). One of these species is the "Oriental Cypress," also called *Platycladosorientalis* by its scientific name (Hassanzadeh *et al.*, 201; Ren *et al.*, 2019). One way to get the Oriental Cypress to produce seeds is by using somatic embryogenesis (SE), which is defined as the direct conversion of adult plant tissues into undifferentiated, totipotent cells capable of further differentiation.

Introduced/exotic species are normally difficult to propagate (Karimi *et al.*, 2018; De Silva, 2003) due to their inability to bear seeds due to different climatic and agronomic conditions, aggravated by insufficiency of scientific knowledge about various propagation methods (Stubbs *et al.*, 1997). In recent years, forest and urban reforestation practices have relied heavily on the use of natural seedlings or sexual means of producing planting materials. However, the asexual process of propagation is vital to horticulture and landscaping since the genetic make-up of most fruit and ornamental species is highly heterozygous and the unique characteristics of such plants are instantly lost if they are grown by seed (Broertjes and Harten, 1988; Maluszynski*et al.*, 1995; Predieri,2001). Propagation of stem cuttings is the most used method to propagate many woody ornamental plants. However, some stem cuttings of many favorite shrubs are quite easy to root (Trigiano and Gray,2016). Hence, this study used different levels of Alpha Naphthalene Acetic Acid (ANAA), a cheap and locally available hormone (Libunao*et al.,* 2013), aimed at providing alternative solutions to individuals who need insights on propagating Oriental Cypress through branch cuttings.

MATERIALS AND METHODS

The experimental study waslaid out in a Completely Randomized Design (CRD) where five (5) different levels of the locally available Alpha Naphthalene Acetic Acid (ANAA) hormone serve as the Treatments, replicated three times. Using the Completely Randomized Design (CRD), the treatments composed of T1 (5ml of ANAA/liter of water), T2(10ml of ANAA/liter of water), T3 (15ml of ANAA/liter of water), T4 (20ml of ANAA/liter of water), and T5 (Control or without application of ANAA hormone. The study was conducted at Surigao Norte State University - Mainit campus Agroforestry Tree Nursery using its propagation chamber intended for asexual method of producing planting materials.

Propagation medium Preparation

Gravel, sand, and sandy loam soils were prepared as its propagation medium mixed at 1:1:1 ratioratio(Lee *et al.*, 2019). The medium was then sterilized with boiled water to kill the soil pathogens. The periphery of the

propagation chamber was also cleared and disinfected to ensure the semi-sterile condition of the experimental site. Shade wasprovided using transparent plastic cover to protect the cuttings from adverse environmental conditions.

Collection and Preparation of cypress leaf cuttings

Experimental Cuttings of cypress were collected from Kitcharao, Agusan del Norte, Philippines where quality Oriental cypress plants is available. One-hundred fifty (150) branch cuttings were initially cut at 15 cm length and then placed in an ice box with covering, matted with sawdust and ice cubes to ensure the vigor of the cuttings while transported from the source to the experimental site. At study site, collected cuttings were cleaned and trimmed to 10 cm in length. Side and base cuts were provided in all cuttings.

Planting of Cuttings to Prepared Medium

Experimental Cuttings were dip into fungicide solutions of 5ml per gallon of water for 20 minutes (Bhuiyan *et al*, 2014; Magarey, 2021;Olufolaji,1993; Rajput *et al*, 2021)to kill any microorganisms that were present to make sure that the cuttings were free from any contaminants. Finally, cuttings were soaked to their respective levels of solutions containing ANAA hormone for 4 hours and then planted to the prepared medium at 10 square centimeters.

Care and Maintenance

To avoid physical disturbances, the experimental set-up was provided with a perimeter fence. Using a knapsack sprayer, watering was done at four hours interval daily, except during rainy days nighttime. Close monitoring was done to ensure the safety of the experiment from any agents of destructions. Weeding was applied to eliminate competitions from any undesired plants that grown also in the prepared growing medium during experimentation.

Data Collection and Statistical Treatment

Data collection was done on a per parameter basis such as: the Average length (cm) of the roots, Average number of roots produced, and Survival Rate (%). Statistical tools such Analysis of Variance (ANOVA) for CRD and Duncan's Multiple Range Test (DMRT) were used to facilitate the statistical analysis of collected data.

RESULTS AND DISCUSSIONS

Average Number of Roots Produced

The average number of roots produced by cuttings of Oriental cypress 180 days after they have been planted is presented in Figure 1. According to the collected data, treatment T4 (20 milliliters of ANAA per liter of water) produced the largest mean number of two roots, whereas the other treatments only produced one root each. The study of the data, however, revealed that there was no discernible difference between the various treatment means. Because of poor root symmetry, cypress cuttings require more time to begin the process of root formation (de Silva, 2002). So, after 180 days, it's too soon to make a final decision about how the ANAA hormone affects the roots of oriental cypress.

Average Length of Produced Roots

Figure 2 shows the average length of produced roots of oriental cypress branch cuttings after 180 days. It was observed that T4 (20ml of ANAA/li. of water) obtained the longest roots produced with 5.95 cm, followed by T3 (15ml ANAA/li of Water) 3.3 cm, while T5 (without application of ANAA) got the lowest length of 0.65cm. A highly significant difference among treatments was disclosed. The Post-hoc analysis of pairs revealed also a significant difference of which T4 (20ml of ANAA/li. of water) showed the best performance among other pairs of treatments in terms of the length of roots produced for cypress.

Average Survival Rate

Figure 3 depicts the graphical presentation of the average Survival (%) of Oriental cypress cuttings applied with different levels of locally available ANAA hormone. For this parameter, itwas disclosed that T4 (20ml of ANAA/li. of

water) got the highest survival rate of 90% followed by T3 (15ml ANAA/li of Water) and T2 (10ml ANAA/li of Water) with 82%, while T5 (without application of ANAA) was observed as thelowest at 47.5%. The ANOVA for CRD shows a significant variation among treatments. It is because ANAA contains Auxins that promotes production of roots (Ullah *et al.,* 2005).Likewise, when ANAA was applied as rooting hormone for rubber branch cuttings, the treatments applied with 1tbs/li of ANAA, the survival was significantly higher than those untreated cuttings(Corpuz, 2020; Priyadarshan, 2017; Rafay et al, 2015).In the study of Libunao*et al* (2013), ANAA was also applied to Pomelo cuttings, and it resulted to higher survival of cuttings compared to unapplied branches.

CONCLUSION

Growing exotic species using the vegetative approach, such as Oriental Cypress, is a highly difficult endeavor (Karimi *et al.*, 2018), especially when low-quality plant hormones are utilized in the process. One of the plant hormones that are readily available in Surigao del Norte, Philippines, is ANAA, which can be purchased at a price that is significantly lower than that of other well-known plant hormones like IBA and NAA. When propagating branch cuttings of Oriental cypress, it is recommended to use twenty milliliters (20 ml) of ANAA hormone per liter of water because this has been shown to be an effective method for initiating longer root development and higher survival rates. This conclusion is based on the findings of the research study.

ACKNOWLEDGEMENT

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(Left)The Mother Oriental Cypress Tree. (Right). The Rooted Oriental Figure 1.180-day-old Oriental cypress cuttings average number of roots	Figure 2. The Average Number of Produced Roots after 180 days
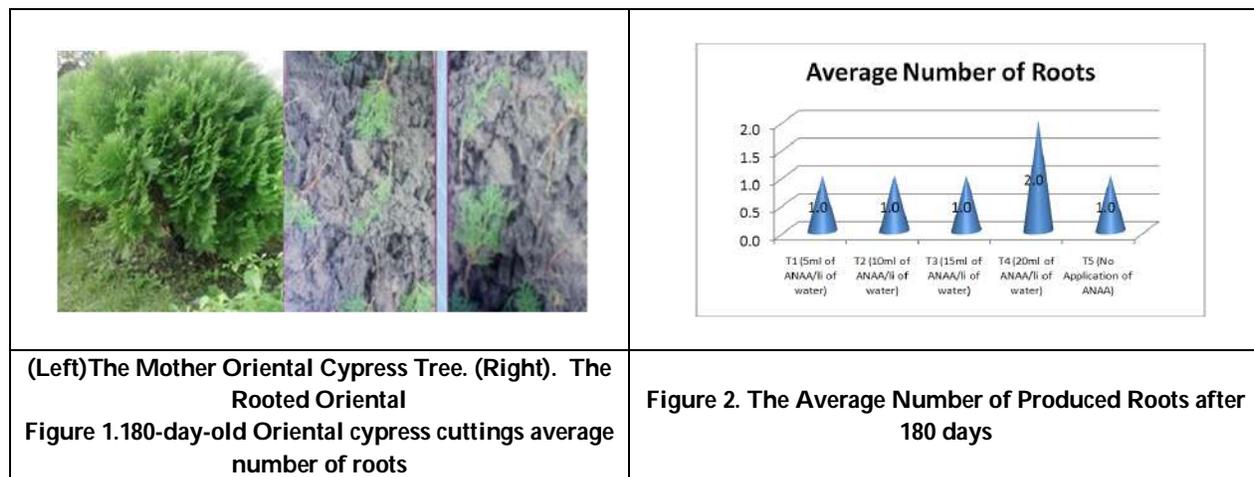
Jerry B. Acero
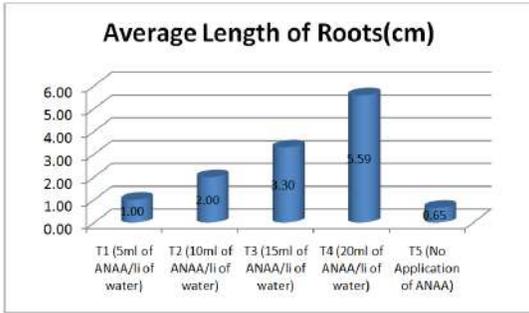
Figure 3. The Average Number of Produced Roots after 180 daysAverage Survival Rate
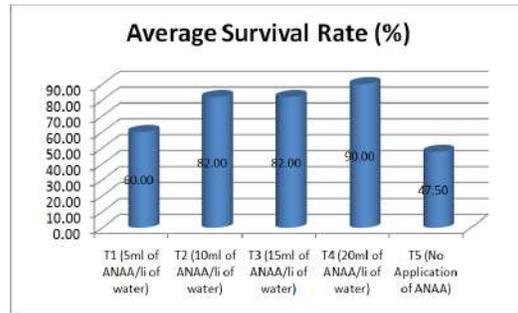
Figure 4. The Average Number of Produced Roots after 180 days

RESEARCH ARTICLE

Kinetic Studies on Microbial Production of Protease by *B.cereus* using Agro Residues

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ABSTRACT

Proteases are hydrolytic enzymes capable of degrading protein molecules into small peptides and amino acids. Proteases are the most important industrial enzymes with considerable application in food, medicines and pharmacy. In the present study, a kinetic model has been developed for the batch fermentation used for the production of Protease by *Bacillus cereus* using agro residues as a substrate. The protease activity was found to increase with respect to fermentation time and reaches a maximum of 81U/gds, 72.96 U/gds and 69.6 U/gds at the end of fermentation time of, 16 hours for cassava waste, 24 hours for groundnut shell and 24 hours for sugarcane bagasse respectively. Kinetic studies on solid state fermentative production of total protease enzyme is carried out using Michaelis Menten kinetics and the kinetic parameters namely K_m and V_{max} were evaluated using Lineweaver-Burk plot under optimum fermentation condition.

Keywords: Protease; *Bacillus cereus*; Agro residues; Kinetics; Optimization.

INTRODUCTION

Protease is an enzyme that catalyses the hydrolysis of peptide bonds present in proteins. In most of the living organisms, protease enzymes are essential for digestion and absorption of proteins. Proteases or proteolytic enzymes are found in all living organisms, e.g. bacteria, algae, plants and animals and in some of the viruses too. They are involved in the catabolism and digestion of proteins and also in cell signalling. Proteases are proteolytic (protein-digesting) enzymes that are mainly classified on the basis of their pH optimum as acidic, neutral, and alkaline

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proteases[1]. Proteases, also known as Peptidyl-peptide hydrolyses, which is the most important category of enzymes from industrial point of view. Protease are responsible for approximately 60% of all enzyme sales and are utilized extensively in a variety of industries, including detergents, meat tenderization, cheese making, dehairing, baking, brewery, and the recovery of silver from photographic film. The uses of these enzymes are detergent additives stimulated their commercial development and resulted in a considerable expansion of fundamental research into these enzymes[2]. Microbial proteases are gaining more importance than conventional chemicals that cleave peptides because of the cheaper production cost and use of renewable resources. Microbial proteases can be produced from bacteria, fungi and yeast using many processes like solid-state fermentation, submerged fermentation.[3,4].Several microbial strains including fungi (*Aspergillus flavus, Aspergillus melleu, Aspergillus Niger, Chrysosporium keratinophilum, Fusarium graminarum, Penicillium griseofulvin, Scedosporium apiosermum*) and bacterial (*Bacillus licheniformis, Bacillus firmus, Bacillus alcalophilus, Bacillus amyloliquefaciens, Bacillus proteolyticus, Bacillus subtilis, Bacillus thuringiensis*) are reported to produce proteases. Among these, Bacillus genus has gained importance at industrial scale[5]. Proteases are generally produced using submerged fermentation due to its apparent advantages in consistent enzyme production characteristics with defined medium and process conditions and advantages in downstream in spite of the cost –intensiveness for medium components. In this context, solid-state fermentation has gained renewed interest and fresh attention from researchers owing to its importance in recent developments in biomass energy conservation, in solid waste treatment and in its application to produce secondary metabolites. Production of these biocatalysts using agro-biotech substrates under solid-state fermentation conditions provide several advantages in productivity, cost-effectiveness in labour, time and medium components in addition to environmental advantages like less effluents production, waste minimization[6]. Industrial Fermentation is moving away from traditional and largely empirical operation towards knowledge based and better controlled process[7]. There are several reports describing use of agro-industrial residues for the production of alkaline protease, e.g. nug meal and bacillus sp. AR009 [8], pigeon pea and bacillus sp. JB-99 [9], wheat bran and Rhizopus oryzae [10]. However, these production characteristics would have to offer a competitive advantage over existing products. In general, each microbial strain is unique in their molecular, biochemical, metabolic and enzyme production properties. On the basis of this background, the aim of the present work is the Kinetic studies on solid state fermentative production of total protease enzyme.

MATTERIALS AND METHODS

Microorganism and inoculums' preparation
Bacterial strain used in this work is well preserved in the laboratory. Bacterial strain Bacillus cereus was a stock of the Microbial Type Culture collection Centre (MTCC), Chandigarh, India. The strain was maintained on nutrient agar medium at 4∘C. The medium composition (g/l) was comprised off the following: Beef extract 1.0; Yeast extract 2.0; Peptone 5.0; NaCl 5.0 and Agar 2.0. Cells were subculture at monthly intervals.

Extraction Of Protease
The enzyme was extracted according to the method described by Nagamine *et al.* (2003)[11]. Fermented medium was mixed thoroughly with 50 mM glycine–NaOH buffer, pH 11 for 30 min and the extract was separated by squeezing through a cloth. This process was repeated three times and extracts were pooled together and then centrifuged. The supernatant was used as enzyme source for protease assay.

Protease Assay
Protease activity was determined using modified Auson–Hagihara method[12]. In this 1 ml of the enzyme solution was added to 1 ml casein solution (1%, w/v casein solution prepared in 50 mM glycine–NaOH buffer, pH 11) and incubated at 70ºC for 20 min. The reaction was terminated by adding 4 ml of 10% trichloroacetic acid and the contents were filtered through a Whatman No. 1 filter paper. The filtrate absorbance was read at 280 nm using UV–Visible spectrophotometer and the protease activity was calculated using tyrosine standard curve. One unit of alkaline protease activity was defined as 1 µg of tyrosine liberated ml^{-1} under the assay conditions.

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Kinetics of Solid-State Fermentative Production of Protease by *Bacillus cereus* Using Cassava waste, Groundnut shell and Sugarcane Bagasse

The production of protease by solid state fermentation was carried out using substrate cassava waste, groundnut shell and sugarcane bagasse as substrate under optimum conditions. The fermentation period was 40 hours. The protease activity was found to increase with respect to fermentation time and reaches a maximum of 81U/gds, 72.96 U/gds and 69.6 U/gds at the end of fermentation time of, 16 hours for cassava waste, 24 hours for groundnut shell and 24 hours for sugarcane bagasse respectively. The results obtained are given in Table 1. and Fig. 1 The rate of product formation (dp/dt) for protease with respect to time was shown in Fig. 1. The rate of product formation (dp/dt) was found to increase gradually and reaches maximum at the end of 16 hours for cassava waste and 24 hours for groundnut shell and sugarcane bagasse and later on it was found to decrease due to non-availability of substrates. The results show that the maximum rate of 5.06 for cassava waste at the end of 16 hours, 3.04 for groundnut shell and 2.9 for sugarcane bagasse was obtained at the end of 24 hours and was found to be optimum fermentation period. The kinetic parameters for protease production using *B.cereus* are evaluated using Line weaver-Burk plot. From the Line weaver-Burk plot V_{max} and K_m values were found and given in Table.3. Therefore the Michaelis Menten kinetic model for protease production was found to

$$V = \frac{V_{max}S}{K_m + S}$$

V - is the rate of reaction
V_{max} - is the maximum rate of production at maximum substrate concentration
K_m - is the Michaelis Menten constant is the substrate concentration at which the reaction rate is at half-maximum.
S - is the substrate concentration

From Fig.1.4 it is found that the predicted values from the kinetic model are in good agreement with the experimental values. The reaction rate increases with increasing substrate concentration, approaching its maximum rate V_{max}, attained when all the enzymes are bound to substrate. It also follows that, $V_{max} = k_{cat} (E_o)$ where E_o is the enzyme concentration, k_{cat} is the turnover number, is the maximum number of substrate molecules converted to product per enzyme molecule per second. The Michaelis constant K_m, is the substrate concentration at which the reaction rate is at half-maximum, and is an inverse measure of the substrate's affinity for the enzyme as a small indicates high affinity, meaning that the rate will approach more quickly. The value of K_m is dependent on the enzyme and the substrate, as well as conditions such as temperature and pH.

CONCLUSION

Kinetic studies on solid state fermentative production of total protease enzyme is carried out using Michaelis Menten kinetics and the kinetic parameters namely K_m and V_{max} are determined for the microorganisms *B.Cereus* under optimum fermentation condition.

ACKNOWLEDGMENT

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Table.1:Effect of fermentation time on protease production by *B.cereus* using cassava waste, groundnut shell and sugarcane bagasse

Time, (hr)	Protease Activity, (U/gds)			Rate of protease formation, (U/gds.hr)		
	Cassava waste	Groundnut shell	Sugarcane bagasse	Cassava waste	Groundnut shell	Sugarcane bagasse
0	0	0	0	0	0	0
8	27.12	12.80	18.20	3.37	1.60	2.27
16	81.24	38.72	41.60	5.06	2.42	2.60
24	74.06	72.96	69.60	3.08	3.04	2.90
32	66.32	70.40	66.18	2.06	2.20	2.06
40	52.01	65.20	47.11	1.30	1.63	1.17

Table.2: Rate of protease formation by *B.cereus* using cassava waste, groundnut shell and sugarcane bagasse

S,(g)	1/S,(g⁻¹)	Rate of protease formation V, (U/gds.hr)			Protease formation 1/V, (gds.hr/U)		
		Cassava waste	Groundnut shell	Sugarcane bagasse	Cassava waste	Groundnut shell	Sugarcane bagasse
3	0.34	2.12	1.60	1.12	0.47	0.62	0.89
6	0.16	3.61	2.42	2.01	0.27	0.41	0.49
9	0.12	5.40	3.04	3.04	0.18	0.32	0.32
12	0.08	4.91	2.81	2.61	0.20	0.35	0.38
15	0.06	4.42	1.63	2.42	0.22	0.38	0.41

Table.3: Michaelis Menten constants for protease production using *B.cereus*

Microorganism	Substrate	V_{max}	K_m
B.cereus	Cassava waste	8.8495	9.2743
	Groundnut shell	3.7878	3.9734
	Sugarcane bagasse	8.4033	20.2358

Table.4: Comparison between experimental values and predicted values for protease production by *B.cereus* using cassava waste, groundnut shell and sugarcane bagasse

S, (g)	Rate of protease formation V, (U/g.hr)					
	Experimental			Predicted		
	Cassava waste	Groundnut shell	Sugarcane bagasse	Cassava waste	Groundnut shell	Sugarcane bagasse
3	2.12	1.62	1.12	2.16	1.60	1.08
6	3.61	2.27	2.01	3.47	2.42	1.92
9	5.40	2.62	3.04	4.35	3.04	2.58
12	4.91	2.84	2.61	4.99	2.81	2.38
15	4.42	2.99	2.42	5.46	2.63	2.78
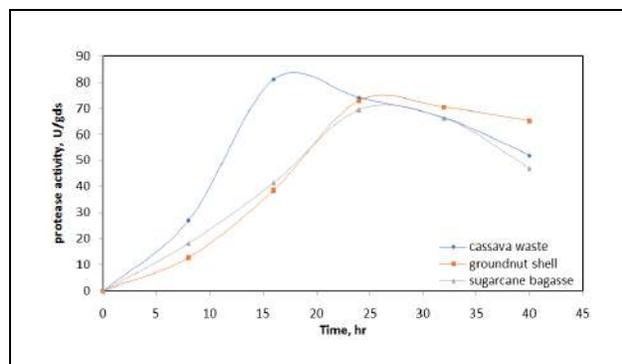
Fig.1:Effect of fermentation time on protease production by *B.cereus* using cassava waste, groundnut shell and sugarcane bagasse
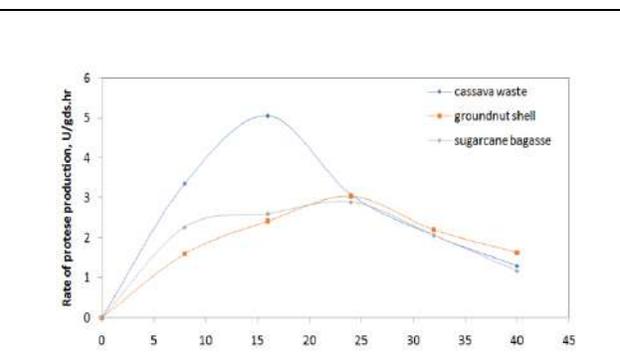
Fig.2:Rate of protease production by *B.cereus* using cassava waste, groundnut shell and sugarcane bagasse
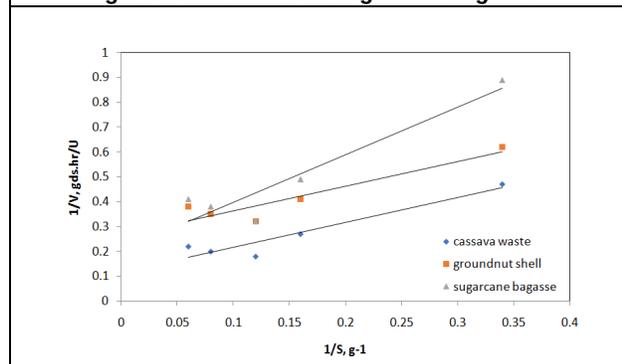
Fig.3: Lineweaver-Burk plot for protease production by *B.cereus* using cassava waste, groundnut shell and sugarcane bagasse
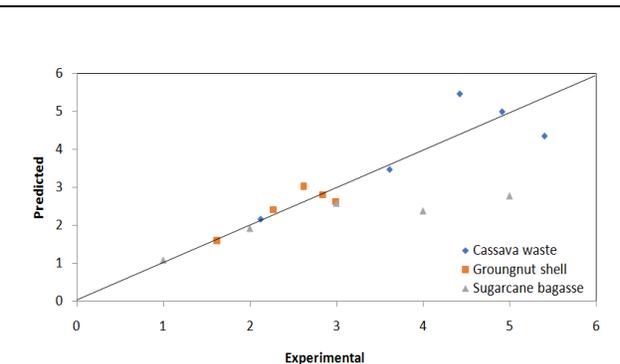
Fig.4:Comparison between experimental values and predicted values for protease production by *B.cereus* using cassava waste, groundnut shell and sugarcane bagasse

RESEARCH ARTICLE

Magnetic Resonance Imaging Characterization of Disc Degeneration

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ABSTRACT

Lower back pain problems initiate gradually, which are often ignored most of the time by the patient. Mild pain might attain severity as the duration of time increases. Plain radiograph AP and lateral view can be helpful in finding gross anatomical changes. MRI is the standard imaging modality due to its advantage of multiplanar imaging capability, superior soft tissue resolution, lack of radiation and precise localization of intervertebral disc changes. Aim of the study was Magnetic Resonance Imaging characterization of disc degeneration. First objective of study was a degree of involvement in males verses females and another objective was to compare lumbar disc degenerative disease changes with different parameters Prospective study was conducted in department of radio diagnosis on a group of 66 patients after clearance from Institutional Ethics Committee. Patients were referred to the department, after considering inclusion and exclusion criteria, routine MRI of lumbar spine was performed on SIEMENS MAGNETOM AVANTO A TIM + DOT SYSTEM, 1.5 Tesla MRI Machine by using T1 weighted, T2 weighted and STIR sequences. Following scan, pathology was identified based on the patients reports and was classified with respect to nine parameters as follows Lumbar Lordosis, Schmorl's node, Disc Desiccation, Annular tear, Disc Protrusion and Extrusion, Sequestration, Ligamentum Flavum Thickening, Spinal Cord Narrowing, Lateral Recess Narrowing. Males (57.50%) were more prone to lumbar disc degenerative disease compared with females (42.50%). Lateral Recess Narrowing (107.57%) commonly found in most of the patients as compared with all other parameters following Disc Protrusion and Extrusion (53.03%). L4/L5 disc level is commonly affected in most of the patients, the D12/L1 Disc level were least affected. Between 40-50 years of age (43.90%) maximum number of patients was affected lumbar disc degenerative disease. Multiple levels of disc involvement

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are present with pathology in Lumbar disc degenerative disease. Plain radiograph AP/Lateral view can be helpful in finding the gross anatomical changes. MRI is the standard imaging modality due to its advantage of superior soft tissue resolution, multiplanar imaging capability, lack of radiation and precise localization of intervertebral disc changes.

INTRODUCTION

As the age advances the low back pain is commonly found in most of the population. It is not necessary to have pain in the lower back during the lumbar degenerative disc disease. It can present with radiating pain to the lower limbs [1]. The patients with lumbar degenerative disc disease can present with a history of sensory disturbances in legs, pain when bending forwards and claudition. The risk problems related with lumbar degenerative disc disease are trauma, heavy weight lifting, obesity, smoking, advancing age, improper use of ergonomics during working hours [2].

Disc Protrusion And Extrusion
The disc herniation is subdivided into protrusion and extrusion (Figure .1). In Disc Protrusion the distance between the edges of disc herniation is less than the distance between the edges of the base is called disc protrusion. In Disc extrusion the distance between the edges of the disc material is greater than the distance at the base [1] .

Sequestration
The isolated fragment is sequestered also known as a free segment (Figure .2). This fragment is posterior or anterior to the posterior longitudinal ligament, superior or inferior to the interface and typically has high signal intensity than of remaining intact lumbar disc on T2 weighted images [3].

Ligamentum Flavum Thickening
The ligamentum flavum connects the laminae and fuses with the facet joint capsules. The forward-facing lamina above and the inferior lamina posteriorly are attached by ligament flava [4].

Narrowing of The Lateral Recess
The lateral recess (Figure .3) creates an entrance zone for the lumbar nerve root entering the nerve root canal. Common pathologies leading to lateral recess narrowing are posterior endplate osteophytes, bulging of disc annulus and hypertrophic facet joint osteoarthritis. Lateral recess is the space that is restricted by posterior surface of a vertebral body, superior articular surface dorsally and laterally by pedicle [5] .

Spinal Canal Narrowing
Narrowing of the spinal canal (Figure .4) due to the pressure on the spinal nerve roots or spinal cord. If the diameter of the spinal canal is less than 12mm it indicates the narrowing of the spinal canal. The patient with lumbar spinal canal narrowing most commonly present with neurogenic claudication and present as discomfort [6] .

Disc Desiccation
The disc desiccation (Figure .5) is commonly found in the degenerative disc disease. The drying up of water contents from the intervertebral disc due to degenerative disc disease is known as disc dessication. It will lead to arthritis. If this process continuous, it may bulge and put on pressure the spinal nerves [7] .

Annular Tears

The annular tear was responsible for lower back pain because annulus fibrosis is innervated by recurrent meningeal nerve and by small branches from the ventral ramus of the somatic nerve [8] . The annular tear (Figure .6) is a separation of fibers from vertebral body insertion, annular fibers or break through fibres involving one or more layers of annular lamella [1] .

Lumbar Lordosis

The lumbar spine lordotic (Figure .7) curve is created by wedging of both the lumbar intervertebral disc and the vertebral bodies. Usually lordosis is an increased inward curving of the lumbar spine (above the buttocks). The changes in the lumbar spine curvature requires adaptation within spinal musculature [9] .

Schmorls Node

Herniation of the disc material through inferior or superior end plate is called as schmorl's node (Figure .8). The schmorl's node in the spine is usually asymptomatic but may occasionally be associated with Lower Back Pain [10-11].

Materials and Mothods:

Prospective study was conducted from April 2019 to March 2020 in department of Radio Diagnosis, Justice K.S.Hegde Charitable Hospital attached to K.S. Hegde Medical Academy, a unit of NITTE (Deemed to be University), Mangaluru on a group of 66 patients after clearance from Institutional Ethics Committee. Patients were referred to the department, after considering inclusion criteria i.e. Patients with history of low backache and Age between 30-60 years and exclusion criteria i.e. History of trauma, prior surgery, Spinal infection, Pregnancy, Uncooperative patient, Acute malignancy routine MRI of lumbar spine was performed on SIEMENS MAGNETOM AVANTO A TIM +DOT SYSTEM, 1.5 Tesla MRI Machine by using T1 weighted, T2 weighted and STIR Sequences.

Following scan, pathology was identified based on the patients reports and was classified with respect to nine parameters as follows Lumbar Lordosis, Schmorl's node, Disc Desiccation, Annular tear, Disc Protrusion and Extrusion, Sequestration, Ligamentum Flavum Thickening, Spinal Cord Narrowing, Lateral Recess Narrowing. Random sampling was followed with proportion of 47% , Precision of 5% with Confidence interval of 95%

$N = \dfrac{4pq}{d2}$ with a finite correction

RESULTS

In the current study, there was no incidence of schmorl's node found in the examined 66 cases. Out of 66 cases, maximum distribution of cases 43.90% (FIGURE.9) were seen between the age group of 40-50 years. About 28.80% disc had disc degenerative disease in the age group of 30-40 years. We found an 43.90% had disc degenerative disease in the age group of 40-50 years. 25.80% had disc degenerative disease in the age group of 50-60 years and 1.50% had disc degenerative disease in the 60 years of age. In the current study among 66 cases, 58% were males and 42% were females considering the inclusion and exclusion criteria. The current study showed variation in disc degeneration with respect to gender but an equal number of males and females were not studied due to a universal sampling. Out of 66 cases, the majority of lumbar disc degenerative disease were seen in male population that is 58% and 42% cases were seen in females (FIGURE.10). The pie chart shows that the males were more prone to the lumbar disc degenerative disease compared to the females. Among all the disc levels in the lumbar spine, (Table 1.) L4 and L5 level were most commonly affected with lumbar disc degenerative disease except schmorl's node. In the present study, it was noted that the disc level at D12 and L1 were least affected for the lumbar disc degenerative disease. The majority of the patients were affected with lateral recess narrowing among 66 cases as compared with the other eight parameters. The second most affected parameter was disc protrusion and extrusion that is 53.03% of cases.

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DISCUSSION

The lumbar disc degenerative disease is commonly seen in Lower Back Pain. The maximum number of cases (43.90%) with lumbar disc degenerative disease was found with an age group of 40-50 years of age. In the age group of 30-40 years (28.80%) cases were found with lumbar disc degenerative disease. Males (58%) were more prone to lumbar disc degenerative disease than females (42%). Due to universal sampling, true incidence of males and females affected could not be found in the study. The L4-L5 disc level was found most commonly affected in most of the parameters except Schmorl's node. In majority of cases, the lateral recess narrowing was affected followed by the Disc Protrusion and Extrusion (53.03%) with lumbar disc degenerative disease. According to Pokhraj Suthar *et al.*, study, the lumbar degenerative disc disease was common source of lower back pain. Decrease disc height was common at the level of L5 and S1 disc level and maximum number of the patients show lumbar lordosis. The involvement of lumbar disc level L1-L2 was less common 1 . In the present study, the narrowing of the lateral recess was the first factor that was evaluated. The total number of disc involvement was evaluated in the narrowing of lateral recess among 66 cases. In disc extrusion and protrusion there was (53.03%) disc involvement was found followed by annular tear and lumbar lordosis (27.27%). The spinal canal narrowing includes (10.60%) and disc desiccation includes (4.54%) also sequestration which includes an (3.03%) of disc involvement. The least incidence of disc involvement was ligamentum flavum thickening (1.51%) and there was no case of schmorl's node found in lumbar degenerative disc disease. The conclusion was that the lumbar disc degenerative mostly shows the lesions at the disc level L4-L5 1 . The results of the present study are similar to that of Shafaq saleem *et. al.*,. The findings showed that the disc degeneration was commonly present at the level of L4-L5 disc level (64.4%) and also showed the mean age of occurrence of lumbar disc degeneration was 43.92% ± 11.76 years of age 12 . In our study lumbar disc degenerative disease were common at the L4-L5 disc level. Most commonly affected at 40-50 years of age group.

Noha Mohamed Osman et al., conducted a study on MRI evaluation of lumbar degenerative disc disease. Result showed that the occurrence of damage of lumbar lordosis, ligamentum flavum hypertrophy, facet joint arthrosis, Endplate changes, and osteophyte formation showed in most of the cases. Disc level of L4-L5 and L5-S1 disc degeneration were present in 42% patient. The common site for bulges (33.6%) and herniation (57.1%) were L4-L5 disc level. Thus conclusion of the study were lumbar disc degeneration is the common source of lower back pain and also the common source of disability at above 45 years of age 13 . In our study Narrowing of Lateral Recess, Disc Protrusion and Extrusion commonly found in most of the cases. At the disc level L4-L5 disc degenerative disease was commonly found in maximum number of cases. According to the Fletcher M. Munter, et al., had done study only about one parameter annular tear with and without contrast. They concluded that enhancement and hyperintensity in MR images cannot determine the tear's acuity 14 . In our study we had taken nine parameters, all the parameters we had done examination on without contrast. Maureen C. Jensen et al., had done an MRI of the lumbar spine with a no history of back pain. They found many abnormalities in subjects such as disc bulges and protrusions 15 . In our study, we had taken patients with a history of back pain and found a narrowing of lateral recess, including disc protrusion and extrusion.

CONCLUSION

As the age advances, there is a recurrent occurrence of lumbar disc degeneration disease. The lumbar disc degeneration disease is the most common source of lower backache and also common reason of disability at the age between 40-50 years of age. The plain radiograph AP and Lateral can be supportive in finding the gross anatomical changes but MRI is the standard imaging modality due to its advantage of multiplanar imaging capability, superior soft-tissue resolution, and precise localization of intervertebral disc changes and absence of radiation.

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Table.1: Different variables like Lumbar Lordosis, Schmorl's Node, Disc Desiccation, Annular Tear, Disc Protrusion and Extrusion, Sequestration, Ligamentum Flavum Thickening, Spinal Canal Narrowing, Lateral Recess Narrowing and their correlation with the Intervertebral disc level.

Lumbar Disc Degenerative Disease	Lumbar lordosis	Schmorl's Node	Disc Dessication	Annular Tear	Disc Protrusion And Extrusion	Sequestration	Ligamentum Flavum Thickening	Spinal Canal Narrowing	Lateral Recess Narrowing
D10-D11	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D11-D12	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D12-S1	4.54%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
L1-L2	4.54%	0.00%	0.00%	1.51%	1.51%	0.00%	0.00%	0.00%	1.51%
L2-L3	4.54%	0.00%	0.00%	3.03%	1.51%	0.00%	0.00%	1.51%	1.51%
L3-L4	4.54%	0.00%	0.00%	6.06%	7.57%	0.00%	0.00%	1.51%	15.15%
L4-L5	4.54%	0.00%	1.51%	12.12%	27.27%	1.51%	1.51%	7.57%	62.12%
L5-S1	4.54%	0.00%	3.03%	4.54%	15.15%	1.51%	0.00%	0.00%	27.27%
S1-S2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
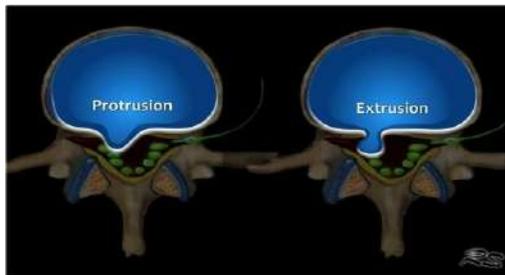
Figure.1: Shows Disc Protrusion and Disc Extrusion.
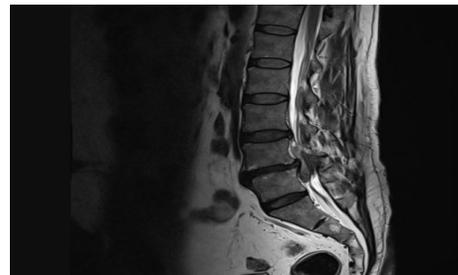
Figure.2: Shows Sequestration of Disc in Lumbar Vertebrae.
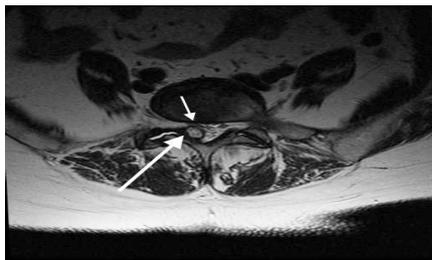
Figure.3: Shows the Narrowing of Lateral Recess in Lumbar Vertebra.
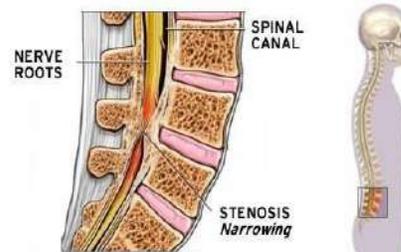
Figure.4: Shows the Lumbar Spinal Canal Narrowing.

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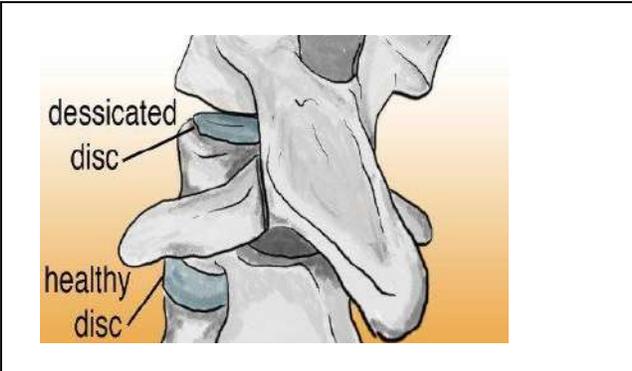
Figure.5: Shows Disc Dessication
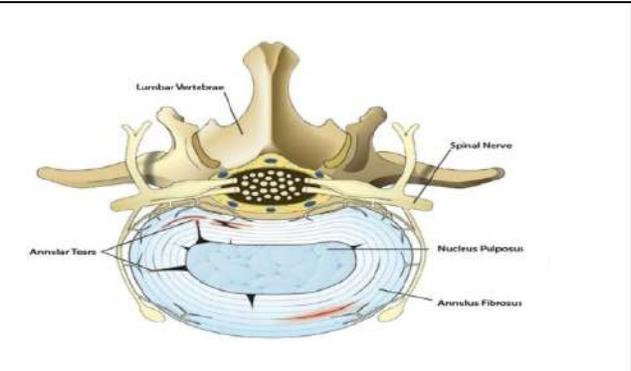
Figure.6: Shows the Annular Tear.
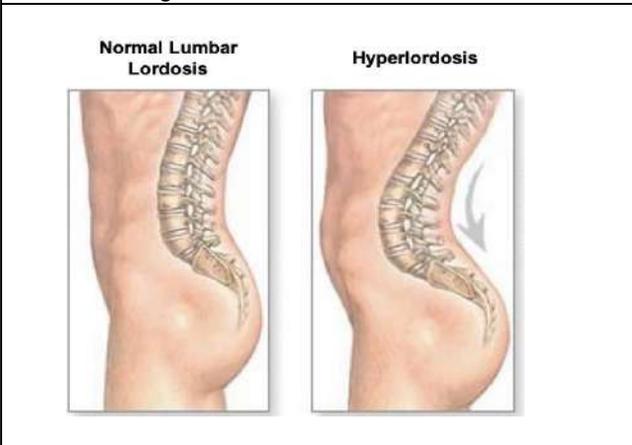
Figure.7: Shows the Lumbar Lordosis.
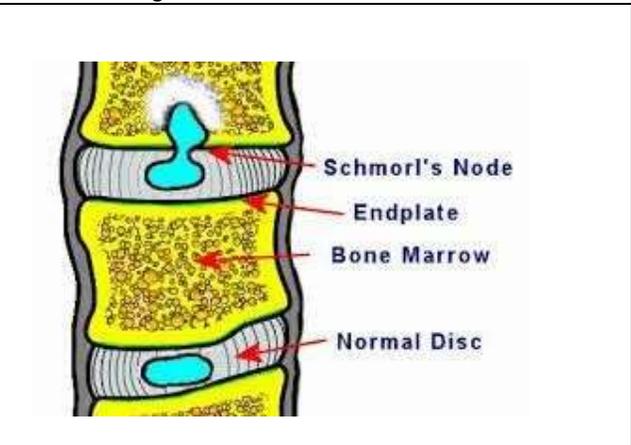
Figure .8: Shows the Schmorls Node.
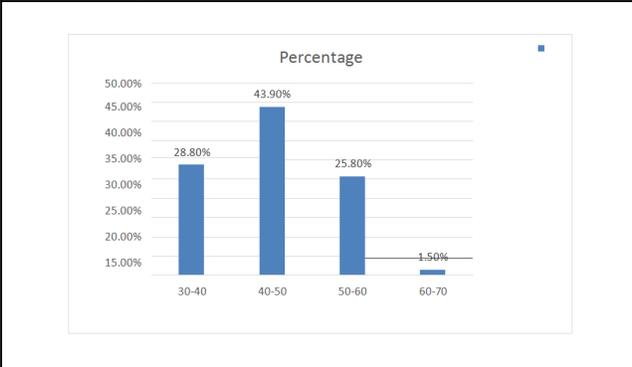
Figure.9: Age Distribution Graph.
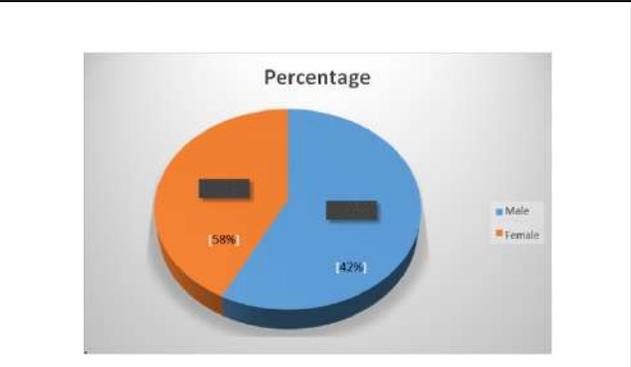
Figure.10: Distribution of male and female patients.

RESEARCH ARTICLE

On $(1,2)^{*}$- $\ddot{g}$ Closed Sets in Intuitionistic Fuzzy Bitopological Space

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ABSTRACT

The aim of this paper is to introduce a new type of the notions of $(1,2)^{*}$- $\ddot{g}$ closed and open sets in intuitionistic fuzzy bitopological spaces and study some their properties in intuitionistic fuzzy bitopological spaces.

Keywords: Intuitionistic fuzzy bitopology, $(1,2)^{*}$-Intuitionistic fuzzy $\ddot{g}$ closed sets, $(1,2)^{*}$-Intuitionistic fuzzy $\ddot{g}$ open sets.

INTRODUCTION

Zadeh [4] was introduced the fuzzy sets and Chang [1] was initiated the fuzzy topology. Kandil [6] introduced the concept of fuzzy bitopological spaces as a natural generalization of Chang's fuzzy topological spaces. Atanassov [3] was introduced the concept of intuitionistic fuzzy sets as a generalization of fuzzy sets. Using the notation of intuitionistic fuzzy sets Coker [7] introduced the notation of intuitionistic fuzzy bitopological spaces. Also, A. Arivu Chelvam was using the concept $(1,2)^{*}$-$\ddot{g}$ closed sets in bitopological spaces. Chandramoorthi [5] introduced the notations of $\ddot{g}$ closed and open sets in intuitionistic fuzzy topological spaces. In this paper, we introduce the concept of intuitionistic fuzzy bitopological spaces as a generalization of fuzzy bitopological spaces. Next, we introduce the notations of $(1,2)^{*}$-$\ddot{g}$ closed sets and $(1,2)^{*}$-$\ddot{g}$ open sets in intuitionistic fuzzy bitopological spaces and study some their properties in intuitionistic fuzzy bitopological spaces.

Preliminaries

Throughout this paper (X, τ_1, τ_2) or simply X denote the intuitionistic fuzzy bitopological spaces (briefly IFBTS). For a subset A of a space X, the closure, interior and complement of A are denoted by cl(A), int (A) and A^c respectively. We recall some basic definitions that are used in the sequel.

Definition 2.1[3]

Let X be a non-empty set. An intuitionistic fuzzy set (briefly IFS) A in X is an object having the form A = {< $X, \mu_A(x), \gamma_A(x) > / x \in X$} where the functions μ_A : X → [0,1] and γ_A: X → [0,1] denote the degree of membership (i.e., $\mu_A(x)$) and the degree of non-membership (i.e.,$\gamma_A(x)$) of each element $x \in X$ to the set A respectively and $0 \leq \mu_A(x) + \gamma_A(x) \leq 1$ for each $x \in X$. The set of all intuitionistic fuzzy sets in X is denote by IFS(X).

Definition2.2[3]

Let A and B be IFSs of the form A = {< $\mu_A(x), \gamma_A(x) > / x \in X$} and B = {< $\mu_B(x), \gamma_B(x) > / x \in X$}. Then

1. A ⊆ B if and only if $\mu_A(x) \leq \mu_B(x)$ and $\gamma_A(x) \geq \gamma_B(x)$ for all $x \in X$,
2. A = B ⟺A ⊆ B and B ⊆ A,
3. A^c = {<$X, \gamma_A(x), \mu_A(x)$> / $x \in X$}
4. A ∩ B = {<$X, \mu_A(x) \wedge \mu_B(x), \gamma_A(x) \vee \gamma_B(x)$> / $x \in X$},
5. A ∪ B = {<$X, \mu_A(x) \vee \mu_B(x), \gamma_A(x) \wedge \gamma_B(x)$> / $x \in X$ },

For simply, we shall use the notation A = <X, μ_A, γ_A> instead of A = {<$X, \mu_A(x), \gamma_A(x)$> / $x \in X$}and also we shall use the notation A = <X, (μ_A, μ_B), (γ_A, γ_B)> instead of A = <X, ($A/\mu_A, B/\mu_B$), ($A/\gamma_A, B/\gamma_B$)>. The intuitionistic fuzzy sets 0~ = {<X,0,1> / $x \in X$} and 1~ = {<X,1,0> / $x \in X$} are respectively the empty set and the whole set in X.

Definition 2.3[2]

An intuitionistic fuzzy topology (briefly IFT) on X is a family$\tau$of IFSs in X satisfying the following axioms.

1. 0~, 1~ ∈ τ
2. $H_1 \cap H_2 \in \tau$ for any $H_1, H_2 \in \tau$
3. ∪ $H_i \in \tau$ for any family {$H_i / i \in$ J} ⊆ τ.

In this state the pair (X,τ) is called an intuitionistic fuzzy topological space (briefly IFTS) and any IFS in τ is known as an intuitionistic fuzzy open set (briefly IFOS) in X. The complement of an intuitionistic fuzzy open set is called an intuitionistic fuzzy closed set (briefly IFCS) in X.

Definition 2.4[11]

Let τ_1 and τ_2 be two intuitionistic fuzzy topologies on a non-empty set X. The triple (X,τ_1, τ_2) is called an intuitionistic fuzzy bitopological spaces (briefly IFBTS), every member of $\tau_{1,2}$ is called $\tau_{1,2}$-intuitionistic fuzzy open sets ($\tau_{1,2}$-IFOS) and the complement of $\tau_{1,2}$-IFOS is $\tau_{1,2}$-intuitionistic fuzzyclosed sets ($\tau_{1,2}$-IFCS).

Definition2.5[9]

Let (X,τ_1, τ_2) be an IFBTS and A = <X, μ_A, γ_A> be an IFS in X. Then

1. $\tau_{1,2}$-int(A) = ∪ {H / H is an $\tau_{1,2}$-IFOS in X and H ⊆ A},
2. $\tau_{1,2}$-cl(A) = ∩ {K / K is an $\tau_{1,2}$-IFCS in X and A ⊆ K},
3. $\tau_{1,2}$-cl(A^c) =($\tau_{1,2}$-int(A))^c,
4. $\tau_{1,2}$-int(A^c) = ($\tau_{1,2}$-cl(A))^c

Result2.6[8]

Let A and B be any two intuitionistic fuzzy sets of an intuitionistic fuzzy bitopological spaces (X,τ_1, τ_2).Then $\tau_{1,2}$-cl(A∪ B) = $\tau_{1,2}$-cl(A) ∪ $\tau_{1,2}$-cl(B).

Definition2.7[9]

An IFS A = <X, μ_A, γ_A> in an IFBTS (X,τ_1, τ_2) is said to be an

- (1,2)*-intuitionistic fuzzy semi-closed set ((1,2)*-IFSCS) if $\tau_{1,2}$-$int(\tau_{1,2}$-$cl(A)) \subseteq A$

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- (1,2)*-intuitionistic fuzzy semi-open set ((1,2)*-IFSOS) if A ⊆ $\tau_{1,2}$-$cl(\tau_{1,2}$-$int(A))$
- (1,2)*-intuitionistic fuzzy α-closed set ((1,2)*-IFαCS) if $\tau_{1,2}$-$cl(\tau_{1,2}$-$int(\tau_{1,2}$-$cl(A)) \subseteq$ A
- (1,2)*-intuitionistic fuzzy α-open set ((1,2)*-IFαOS) if A $\subseteq \tau_{1,2}$-$int(\tau_{1,2}$-$cl(\tau_{1,2}$-$int(A))$
- (1,2)*-intuitionistic fuzzy regular closed set ((1,2)*-IFRCS) if A = $\tau_{1,2}$-$cl(\tau_{1,2}$-$int(A))$
- (1,2)*-intuitionistic fuzzy regular open set ((1,2)*-IFROS) if A $=\tau_{1,2}$-$int(\tau_{1,2}$-$cl(A))$
- (1,2)*-intuitionistic fuzzy generalized closed set ((1,2)*-IFGCS) if $\tau_{1,2}$-cl(A) ⊆ U whenever A ⊆ U and U is an $\tau_{1,2}$-IFOS in X. The complement of an (1,2)*-IFGCS is an (1,2)*-IFGOS.
- (1,2)*-intuitionistic fuzzy semi generalized closed set ((1,2)*-IFSGCS) if $\tau_{1,2}$-scl (A) ⊆ U whenever A ⊆ U and U is an (1,2)*-IFSOS in X. The complement of an (1,2)*-IFSGCS is an (1,2)*-IFSGOS.
- (1,2)*-intuitionistic fuzzy ω closed set ((1,2)*IFωCS) if $\tau_{1,2}$-cl(A) ⊆ U whenever A ⊆ U and U is an (1,2)*-IFSOS in X. The complement of an (1,2)*-IFωCS is an (1,2)*-IFωOS

$(1,2)^{*}$-$\ddot{g}$INTUITIONISTIC FUZZY CLOSED SETS
Definition 3.1
An IFS A in an IFBTS (X,τ_1,τ_2) is said to be an (1,2)*-intuitionistic fuzzy $\ddot{g}$ closed set ((1,2)*-IF$\ddot{g}$CS) if $\tau_{1,2}$-cl(A) ⊆ U whenever A ⊆ U and U is an (1,2)*-IFSGOS in (X,τ_1,τ_2). The family of all (1,2)*-IF$\ddot{g}$CS of an IFBTS (X,τ_1,τ_2) is denoted by (1,2)*-IF$\ddot{g}$CS(X). The complement of the (1,2)*-IF$\ddot{g}$CS is an (1,2)*-IF$\ddot{g}$OS in (X,τ_1,τ_2).

Theorem 3.2
Every$\tau_{1,2}$-IFCS in (X,τ_1,τ_2) is an (1,2)*-IF$\ddot{g}$CS, but not conversely.

Proof
Let A be an $\tau_{1,2}$-IFCS and A ⊆ U where U is an (1,2)*-IFSGOS in (X,τ_1,τ_2). Then $\tau_{1,2}$-cl(A) = A ⊆ U, by hypothesis. Hence A is an (1,2)*-IF$\ddot{g}$CS in (X,τ_1,τ_2).

Example 3.3
Let X = {a, b} and H_1 = <X, (0.5,0.5), (0.2,0.3)> and H_2 = <X, (0.4,0.5), (0.4,0.3)> then τ_1 = {0~,H_1,1~} and τ_2 = {0~,H_2,1~} is an IFBT on X and the IFS A = <X, (0.1,0.2), (0.5,0.6)> is an (1,2)*-IF$\ddot{g}$CS, but not an $\tau_{1,2}$-IFCS in (X,τ_1,τ_2).

Theorem 3.4
Every (1,2)*-IFRCS in (X,τ_1,τ_2) is an (1,2)*-IF$\ddot{g}$CS, but not conversely.

Proof
Since every (1,2)*-IFRCS is an $\tau_{1,2}$-IFCS and by Theorem 3.2, A is an (1,2)*-IF$\ddot{g}$CS in X.

Example 3.5
Let X = {a, b} and H_1 = <X, (0.6,0.7), (0.4,0.3)> and H_2 = <X, (0.5,0.6), (0.3,0.3)> then τ_1 = {0~,H_1,1~} and τ_2 = {0~,H_2,1~} is an IFBT on X and the IFS A = <X, (0.2,0.1), (0.7,0.8)> is an (1,2)*-IF$\ddot{g}$CS, but not an (1,2)*-IFRCS in (X,τ_1,τ_2).

Theorem 3.6
Every (1,2)*-IFSCS in (X,τ_1,τ_2) is an (1,2)*-IF$\ddot{g}$CS, but not conversely.

Proof
Let A be an(1,2)*-IFSCS and A⊆ U where U is an (1,2)*-IFSGOS in (X,τ_1,τ_2). Then $\tau_{1,2}$-Scl(A)⊆ $\tau_{1,2}$-cl(A)⊆ A. by hypothesis we have, $\tau_{1,2}$-cl(A)⊆U. Hence A is an (1,2)*-IF$\ddot{g}$CS in (X,τ_1,τ_2).

Example 3.7
Let X = {a, b} and H_1 = <X, (0.5,0.4), (0.3,0.4)> and H_2 = <X, (0.4,0.4), (0.3,0.3)> then τ_1 = {0~,H_1,1~} and τ_2 = {0~,H_2,1~} is an IFBT on X and the IFS A = <X, (0.2,0.2), (0.6,0.6)> is an (1,2)*-IF$\ddot{g}$CS, but not an (1,2)*-IFSCS in (X,τ_1,τ_2).

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Theorem 3.8
Every (1,2)*IFωCS in (X,τ_1, τ_2) is an (1,2)*-IF$\ddot{g}$CS, but not conversely.

Proof
Let A be an (1,2)*-IFωCS and A⊆U where U is an (1,2)*-IFSOS. Every (1,2)* IFSOS is an (1,2)*-FSGOS. by hypothesis we have, $\tau_{1,2}$-cl(A)⊆U. Hence A is an (1,2)*-IF$\ddot{g}$CS in (X,τ_1, τ_2).

Example 3.9
Let X = {a, b} and H_1 = <X, (0.5,0.6), (0.2,0.3)> and H_2 = <X, (0.5,0.5), (0.3,0.4)> then τ_1 = {0~,H_1,1~} and τ_2 = {0~,H_2,1~} is an IFBT on X and the IFS A = <X, (0.4,0.4), (0.5,0.5)> is an (1,2)*-IF$\ddot{g}$CS, but not an (1,2)*-IFωCS in (X,τ_1, τ_2).

Theorem 3.10
Every(1,2)*-IFαCS in (X,τ_1, τ_2) is a (1,2)*-IF$\ddot{g}$CS but not conversely.

Proof
Let A be an (1,2)*-IFαCS and A ⊆ U where U is an (1,2)*-IFSGOS in (X,τ_1, τ_2). Then $\tau_{1,2}$-αcl(A)⊆ $\tau_{1,2}$-cl(A). by hypothesis $\tau_{1,2}$-cl(A)⊆ A ⊆ U. Hence A is (1,2)*-IF$\ddot{g}$CS.

Example 3.11
Let X = {a, b} and H_1= <X, (0.5,0.4), (0.3,0.4)> and H_2 = <X, (0.4,0.4), (0.3,0.3)> then τ_1 = {0~,H_1,1~} and τ_2 = {0~,H_2,1~} is an IFBT on X and the IFS A = <X, (0.2,0.2), (0.6,0.6)> is an (1,2)*-IF$\ddot{g}$CS, but not an (1,2)*-IFαCS in (X,τ_1, τ_2).

Theorem 3.12
Every (1,2)*-IF$\ddot{g}$CS in (X,τ_1, τ_2) is a (1,2)* –IFGCS but not conversely.

Proof
Let A ⊆ U where U is an $\tau_{1,2}$-IFOS in (X,τ_1, τ_2). Since every $\tau_{1,2}$-IFOS is an (1,2)*-IFGOS and by hypothesis we have $\tau_{1,2}$-cl(A)⊆ A ⊆ U. Hence A is an (1,2)*-IFGCS in (X,τ_1, τ_2).

Example 3.13
Let X = {a, b} and H_1 = <X, (0.5,0.3), (0.3,0.4)> and H_2 = <X, (0.6,0.4), (0.3,0.3)> H_3 = <X, (0.8,0.8), (0.2,0.1)> then τ_1 = {0~,H_1,H_2,1~} and τ_2 = {0~,H_3,1~} is an IFBT on X and the IFS A = <X, (0.8,0.7), (0.1,0.3)> is an(1,2)*-IFGCS, but not an(1,2)*-IF$\ddot{g}$CS in (X,τ_1, τ_2).

Theorem 3.14
Every (1,2)*-IF$\ddot{g}$CS in (X,τ_1, τ_2) is a (1,2)*-IFRGCS but not conversely.

Proof
Let A ⊆ U where U is an $\tau_{1,2}$-IFROS in (X,τ_1, τ_2). Since every (1,2)*-IFROS is an (1,2)*-IFSGOS and by hypothesis we have $\tau_{1,2}$-cl(A)⊆ A ⊆ U. Hence A is an (1,2)*-IFRGCS in (X,τ_1, τ_2).

Example 3.15
Let X = {a, b} and H_1 = <X, (0.4,0.3), (0.3,0.4)> and H_2 = <X, (0.6,0.5), (0.3,0.3)> H_3 = <X, (0.8,0.8), (0.2,0.1)> then τ_1 = {0~,H_1,1~} and τ_2 = {0~,H_2,H_3,1~} is an IFBT on X and the IFS A = <X, (0.9,0.7), (0.1,0.3)> is an (1,2)*-IFRGCS, but not an (1,2)*-IF$\ddot{g}$CS in (X,τ_1, τ_2).

Theorem 3.16
Every (1,2)*-IF$\ddot{g}$CS in (X,τ_1, τ_2) is a (1,2)*-IFGαCS but not conversely.

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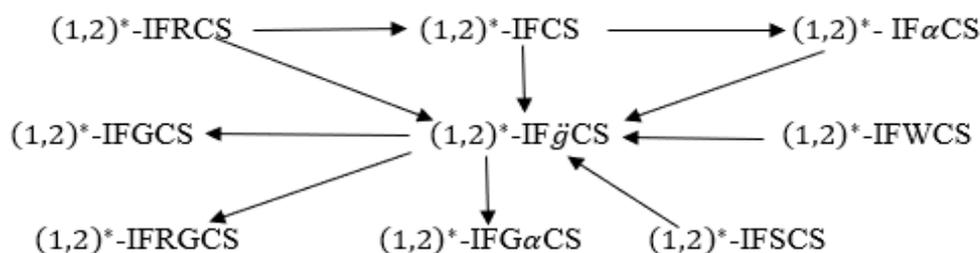
Proof

Let A ⊆ U where U is an $(1,2)^*$-IFαOS in (X,τ_1,τ_2). Since every $(1,2)^*$-IFαOS is an $(1,2)^*$-IFSGOS. Then $\tau_{1,2}$-αcl(A)⊆ $\tau_{1,2}$-cl(A) and by hypothesis we have $\tau_{1,2}$-cl(A)⊆ A ⊆ U. Hence A is an $(1,2)^*$-IFαGCS in (X,τ_1,τ_2).

Example 3.17

 Let X = {a, b} and H_1 = <X, (0.4,0.3), (0.5,0.4)> and H_2 = <X, (0.7,0.7), (0.3,0.2)> H_3 = <X, (0.5,0.4), (0.4,0.3)> then τ_1 = {0~,H_1,H_2,1~} and τ_2 = {0~,H_3,1~} is an IFBT on X and the IFS A = <X, (0.6,0.6), (0.3,0.4)> is an $(1,2)^*$-IFGαCS, but not an $(1,2)^*$-IF$\ddot{g}$CS in (X,τ_1,τ_2).

In the following diagram, we have provided the relation among various type of intuitionistic fuzzy closed sets with $(1,2)^*$-IF$\ddot{g}$CS.

In this diagram A ————▶B, this means A implies B but not conversely.

Theorem 3.18

Let A and B be two $(1,2)^*$-IF$\ddot{g}$CSs in an IFBTS (X,τ_1,τ_2) then A ∪ B is an $(1,2)^*$-IF$\ddot{g}$CS in X.

Proof

Let U be an $(1,2)^*$-IFSGOS in (X,τ_1,τ_2) such that A ∪ B ⊆ U. since A and B are $(1,2)^*$-IF$\ddot{g}$CSs, we have $\tau_{1,2}$-cl(A) ⊆ U and $\tau_{1,2}$-cl(B) ⊆ U. Therefore, by the result 2.6 $\tau_{1,2}$-cl(A) ∪ $\tau_{1,2}$-cl(B) = $\tau_{1,2}$-cl(A∪B) ⊆ U.Hence A ∪ B is an $(1,2)^*$-IF$\ddot{g}$CS in (X,τ_1,τ_2).

Theorem 3.19

If A is an $(1,2)^*$-IF$\ddot{g}$CS and A ⊆ B ⊆ $\tau_{1,2}$-cl (A), then B is an $(1,2)^*$-IF$\ddot{g}$CS.

Proof

Let U be an $(1,2)^*$-IFSGOS such that B ⊆ U. since A is an $(1,2)^*$-IF$\ddot{g}$CS, we have $\tau_{1,2}$-cl(A) ⊆ U. by hypothesis $\tau_{1,2}$-cl(B) ⊆ $\tau_{1,2}$-cl(A) ⊆U. Hence B is an $(1,2)^*$-IF$\ddot{g}$CS.

4. $(1,2)^*$-$\ddot{g}$INTUITIONISTIC FUZZY OPEN SETS

Definition 4.1

An IFS A is said to be an intuitionistic fuzzy $\ddot{g}$ open set (briefly $(1,2)^*$-IF$\ddot{g}$OS) if A^c is an $(1,2)^*$-IF$\ddot{g}$CS in X.

Theorem 4.2

For any IFBTS (X,τ_1,τ_2), we have the following:

1. Every $\tau_{1,2}$-IFOS is an $(1,2)^*$-IF$\ddot{g}$OS,
2. Every $(1,2)^*$-IFROS is an $(1,2)^*$-IF$\ddot{g}$OS
3. Every $(1,2)^*$-IFSOS is an $(1,2)^*$-IF$\ddot{g}$OS,
4. Every $(1,2)^*$-IFαOS is an $(1,2)^*$-IF$\ddot{g}$OS

Remark 4.3

The converses of the above theorem need not be true is general as seen from the following examples.

Example 4.4

Let X = {a, b} and H_1 = <X, (0.6,0.5), (0.2,0.1)> and H_2= <X, (0.5,0.5), (0.2,0.3)> then τ_1= {0~,H_1,1~} and τ_2 = {0~,H_2,1~} is an IFBT on X and the IFS A = <X, (0.6,0.6), (0.4,0.4)> is an (1,2)*-IF$\ddot{g}$OS but not an $\tau_{1,2}$-IFOS and (1,2)*-IFROS in (X,τ_1,τ_2).

Example 4.5

Let X = {a, b} and H_1 = <X, (0.5,0.5), (0.2,0.3)>and H_2= <X, (0.6,0.5), (0.2,0.1)> then τ_1= {0~,H_1,1~} and τ_2 = {0~,H_2,1~} is an IFBT on X and the IFS A = <X, (0.6,0.6), (0.4,0.4)> is an (1,2)*-IF$\ddot{g}$OS but not an (1,2)*-IFSOS and (1,2)*-IFαOS in (X,τ_1,τ_2).

Theorem 4.6

An IFS A of an IFBTS (X,τ_1,τ_2) is an (1,2)*-IF$\ddot{g}$OS if and only if U ⊆ $\tau_{1,2}$-int(A), whenever U ⊆ A and U is an (1,2)*-IFSGCS.

Proof:

Assume that A is an (1,2)*-IF$\ddot{g}$OS in X. Let U be an (1,2)*-IFSGCS such that U ⊆ A. Then U^c is an (1,2)*-IFSGOS and A^c ⊆ U^c. Then by assumption A^c is an (1,2)*-IF$\ddot{g}$CS in X. Therefore, we have $\tau_{1,2}$-cl(A^c) ⊆ U^c. Hence U ⊆ $\tau_{1,2}$-int(A). conversely, let U be an (1,2)*-IFSGOS in X such that A^c ⊆ U. Then U^c ⊆A and U^c is an (1,2)*-IFSGCS. Therefore, U^c ⊆ $\tau_{1,2}$-int(A). since U^c ⊆ $\tau_{1,2}$-int(A), we have ($\tau_{1,2}$-int(A))^c⊆U that is $\tau_{1,2}$-cl(A^c) ⊆ U. Thus A^c is an (1,2)*-IF$\ddot{g}$CS. Hence A is an (1,2)*-IF$\ddot{g}$OS in X.

Theorem 4.7

If A is an (1,2)*-IF$\ddot{g}$OS and $\tau_{1,2}$-int(A) ⊆ B ⊆ A, then B is an (1,2)*-IF$\ddot{g}$OS.

Proof

If $\tau_{1,2}$-int(A) ⊆ B ⊆ A, then A^c ⊆ B^c ⊆ ($\tau_{1,2}$-int(A))^c= $\tau_{1,2}$-cl(A^c). Since A^c is an (1,2)*-IF$\ddot{g}$CS then B^c is an (1,2)*-IF$\ddot{g}$CS. Therefore, B is an (1,2)*-IF$\ddot{g}$OS.

CONCLUSION

In this paper we investigated a new concept of intuitionistic fuzzy sets in bitopological spaces and also introduced some new set of classes, called this class (1,2)*-$\ddot{g}$ closed sets and (1,2)*-$\ddot{g}$ open sets in intuitionistic fuzzy bitopological spaces.Also, some of their properties are discussed.

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RESEARCH ARTICLE

Experimental Study on Strength and Durability of Concrete with Partial Replacement of Cement with Granite Slurry and Aggregates with Quartz Stone

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ABSTRACT

Durability of concrete is controlled by its capacity to oppose enduring activity, chemical attack, scraped spot, or some other cycle of crumbling, and will hold its unique structure, quality, and serviceability when presented to its current circumstance. Solid concrete is a consequence of appropriate plan, proportioning, placement, completing the process of, testing, review, and relieving. India is second biggest shopper of cement after china. However, these days Cement enterprises produce about 10% of the world's carbon dioxide which influences the climate and cause irregularity in the biological system. The surprising expansion in foundation in India has made Indians the best customers of building materials, where the issue of durability over strength is basic. Huge quantity of granite and quartz stone production leads to the collection of enormous quantity of slurry and quartz. Random disposal of this generated waste degrades the environment in numerous ways. Utilization of this waste may solve the problem of waste generation and also the problem of scarcity of natural resources. An exploratory assessment was attempted in this work to examine the durability of M40 grade concrete using granite slurry as cement and quartz as coarse aggregates. Workability, compressive strength, acid attack, alkaline attack, chloride attack, sulfate attack, Rapid chloride test, and porousness test discoveries of concrete are surveyed for 56 and 84 day cubes separately.

Keywords: Durability, chemical attack, Rice husk ash, compressive strength, Permeability test, Rapid chloride test, acid attack test, chloride attack test.

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INTRODUCTION

Background Information

Concrete has been available from here onward, indefinitely quite a while; the Minoan human civilization around 2000 BC is the primary reported utilization of a material in view of concrete. Around 300 BC, during the beginning of the Roman Empire, the Romans found that joining a sandy volcanic slag with lime mortar created a hard water boundary material that we currently know as concrete. The most generally involved sort of bond in current cement is Portland concrete. Portland concrete is fabricated by consolidating calcium carbonate, which might be found in limestone or chalk, with silica, alumina, and iron oxide, which can be found in the ground or shale. Contingent upon the nature of the stones utilized, the two fixes are ground and participated in a dry or wet condition. The blend is then warmed to temperatures as high as 1400 degrees Celsius in a heater, where the two rocks entwine to frame clinker. The clinker is permitted to cool before gypsum is added at a pace of 1-5%. The combination is then finely squashed and sprinkled among Concrete cluster plants. Due to the nearby likeness of the completed concrete to the Portland limestone, the Portland bond is named after it. Concrete is quite possibly the most broadly utilized development material since it very well may be tossed into practically any structure, has fantastic compressive properties, is promptly accessible anyplace, and is regularly more affordable than other development materials like steel or fiber composites. Somewhat, these consider total highlights like sub-atomic gauge course, all out total size, and total structure (trademark or crushed). In any case, in light of the fact that these techniques depend on quantifiable information from a wide scope of concrete blends, the outcomes are totaled up, and a particular kind of total, for example, smasher dust or produced totals, is probably not going to convey the normal last Concrete characteristics. Besides, concrete compressive quality evaluations depend on the w/e extent, which might be exact for conventional totals yet might be wrong for outstandingly exact or fine particles. In consistency assessments, comparable impacts might be noticed.

General

In Concrete, the replacement of cement with a certain type of wood powder makes the construction lighter in weight. This article delves into the quality and functionality tests. Compressive strength is one of the most important qualities of cement. Furthermore, increasing the amount of wood residue in the organization resulted in lower unit weights and compressive quality estimates for mortars, as well as an increase in water retention esteems at all ages. The features and benefits in the genuine generation of cement are provided by the hardwood powder dust that is superseded by cement.

Cement and Environment

Concrete is a famous creation fabric because of its excessive quality, solidity, and simplicity of blending and setting. The pinnacle 3 bond-developing international locations are China, India, and the United States. In 2015, China brought 2350 million metric tonnes of concrete, observed through India with 270 million metric tonnes. (www.statista.com). Bond hobby is at the upward thrust globally, and it's far anticipated to upward thrust through 4.five percentage over the subsequent 5 years. The worldwide call for for concrete is anticipated to attain 5190 million metric tonnes in 2019.Concrete is crafted from a limestone and dirt combination that has been warmed the usage of an electric powered or coal-fired heater. In addition, the manufacturing of bonds creates carbon dioxide, that's one of the most important greenhouse gases that contributes to worldwide warming. It is envisioned that I tonne of bond produced releases about 1 tonne of CO_2 into the atmosphere (Davidovits, 1996). The bond enterprise is accountable for 6% of overall CO_2 emissions (www.epa.gov). As humanity faces the wrath of nature within side the shape of massive, inexplicable herbal disasters, it's far essential to keep our surroundings clean. Because bond manufacturing depletes herbal resources, vitality, and leaves a carbon footprint at the planet, it's far essential to locate an opportunity to concrete (Scrivener, 2007).

Granite

Granite is a coarse-grained, tough igneous rock this is typically composed of quartz, orthoclase or microcline, and mica. Since historical times, granite has been utilized as a creation fabric. It is one of the maximum historical and long-lasting constructing substances accessible, and it'll outlive the shape wherein it's miles put. Because of its undying splendor and the reality that no artificial fabric can but healthy its beauty and performance, it has come to be the fabric of preference for ultra-modern luxurious homes and businesses. Granite is a not unusual place countertop fabric in kitchens and bathrooms. Granite tiles with a thickness of 20 to 50 mm are usually utilized as counter tops, cashier desks, shelving, benches, and tables. These surfaces are regularly known as granite, however they may be made of loads of stone kinds, which include granite and marble.

Properties of Granite Slurry Concrete

Exploratory examination on the proficient utilization of rock slurry waste might be found in the writing. The utilization of extra stone slurry was accounted for in these preliminaries as changing degrees of F.A. furthermore, concrete replacement. Besides, it has been exhibited that the utilization of stone slurry squander modifies the attributes of both new (functionality) and restored concrete. The effect has been inspected for mechanical characteristics (compressive strength, split elastic, and so forth) and solidness boundaries in solidified concrete (water penetrability, quick chlorine infiltration, and so on). In this way, a basic assessment of the current writing on new substantial characteristics (usefulness), mechanical properties, and strength properties has been audited.

Quartz stone

Quartz is a widely administered mineral this is typically made out of silica, or silicon dioxide (SiO_2). Lithium, sodium, potassium, and titanium are instances of fledgling contaminations. Water-clean gems have been perceived to the memorable Greeks as krystallos, so the expression precious stone, or more prominent oftentimes rock gem, completed to this structure. Quartz is an antique German time-frame of obscure provenance that turned out to be first used in 1530 through method of method for Georgius Agricola. Quartz has a huge industrial value. Amethyst, citrine, smokey quartz, and rose quartz are only some examples of gemstones. Sandstone is a not unusual place creation stone this is usually manufactured from quartz. Quartz sand (additionally referred to as silica sand) is extensively used with inside the manufacturing of glass and ceramics, in addition to for foundry moulds in metallic casting. Sandpaper consists of beaten quartz as an abrasive, silica sand is utilized in sandblasting, and whole sandstone continues to be utilised to fabricate whetstones, millstones, and grindstones. In optics, silica glass (additionally referred to as fused quartz) is used to transmit ultraviolet light. Fused quartz tubing and bins are utilised in a whole lot of clinical applications, and quartz fibres are utilized in ultra-touchy weighing systems. After feldspar, quartz is the second one greatest common mineral with inside the Earth's hull. Practically all corrosive volcanic, transformative, and sedimentary rocks consolidate it. In silica well off felsic rocks like stones, granodiorites, and Rhyolites, it's far a significant mineral. It has a phenomenal protection from enduring and is found typically in sandstones and different detrital rocks.

Objectives And Scope of Investigation

Because of the following factors, concrete has become a prominent building material in all disciplines of modern construction.

1. Using suitable gradients and unique processing techniques, such as mechanical, chemical, and physical, it is feasible to regulate the characteristics of cement concrete across a large range. It is possible to totally automate the process of preparation and placement. It has sufficient plasticity for mechanical work.

2. It's tough to think of another construction material that is as adaptable as concrete. When strength, durability, permanence, permeability, and fire resistance are necessary, concrete is by far the best material to use.

3. In today's world, inflation is one of the most serious issues that any country must deal with. It has become critical to reduce building costs while maintaining structural strength and longevity.

4. Cost reduction may be accomplished in a variety of ways. The utilisation of waste material as a replacement is the

most efficient of all the options accessible to us. Shelter is a basic necessity of all humans.

5. The expanding interest for delivering sturdy materials is the result of quick dirtying climate. Beneficial cementitious materials end up being successful to meet the vast majority of the necessities of the tough concrete. Granite slurry and quartz dust are observed to be more noteworthy to other valuable materials like, silica fume and fly debris.

6. To produce concrete of specified qualities from materials of varied characteristics, extensive understanding of the interaction of numerous elements that go into the formation of concrete is necessary, both in the pliable and harden conditions. The strength of concrete is determined by factors such as aggregate, cement quality, water-cement ratio, workability, mix percentage consistency, and concrete age. New building materials are used to accelerate the construction work, in which the mixture plays an important role in characteristics of concrete. The growth in various types of industries together with population growth has resulted in enormous increase in the production of various types of industrial waste materials such as rice husk ash, foundry sand, blast furnace slag, fly ash, steel slag, scrap tires, waste plastic, broken glass, etc

MATERIALS AND METHODOLOGY

Materials Used
Cement
Portland cement is produced using calcareous substances which incorporate limestone and chalk. notwithstanding argillaceous minerals which incorporate shale and earth. Wet and dry cycles are the 2 sorts of cycles. The best variation is if the uncooked substances are blended and floor soggy or dry. Lime, silica, alumina, and iron oxide are the most extreme well known fundamental added substances utilized in cement fabricate. These oxides gather with inside the heater at unreasonable temperatures, resulting in more prominent convoluted blends. The compound linkages that emerge among cement and water are noted as "hydration of cement." Cement hydration might be dealt with in manners. The first is a reaction instrument, wherein cement breaks down to make a totally lowered affiliation wherein hydrated organic entities can create. Second, water falls apart cement compounds over the long run, beginning the floor and progressing into the design. Cement and water take part in an exothermic way. Warmth is gotten because of the reaction. "Warmth of hydration" is the time span for this sort of warm temperature release as shown in table 1. In this examination Ordinary Portland concrete of 53 grade (ACC concrete) has been acquired and has been utilized.

Aggregates
Aggregates are an important part of concrete. They offer a strong base for concrete, decrease shrinkage, and save money. Aggregates are non-essential granular elements that are provided by themselves, such as sand, rock, or crushed stone. They're also the raw ingredients that go into making concrete. Clean, hard, and solid aggregates should be devoid of absorbed synthetic chemicals, dirt, and other small particles that might cause cement to disintegrate.

Coarse Aggregates
Coarse aggregates are debris with a width extra than 4.75mm however a steady variety of 9.5mm to 37.5mm. They can be created out of a huge variety of substances which can be essential, auxiliary, or reused. Essential or virgin aggregates may be located on land or with inside the ocean. Rock is a coarse, land-gained general produced via way of means of the ocean. Rock and beaten stone are examples of course aggregate. Rock makes up the bulk of the course fabric in concrete, with beaten stone accounting for the rest.

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Fine Aggregates

Sands from both the land and the ocean are used to make pleasant mixture. The maximum not unusual place pleasant aggregates are herbal sand or beaten stone, with the bulk of debris passing thru a 4.75mm screen.

The pleasant mixture on this observe became river sand, which become received from a nearby producer and illustrated within side the figure.

Water

Water is an critical issue of cement as it performs a position within side the compound response 35 of concrete and water. Because it advances the layout of the strength-giving concrete gel, the quantity and sort of water have to be cautiously studied. C3S calls for 24% water through weight. while C2S necessitates 21%. A produced response the use of Portland concrete mixes has additionally been determined to want on common 23 percentage water through weight of concrete. Because it's far purposely bonded to solidify, this 23 percentage of water is known as bound water. It's additionally been calculated that kind of 15% of the burden of the concrete could be used to fill the gel-pores. For the whole chemical response and to burn-thru the vicinity inner gel-pores, a flat out 38 percentage of water through weight of concrete is necessary. We have to study the perfection and nature of water in view that they've an effect on strength. When figuring out if water is appropriate for blending concrete, the guideline of thumb of thumb is if it's far appropriate for drinking. Manganese, tin, zine, copper, and lead salts all degrade cement's strength. A turbidity restriction of 2000 segments in keeping with million has been counseled as a very good beginning point. This experimental programme hired regionally available consumable new water that become freed from centralizations of aid and normal materials for mixing and reestablishing.

Granite Slurry

Granite's hardness and durability, in addition to its ubiquitous availability, have made it a family call for utilization as a constructing stone all around the world. Granite is ample in India, and in spite of its recognition as a miner's material, it's far a huge supply of forex revenue. After China. India is the second one biggest provider of uncooked granite, after handiest Brazil and South Africa. Granite mines in India are disbursed throughout the country, with Karnataka (25%) main 15 the way, accompanied via way of means of Jharkhand (24%), Rajasthan (23%). Andhra Pradesh (69%), Madhya Pradesh (five), and Orissa (4%). (five percent). Karnataka's granite zone contributes a massive part of countrywide and global output, accounting for round 20% of the worldwide market.

Quartz Stone

Granite and other felsic igneous rocks have quartz as a distinguishing element. Sandstone and shale are examples of sedimentary rocks where it is quite frequent. Schist, gneiss, quartzite, and other metamorphic rocks all contain this mineral. Because quartz has the lowest weathering potential of the Goldich dissolution family, it is abundant as a residual mineral in stream sediments and residual soils. Quartz is commonly found in abundance in "mature" rocks. indicating that the rock has been severely reworked and that quartz was the dominant material that withstood severe weathering. Quartz crystallises from molten magma in the majority of cases, although it also chemically precipitates as gangue in hot hydrothermal veins, occasionally alongside ore minerals like gold, silver, and copper. In magmatic pegmatites, large quartz crystals can be found. Crystals that are well-formed can grow to be several metres long and weigh hundreds of kilos. Quartz crystals of exceptionally high purity, which are required for the crucibles and other equipment used in the semiconductor industry to create silicon wafers, are expensive and scarce.

Methodology Used

Slump Cone Test

The droop cone take a look at is used to estimate a function of latest concrete. The test is designed to decide how nicely new concrete performs. It assesses consistency among bunches in a extra distinct manner. The take a look at is famous due to the device's simplicity and easy methodology.

1. A cone frustum with a peak of three hundred mm is used for the hunch take a look at (12 in). The base is about 2 hundred mm (8in) lengthy with a one hundred mm hole at its finest factor.

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2. The shape is placed on a stage floor, and the compartment is full of 3 layers of concrete, so as to be evaluated for usability.

3. Each layer is heated usually over a sixteen mm (five/eight in) metal rod, with the gap among layers changing because the manner advances.

4. After the shape has been totally loaded with concrete, the finishing floor is struck off (leveled out with the shape zenith opening) utilizing screening and temping shaft advancement.

5. During the action, the shape should be safely gotten towards its base all together that it

truly does now never again stream in light of the pouring of cement, which might be accomplished with the guide of utilizing methods along with holds or stools brazed to the

shape.

6. Once the filling is whole and the concrete is leveled out, the cone is reasonably and as it thought to be driven higher, an unsupported durable will currently get a handle on. Slump relates to the suspended concrete's factor of convergence's diminution in peak. The grasp is calculated with the aid of using setting the cone close to to the placing concrete after which positioning the temping submit over the cone in order that it does now no longer contact the hung concrete.

7. Scale suggests the lower in cement's stature in comparison to that of the construction. (Most measurements are taken to the nearest five mm (1/four in).)

Compressive strength test

The following ideas have been accompanied while developing this test: ([9] IS516-1959). The compressive strength of concrete changed into examined the use of widespread 150x150x150mm cubes. On a CTM bearing floor with a restriction of 200T and a regular charge of stacking connected. The compressive quality ([21] AS Alumium) changed into calculated after the very best intense load changed into observed.

Durability of concrete

The toughness of M40 grade still up in the air with various level of rock slurry and quartz stone. Strength concentrates on for the most part Acid assault test. Sulfate assault test, Alkaline assault test, Chloride assault test and Rapid Chloride Permeability Test.

MIX DESIGN OF CONCRETE

In this study, mix proportion for M40 grade concrete is done utilizing the IS technique.

RESULTS ANALYSIS

Workability of Concrete:
Slump Cone Test
Compressive Strength of Concrete
Durability of Concrete
Acid attack test
Alkaline attack test
Chloride attack test
Sulphate attack test
Durability of Concrete

CONCLUSIONS

The motivation behind this examination is to explore the strength and durability of concrete using fluctuating rates of granite slurry and quartz stone in M40 grade concrete, going from 0% to 25% and 0% to 50%. The accompanying discoveries were drawn from this exploration.

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1. For M40 grade concrete, the slump cone test esteems increment when the extent of granite slurry and quartz stone from 0% to 25% and 0% to 50%

2. The 10%GS+20%QS case yielded the most elevated compressive strength for the M40 grade following 7 days and 28 days of relieving, contrasted with different blends.

3. To keep up the ideal workability, the measurement of super plasticizer must be brought up pair with the GS fineness because of the GS high ingestion quality.

4. For M40 grade concrete blend, the rate loss of compressive strength for corrosive, basic, sulfate, chloride, and alkalinity arrangement increments as the extent of granite slurry and quartz stone from 0% to 25% and 0% to 50%

5. The quick chloride porousness test is performed with fluctuating groupings of granite slurry and quartz stone from 0% to 25% and 0% to 50%. As the extent of rice husk ash is expanded, the RCPT esteem brings down.

6. As the measure of rice husk ash in the water penetrability rises, the profundity of entrance for the M40 grade increments.

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Table 1: Constituents of Cement

Constituents	Percentage	Averages
Lime (CaO)	60 to 70%	63
Silica (SiO_2)	17 to 25%	20
Alumina (Al_2O_3)	3 to 8%	6
Iron oxide (Fe_2O_3)	0.5 to 6%	3
Magnesia (MgO)	0.1 to4%	2
Sulphur Trioxide (SO_3)	1 to 3%	1.5
Soda and potash($Na_2O + k_2O$)	0.5 to 1.3%	1

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Table 2 : Chemical composition of cement

Physical properties	Test result	Test method/ Remarks	Requirement as per IS 12269 (1987)
Specific gravity	3.15	IS 4031(1988) – part 11	_
Fineness (m²/Kg)	311.5	Manufacturer data	Min.225 m²/kg
Normal consistency	30%	IS 4031 (1988)- part 4	_
Initial setting time (min)	90	IS 4031 (1988)- part 5	Min. 30 min
Final setting time (min)	220	IS 4031 (1988)- part 5	Max. 600 min
Soundness			
Lechatelier Expansion (mm)	0.8	Manufacturer data	Max. 10 mm
Autoclave Expansion (%)	0.01		Max. 0.8%
Compressive strength (MPa)			
3 days	25	IS 4031 (1988)- part 6	27 MPa
7 days	39		37 MPa
28 days	57		53 MPa

Table 3: Final trial mix for M40 grade concrete

MATERIAL	CEMENT	FINE AGGREGATES	COARSE AGGREGATES	WATER
Density	438 kg/m3	717.12 kg/m3	1115 kg/m3	197 kg/m3
Proportions	1	1.63	2.54	0.45

Fig 1: OPC 53 Grade Cement

Fig 2 :20mm and 12mm Coarse Aggregates

Fig 3: Fine Aggregate

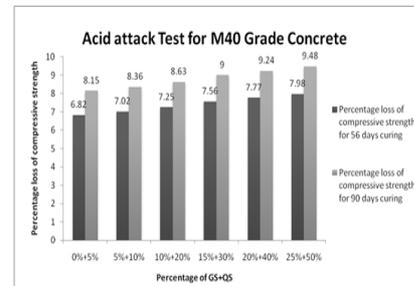**Fig 4 : Granite Slurry**

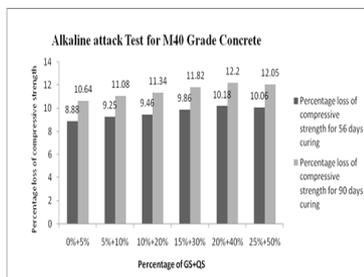52976

Fig 5 : Quartz Stone
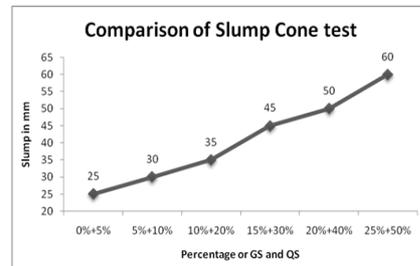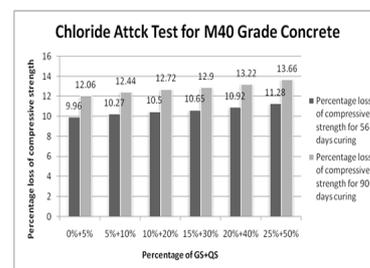

Fig 6: Slump Cone Test
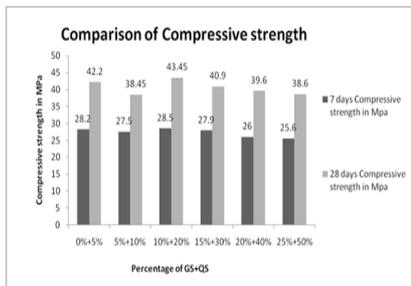
Fig 7: Compressive Strength of Concrete
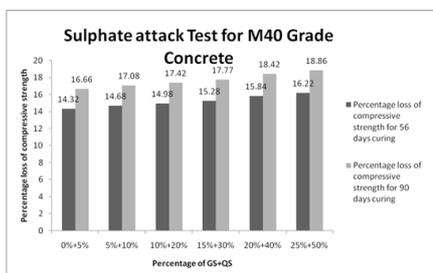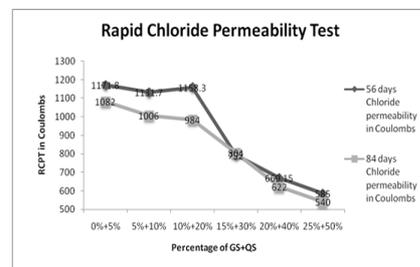

Fig 8: Acid attack test

Fig 9: Alkaline attack test

Fig 10: Chloride attack test

Fig 11 : Sulphate attack test

Fig 12: Durability of Concrete

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RESEARCH ARTICLE

SvNet for Detecting Pneumonia from Chest X-Ray Images

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ABSTRACT

Pneumonia is a contagious and fatal respiratory disease caused by bacteria, fungi, or viruses that fill the air sacs in the human lungs with fluid or pus. There are various methods to detect the presence of pneumonia, out of which most frequently used is using chest X-rays. Medical professionals identify the presence of pneumonia using the X-ray images of lungs. Due to poor diagnosis and treatment, the problematic way of diagnosing pneumonia results in a loss of life. With advancements in technology and various computer vision algorithms, quick detection of pneumonia from X-ray images are possible which can help in treatment. The proposed novel architecture consists of 20 convolutional layers, 20 batch normalization layers followed by 20 ReLu layers. This novel architecture using deep learning algorithm is designed in such a way that it improves the accuracy in detection of pneumonia. The proposed architecture detects the presence of pneumonia with an accuracy rate of 95.4%. The trained model is successful in identifying pneumonia from the chest X-ray images and can successfully distinguish between pneumonia and normal chest x-ray images. The future work of this architecture can include chest x-rays with artifacts and this is considered as one of the limitation of this study.

Keywords: Pneumonia, Chest X-ray, Deep Learning, Convolutional Neural Network, CNN

INTRODUCTION

Pneumonia is inflammation in the lungs of an individual which fills the air sacs with pus. This condition makes an individual difficult to breath and lead to respiratory issues and various neurological diseases. The common causes of pneumonia are bacteria, fungus, or a virus that affects the air sacs in the lungs, causing them to swell with discharge

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fluids. This can cause chills, fever, cough accompanied with mucous, and breathing difficulties in those who have the disease. Children under the age of five and elderly patients with weakened immune systems are particularly susceptible to these infections[1].The most usual way to find pneumonia is through radiography, CT scanning, or MRI. To identify the presence of pneumonia in a patient, medical professionals examine the patient's chest radiograph. Additionally, the patient's medical history and laboratory test results are typically how pneumonia is discovered[2].Patients with pneumonia exhibit symptoms of fluid filling the lungs air sacs in the chest cavity which can be visible in the radiograph, with a brighter patch or white colour[1]. Brighter hue may indicate a number of problems on the lung cavities, including the presence of cancer cells, swollen blood vessels, and heart issues[3].Chest x-rays are the best approach to confirm the location and severity of a lung infection. This has led to classifying X-ray images using various approaches in order to achieve a faster result. Image classification is a technique that can classify the images more systematically and accurately. CNN (convolutional neural network) is a branch of deep learning neural network which is used for image recognition and classification. CNN has the capability of extracting features from an image that can help in classification more accurately. CNN has found to have immense contribution in the field of image classification and also it provides localization in computer vision[4].Various research works have proved that chest X-ray images can be used in identifying pneumonia from chest X-ray images. The objective of this study is to detect the presence on pneumonia more accurately from a wide collection of chest X-ray images. This classification can help in early diagnosis to provide appropriate treatment at the earliest.

LITERATURE STUDY

One of the common infections that results from a bacterium, virus, or fungus attacking the lungs is pneumonia. The word "pneumonia" comes from the Greek word "*pneumon*," which also means "lungs." As a result, pneumonia is linked to inflammation in the parenchyma of the lungs. Aspiration of food or exposure to certain toxins are additional potential causes[5]. Pneumonia is defined differently depending on the viewpoint. According to the definition provided by the World Health Organization, pneumonia is a "acute lower respiratory tract infection" for some people, while for others it is specific indications seen in the respiratory functions. Pneumonia develops when the alveoli of the lungs become filled with liquid, reducing the exchange of oxygen and carbon dioxide between the blood and the lungs. This will make it harder for air to enter the lungs, which will make it harder for the person to breathe. The additional signs and symptoms could be chest pain, fever, coughing, and shortness of breath[6]. Elderly are more vulnerable. Also Patients with other respiratory and heart conditions, as well as children under the age of five, are also greatly at danger[5][6]. Patients with a history of lung illnesses, heart ailments, bronchial asthma, and patients receiving immunosuppressive medications are among the risk factors for pneumonia [7].With about 3,00,000 children dying from pneumonia in India in 2016, this country has the highest rate of paediatric pneumonia mortality worldwide[8].There are various methods for diagnosing pneumonia, including clinical evaluation along with microscope examination and tracheal discharge culture[9]. Along with X-ray pictures, pulse oximetry testing, sputum examination, blood gas analysis, bronchoscopy, and a complete blood count are further alternative methods to diagnose pneumonia. Pneumonia comes in three different forms: bacterial, viral, and fungal.

Because pneumonia is caused by causative pathogens, antibiotics are used to treat bacterial pneumonia, antiviral medications are used to treat viral pneumonia, and antiviral medications are used to treat fungus pneumonia. The diagnosis of pneumonia is made using the chest x-ray pictures, and all subsequent decisions are based on this radiological result. In comparison to other approaches, it is also quite affordable. The person in charge will look for white areas in the lungs known as infiltrates that are classified as a contamination when examining the chest x-rays for pneumonia. Patients with bronchitis and tuberculosis may also experience them[8].Early pneumonia detection is usually preferable because postponing treatment might have a number of negative effects [10]. Deep learning might be utilised for this. A subset of machine learning, which is a component of artificial intelligence, is deep learning. Artificial intelligence-based models can be used to diagnose several biomedical health issues, including cancer. Sometimes these models can find features that are buried or difficult for professionals to see. The most popular tool in the fields of deep learning and machine learning is convolutional neural networks. This technology has been used

most frequently and most recently in the healthcare industry since it can extract a lot of new information and distinguish between classes like benign and malignant cancer, infected or healthy tumours, etc.[1].

METHODOLOGY

The X-ray images with pneumonia as well as normal healthy person's X-ray images are used for this study from publicly available data source, National Institutes of Health, which authorized public use of the image data [11]. In order to train the model with variety of X-ray images that can help in accurate identification of pneumonia, we have included X-ray images with covid pneumonia from kaggle[12].In order to train the model, 500 X-ray images of Pneumonia,500 images of covid-19 pneumonia and 500 X-ray images of a typical, healthy person are included in the chest X-ray data set of 1500 images. While preprocessing the images, to feed it as an input to the model, X-ray images are resized to size of 227*227. Sample set of the images from the dataset used in this study is shown in Figure 1. The images are preprocessed with various techniques to achieve uniform images as input to the training model. As a second step, the dataset is split into training and testing set. 70% of the data from the overall dataset is used for the training and the remaining 30% of data is used for the testing purpose. Once the model is trained, model's accuracy and other performance indicators are tested in the third step using the remaining 20% of the dataset.

Architecture
CNN works good for image classification. In order to achieve a good accuracy rate in classifying the X-ray images, the CNN model is modified and is represented in figure 2. The proposed architecture consists of 20 convolutional layers, 20 batch normalization layers followed by 20 ReLu layers. The classification part contains one average pooling, batch normalization layer followed by fully connected layer, Soft max layer and the classification output layer. We have experimented with other activation function such as leaky ReLu and came to a conclusion that ReLu helped in achieving higher accuracy rate in classification when compared to all other activation functions.

RESULTS OBTAINED AND ITS ANALYSIS

To test the consistence of classification with the proposed architecture, the image set was broken into various category and the accuracy was tested. These samples were tested as per the system configuration which was a X64 based PC and Intel(R) Core(TM) i7-7700 CPU @ 3.60GHz, 3601 Mhz, 4 Core(s), 8 Logical Processor(s). It is very clear that the proposed architecture gives an average accuracy of 95.4% with 3 classifications. To discuss the result of the classification, 1500 X-ray images are considered out of which 500 images are of Covid-19 pneumonia affected people, 500 are pf pneumonia effected people and another 500 images are of normal x-ray. The 1500samples are divided into 70% of data for training and 30%testing. The performance of the model is based on how well it is able to perform during testing of the data. Thetrainingsegmentcontains70%. The proposed architecture acquired95.4% accuracy with 25 epochs on a dataset of 1500 images. The loss and accuracy of training set as seen in figure 3and it took approx. 77 minutes and 18 seconds to complete the training with the system configuration mentioned above. It is noticeable that the loss of the model is gradually decreasing and consistent after 500 iterations. Figure 4 is the confusion matrix for the given dataset. Confusion Matrix tells about the properly classified images and images which are not classified. This model is correctly able to classify pneumonia with a percentage of 95.4 percent. The data is split in to 2 folds for analysis. This type of validation will help to provide better estimate of the performance. Figure 5 indicates the ROC curve which will help to identify the AUC. Here AUC (area under the curve) is approximately 0.99.

CONCLUSION

This paper proposes a deep learning model to accurately classify if the image of the chest x-ray belongs to normal healthy person or a person affected by pneumonia using the proposed architecture. This study showed that this framework fetched an accuracy of 95.4 %. This proposed method can be extended for future works with high quality data.

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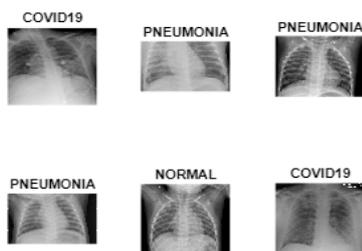
Fig. 1 Sample X-Ray Images
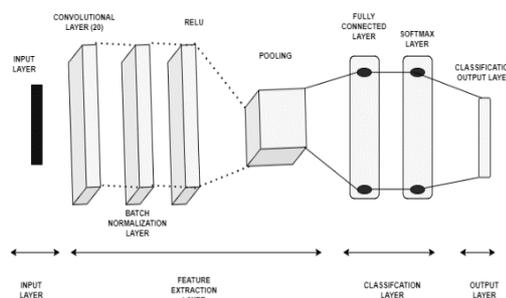
Fig. 2 Architecture diagram

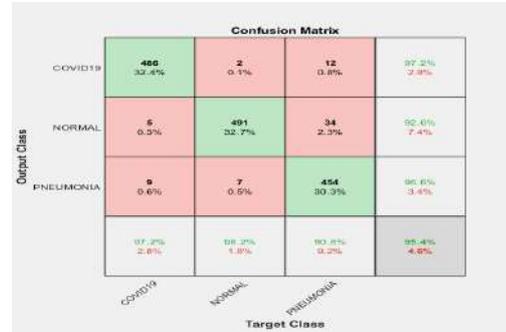**Sarwath Unnisa and Vijayalakshmi**
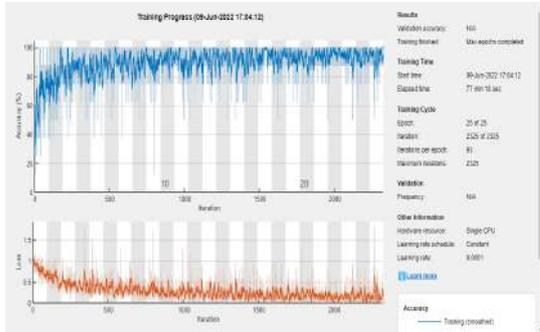
Fig. 3 Training and loss graph
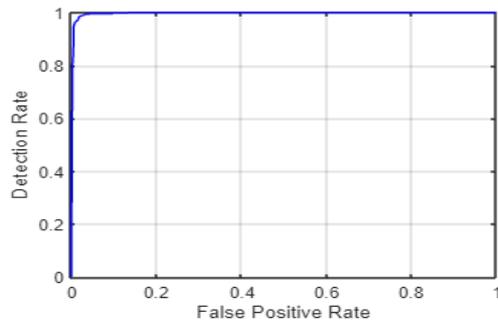

Fig. 4 Confusion Matrix

Fig.5 ROC curve

RESEARCH ARTICLE

Plithogenic Picture Fuzzy EDAS and Digital Teaching Tools

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ABSTRACT

The field of the Educational system is witnessing a wide range of transitions from reality to virtual classroom scenarios. The online engagements of the teachers in the context of teaching and learning demands time and energy and the challenging part lies in keeping the students on track. The teachers are expected to make teaching effective and interactive on online platforms which demand the right choice of digital tools. This research work proposes a decision-making model to make ideal decisions on the digital tools concerning four significant criteria. To control the influence of the external factors and to alleviate uncertainty in decision process, the method of Plithogenic Picture Fuzzy EDAS (The Evaluation Based on Distance from Average Solution) a MCDM is chosen. The optimal decisions arrived will facilitate digital teaching effective to a greater extent. The proposed decision-making model can be validated with other kinds of Plithogenic representations.

Keywords: Plithogeny, Picture Fuzzy Sets, EDAS, Decision-making, Digital Tools

INTRODUCTION

Decision making is an inevitable process that takes place continuously in almost all organizational and business sectors. The decision-making environment comprises alternatives, criteria, criterion satisfaction rate from an expert's perspective and suitable decision methods. The decision process is simple when it involves a considerate number of alternatives and criteria, but it is complicated to handle several alternatives. The ultimate aim of any MCDM method is to determine the most optimal alternative that satisfies almost all the alternatives to a maximum extent. There are

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many MCDM methods to handle the decision-making environment as mentioned in Table 1. This paper applies the method of EDAS proposed by Mehdi [1] to make optimal decisions on digital tools. The method EDAS is chosen as a decision method because of its advantages in eliminating the biasedness of the experts and it enhances the consistency of the results over the commonly used techniques such as TOPSIS and VIKOR. The method of EDAS has been discussed under fuzzy environment by Ghorabaee and Mehdi [2]. Zadeh [3] developed the concept of fuzzy to handle uncertainties in making decisions. Cengiz et al [4] discoursed EDAS in intuitionistic representations. The intuitionistic sets developed by Atannsov [5] are the extensions of fuzzy sets which consists of membership and non-membership values. Li et al [6] applied linguistic neutrosophic representations in EDAS. Smarandache [7] developed the notion of neutrosophy and characterized the neutrosophic set as a triplet with the membership values of truth, indeterminacy and falsity. The method EDAS was applied to various decision-making situations across these three environments. The theory of Plithogeny [8] developed by Smarandache deals with the attributes and it is the generalization of crisp and its extended forms. Many MCDM methods are discussed in a plithogenic environment but to the best of the author's knowledge, the method of EDAS remains still not unveiled and unexplored in plithogenic background. This has motivated the authors to discuss the method of EDAS under plithogeny with picture fuzzy representations. Picture fuzzy sets introduced by Cuong and Kreinovich [9] which is an extension of fuzzy and intuitionistic fuzzy sets that consists of positive, neutrality and negative values. The form of a picture fuzzy set is $\{(x, \mu_A(x), \rho_A(x), \vartheta_A(x)): x \in X\}, 0 \leq \mu_A(x) + \vartheta_A(x) \leq 1$. Where $\pi(x) = 1 - (\mu_A(x) + \rho_A(x) + \vartheta_A(x))$ is called the refusal value of x in A. The picture fuzzy sets handle almost all the possibilities of representations by the professionals in the decision- process. This paper makes an attempt to study EDAS in a plithogenic picture fuzzy environment and it is structured as follows: Section 2 describes the proposed methodology; section 3 applies the proposed approach to make optimal decisions on digital tools and the last section concludes the research work.

2. PLITHOGENIC PICTURE FUZZY EDAS

The steps in the suggested method are presented in this segment.
This section describes the proposed decision-making approach based on [10] with further inclusions of plithogenic concepts.
Step 1: The initial decision-making matrix comprising of alternatives, criteria and criterion satisfaction rate is constructed based on expert's opinion.

The combined decision-plithogenic intersection operator $D = [D_{AB}]_{g \times h} = \begin{bmatrix} D_{11} & D_{12} & \dots \dots \dots & D_{1g} \\ \dots & \dots & \dots \dots \dots & \dots \\ D_{h1} & D_{h2} & \dots \dots \dots & D_{hg} \end{bmatrix}$ making matrix is obtained using for the picture fuzzy sets.

$(a_1, a_2, a_3) \wedge_p (b_1, b_2, b_3)$

$\left(a_1 \wedge_F b_1, \frac{1}{2}[(a_2 \wedge_F b_{12}) + (a_2 \vee_F b_2)], (a_3 \vee_F b_3)\right)$

$a \wedge b = ab, a \vee b = a + b - ab$

Step 2: The aggregate solution values is determined using

Step 3: The optimistic and $A = \dfrac{\sum_{A=1}^{g} D_{AB}}{g}$ pessimistic distance values from the average solution values are calculated for

$P - [P_{AB}]_{gh}$ $N = [N_{AB}]_{gh}$

beneficial (BC) and non-beneficial criteria (NBC).
BC

$P_{AB} = \dfrac{\max(0, (D_{AB} - A))}{A}$

$N_{AB} = \dfrac{\max(0, (A - D_{AB}))}{A}$

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NBC

$$P_{AB} = \frac{\max(0,(A - D_{AB}))}{A}$$

$$N_{AB} = \frac{\max(0,(D_{AB} - A))}{A}$$

Step 4: The aggregate sum of optimistic and pessimistic distances are calculated using

SoP$_A$ = $\sum_r w_r P_{AB}$ SoN$_A$ = $\sum_r w_r N_{AB}$

Step 5: The values are standardized using

SSoP$_A$ = $\frac{SoP_A}{\max(SoP_A)}$ SSoN$_A$ = 1 - $\frac{SoN_A}{\max(SoN_A)}$

Step 6: The appraisement score of the alternatives is determined using

AS$_A$ = $\frac{1}{2}$[SSoP$_A$ + SSoN$_A$]

3. DECISION-MAKING ON DIGITAL TOOLS

This section applies the proposed approach to make optimal decisions on digital tools. Presently the number of digital tools are overwhelming and the teaching fraternity is quite puzzled in choosing the optimal digital tools amidst several existing feasible alternatives. This section takes into account four core criteria and six alternatives. The criteria considered in making decisions are Accessibility, Customization, Interaction and Cost Efficiency. The combined expert's decision matrix is obtained from two expert's opinions.

CONCLUSION

This paper discusses Plithogenic picture fuzzy EDAS to make optimal decisions on the choice of digital tools. The proposed combination has not been discussed so far and the advantages of this combination shall be justified by taking comparative study over the existing approaches, which is the future scope of this study.

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Table 1 presents MCDM methods to handle the decision-making environment

ELECTRE	Elimination E1 Choice Translating Reality
TOPSES	Technique For Order of Preference By Similarity To Ideal Solution
SMART	Simple Multi - Atribute Rating Technique
VIKOR	Vlekriterijumsko KOmpromicno Rangiranje
MOORA	Multi - Objective Optimization By Ratio Analysis
COPRAS	Complex Proportional Assessment
ARAS	Additive Ration Assessment
DEMATEL	Decision Making Trial and Evaluation Laboratory
EDAS	Evaluation Based on Distance From Average solution
MARCOS	Measurement Alternatives and Ranking According to the Compromise Solution
SWARA	Stepwise Weight Assessment Ratio Analysis
FUCOM	Full consistency Method
AHP	Analytical Hierarchy Process
BWM	Best Worst Method

Table 2: Is the First Expert's Opinion

Criteria / Digital Tools	Accessibility	Customization	Interaction	Cost Efficiency
DT1	(0.6,0.1,0.1)	(0.5, 0.2, 0.1)	(0.8,0.1,0.1)	(0.6,0.1,0.2)
DT2	(0.5,0.2,0.1)	(0.4,0.3,0.1)	(0.5,0.3,0.1)	(0.6,0.2,0.1)
DT3	(0.6,0.2,0)	(0.8,0.1,0)	(0.5,0.2,0.1)	(0.4,0.3,0.1)
DT4	(0.5, 0.3, 0.1)	(0.7,0.1,0)	(0.6,0.1,0.1)	(0.4,0.1,0.1)
DT5	(0.7,0.1,0.1)	(0.6,0.2,0.1)	(0.4,0.1,0.1)	(0.7,0.1,0.1)
DT6	(0.5,0.1,0.1)	(0.6,0.1,0.2)	(0.5,0.1,0.1)	(0.7,0.1,0.1)

Table 3 Represents the Second Expert's Opinion

Criteria / Digital Tools	Accessibility	Customization	Interaction	Cost Efficiency
DT1	(0.7,0.1,0.1)	(0.6,0.2,0.1)	(0.5,0.1,0.1)	(0.7,0.1,0.1)
DT2	(0.6,0.1,0.1)	(0.4,0.1,0.1)	(0.4,0.1,0.1)	(0.7,0.1,0.1)
DT3	(0.7,0.1,0.1)	(0.6,0.2,0.1)	(0.5,0.2,0.1)	(0.4,0.3,0.1)
DT4	(0.5, 0.3, 0.1)	(0.7,0.1,0)	(0.6,0.1,0.1)	(0.4,0.1,0.1)
DT5	(0.7,0.1,0.1)	(0.6,0.2,0.1)	(0.4,0.1,0.1)	(0.7,0.1,0.1)
DT6	(0.4,0.1,0.1)	(0.7,0.1,0.1)	(0.6,0.2,0)	(0.8,0.1,0)

Table 4: The combined plithogenic decision-matrix is in Table 3.3

Criteria / Digital Tools	Accessibility	Customization	Interaction	Cost Efficiency
DT1	(0.42, 0.1, 0.19)	(0.3, 0.2, 0.19)	(0.4, 0.1, 0.19)	(0.42, 0.1, 0.28)
DT2	(0.3, 0.15, 0.19)	(0.16, 0.2, 0.19)	(0.2, 0.2, 0.19)	(0.42, 0.15,0.28)
DT3	(0.42, 0.15, 0.1)	(0.48, 0.15, 0.1)	(0.25, 0.2, 0.19)	(0.28, 0.2, 0.19)
DT4	(0.25, 0.3, 0.19)	(0.49, 0.1, 0.19)	(0.36, 0.1, 0.19)	(0.2, 0.2, 0.19)

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| DT5 | (0.49, 0.1, 0.19) | (0.36, 0.2, 0.19) | (0.16, 0.1, 0.19) | (0.49, 0.1, 0.19) |
| DT6 | (0.2, 0.1, 0.19) | (0.42, 0.1, 0.28) | (0.3, 0.15, 0.1) | (0.28, 0.1, 0.19) |

Table 5: Is Ranking of the Alternatives

DT1	DT2	DT3	DT4	DT5	DT6
2	6	4	3	1	5

Fig.1. Ranking of Alternatives

RESEARCH ARTICLE

Critiquing the Native Spirit of Adi Tribe in Mamang Dai's the Black Hill

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ABSTRACT

Mamang Dai is one of the most influential writers from the north-east India. In the beliefs of *Adi* tribes of Arunachal Pradesh nature, landscape, and traditions play a very significant role. These aspects, influenced by myths and associated values, have also been significant in the development and dimension of Mamang Dai's writings. Nature has been idealized, mystified, exploited, and interacted in emerging literature known as regional literature, a disjointed collection of Indian English Literature. The lifestyle of her characters impetus of the variety of spirits, supernatural powers and forces of faith, fantasies, and myths. *The Black Hill*(2014), as a result, is a literary articulation of the different myths that have been passed down through time. The present paper investigates the social reality and daily living of the tribal society, *Adi* tribes in this context, of Arunachal Pradesh in India's north-eastern region.

Keywords: *Adi* Tribe,Mystery, Myths, Nature, Tradition, *The Black Hill*

INTRODUCTION

The northeast part of India is home to two of the most important biodiversity hotspots, the Eastern Himalayan and Indo-Burman biodiversity regions. A tribal community named *Adi* dwells in this region. The *Milangs, Komkars, Minyongs, Padams*, and *Pasis* refer to themselves as *Adi*, which means the people who live in hill areas. The *Adis* are the largest group and reside in the lowest section of the Dibang Valley district, particularly in the Roing and Dambuk localities. They are similar in certain aspects as they speak the same vernacular language, assert the exact origin, and conduct and commemorate the same rituals and festivals. A BBC report states about *Adis*, "The *Adi* are subsistence farmers who live in the foothills of the Himalayas in the far northeast of India" (BBC). *Adis*are known for living in heat and humidity and cultivating various crops. Tribes are indigenous or native people. According to *Cambridge*

Dictionary the term 'tribe' as "a group of people, often of related families, who live together, sharing the same language, culture, and history, especially those who do not live in towns or cities." (Cambridge Dictionary) Tribes live in forest areas and have good knowledge about animals, landscape, plants, water bodies, etc. Ranjay K Singh et al. in their research paper titled "Traditional Skill among the *Adi* Tribes of Arunachal Pradesh" state, "In recent decade, the traditional communities worldwide are increasingly using their intimate knowledge of plants, soils, animals, climate and seasons in sustainable and holistic approach without cause" (27). Each group in Arunachal Pradesh has its own culture, language, traditions, and customs that distinguish it from the others. The *Adi* tribe, like many others, received rich oral literature from their forebears. These oral traditions frequently cross paths with myth, legend, cosmogony, and other conventional categories of knowledge. Numerous tribal and sub-tribal communities live in Northeast India. The tribes of Arunachal Pradesh, in Northeast India, have a long tradition of manufacturing a wide variety of crafts, and each group excels at them. Whatever craft products they make, the quality of such craft products reflects the tribes' aptitude and ingenuity. Except for the Manipuris and the Assamese, there is no written history of any other tribes in this region. British officials published a few texts during the colonial period who served as amateur anthropologists to document their findings. It was necessary to keep those records on hand for administrative purposes. As a result, for most of the communities occupying this region, establishing the origins of a tribe may rely significantly on oral traditions, material culture, and British documents to be successful.

Arunachal Pradesh is a state with pristine natural beauty. A variety of rivers, extensive open lush forests, and rolling hills provide the sense of a beautiful paradise. It is one of the least populated areas in India and offers a calm retreat to visitors. However, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, and Sikkim are eight states in the country's northeast part. The states have prime importance because of their geographical location and cultural and historical diversity. Therefore, they are called as eight siblings and denoted "seven sisters and one brother." The eight states have an area of 2,63,179 square kilometres. About it is eight per cent of India's total area. Hence, the states have 3.76 per cent of the country's populace. The eight states have over 635 tribal communities in northeast. They speak numerous Tibeto-Burman languages and other native dialects. Numerous tribes inhabit Arunachal Pradesh, Meghalaya, Mizoram, and Nagaland. "States like Assam, Manipur, Tripura, and Sikkim are inhabited by people of various religious denominations like Hindus, Christians, and Muslims and a combination of local tribes and communities" (Rashmi 44). Since 1900, Christian missionaries have been developing *Adi* literature. J. H. Lorrain and F. W. Savidge, preachers regarded as the predecessors of the *Adi* language, released an *Abor Miri Dictionary* in 1906 with the assistance of Mupak Mili and Atsong Pertin. Northeast India has many writers and poets who have translated the majesty and beauty of its scenery onto the literary canvas. The Northeast has created literary pieces that naturally include nature and its relevance in human life. The land and its inhabitants are from the region's spiritual environment. Many writers and poets from Northeast India have achieved renown and critical acclaim in recent decades. Mamang Dai is one of these literary talents who has written four poetry collections, two non-fiction volumes, and five novels in addition to hundreds of newspaper pieces. She won the Sahitya Akademi Award for her novel *The Black Hill* (2014) in 2017.

METHODOLOGY

Vernacular works of literature portray nature as paradise in the English writings from eight different provinces of the region in fiction and poetry, influenced by this area's rich flora and fauna and picturesque landscape. Northeast Indian Literature has a new and exciting voice in Mamang Dai from Arunachal Pradesh. Mamang Dai shows the tribes' protective and possessive attitude toward their land and territory throughout the narrative. When tribes are constantly fighting for areas, it's hard to tell how they respond when individuals from other countries live among them. The novel also has a reflection of contemporary historical incidents. As depicted in the novel, hostility towards outsiders is shared among the tribes of Arunachal Pradesh's hills. Mamang Dai's use of storytelling as a vehicle for expressing the hitherto silenced history of her tribe is emphasised. Mamang Dai portrays, "The sky above shone with a soft, clear light. She could inhale the grandeur of the sky...Her soul was returning to her. Beyond this spot the true forest would begin…She gazed up at the sky. In the gathering darkness, a smile stretched her pale face" (Dai 288). Thus, she extensively portrays Arunachal Pradesh's natural and ethnic beauty.

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RESULTS AND DISCUSSION

The Black Hill is set in mid-19th century Arunachal Pradesh, undisturbed by British occupiers. Gimur, Kajinsha, and Father Krick are the novel's three primary protagonists. In the first chapter, Gimur, a seventeen-year-old girl, stands on the top of a hill. She is from the Abor tribe of Mebo village, with ironic traditions and principles. The community lives in the Mishmee highlands, away from strangers. Her blue chin tattoo makes her a Mebo Villager. The girl is portrayed as a rebel in her tribe's civilization. Dai states, "Gimur did everything that young girls in the village were expected to do, in fact she was better than most at household chores; but as her mother always said, she was uncontrollable and daring, more like a boy, whistling and climbing trees and getting into scrapes" [2]. Thus, Dai beautifully portrays the life of women having freedom. Women's freedom is a result of their rebellious spirit. The Abor, Santal, Munda, and Mishmee tribes are at the core of Mamang Dai's novel, set in the mid-nineteenth century, soon before the 1857 revolt in North India. In Upperside of Assam, the region above the Brahmaputra and below Tibet, tribes live in this state. Tibet has been a forbidden land throughout history. It depicts the storey of a French priest going to Tibet to construct a church. He was on his own when he left Assam, trying to find a way through the hills. *The Black Hill* is set around 1840s and 1850s Arunachal Pradesh. A French priest, Father Nicolas Krick, travels to proclaim the word of his Lord and possibly establish a mission in Southern Tibet. Ambitious and religious, he is not discouraged by new terrains or hostile tribals. Gimur, a Mebo girl from the Abor tribe, is a fiery young lady. She defies social conventions and does what she wants. But circumstances are changing, and the threat of British invasion looms large. Kajinsha, one of the novel's protagonists, has a subject of inter-tribal animosity. Kajinsha and his father work tirelessly to reconcile the tribes and even help the fellow tribes at the risk of their own lives.

Although he is innocent, he has been charged with the priest's death. When he chooses to remain hidden with his family in a remote location, the people of his neighbouring tribes assist the troops in locating him. He is sentenced to death. Mamang Dai also discusses the *Adi* and Mishmi ethnic origin and migration stories. In the introduction, the author details individual life and social structure. Dai, a member of the *Adi* Tribes, gives a comprehensive overview of her people's history. Arunachal Pradesh's *Adi* tribes were previously part of the Tani. This large Tribal group migrated from Tibet to the north of the Himalayas and settled beside the Siang River basin. The tribal groups of the Siang Valley area are called *Abor* by the Assamese. *Abor* has a pejorative connotation for the Tribes. Thus, they choose to use *'Adi'* instead. According to the book, *Abor* "conveyed something that meant both barbarous and independent in Assamese, and was a term applied to all the tribes occupying the Siang valley in the mountainous country between Assam and Tibet" (Dai 26). There were some other names that were used for the other Abor communities as "Pasi, Minyong, Shimong, Komkar, Tangam and Pangi" [26]. Mamang Dai portrays border tribes and their different societal facets in her fiction. The novelist portrays Tribes of North-eastern India in a pre-independence environment. Contact with the outsiders and furious combat against non-natives to safeguard their land remind depict difficulties of tribal life. A rift develops between the *Mebo* and the white men attempting to infiltrate their hamlet. They are apprehensive about even confronting them. Tribal people like *Moi* are perplexed by the invasion of the strangers and wonder, "What was it they wanted, so far away from home? What hungers drove them?" (21).

To protect their lands from intruders, the tribes devise strategies to thwart their attempts at incursions into their area. In the story, there are several instances in which they attack the British camps with meticulous design. "The people of the land called themselves into separate existences into the questions of identity, nationality, homeland, or insider/outsider conflict" (Chakraborty 65). The people of the tribal community seem very innocent as the lack of knowledge hinders their arguments. The rift between both Natives and Britishers could be a reason that developed due to suspicious acts of later. For instance, Gimur's father becomes the cause of distrust. Gimur is only six years old and her father, who was very fit, died suddenly. The white people are blamed for his death, but he suffers from a dangerous disease. No one was aware of his illness. One of her uncles states, "No! It was not true. The migluns had not killed him. He had been ill. I do not know what illness was eating him, the uncle had continued but he told me he had been struck by visions. He said that a bad time was coming, and that dread followed him in his dreams" (Dai 19). Thus, the tribes faced severe exploitation of colonisers. Mamang Dai represents the spiritual response of the

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indigenous people to impostors in their area. However, the contemporary politics of the province is explosive, which cultural significance. Water, forest, and land are essential resources of *Adi* tribe. Industrialists and colonisers attempt to occupy the natural resources. The tribal communities have a sense of association with the natural resources. Marginal tribes of the northeast are the victim of colonisers and native exploiters. Similarly, social justice and the related issues of the area remain very complex. Sanjib Baruah argues, "Questions of social justice in Northeast India are significantly more complex today than what the regime of protection was originally designed to accomplish. The informality of the arrangements exposes a large number of poor people to a more vulnerable legal position than that already implied in the marginal nature of the economic riches they occupy." (Baruah 197). Thus, the land plays a substantial role in tribal life. The land is at the heart of most of the confrontations in northeast India, especially among tribal communities.

It is also the most threatened resource, particularly in tribal areas. The region is known for its diversity too. In the northeast part, tribes and tribal economies have been widely characterised as isolated, paddy producing, and land constrained villages where the residents employ community land and community labour to practice shifting agriculture. The tribe people feel that the land is everything they have and need. Regarding the role of land Erik de Maaker and Meenal Tula argue, "Politically, control over people appears to have mattered much more than the control of land or territory" [3]. Thus, political occupation over land is a matter of tussle between capitalists and tribal communities. Kajinsha witnesses the presence of others at Brokpa camp that is close to hilly area. As the number increased, there was a fight between both groups, and the battle was only for the land. "Land is a place of ownership and rest, Kajinsha's father had said over and over" (Dai 112). The concept of owning the land is very unpretentious. Anyone can attain ownership if individuals clear the forest area and construct a dwelling where crops are also cultivated. Further, Dai portrays richness among the community when she writes, "If a man owns land, he owns rest. He can live his life with nothing to worry about" (112). Thus, ownership of land highlights prosperity in *Adi* tribal people. Furthermore, Kajinsha's father states, "He can plant crops and fish in the river, and he can raise his sons and daughters and live on from generation to generation." (112) Kajinsha tries to differentiate the areas of interest of tribes and non-tribes. Land with grass, rocks, thunder, and lightning are the expressions to guide them for future happenings. The community mainly depends on natural resources. They have immense love and attachment with land and natural resources, whereas Dai portrays colonisers and capitalists as exploiters of nature. In other words, it is their way of life, as Kajinsha reveals, "The time we have is what we call our life. It is how I stand, hunt, sleep, breathe" (140). Mamang Dai highlights the values associated with land and its role in the life of their community: "The Tibetan lamas have books and you read your book for knowledge of God. We read the land. The land is our book. Everything here on this hill, the grass and rocks and stones is saying something. And what falls from the sky- rain, thunder, and lightning- are also the voices of spirits telling us something" (140).

To protect their territory from intruders and neighbours, they are prepared to go to any length. Because only such things provide them with a sense of belonging to this world, they are clinging to the borderlines and cultural traditions. All that pushes them to protect their borders from intruders is their natural survival instinct. Their attachment and love with the soil prevent them from welcoming visitors from other parts of the country. Indigenous people's belief system is based on myths and tales, which are fundamental to their existence. Numerous traditional narratives are related with and told from a mythological perspective in the mythologies of the northeast indigenous people, including many conventional records. Traditionally, myths serve as real tales of a community. They include stories of the birth of tribes, teaching on communal values, society's norms, institutions, and taboos. A version of creation stories that narrate how the tribe came into existence may be found in almost every tribal community in the northeast states, with some variations. Poets and fiction writers from this region attempted to preserve these stories as they retell them in poetry and short stories. Joseph Campbell in *Primitive Mythology: The Masks of God*(1959) emphasises the necessity for myths, "Man, apparently, cannot maintain himself in the universe without belief in some arrangement of the general inheritance of myth. In fact, the fullness of his life would even seem to stand in direct ratio to the depth and range not of his rational thought but of his local mythology" (4) . For ages, myth has persisted as an archetype in practically all pieces of literature. Its continual development across traditions recognises an inextricable tie between mythology and literary works in the present and even envisions the same for generations

to come. Mamang Dai, in her non-fiction book titled Arunachal Pradesh: The Hidden Land(2002),discusses the dire need to retrace the unheard and repressed voices from tribal culture and histories. Mamang Dai states: Today change has come like a steam roller. The transition from unknown frontier to modern state has been sharp and rapid and the question of direction and destiny has become one of great complexity and soul searching. On the one hand, in keeping with the national agenda, the state is forging ahead with goals for progress and development(9). Dai's knowledge of the *Adi* and Mishmi tribes' available history prompts her to re-imagine the tribal society's precious memories. The Black Hill depicts the pre-independence reality life of *Adi*tribal community. Their first confrontation with non-natives indicates their ability to confront to rebel against incroachment. "[T]he history of our people, our origins and routes of migration remain a matter of speculation, based purely on the few recorded documents left by the early explorers. There are also specialized niches in our tribal heritage that may be erased forever if change is not assessed and negotiated carefully" (9).

Thus, Dai is concerned with the radical transformation of the tribal culture. She exposes invaders and the helplessness of the marginal communities. The immediate context of writing The Black Hill reveals artistic correlation of the concealed past to known history concerning a Mishmi Chief convicted of murder a French Father Krick and Augustine Bourry. In the plot of The Black Hill, Mamang Dai used many myths from the *Adis* oral tradition. On several occasions in The Black Hill, the various characters in her stories consider themselves as followers of Donyi-Poloiv, and Donyi-Polo also invigilates their lives. Gimur's life was unfinished and destroyed by the end of the novel, which she saw as the punishment for breaking taboos. At that point, Mamang Dai merges *Adis'* creation of myth with Gimur's life. *Adis* are followers of a naturalistic religion. They follow Donyi-Polo. They even see good and evil spirits overseeing their lives on earth, with the Sun (Donyi) and Moon (Polo) ruling supreme. In *Adi* theology, Donyi- Polo is the highest deity. According to *Adis* Donyi-Polo, mythology is derived from Kayum (The Mother Earth). Others say there were two intolerable Suns at first. The frog shot at one of them, dimming its luminosity to the Moon's. The *Adi*s worship Donyi-Polo as their ultimate deity. The tale of The Black Hill is based on myths, such as: At first, there was no earth and sky: there were only two great eggs. But they were not ordinary eggs…From one came the Earth, from the other the Sky, her husband. Now the Earth was too big for the Sky to hold in his arms… The Earth… made herself paliable and the mountains and valleys were formed… When the Sky made love to Earth, every kind of tree and grass and all living creatures came into being. (Elwin 15-16) Most *Adi*s myths and tales relating to the origin of gods and spirits convey about the human world. Along with the advent of spirits and gods, the basis of sacrifices appeases gods' wrath and quench the hunger of the evil spirits can be observed. The indigenous community people believe in the ability of unseen evil and good spirits to harm and benefit humans. The novelist portrays the rite *Ipakviii* for the village's ailing young guy named Mebo in The Black Hill. The young man was afflicted with an incurable ailment. Mutsang, a great shaman recounted by Lendem, sacrificed a chicken with his sword to loosen the grip of a deceased warrior's soul. Later, the Miri or Shaman used the dead bird to cure the sick man and placed the blue beads around his neck on his head. Through writings, such rites and beliefs gained representation and became static in written literature.

As nature and landscapes are the primary things to the life of *Adi* tribes. The myths and rituals remain close to it as river, forest, snake, birds etc., are the integral parts of numerous legends. Mamang Dai also uses some snake myths in *The Black Hill*. For instance, "Gimur remembered stories from her childhood about water serpents that lived in big rivers. The Kmaan also belived there was a snake as long as river. There is always a serpent sprit lurking in deep water waiting to pull someone in, she thought" (84). The snake was angry because someone had killed her offspring. In revenge, it will bite the next passer-by. The birth of twin babies is a bad omen in Mebo and nearby areas. In the middle of two nights, two boy babies are born to Gimur. She is aware of myths as she shouts, but no one hears her. She faces utter silence everywhere after the birth of twins. "[F]rom the silent faces watching over her, she could tell that nothing would be the same again" (85). Her fear was unpretentious as this myth was common in *Adi* community. Neighbours, friends, and others do not share anything with the mother in fear of giving birth to twins. She is alienated from her people. It assumes, "[T]he souls of children who died at birth went to a middle world under the earth. Sometimes these children joined hands and danced and when they did this it caused an earthquake" (85).

Kajinsha thinks that the spirits have brought bad fortunes that torment them. Kajinsha knows it can happen to any woman as it is natural, but the people contemplate Kajinsha.

CONCLUSION

To sum up, Arunachal Pradesh's rich arts, local rituals, culture, the role of land, and mythology will undoubtedly give colour to the country's cultural heritage. The oral literature of *Adi* tribe, which had been stifled by the entrance of print culture and modernisation, finds a central place in The Black Hill. Mamang Dai plays the role of the brilliant genius of her community or informer by presenting the myths of the *Adi* tribe in a polished and printed form. Certain myths like the myth of twins, snakes, water, and river depict the culture of *Adi* tribes. *Adi* literature in English from northeast India is a voice of native people. Dai's delineation attempts to preserve cultural history and abundant biodiversity of the seven sisters state of India. Mamang Dai, a master storyteller, significantly raises indigenous people's issues. *The Black Hill* Dai creates a new rendition of the tribal past with a native spirit. The novelist succeeds in bringing up the forgotten history and rapidly fading cultural ethos of the northeast tribes.

ACKNOWLEDGEMENT

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RESEARCH ARTICLE

Chebyshev and Block Pulse Wavelet Approach for the Non-Linear Quasi-Singular Integral Equation

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ABSTRACT

This paper presents, the wavelet-based quadrature scheme is proposed and numerically investigate the quasi-type singular integral equations arrived in electromagnetic field theory by Chebyshev and Block pulse wavelet method, the comparison of the obtained numerical results with earlier results and they have been found in good agreement.

Keywords: Integral equation, Chebyshev wavelet method, Block pulse function, Quadrature, Magnetic field.

INTRODUCTION

The wavelet theory is a powerful mathematical tool and it has been widely used in quantum field theory, image processing and many numerical methods, quasi-singular integral equations are frequently arrived in electromagnetic field theory and it is in the form of

$$I(x) = \int_0^h f(x') K_n(x', x) \, dx' \tag{1}$$

Where $f(x')$ = continuous function or charge basis in electromagnetic field

$K_n = \frac{e^{-iRc}}{R^n}, n = 1,2,3,4 - - - -$ is the kernel,
$c =$ phase constant,

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$R = \sqrt{r^2 + (x' - x)^2}$ is the length between stationary point to source element of the linear conductor axis the quasi-singular integral equations are approximated numerically by use of Gauss-Legendre quadrature [1], Gaussian quadrature [2] and Mixed quadrature [3], the wavelet based quadrature scheme like Haar wavelet, Hybrid wavelet, Chebyshev wavelet, and Block pulse wavelet, coif wavelet method are used to find the numerical solution of integrals and multiple integrals are demonstrated in [4-6], In this paper, the integral equation (1) are approximated based on efficient numerical technique by Chebyshev and Block pulse wavelet method using MAPLE software.

We organize this paper as follows. In section II, we briefly explain the Chebyshev and block pulse wavelet method to solve quasi type singular integral equations of various order N, in section III contains various numerical examples, which demonstrated the effectiveness of the proposed Chebyshev and block pulse wavelet methods in comparison with Gauss-Legendre quadrature method(GLQM)[1] and Gauss quadrature method(GQM)[2] and Mixed quadrature method(MQM)[3], some conclusions are given in section III by uses of Maple-13 software.

II.Wavelet Based Quadrature Method

a. Chebyshev wavelet method(CWM)
The Chebyshev wavelet $\emptyset_{k,m} = \emptyset(k,n,m,t)$ is defined on the interval [0,1) as

$$\Phi_{k,m} = \begin{cases} \sqrt{\frac{2^{k+1}}{\pi}} T_m(1 + 2^k t - 2n), \frac{n-1}{2^{k-1}} \leq t \leq \frac{n}{2^{k-1}} \\ 0, \qquad otherwise \end{cases} \qquad (2)$$

$k = 0,1,2,3, - - - -, \quad$ and $n = 1,2,3,4, - - - -, 2^{k-1}$

m is the degree of the polynomials and t denotes the normalized time, T_m (t) denotes the Chebyshev polynomial of order m, which are orthogonal with the weight function $w(t) = 1/\sqrt{1 - t^2}$ on [-1, 1] and satisfies the recursive formula as follows

$T_0(t) = 1, \; T_1(t) = t, - - -, \; T_{m+1}(t) = 2tT_m(t) - T_{m-1}(t)$

Where   m = 1,2,3, - - - -, M-1

The function $f(t) \in L^2[0,1]$ may be expanded into Chebyshev wavelet basis as

f(t) = $\sum_{n=1}^{\infty} \sum_{m=0}^{\infty} \phi_{n,m}(t) \, \emptyset_{n,m}(t) \, c_{n.m}$ \qquad (3)

The truncated series in eqn. (3) can be demonstrated as

$f(t) = \sum_{n=1}^{2^{k-1}} \sum_{m=0}^{M-1} \phi_{n,m}(t) \, c_{n.m}$ \qquad (4)

$\int_0^1 \phi_{n,m}(t) \, dt = \int_{-1}^1 2^{-\frac{k}{2}} T_m(t) \, dt$
and

$\int_{-1}^1 T_m(t) \, dt = \begin{cases} -\dfrac{2}{m^2 - 1}, \; if \; m \; is \; even \\ 0 \quad, if \; m \; is \; odd \end{cases}$

Then

$\int_0^1 \phi_{n,m}(t) \, dt = \begin{cases} \dfrac{2^{1-\frac{k}{2}}}{\sqrt{\pi}}, \; if \; m = 0 \\ \dfrac{2^{1-\frac{k}{2}}}{1 - m^2} \sqrt{\dfrac{2}{\pi}} \; if \; m \; is \; even \\ 0 \; if \; m \; is \; odd \end{cases}$

We consider the nodal points x_p as

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$x_p = \frac{2i-1+2(n-1)M}{M\,2^k}, i = 1,2,3,---,M$

eqn. (4) reduced to

$$f(\frac{2(n-1)M+2i-1}{2^k M}) = c_{n,0}\frac{2^{\frac{k}{2}}}{\sqrt{\pi}} + \sum_{m=1}^{M-1}\sqrt{\frac{2}{\pi}}2^{\frac{k}{2}}c_{n,m}T_m(\frac{2i-1}{M}-1) \tag{5}$$

Were

$$c_{n,0} = \sqrt{\frac{\pi}{2}}\,2^{-\frac{k}{2}}f(\frac{1+2(n-1)M}{M\,2^k})$$

$$c_{n,m} = \sqrt{\frac{\pi}{2}}\,2^{-\frac{k}{2}}f(\frac{2M-1+2(n-1)M}{M2^k})$$

If $M = 1$

$$\int_0^1 f(t)\,dt = \sum_{n=1}^{2^{k-1}}\frac{1}{2^{k-1}}\,f(\frac{2n-1}{2^k}) \tag{6}$$

Substituting, $x = a + (b-a)t$ then eqn. (6) reduces to

$$\int_0^1 f(x)dx = \frac{(b-a)}{2^{k-1}}\sum_{n=1}^{2^{k-1}}f(a+\frac{(b-a)(2n-1)}{2^k})$$

If $M = 2$

$$\int_0^1 f(x)dx = \frac{1}{2^k}\sum_{n=1}^{2^{k-1}}[f\left(\frac{(4n-1)}{2^{k+1}}\right)+f\left(\frac{(4n-3)}{2^{k+1}}\right)]$$

If $M = 3$

$$\int_0^1 f(t)dt = \frac{1}{2^{k+2}}\sum_{n=1}^{2^{k-1}}[\,3f\left(\frac{6n-1}{2^k}\right)+2f\left(\frac{6n-3}{2^k}\right)+3f(\frac{6n-5}{2^k})]$$

If M = 4

$$\int_0^1 f(t)dt = \frac{1}{2^{k+3}3}\sum_{n=1}^{2^{k-1}}[13f(\frac{8n-7}{2^{k+2}})+11f\left(\frac{8n-3}{2^{k+2}}\right)+13f\left(\frac{8n-1}{2^{k+2}}\right)+11f(\frac{8n-5}{2^{k+2}})]$$

b. Block pulse wavelet method(BPWM)

The Block pulse wavelet is defined over the region [0, T) as follows

$$\emptyset_i(t) = \begin{cases}1, & ih \le t < (1+i)h \\ 0 & otherwise\end{cases} \tag{7}$$

Where $i = 0,1,2,3,4 ----,(m-1)$ and $h = T/m$

The function $f(t) \in L^2[0,1)$ is integrable over the interval [0, T) , the block pulse wavelet
is expanded as

$= \sum_{i=1}^{m-1}f_i\emptyset_i(t)$ \hfill (8)

$$\int_0^1 f(t)dt \cong \sum_{i=1}^m f_i\int_0^1 \emptyset_i(t)\,dt = \sum_{i=1}^m \frac{1}{m}f_i$$

the nodal points t_k as

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$t_k = \frac{2k-1}{2m}$ $where$ $k = 1,2,3,---,m$

Numerical integral based Block-pulse wavelet method is

$\int_0^1 f(t)dt = \sum_{i=1}^m \frac{1}{m} f(\frac{2i-1}{2m})$s

In generally

$\int_a^b f(x)dx = \frac{1}{m}\sum_{i=1}^m (b-a) f((b-a)\frac{(2i-1)}{2m} + a)$ (9)

III.NUMERICAL RESULTS

Chebyshev and block pulse wavelet methods are presented, to solving the nonlinear quasi singular integral equations numerically and comparing the results with [1-3] are shown graphically in Fig.1 and Fig.2, results are more accurate by increasing order N.

CONCLUSIONS

In this paper, we proposed a Chebyshev and block pulse wavelet quadrature method to approximate the nonlinear quasi singular integral equation with $f(x') = x'^{10}, |x' - 0.6|^5, sin(3\pi x')$ functions with various parameters, the present method the results are more accurate with exact value.

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Table 1: Evaluated value of eq. (1) with $f(x') = x'^{10}, h = 1, x = 0.5, r = 10, a = 10, n = 3$
Exact value= 0.0000819479491247904+ i 0.0000387082536722379

Order	Numerical value by BPWM
100	0.0000819090603613819 + i 0.0000386937883056053
200	0.0000819382253144580 + i 0.0000387046370395056
300	0.00000819436272980047 + i 0.0000387066462559617
400	0.000081945180709792 + i 0.0000387073494958685
500	0.000081946393242575 + i 0.0000387076749979662
Order	Numerical value by CWM
5	0.0000819471950946529 + i 0.0000387081167261901
10	0.0000819479491240683 + i 0.0000387082536721096
15	0.00000819479491247874 + i 0.0000387082536722358
20	0.0000819479491247902 + i 0.0000387082536722373

Table 2: Evaluated value of eq.(1) with $f(x') = x'^{10}, h = 1, x = 0.5, r = 0.01, a = 10, n = 3$
Exact value = 19.0303251686328 – i 2.95722284444424

Order	Numerical value by BPWM
100	18.7922191858758- i 2.94602431612261
200	19.0296235573669- i 2.95721009196482
300	19.0302840873684- i 2.95722647534376
400	19.0303028378242- i 2.95722490854125
500	19.0303108788807- i 2.95722416542894
Order	Numerical value by CWM
5	18.2518270886921- i 2.96162217241533
10	19.0303251686391- i 2.95722284443643
15	19.0303251686347- i 2.95722284444427
20	19.0303251686327- i 2.95722284444424

Table 3: Evaluated values of eq. (1) with $f(x') = |x' - 0.6|^5, h = 1, x = 0.5, r = 0.01, a = 3, n = 2$
Exact value = 0.0284768485872135 – i 0.0494353509849795

Order	Numerical value by BPWM
100	0.0284701904168382- i 0.0494278951795616
200	0.0284778009980239- i 0.0494335112369667
300	0.0284772806223409- i 0.0494345333828590
400	0.0284770916293625- i 0.0494348910850312
500	0.0284770041347460- i 0.0494350566493484
Order	Numerical value by CWM
5	0.0284810391887525- i 0.0494362917479419
10	0.0284768485872611- i 0.0494353509850106
15	0.0284768485872122- i 0.0494353509849791
20	0.0284768485872131- i 0.0494353509849795

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Table 4: Evaluated values of eq. (1) with $f(x') = |x' - 0.6|^5, h = 1, x = 0, r = 0.01, a = 3, n = 2$
Exact value = 10.1956656602984 – i 0.599556837050299

Order	Numerical value by BPWM
100	10.1167320514796- i 0.598222743407529
200	10.1884816613734- i 0.599348787535050
300	10.1926046468922- i 0.599465939315110
400	10.1939598468805- i 0.599505939757945
500	10.1945784421579- i 0.599524329299844
Order	Numerical value by CWM
5	10.1251713551509- i 0.603339351499463
10	10.1956660638621- i 0.599556843068462
15	10.1956656602995- i 0.599556837050302
20	10.1956656602983- i 0.599556837050300

Table 5: Evaluated values of eq. (1) with $f(x') = sin(10\pi x'), h = 1, x = 0, r = 0.01, a = 3, n = 2$
Exact value = 50.8002591897036 – i 3.87209815645119

Order	Numerical value by BPWM
100	52.4311626020136- i 3.91627356630473
200	51.1447591756565- i 3.88216124588674
300	50.9487218519673- i 3.87650474250200
400	50.8829845942242- i 3.87456523038332
500	50.8529814594094- i 3.87367375080034
Order	Numerical value by CWM
5	55.1568968156749- i 3.95035093928892
10	50.8002392915780- i 3.87209785480725
15	50.8002591896843- i 3.87209815645085
20	50.8002591897043- i 3.87209815645115

Table 6: Evaluated values of eq. (1) with $f(x') = sin(3\pi x'), h = 1, x = 0.5, r = 0.01, a = 3, n = 2,$
Exact value = - 285.993426532117 + i 14.2651493212776

Order	Numerical value by BPWM
100	- 284.817037321330 + i 14.2537941540768
200	- 285.991220113066 + i 14.2650562799346
300	- 285.993419965067 + i 14.2651144922454
400	- 285.993425142192 + i 14.2651297427137
500	- 285.993425647410 + i 14.2651367910604
Order	Numerical value by CWM
5	-286.455066560024+ i 14.4075163381849
10	-285.993426532121+ i 14.2651493212814
15	- 285.993426532101+ i 14.2651493212773
20	- 285.993426532117+ i 14.2651493212776

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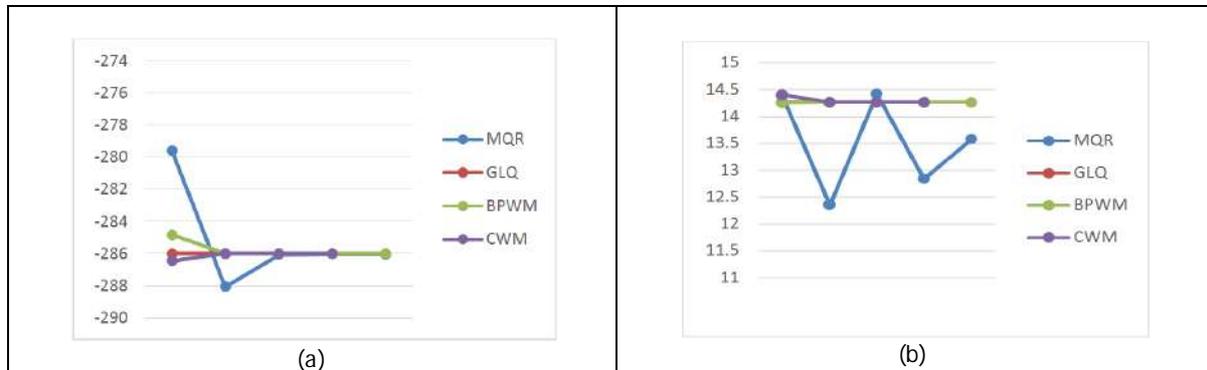(a)   (b)

Fig. 1 comparative results of real part(a) and imaginary part(b) of eqn. (1) with
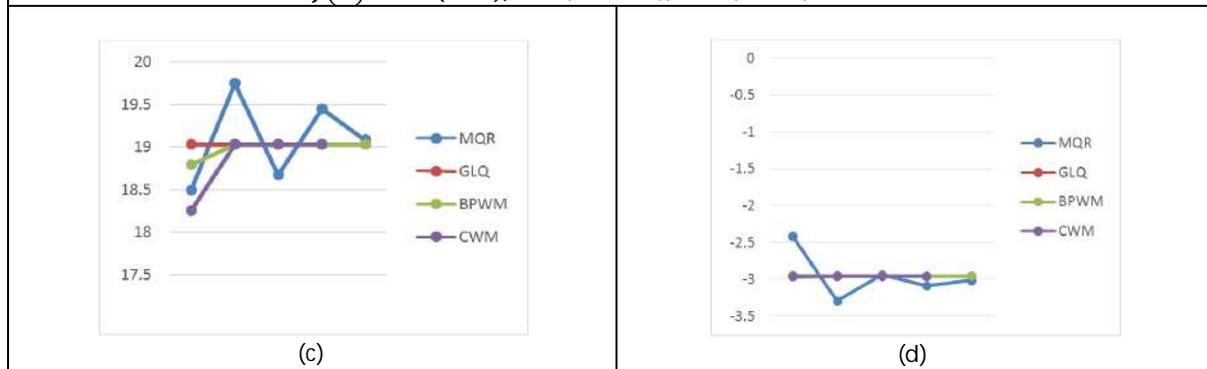$$f(x') = \sin(3\pi x'), h = 1, x = 0.5, , a = 3, n = 2, r = 0.01$$

(c)   (d)

Fig. 2. Comparative results of real part(c) and imaginary part(d) of eqn. (1) with
$$f(x') = x'^{10}, h = 1, x = 0.5, r = 0.01, a = 10, n = 3$$

RESEARCH ARTICLE

Extraction and Evaluation of Antimicrobial Activity from *Basella alba* Leaves

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ABSTRACT

Anthocyanin is a major class of vacuolar pigment which are hydrophilic in nature. It holds an array of desirable attributes as antimicrobial, antioxidant, antidiabetic, anti-inflammatory and anticancer properties. It is most commonly accepted as a natural colorant in food industries. However, the major problem associated with anthocyanin applications are due to their degradative property, their stability challenges during extraction, storage and consumption. The total anthocyanin content was estimated at 32.5µg/g. The free radical scavenging activity was identified by performing DPPH of the extract as 13.3% and the reducing power was determined with varying concentrations from 5 mg/mL, 10mg/mL and 20 mg/mL were 0.113, 0.137 and 0.561 respectively. The aim of this study was to identify efficient solvent for anthocyanin extraction, antibacterial activity and the factors influencing its activity. The functional groups in anthocyanin were identified through FTIR analysis. Encapsulation process is carried out to ensure the stability of anthocyanin using sodium alginate and calcium chloride. The nature of anthocyanin shall get protected through encapsulation techniques to improve their shelf life and its potential character. The extracted anthocyanin pigments were examined at varying pH and temperature for its efficacy and stability. Anthocyanin was more stable at pH 4 and the temperature as 40^{0}C.

Keywords: *Basella alba*, Anthocyanin, Encapsulation, pH and Temperature

INTRODUCTION

Anthocyanins are naturally occurring water soluble plant pigments. They are polyphenols belonging to the group of flavonoids commonly found in plant parts such as fruits, vegetables, flowers, leaves, roots, stems, storage parts and which are accountable for the colour of plant parts (Santos *et al.*, 2013; Patel *et al.*, 2020). The anthocyanin displays several enchanting colour spectra such as red, pink, orange, yellow, purple and blue to facilitate it as potential alternative for colorant in food industry (Jenshi *et al.*, 2011). Around 600 types of anthocyanins were found in nature of which only six of them are found in edible plants, it includes Cyanidin, Malvidin, Delphinidin, Petunidin, Pelargonidin, Peonidin. The stability and colour intensity are influenced by factors such as intensity of light, temperature, pH, metal ions, oxygen, sulfur oxide presence of other pigments together, enzymes, ascorbic acid, sugar and sugar derivatives (Abass, 2015). Due to the ionic properties anthocyanin tend to be stable at acidic pH. In this case the colourization turns into violet or dark blue. The presence of light and temperature more than $60^{0}C$ makes anthocyanin susceptible to degradation. Anthocyanin pigment pose remarkable properties such as anti inflammatory, antioxidant, cardio protective, anti-cancer, anti-microbial, chemo preventive, anti-diabetic, anti-neurodegenerative, anti-obesity properties and vision boosting quality. These properties increased the demand of anthocyanin as a potent natural colouring property and are widely employed in the pharmaceutical industry (Patel *et al.*, 2020; Sasikumar *et al.*, 2020). *Basella alba* or Malabar spinach is a climbing perennial plant belongs to the family *Basellaceae*.

The matured leaves and stem are purple in colour. Ripped dark purple fruits are attached to the stem and it is rich in vitamin A, C, K, fibre, calcium and minerals. The encapsulation was carried out to overcome challenges faced by the pigment against adverse environmental stress to its stability, increase shelf lives and activity (Santos *et al.*, 2013). Mostly polysaccharides such as starch, cyclodextrins, alginates, gum arabic, chitosan, tapioca starch, soy protein isolates and whey proteins are used as food grade encapsulating agents (Patel *et al.*, 2020). The choice of selecting encapsulating agents plays a major role in producing good quality of microspheres (Nur *et al.*, 2014). In the present study, anthocyanin pigment was extracted from *Basella alba* leaves using solvents such as acidified methanol, methylated water and acetone. Identification of suitable solvent along with anthocyanin against the selected pathogens was performed by Kirby-Bauer assay. The anthocyanin content was estimated using spectrophotometer and subjected to further analysis. The major problem associated with anthocyanin as a food colorant is due to its instability nature and difficulties associated with extraction process. The encapsulation was performed using sodium alginate; the pigment stability was studied at various parameters such as temperature and pH. This research will help us to understand the characteristics of anthocyanin from *Basella alba* and their utilization in medicine, food and cosmetic industry, along with its stability and the need of encapsulation process.

MATERIALS AND METHODS

Sample collection

The *Basella alba* plants were grown in the green house at PSG College of Arts and Science College, Coimbatore, Tamil Nadu. Matured leaves of *Basella alba* (Malabar spinach) were collected from plant and the leaves were rinsed thoroughly with running tap water for 10 minutes and washed with tween 20 for about 2 minutes. The leaves were further shade dried to avoid direct sunlight and stored at $-18^{0}C$ for further research.

Extract preparation

About 10 grams of dried *Basella alba* leaves were treated with 10 ml of acidified methanol, acetone and methylated water separately further homogenized using mortar and pestle. The crude samples were filtered using Whatman No 1 filter paper and additional solvent was also added to improve the extraction process. The extracts were centrifuged at 1500 rpm for 10 minutes and the supernatant was collected and maintained at 4°c in dark condition (Reshmi *et al.*, 2012).

Evaluation of anthocyanin content (Patel *et al.*, 2020)

The extracted filtrates were dissolved in buffers of 0.4 M acetic acid sodium acetate buffer with pH 1.0 and 0.1 M hydrochloric acid with potassium chloride buffer of pH 4.5. The anthocyanin content was analysed by UV-spectrophotometer. The total anthocyanin content was calculated using the formula

Total anthocyanin content = $\dfrac{A \times MW \times DF \times V \times 100}{\varepsilon \times L \times W}$

Where;

Absorbance = (A540 - A700) pH1.0 - (A540 - A700) pH 4.5

MW= molecular weight, DF= dilution factor, ε=26,900 molar extinction coefficient in L, V= final volume, W= mass of the sample taken, L= cell path length (1cm)103= converting factor.

Antioxidant assays

Free radical scavenging activity by inhibiting 2,2-diphenyl -1-picrylhydrazyl hydrate (DPPH) radical

Free radical scavenging activity of the extract against DPPH was determined by DPPH Scavenging method. About 1mL of 0.1mm DPPH – Methanol solution was prepared and added accordingly. The samples were thoroughly mixed and it was incubated for 30 minutes at 25℃ and maintained in a dark environment. The absorbance was measured at 514 nm with ascorbic acid serving as positive control and methanol as a blank. The DPPH radical scavenging activity was calculated using the formula,

DPPH-scavenging activity (%) = $1 - \dfrac{\text{(absorbance of the sample – absorbance of blank)}}{\text{Absorbance of control}} \times 100$

Determination of Reducing power

The crude extracts at concentrations of 5mg/ml, 10mg/ml and 20mg/ml was mixed with 1ml of phosphate buffer, 1 mL of 1% potassium ferricyanide of pH 6.6 and the mixture was incubated for 30 minutes at 50℃. Later 1mL of 5% (Trichloroacetic acid) was added to the mixture and centrifuged at 1500 rpm for 10 min. Finally,1 mL of top layer solution is mixed with 1ml of distilled water and 100 μl of 0.1 % ferric chloride solution and absorbance at 700 nm was measured.

FTIR Analysis of Anthocyanin extract (Kabir *et al.*, 2019)

The chemical nature of anthocyanin crude extract was analysed to identify functional group using vibrations in chemical functional group through Fourier transform infrared spectroscopy. FTIR analysis was done through Shimadzu 8400S Fourier transform infrared spectrometer in the mid-IR region of 500 to 4000 cm-1. The acetone extract was analysed through FTIR.

The effect of temperature

The effect of temperature on pigment stability was examined at 30°C, 40°C and 50°C. The samples were kept in a screw cap tube covered with aluminium foil sealed with parafilm, maintained at different temperature and their colour change was observed in triplicates after 72 hours. The absorbance was measured at 540 nm using UV-spectrophotometer using distilled water as blank.

The effect of pH

The effect of pH on pigment stability was examined in the samples with pH 1, 5 and 8. The samples inside screw cap tube covered with aluminium foil sealed with parafilm and pH was adjusted to 1.0, 4.0 and 8.0 and their colour change was observed and samples were taken in triplicates after 72 hours and the absorbance was measured at 540 nm by UV-spectrophotometer using water as blank.

Encapsulation of anthocyanin

The anthocyanin extracts were air dried in dark condition and the dried samples were treated with phosphate buffered saline of pH 7.4 and centrifuged at 1500 rpm for 5 minutes to remove debris and the supernatant was used for encapsulation process. The gelling agent used for encapsulation was 5% sodium alginate with the extract and

dropped in 0.8 M calcium chloride solution; the beads formed were left for 1-2 hours. They are separated by filtration and the beads are washed with distilled water and stored.

RESULTS

Sample Extraction
In figure 1 matured *Basella alba* leaves were collected, washed and extracted using the solvents such as acetone, acidified methanol, methylated water by conventional methods to extract bioactive compounds. The extracts were stored till it was used for further analysis.

Total anthocyanin content
The crude extracts were diluted separately with 0.4 M sodium acetate and acetic acid buffer of pH 1.0 and 0.1 M Potassium chloride with hydrochloric acid buffer of pH 4.5 and the extracts were read under UV-Vis spectrophotometer and the absorbance was read at 520 and 700 nm respectively. The total anthocyanin content of extracted sample with acetone was found to be 16.8 mg/L, 32.5mg/L from sample treated with acidified methanol, 19.8mg/L from sample treated with methylated water and the results were presented in Table 1.

Antioxidant analysis
DPPH radical scavenging activity
DPPH is a free radical compound which is used to test the free radical scavenging activity of various plant extracts under *invitro* conditions. The pigment has significantly inhibited the radicals produced by DPPH which resulted in natural decolouration of the sample. Antioxidant activity of the sample extracted from acidified methanol at 1mg/ml the scavenging effect was found to be 13.3%. The reduction of pigmentation is also due to the presence of phenolic compounds which serves as natural antioxidants.

Determination of reducing power
The reducing power of the pigment serves as an indicator for antioxidant activity. The presence of antioxidants in the extract reduces Ferric ion to Ferrous ion which results in color change. In the present study upon increasing the concentration of the extracts the increase in absorbance shows good reducing power. The reducing power of the extracts at varying concentrations at 5 mg/ml, 10mg/ml and 20mg/ml were found to be 0.113, 0.137 and 0.561, respectively. The result indicated that the reducing power of *Basella alba* leaves is due to the presence of phenolic compounds (Reshmi *et al.*, 2012).

FTIR analysis of anthocyanin
The acetone extract was observed with absorbance peak at wave number 3394.42 cm^{-1} corresponding to the stretch in peak indicating the presence of hydroxyl group. The absorbance was recorded at 2978.09 cm^{-1} with a narrow peak indicating the presence of C-H group in sample. In the fingerprint region the absorbance at 1651.07cm^{-1} and 1697.36 cm^{-1} narrow peak indicates the presence of C=C group and absorbance at 671.23cm^{-1} indicates aromatic C-H ring, represented in Figure 2.

Encapsulation of anthocyanin
The extracts were dissolved with sodium alginate and the beads were dropped in calcium chloride solution. The rigid beads were formed in sample extracted from acetone and methylated water and the sample were washed with phosphate buffered saline. Whereas in acidified methanol the beads were not formed was represented in figure 3.In the current study natural polymer alginate is used for encapsulating anthocyanin. The results indicate encapsulation is significant, further studies are necessary to make the encapsulation better and to check its encapsulation efficiency and morphological identifications. Anthocyanins are susceptible to degradation so in order to prevent anthocyanin from degradation encapsulation is carried out to facilitate the light and heat liable molecules to maintain their stability and its bioavailability and biocompatibility. The encapsulated beads from the extract did not result in a

spherical geometry. However, when the sample was dissolved in phosphate buffered saline of pH 7.4, the rigid beads were not formed and also the extracts showed some color change from pink to brown due to degradation of the anthocyanin (Santos *et al.*, 2013).

Anthocyanin Stability Studies

The extracted anthocyanin stability was analyzed at various physiochemical factors such as temperature and pH. pH is the major factor significantly influenced the intensity and stability of anthocyanin pigment. Anthocyanins are more stable in acidic condition than in alkaline conditions in figure 4 and 5. The pigment tends to change their colour in the solution in response to the pH of the solution or the external environment. Anthocyanins tend to degrade easily due to the influence of external factors and the degradation can be identified by color change , they retain the color at pH less than 3 by retaining the flavylium cation in the β ring and the hydrolysis of the glycosidic bond results in structural modification and thereby the color destabilization occurs and to determine the stability, Anthocyanin extracts are dissolved in 0.4M sodium acetate with acetic acid buffer at pH 3.0 and the pH was adjusted to 1.0 and the samples was kept in various temperatures 30°C and 40° C and 50°C the stability is determined by reading the absorbance at 540 nm and 700 nm. The samples were maintained in dark environment the skeletal modifications take place in anthocyanin upon increasing pH and temperature resulted in visible color change and the absorbance reading from the UV-Spectrophotometer. Xuan *et al.,* 2019, reported while increase in temperature gradually the concentration of anthocyanin also decreased moderately.

From the data given in table 3 and figure 6A and 6B it shows that at 40^0C the extract was found to be stable and the pigment had degraded upon increase in temperature. The pigment stability was also influenced by increasing pH. Due to increasing pH the flavylium cation switches its position and gets transformed into quinoidal base which is quite unstable and which result in the formation of colorless compound. The result suggested that the sample maintained at pH 1.0 was found to be quite stable where it retained its color upon increasing the pH there showed decrease in color intensity, in figure 4 and 5. Nowadays we are fond of sun-screen lotions or creams to get ourselves protected from harmful UV-radiations. The cosmetics had predominately tapped its customers with chemical-based lotions. It may lead to certain skin related diseases in near future. In order to overcome that anthocyanin serves as a strong UV-protecting agent and since it is a natural coloring agent, it can be used in cosmetic industries to reduce the levels of toxicity and can also prevent skin aging. From the future perspective these anthocyanin based sugar free candies and administered to diabetic patients. Detailed investigation has to be done about anthocyanins and there are still to be known during encapsulation, stability and formulations, etc to be discovered in near future for the benefit of consumers.

CONCLUSION

Although there are many attractive food colors which are existing, due to the level of toxicity and chemical composition it is better to use some healthy and safe natural color producing pigments like anthocyanins which has color producing property and also it aids in curing many health issues. In this study, Anthocyanin extract was extracted using methanol, acidified methanol and acetone from *Basella alba* leaves and the content of the anthocyanin was also estimated. The methanol extract is better than other solvent based on their anthocyanin concentration, FTIR analysis and colour visibility. The anthocyanin extract was used for antibacterial studies. From the above study it can be concluded that anthocyanin extract of *Basella alba* leaves were moderately resistant to bacteria such as *E. coli, S. aureus* and not resistant to *P. aeruginosa*. The anthocyanin extract was encapsulated using sodium alginate and calcium chloride. The effect of pH and temperature on the stability of pigment was studied. It was clear that anthocyanin was more stable at acidic pH 5, low temperature and this property makes *Basella alba* pigment as good alternate food colorant. The study revealed that the higher pH and temperature declines the stability of anthocyanin molecule. The present work of anthocyanin extract from *Basella alba* leaves will increase the application of plant in the medicinal, food and cosmetic industry to utilize it as antioxidant, antidiabetic, nutraceutical, food colorant especially in chocolates and beverages and UV protection sunscreen and skin cancer, so on.

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Table 1 Solvent extraction of anthocyanin

S. No	Types of Solvent	Total anthocyanin content (mg/L)
1	Acetone	16.8 mg
2	Acidified methanol	32.5 mg
3	Methylated water	19.8 mg

Table 2 Characteristic IR absorption frequencies of functional group present in sample

S. No	Characteristic Absorption(cm^{-1})	Functional bond	Functional group
1	3394	O–H	Alcohol
2	2978	CH3	Methyl
3	1697	C=C	Alkane
4	641	C-H	Phenyl

Table 3 Effect of temperature and pH on stability of anthocyanin

S. No	Temperature (°C)	Absorbance (nm)	pH	Absorbance (nm)
1	30	0.301	1.0	0.530
2	40	0.630	4.0	0.679
3	50	0.525	8.0	0.320

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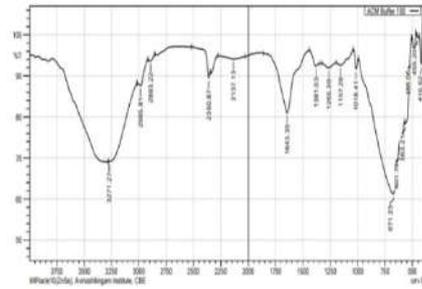**Figure 1:** *Basella alba* **leaves**

Figure 2 FTIR analysis of acetone extract

Figure 3 Encapsulation of Anthocyanin

Fig 4 Effect of temperature
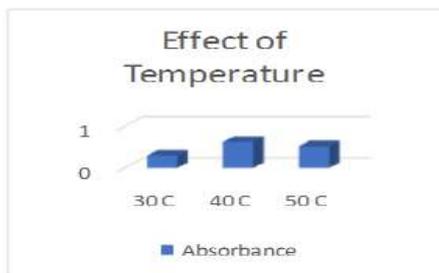

Fig 5 Effect of pH

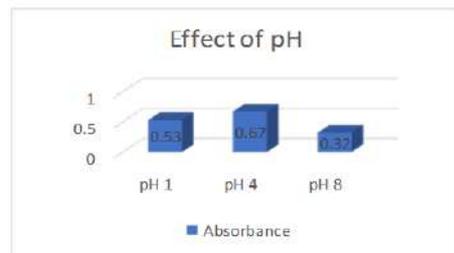**Fig 6A Effect of temperature**

Fig 6B Effect of pH

RESEARCH ARTICLE

Bipolar Valued Multi I-Fuzzy Subrings of A Ring

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ABSTRACT

This paper is developed by the given references. Here bipolar valued multi I-fuzzy subring of a ring is defined and introduced and their properties are stated and proved.

Keywords: Interval valued fuzzy subset, bipolar valued fuzzy subset, bipolar valued multi fuzzy subset, bipolar valued multi I-fuzzy subset, bipolar valued multi fuzzy subring, bipolar valued multi I-fuzzy subring, union and intersection.

INTRODUCTION

In 1965, Zadeh [16] introduced the notion of a fuzzy subset of a set, fuzzy sets are a kind of useful mathematical structure to represent a collection of objects whose boundary is vague. Since then it has become a vigorous area of research in different domains, there have been a number of generalizations of this fundamental concept such as intuitionistic fuzzy sets, interval-valued fuzzy sets, vague sets, soft sets etc. Fuzzy group was introduced by Azriel Rosenfeld [4]. After that Fuzzy groups Redefined was introduced by Anthony.J.M and H. Sherwood[2] and Q-fuzzy concepts were applied in nearring by Chitra.V and K.Arjunan[6]. Multi fuzzy sets was introduced by Sabu Sebastian, T.V.Ramakrishnan[12].Lee [9] introduced the notion of bipolar valued fuzzy sets. Bipolar valued fuzzy sets are an extension of fuzzy sets whose membership degree range is enlarged from the interval [0, 1] to [−1, 1]. Bipolar valued fuzzy sets and intuitionistic fuzzy sets look similar each other. However, they are different each other [9, 10].After that bipolar valued fuzzy subgroups of a group was introduced by Anitha.M.S *et al* [1] and Arsham Borum and Saeid[3] introduced the bipolar valued fuzzy BCK/BCI-algebras. Properties of Bipolar interval valued fuzzy

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subgroups of a group were introduced by Balasubramanian. A et al [5]. Bipolar fuzzy subalgebras and bipolar fuzzy ideals of BCK/BCI-algebras were introduced by Kyoung Ja Lee[8]. A study on interval valued fuzzy subsemirings of a semiring was introduced by Murugalingam.K and K.Arjunan[11] and Shanmugapriya.M.M & K.Arjunan[13] introduced the (Q, L)-Fuzzy subnearrings of a nearing."A study on interval valued fuzzy, anti fuzzy, intuitionistic fuzzy subrings of a ring" by Somasundra Moorthy.M.G[14], the thesis was useful for writing this paper. In this paper, the concept of bipolar valued multi I-fuzzy subring of a ring is introduced and established some results.

Preliminaries
Definition 1.1
[16]Let X be any nonempty set. A mapping $[M] : X \rightarrow D[0, 1]$ is called an interval valued fuzzy subset (briefly, I-FS) of X, where $D[0,1]$ denotes the family of all closed subintervals of $[0,1]$ and $[M](x) = [M^-(x), M^+(x)]$, for all x in X, where M^- and M^+ are fuzzy subsets of X such that $M^-(x) \leq M^+(x)$, for all x in X. Thus $[M](x)$ is an interval (a closed subset of $[0,1]$) and not a number from the interval $[0,1]$ as in the case of fuzzy subset. Note that $[0] = [0, 0]$ and $[1] = [1, 1]$.

Definition 1.2
[9] Abipolar valued fuzzy set (BVFS) D in X is defined as an object of the form $D=\{ < x, D^+(x), D^-(x) >/ x \in X\}$, where $D^+: X \rightarrow [0,1]$ and $D^-: X \rightarrow [-1, 0]$.The positive membership degree $D^+(x)$ denotes the satisfaction degree of an element x to the property corresponding to a bipolar valued fuzzy set D and the negative membership degree $D^-(x)$ denotes the satisfaction degree of an element x to some implicit counter-property corresponding to a bipolar valued fuzzy set D.

Example 1.3
A= { <x,0.5,–0.6>,<y,0.3,–0.9>, <z,0.8,–0.4>} is aBVFSofX= { u, v, w }.

Definition 1.4
[15] A bipolar valued multi fuzzy set (BVMFS) A in X is defined as an object of the form A = { ⟨x, $A_1^+(x), A_2^+(x),…, A_n^+(x), A_1^-(x), A_2^-(x), …, A_n^-(x)$ ⟩/ x∈X}, where $A_i^+: X \rightarrow [0, 1]$ and $A_i^-: X \rightarrow [-1, 0]$, for all i. The positive membership degrees $A_i^+(x)$ denote the satisfaction degree of an element x to the property corresponding to a bipolar valued multi fuzzy set A and the negative membership degrees $A_i^-(x)$ denote the satisfaction degree of an element x to some implicit counter-property corresponding to a bipolar valued multi fuzzy set A.

Example 1.5
C = { <u, 0.3, 0.7, 0.4, –0.9, –0.5, –0.4>, <v, 0.6, 0.4, 0.8, –0.5, –0.7, –0.2>, <w, 0.3, 0.9, 0.7, –0.2, –0.4, –0.6>} is a BVMFS of X= {u, v, w }.

Definition 1.6
A bipolar valued multi I-fuzzy set (BVMI-FS) A in X is defined as an object of the form $[A] = \{ ⟨x, [A]_1^+(x),[A]_2^+(x),…, [A]_n^+(x),[A]_1^-(x), [A]_2^-(x), …, [A]_n^-(x) ⟩/ x \in X\}$, where $[A]_i^+: X \rightarrow D[0, 1]$ and $[A]_i^-: X \rightarrow D[-1, 0]$, for all i, where $D[0,1]$ denotes the family of all closed subintervals of $[0,1]$ and $D[-1, 0]$ denotes the family of all closed subintervals of $[-1, 0]$. The positive membership degrees interval $[A]_i^+(x)$ denote the satisfaction degree interval of an element x to the property corresponding to a bipolar valued multi I-fuzzy set [A] and the negative membership degrees interval $[A]_i^-(x)$ denote the satisfaction degree interval of an element x to some implicit counter-property corresponding to a bipolar valued multi I-fuzzy set [A].Note that $[0] = [0, 0]$, $[1] = [1, 1]$and $[-1] = [-1, -1]$.

Example 1.7
A = { <x, [0.4, 0.5], [0.6, 0.7], [0.1, 0.3], [–0.8, –0.7], [–0.7, –0.5], [–0.5, –0.2]>, <y, [0.7, 0.8], [0.4, 0.5], [0.6, 0.9], [–0.5, –0.3], [–0.7, –0.5], [–1, –0.8]>, <z, [0.3, 0.6], [0.7, 0.9], [0.7, 1], [–0.8, –0.4], [–0.9, –0.5], [–0.6, –0.1]>} is a BVMI-FS of X= {x, y, z}.

Definition 1.8

Let $(R, +, \cdot)$ be a ring. A BVMFSB of R is said to be a bipolar valued multi fuzzy subring of R (BVMFSR) if the following conditions are satisfied, for all i,

(i) $B_i{}^+(u–v) \geq \min\{ B_i{}^+(u), B_i{}^+(v) \}$

(ii) $B_i{}^+(uv) \geq \min\{ B_i{}^+(u), B_i{}^+(v) \}$

(iii) $B_i{}^-(u–v) \leq \max\{ B_i{}^-(u), B_i{}^-(v) \}$

(iv) $B_i{}^-(uv) \leq \max\{ B_i{}^-(u), B_i{}^-(v) \}, \forall\ u, v \in R.$

Definition 1.9

Let $(R, +, \cdot)$ be a ring. A BVMI-FS[B] of R is said to be a bipolar valued multi I-fuzzysubring of R (BVMI-FSR) if the following conditions are satisfied, for all i,

(i) $[B]_i{}^+(u–v) \geq rmin\{[B]_i{}^+(u), [B]_i{}^+(v)\}$

(ii) $[B]_i{}^+(uv) \geq rmin\{ [B]_i{}^+(u), [B]_i{}^+(v) \}$

(iii) $[B]_i{}^-(u–v) \leq rmax\{[B]_i{}^-(u), [B]_i{}^-(v)\}$

(iv) $[B]_i{}^-(uv) \leq rmax\{ [B]_i{}^-(u), [B]_i{}^-(v) \}, \forall\ u, v \in R$, where rmin $\{ [a, b], [c, d] \} = [\min \{ a, c\}, \min \{ b, d\}]$ and rmax $\{ [a, b], [c, d] \} = [\max \{ a, c\}, \max \{ b, d\}]$.

Example 1.10

Let $R = Z_3 = \{ 0,1, 2\}$ be a ring with respect to addition modulo 3 and multiplication modulo 3.Then $[A] = \{ <0,[0.72, 0.81],[0.91, 1],[0.52, 0.63], [–0.91, –0.81], [–1,–0.91],[– 0.81, –0.72>,<1,[0.51,0.61], [0.71, 0.81], [0.31, 0.41], [–0.71, –0.61], [– 0.61, –0.51>,<2,[0.51,0.61], [0.71, 0.81], [0.31, 0.41], [–0.71,–0.61],[–0.61, –0.51], [–0.51, –0.41]>\}$ is a BVMI-FSR of R.

Definition 1.11

Let $[A] = \langle [A]_1{}^+, [A]_2{}^+, \ldots, [A]_n{}^+, [A]_1{}^-, [A]_2{}^-, \ldots, [A]_n{}^- \rangle$ and $[B] = \langle [B]_1{}^+, [B]_2{}^+, \ldots, [B]_n{}^+, [B]_1{}^-, [B]_2{}^-, \ldots, [B]_n{}^- \rangle$ be two bipolar valued multi I-fuzzy subsets with degree n of a set X. We define the following relations and operations:

(i) $[A] \subset [B]$ if and only if for all i, $[A]_i{}^+(u) \leq [B]_i{}^+(u)$ and $[A]_i{}^-(u) \geq [B]_i{}^-(u), \forall\ u \in X.$

(ii) $[A] = [B]$ if and only if for all i, $[A]_i{}^+(u) = [B]_i{}^+(u)$ and $[A]_i{}^-(u) = [B]_i{}^-(u), \forall\ u \in X.$

(iii) $[A] \cap [B] = \{ \langle u, rmin ([A]_1{}^+(u), [B]_1{}^+(u)), rmin ([A]_2{}^+(u), [B]_2{}^+(u)), \ldots, rmin ([A]_n{}^+(u), [B]_n{}^+(u)), rmax ([A]_1{}^-(u), [B]_1{}^-(u)), rmax ([A]_2{}^-(u), [B]_2{}^-(u)), \ldots, rmax ([A]_n{}^-(u), [B]_n{}^-(u)) \rangle / u \in X \}.$

(iv) $[A] \cup [B] = \{ \langle u, rmax ([A]_1{}^+(u), [B]_1{}^+(u)), rmax ([A]_2{}^+(u), [B]_2{}^+(u)), \ldots, rmax ([A]_n{}^+(u), [B]_n{}^+(u)), rmin ([A]_1{}^-(u), [B]_1{}^-(u)), rmin ([A]_2{}^-(u), [B]_2{}^-(u)), \ldots, rmin ([A]_n{}^-(u), [B]_n{}^-(u)) \rangle / u \in X \}.$

Properties

Theorem 2.1.

If $[B] = \langle [B]_1{}^+, [B]_2{}^+, \ldots, [B]_n{}^+, [B]_1{}^-, [B]_2{}^-, \ldots, [B]_n{}^- \rangle$ is a BVMI-FSR with degree n of a ring$(R, +, \cdot)$, then for all i, i = 1, 2, …, n, $[B]_i{}^+(–u) = [B]_i{}^+(u), [B]_i{}^-(–u) = [B]_i{}^-(u), [B]_i{}^+(u) \leq [B]_i{}^+(0)$ and $[B]_i{}^-(u) \geq [B]_i{}^-(0), \forall u \in R$, where 0 is the identity element of $(R, +)$.

Proof.

Let $u \in R$ and 0 be identity element of $(R, +)$. For all i, $[B]_i{}^+(u) = [B]_i{}^+(–(–u)) \geq [B]_i{}^+(–u) \geq [B]_i{}^+(u)$.Thus$[B]_i{}^+(u) = [B]_i{}^+(–u), \forall u \in R$. And for all i, $[B]_i{}^-(u) = [B]_i{}^-(–(–u)) \leq [B]_i{}^-(–u) \leq [B]_i{}^-(u)$.Thus$[B]_i{}^-(–u)=[B]_i{}^-(u), \forall u \in R$. For all i, $[B]_i{}^+(0) = [B]_i{}^+(u–u) \geq rmin\{ [B]_i{}^+(u), [B]_i{}^+(u)\} = [B]_i{}^+(u)$.Thus$[B]_i{}^+(0) \geq [B]_i{}^+(u), \forall u \in N$. For all i, $[B]_i{}^-(0)= [B]_i{}^-(u–u) \leq rmax\{[B]_i{}^-(u), [B]_i{}^-(u) \} = [B]_i{}^-(u)$.Thus$[B]_i{}^-(0) \leq [B]_i{}^-(u), \forall u \in R$.

Theorem 2.2

If $[B] = \langle [B]_1{}^+, [B]_2{}^+, \ldots, [B]_n{}^+, [B]_1{}^-, [B]_2{}^-, \ldots, [B]_n{}^- \rangle$ is a BVMI-FSR with degree n of a ring$(R, +, \cdot)$, then S = $\{ u \in R \mid [B]_i{}^+(u) = [1]$ and $[B]_i{}^-(u) = [–1]$, for all i $\}$ is either empty or is a subring of R.

Proof

If no element satisfies this condition, then S is empty.

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If u, v∈S, then $[B]_i{}^+(u-v) \geq rmin$ {$[B]_i{}^+(u)$, $[B]_i{}^+(v)$}=rmin{[1], [1]}=[1]. Thus$[B]_i{}^+(u-v)$ =[1], for all iand u, v∈S. And$[B]_i{}^-(u-v) \leq rmax$ {$[B]_i{}^-(u)$, $[B]_i{}^-(v)$}= rmax{[–1], [–1]}= [–1]. Thus$[B]_i{}^-(u-v)$ = [–1], for all iand u, v∈S. Therefore u–v∈S. Also $[B]_i{}^+(uv) \geq rmin$ { $[B]_i{}^+(u)$, $[B]_i{}^+(v)$}= rmin{ [1], [1] }= [1].Thus$[B]_i{}^+(uv)$ = [1], for all i and u, v∈S.And$[B]_i{}^-(uv) \leq rmax$ { $[B]_i{}^-(u)$, $[B]_i{}^-(v)$ } = rmax {[–1], [–1] }= [–1].Thus$[B]_i{}^-(uv)$ = [–1], for all iand u, v∈S. Therefore uv∈S. Hence S is a subring of R.

Theorem 2.3
If $[A] = \langle [A]_1{}^+, [A]_2{}^+, ..., [A]_n{}^+, [A]_1{}^-, [A]_2{}^-, ..., [A]_n{}^- \rangle$ is a BVMI-FSR with degree no f a ring(R, +, **·**), then S = { u∈R | $[A]_i{}^+(u) = [A]_i{}^+(0)$ and $[A]_i{}^-(u) = [A]_i{}^-(0)$, for all i } is a subring of R, where 0 is the identity element of (R, +).

Proof
Clearly S is a non-empty set, since 0∈S. By Theorem 2.1,for every i, $[A]_i{}^+(-u) = [A]_i{}^+(u) = [A]_i{}^+(0)$ and $[A]_i{}^-(-u) = [A]_i{}^-(u) = [A]_i{}^-(0)$, ∀u∈R. Therefore –u∈S, ∀u∈S. Let u, v∈S. Then $[A]_i{}^+(u-v) \geq rmin$ { $[A]_i{}^+(u)$, $[A]_i{}^+(v)$ } = rmin{ $[A]_i{}^+(0)$, $[A]_i{}^+(0)$ }= $[A]_i{}^+(0)$, for all i. Thus $[A]_i{}^+(0) = [A]_i{}^+(u-v)$, for all i and u, v∈S. Also$[A]_i{}^-(u-v) \leq rmax$ {$[A]_i{}^-(u)$, $[A]_i{}^-(v)$}= rmax{ $[A]_i{}^-(0)$, $[A]_i{}^-(0)$ }= $[A]_i{}^-(0)$, for all i. Thus$[A]_i{}^-(0) = [A]_i{}^-(u-v)$, for all i and u, v∈S. Therefore u–v∈S.Let u, v∈S. Then $[A]_i{}^+(uv) \geq rmin$ { $[A]_i{}^+(u)$, $[A]_i{}^+(v)$ }= rmin{ $[A]_i{}^+(0)$, $[A]_i{}^+(0)$ }= $[A]_i{}^+(0)$, for all i. Thus $[A]_i{}^+(0) = [A]_i{}^+(uv)$, for all i and u, v∈S.Also$[A]_i{}^-(uv) \leq rmax$ { $[A]_i{}^-(u)$, $[A]_i{}^-(v)$ }= rmax{ $[A]_i{}^-(0)$, $[A]_i{}^-(0)$ }= $[A]_i{}^-(0)$,for all i. Thus$[A]_i{}^-(0) = [A]_i{}^-(uv)$, for all i and u, v∈S. Therefore uv∈S. Hence S is a subring of R.

Theorem 2.4
Let $[P] = \langle [P]_1{}^+, [P]_2{}^+, ..., [P]_n{}^+, [P]_1{}^-, [P]_2{}^-, ..., [P]_n{}^- \rangle$ be a BVMI-FSR with degree n of a ring(R, +, **·**).(i) For all i, if $[P]_i{}^+(u-v) = [1]$, then $[P]_i{}^+(u) = [P]_i{}^+(v)$,∀ u, v∈R.(ii) For all i, if $[P]_i{}^-(u-v) = [-1]$, then $[P]_i{}^-(u) = [P]_i{}^-(v)$,∀ u, v∈R.

Proof
Let u, v∈R. (i) For all i, $[P]_i{}^+(u) = [P]_i{}^+(u-v+v) \geq rmin$ { $[P]_i{}^+(u-v)$, $[P]_i{}^+(v)$ }= rmin { [1], $[P]_i{}^+(v)$ } = $[P]_i{}^+(v)$ =$[P]_i{}^+(-v)$
= $[P]_i{}^+(-u+u-v) \geq rmin$ { $[P]_i{}^+(-u)$, $[P]_i{}^+(u-v)$ } = rmin { $[P]_i{}^+(u)$, [1] } =$[P]_i{}^+(u)$. Therefore $[P]_i{}^+(u) = [P]_i{}^+(v)$,∀ u, v∈R.
(i) For all i, $[P]_i{}^-(u) = [P]_i{}^-(u-v+v) \leq rmax$ { $[P]_i{}^-(u-v)$, $[P]_i{}^-(v)$ }= rmax { [–1], $[P]_i{}^-(v)$ }= $[P]_i{}^-(v)$ =$[P]_i{}^-(-v)$
= $[P]_i{}^-(-u+u-v) \leq rmax$ { $[P]_i{}^-(-u)$, $[P]_i{}^-(u-v)$ } = rmax{ $[P]_i{}^-(u)$, [–1] } =$[P]_i{}^-(u)$. Therefore $[P]_i{}^-(u) = [P]_i{}^-(v)$,∀ u, v∈R.

Theorem 2.5
Let $[A] = \langle [A]_1{}^+, [A]_2{}^+, ..., [A]_n{}^+, [A]_1{}^-, [A]_2{}^-, ..., [A]_n{}^- \rangle$ is a BVMI-FSR with degree n of a ring(R, +, **·**).(i) For all i, if $[A]_i{}^+(u-v) = [0]$, then either $[A]_i{}^+(u) = [0]$ or $[A]_i{}^+(v) = [0]$,∀ u, v∈R.
(ii)For all i, if $[A]_i{}^+(uv) = [0]$, then either $[A]_i{}^+(u) = [0]$ or $[A]_i{}^+(v) = [0]$,∀ u, v∈R.
(iii) For all i, if $[A]_i{}^-(u-v) = [0]$, then either $[A]_i{}^-(u) = [0]$ or $[A]_i{}^-(v) = [0]$,∀ u, v∈R.
(iv) For all i, if $[A]_i{}^-(uv) = [0]$, then either $[A]_i{}^-(u) = [0]$ or $[A]_i{}^-(v) = [0]$,∀ u, v∈R.

Proof
Let u, v∈R.(i) For all i, by the definition $[A]_i{}^+(u-v) \geq rmin$ { $[A]_i{}^+(u)$, $[A]_i{}^+(v)$ }⇒[0]≥rmin { $[A]_i{}^+(u)$, $[A]_i{}^+(v)$ }.Therefore either $[A]_i{}^+(u) = [0]$ or $[A]_i{}^+(v) = [0]$,∀ u, v∈R.(ii) For all i, by the definition $[A]_i{}^+(uv) \geq rmin$ { $[A]_i{}^+(u)$, $[A]_i{}^+(v)$ }⇒[0]≥rmin { $[A]_i{}^+(u)$, $[A]_i{}^+(v)$ }. Therefore either $[A]_i{}^+(u) = [0]$ or $[A]_i{}^+(v) = [0]$,∀ u, v∈R. (iii)For all i, by the definition $[A]_i{}^-(u-v) \leq rmax$ {$[A]_i{}^-(u)$, $[A]_i{}^-(v)$ }⇒[0] ≤ rmax {$[A]_i{}^-(u)$, $[A]_i{}^-(v)$}.Therefore either $[A]_i{}^-(u) =[0]$ or $[A]_i{}^-(v)= [0]$,∀ u, v∈R.(iv)For all i, by the definition $[A]_i{}^-(uv) \leq rmax$ {$[A]_i{}^-(u)$, $[A]_i{}^-(v)$}⇒[0] ≤ rmax {$[A]_i{}^-(u)$, $[A]_i{}^-(v)$}. Therefore either $[A]_i{}^-(u) = [0]$ or $[A]_i{}^-(v) = [0]$,∀ u, v∈R.

Theorem 2.6
Let $[C] = \langle [C]_1{}^+, [C]_2{}^+, ..., [C]_n{}^+, [C]_1{}^-, [C]_2{}^-, ..., [C]_n{}^- \rangle$ be a BVMI-FSRwith degree n of a ring(R, +, **·**).(i) For all i, if $[C]_i{}^+(u-v) = [C]_i{}^+(0)$, then $[C]_i{}^+(u) = [C]_i{}^+(v)$,∀ u, v∈R. (ii) For all i, if $[C]_i{}^-(u-v) = [C]_i{}^-(0)$, then $[C]_i{}^-(u) = [C]_i{}^-(v)$,∀ u, v∈R, where 0 is the identity element of (R, +).

Proof

Let u, v∈R. (i) For all i, $[C]_i{}^+(u)$ = $[C]_i{}^+(u–v+v)$≥rmin { $[C]_i{}^+(u–v)$, $[C]_i{}^+(v)$ }= rmin { $[C]_i{}^+(0)$, $[C]_i{}^+(v)$ } = $[C]_i{}^+(v)$ =$[C]_i{}^+(–v)$ = $[C]_i{}^+(–u+u–v)$≥rmin { $[C]_i{}^+(–u)$, $[C]_i{}^+(u–v)$ }= rmin {$[C]_i{}^+(u)$, $[C]_i{}^+(0)$ } =$[C]_i{}^+(u)$. Therefore $[C]_i{}^+(u)$ = $[C]_i{}^+(v)$,∀ u, v∈R.
(ii) For all i, $[C]_i{}^-(u)$ = $[C]_i{}^-(u–v+v)$≤rmax { $[C]_i{}^-(u–v)$, $[C]_i{}^-(v)$ }= rmax{$[C]_i{}^-(0)$, $[C]_i{}^-(v)$ } = $[C]_i{}^-(v)$ =$[C]_i{}^-(–v)$ = $[C]_i{}^-(–u+u–v)$≤rmax { $[C]_i{}^-(–u)$, $[C]_i{}^-(u–v)$ } = rmax {$[C]_i{}^-(u)$, $[C]_i{}^-(0)$ } =$[C]_i{}^-(u)$. Therefore $[C]_i{}^-(u)$ = $[C]_i{}^-(v)$,∀ u, v∈R.

Theorem 2.7

Let $[B]$ = ⟨$[B]_1{}^+$, $[B]_2{}^+$, …, $[B]_n{}^+$, $[B]_1{}^-$, $[B]_2{}^-$, …, $[B]_n{}^-$⟩ be a BVMI-FSRwith degree n of a ring (R, +, **·**). (i) For all i, if $[B]_i{}^+(u)$ ≠$[B]_i{}^+(v)$, then $[B]_i{}^+(u+v)$ = rmin{ $[B]_i{}^+(u)$, $[B]_i{}^+(v)$ },∀ u, v∈R. (ii) For all i, if $[B]_i{}^-(u)$ ≠$[B]_i{}^-(v)$, then $[B]_i{}^-(u+v)$ = rmax{ $[B]_i{}^-(u)$, $[B]_i{}^-(v)$ }, ∀ u, v∈R.

Proof

Let u, v∈R. (i) For all i, assume that $[B]_i{}^+(u)$ >$[B]_i{}^+(v)$,∀ u, v∈R. Then $[B]_i{}^+(v)$ = $[B]_i{}^+(–u+u+v)$ ≥rmin { $[B]_i{}^+(–u)$, $[B]_i{}^+(u+v)$ } ≥rmin { $[B]_i{}^+(u)$, $[B]_i{}^+(u+v)$ }>rmin { $[B]_i{}^+(v)$, $[B]_i{}^+(u+v)$ = $[B]_i{}^+(v)$ which is contradiction. Therefore $[B]_i{}^+(v)$ = rmin { $[B]_i{}^+(u)$, $[B]_i{}^+(u+v)$ } = $[B]_i{}^+(u+v)$. Hence $[B]_i{}^+(u+v)$ = $[B]_i{}^+(v)$ = rmin { $[B]_i{}^+(u)$, $[B]_i{}^+(v)$ }.
(ii) For all i, assume that $[B]_i{}^-(u)$ <$[B]_i{}^-(v)$, ∀ u, v∈R. Then $[B]_i{}^-(v)$ = $[B]_i{}^-(–u+u+v)$ ≤rmax{ $[B]_i{}^-(–u)$, $[B]_i{}^-(u+v)$ } ≤rmax { $[B]_i{}^-(u)$, $[B]_i{}^-(u+v)$ }< max { $[B]_i{}^-(v)$, $[B]_i{}^-(u+v)$ = $[B]_i{}^-(v)$ which is contradiction. Therefore $[B]_i{}^-(v)$ = rmax { $[B]_i{}^-(u)$, $[B]_i{}^-(u+v)$ } = $[B]_i{}^-(u+v)$. Hence $[B]_i{}^-(u+v)$ = $[B]_i{}^-(v)$ = rmax { $[B]_i{}^-(u)$, $[B]_i{}^-(v)$ }.

Theorem 2.8.

If$[B]$ = ⟨$[B]_1{}^+$, $[B]_2{}^+$, …, $[B]_n{}^+$, $[B]_1{}^-$, $[B]_2{}^-$, …, $[B]_n{}^-$⟩and $[C]$ = ⟨$[C]_1{}^+$, $[C]_2{}^+$, …, $[C]_n{}^+$, $[C]_1{}^-$, $[C]_2{}^-$, …, $[C]_n{}^-$⟩ are two BVMI-FSRs with degree n of a ring (R, +, ·), then their intersection $[B]\cap[C]$ is a BVMI-FSR of R.

Proof.

Let $[D]$= $[B]\cap[C]$.Let u, v∈R. For all i, $[D]_i{}^+(u–v)$=rmin{$[B]_i{}^+(u–v)$, $[C]_i{}^+(u–v)$}≥rmin{rmin{$[B]_i{}^+(u)$, $[B]_i{}^+(v)$ }, rmin {$[C]_i{}^+(u)$, $[C]_i{}^+(v)$ } }≥rmin {rmin{$[B]_i{}^+(u)$, $[C]_i{}^+(u)$}, rmin{$[B]_i{}^+(v)$, $[C]_i{}^+(v)$}}= rmin {$[D]_i{}^+(u)$, $[D]_i{}^+(v)$ }. Thus$[D]_i{}^+(u–v)$≥rmin{$[D]_i{}^+(u)$, $[D]_i{}^+(v)$}, ∀ u, v∈R. And $[D]_i{}^+(uv)$=rmin{$[B]_i{}^+(uv)$, $[C]_i{}^+(uv)$}≥rmin{rmin{$[B]_i{}^+(u)$, $[B]_i{}^+(v)$ }, rmin {$[C]_i{}^+(u)$, $[C]_i{}^+(v)$ }≥rmin {rmin{$[B]_i{}^+(u)$, $[C]_i{}^+(u)$}, rmin{$[B]_i{}^+(v)$, $[C]_i{}^+(v)$}}= rmin { $[D]_i{}^+(u)$, $[D]_i{}^+(v)$}. Thus$[D]_i{}^+(uv)$≥rmin{$[D]_i{}^+(u)$, $[D]_i{}^+(v)$}, ∀ u, v∈R.Also $[D]_i{}^-(u–v)$ = rmax{ $[B]_i{}^-(u–v)$, $[C]_i{}^-(u–v)$ }≤rmax{rmax {$[B]_i{}^-(u)$, $[B]_i{}^-(v)$}, rmax{$[C]_i{}^-(u)$, $[C]_i{}^-(v)$ }}≤rmax{rmax{$[B]_i{}^-(u)$, $[C]_i{}^-(u)$}, rmax{$[B]_i{}^-(v)$, $[C]_i{}^-(v)$}}= rmax {$[D]_i{}^-(u)$, $[D]_i{}^-(v)$ }. That is$[D]_i{}^-(u–v)$ ≤rmax{ $[D]_i{}^-(u)$, $[D]_i{}^-(v)$ }, ∀ u, v∈R. And $[D]_i{}^-(uv)$ = rmax{$[B]_i{}^-(uv)$, $[C]_i{}^-(uv)$ }≤rmax{rmax{$[B]_i{}^-(u)$, $B_i{}^-(v)$}, rmax {$[C]_i{}^-(u)$, $[C]_i{}^-(v)$ }}≤rmax { rmax {$[B]_i{}^-(u)$, $[C]_i{}^-(u)$}, rmax {$[B]_i{}^-(v)$, $[C]_i{}^-(v)$}}= rmax { $[D]_i{}^-(u)$, $[D]_i{}^-(v)$ }. Thus$[D]_i{}^-(uv)$ ≤rmax{$[D]_i{}^-(u)$, $[D]_i{}^-(v)$ },∀ u, v∈R. Hence $[B]\cap[C]$ is a BVMI-FSR of R.

Theorem 2.9

The intersection of a family of BVMI-FSRs with degree n of a ring (R, +, ·)is a BVMI-FSR of R.

Proof

The proof follows from the theorem 2.8.

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Plant Disease Analysis in Industrial Region by using Machine Learning Techniques

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ABSTRACT

Nowadays the industrial exhaust particles creating the climate change, rise in temperature and affect the green house gas for backbone of agriculture land. Due to the development of manufacturing industries and power plant industries, various plant diseases are mainly occurred to agriculture land. To resolve the rapid control of different plant diseases in effective manner, AI based automated identification of plant diseases are mandatory task. So far, different techniques have been used to identify the diseases in plants. Machine learning is among the most widely used techniques in recent times due to its massive result. In this work, the machine learning techniques is carried out for plant disease analysis in agriculture land near by thermal power plant area (Industrial area) and Non Industrial Area. We have experimented three machine learning algorithm namely SVM, Decision tree and Naïve bayes to identify the plant diseases. The experiments are carried on three different plants namely groundnut, mango and banana. The collected samples from the three plant were process with preprocessing, segmentation, feature extraction and finally trained with our proposed machine learning algorithms The result shows that the machine learning classifiers Gaussian SVM model outperforms naïve bayes and decision tree models with respect to accuracy, precision, recall, f1-score, and specificity.

Keywords: Support Vector Machine, Naive Bayes, Decision Tree, Machine Learning Artificial Intelligence Plant Disease Identification

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INTRODUCTION

A plant illness Intercept a plant from arriving at its most extreme capability of yield production. This definition incorporates with infectious and non-infectious diseases [1] that present danger to the farming business by causing a decrease in yield production and financial as well as decrease in the quality and the amount of the agriculture product. A review led to report the impact of the plant infection on worldwide Agri-production [2]. The agriculturist in particular region might believe that it's difficult to separate the disease which might be accessible in their harvests. It's not moderate for them to go to agribusiness office and find what the contamination might be in plant leaves. Our main objective is to recognize the disease present in a three kind of plants namely groundnut, mango, and banana. The proposed classification model carried out to classify the 15 types of diseases in two different regions. The first agriculture region nearby neyveli power plant industries chosen at periyakurichi in cuddalore district another agriculture region away from power plant industries chosen at muthanai in cuddalore district. The modern innovative technologies have arisen to limit postharvest handling, to trace farming supportability and to augment the quality efficiency. Different Laboratory based approaches, for example, polymerase chain response, thermography and remote sensing techniques have been utilized for plant disease recognition and identification. Nonetheless, these procedures are not financial effective and are high tedious. Lately, mobile application based approach has been used for disease identification method. A few elements of these advances being high goal camera, superior execution handling and broad implicit embellishments are the additional benefits in auto plant disease identification. To resolve the pertaining issue we have implemented machine learning based plant disease identification in two different regions with characterization of 15 kinds of diseases.

AI based plant recognizable proof techniques can quantitatively analyze a leaf mathematically and picture contrasts in a compelling, reproducible, exact, and genuinely effective manner. Factors which are generally viewed as in leaf morphological review incorporate length, width, region, border, and distance across, shape, and colour shading. In this work, the feature extraction, for example, Haralick features, HSV segmentation are proposed to recognize the plant illness from three plants namely ground nut, mango and banana. The experimental in highlight of the accuracy pace of SVM classifier is relied upon to be on par to the with other machine learning models like Decision Tree (DT) and naïve bayes. The intricacy will be also decreased. The remaining paper will depicts existing research methodology in Section 2. Then, followed by the proposed methodology and classifier in Section 3. The experimental result and discussion will be explained in Section 4. Finally the proposed method will be concluded in section 5.

Related Works

The Machine learning algorithm can access input either be supervised or unsupervised method. Supervised learning can be implemented and trained by using pre labeled plant leaf image dataset from particular region or laboratory data. The labeled image has been processed already with AI techniques and it may be ML or DL. The most examination in plant disease classification has evaluated by use of the conventional machine learning classifier [3 and 4]. SVM has been broadly utilized in addressing the plant disease classification issues in small amount plant dataset. In more regularly cases, it has proved that SVM modeling with limited dataset have a fine capability to identify the plant disease than deep learning model. The examination is focusing on the comprehension of appearance for essential stage revelation so the yield can should be precluded from disability [7]. The author [8] to prepare the experimentation, the texture GLCM feature extraction and KNN algorithms has been implemented for input preparation and preprocessing the plant leaf image . The techniques GLCM and KNN are guided for streamline the plant disease identification from conversion of raw image into training assessment stage in proposed plant disease identifier.

The Hydrangea Leaf has been processed [6] with ANN classifier which mainly guides to predict the most affected area in plant leaves. To fine tune the plant leaf features effective preprocessing such as resizing ,filtering ,image cropping, segmentation and Binarization has been used in this method .the plant leaves was graded by implementing computer vision technology and fuzzy logic controller.

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Maniyath [11] suggests Plant Disease Identification AI models by using Support Vector Machine (SVM), K-Nearest Neighbors (KNN), and RF. To testing and training the plant leaves they have used the public dataset of infected leaves and the feature extraction has been done using histogram of orientated gradients (HOG) such as Haralick textures and color histogram. The performance results with random forest have proved that highest accuracy of 70.14 %. The RF model can be improved with carrying out the ELM model and features of ELM has compared with RF and decision tree. The ideal results are found from the IMPS strategy that shows 88.57% in CA and 89.19% in AUC. The outcome can be improved; henceforth this work [11] has utilize tomato dataset. As per exiting work, it is seen that feature input of plant leaves assume a critical part in further developing classification result. Moreover, the supervised SVM machine learning model can give the better classification result plant leaves in two different region (power plant region and non power plant region) .

Proposed Methodology
The proposed methodology of plant disease classification consist of dataset collection, preprocessing, HSV segmentation, GLCM feature extraction, Classification model and performance metrics .The work flow diagram of proposed classification model is shown in fig 4.

Dataset Collection
Dataset for the experimentation is taken from two different regions. We have used the 25236 leave from the three plants namely groundnut, mango and banana .the plant leaf image were collected by using Canon EOS 1500D 24.1. This dataset characterized into 15 various classes. the plant leaf images includes of healthy and unhealthy disease .the unhealthy groundnut leaves are early leaf spot, late leaf spot, rust, stem root, Alternaria, anthracnose. Unhealthy mango leaves are anthracnose, gall midge powdery mildew and unhealthy banana leaves are bacterial wilt, black sigatoka, leaf spot .The entire dataset is separated into 60/40 ratio of training and validation for machine learning models. To differentiate the plant disease affected ratio in two different region, we have used 7562 plant leaves in Powerplant region (periyakurichi) and 7674 plant leaves in Non- Powerplant region (Muthanai) .the collected plant leaf images were processed with machine learning models like SVM ,decision tree and naïve bayes by using image processing tool such as MATLAB 2020 . Figure 1,2, and 3 shows the different healthy and unhealthy leaves of groundnut, banana and mango from the dataset.

Image Preprocessing
Initially the collected plant leaf images from two different regions were resized into the dimension of 256 × 256 x 3 pixels and leaves were separated from background data capture by digital cameras to reduce the error prediction in machine learning training model. To remove the surface commotion we have applied to median filter in our proposed machine learning model. It can is consummate by sliding a window over the collected plant leaf image. The filtered input plant leaf data is obtained by applying median value.

HSV Segmentation
In the preprocessing, It is relevant for all color spaces, for example, greyscale, RGB, HSV, and CMYK. Each colour channel introduced in a image is 8 bit digital size, there are 256 colour pixel intensities accessible to be shown in the histogram. Initially in HSV segmentation the RGB image will be converted into HSV. Each part Hue, Saturation and Value is isolated, and its magnitude is addressed in a particular range by using GUI development available in MATLAB 2020 . The Hue is in the scope of 0-179 though Saturation and Value is in the scope of 0-255. By hauling the track bar and changing its magnitude over it a maximum value for all HSV components are identified. Thus, the background leaf image is marked and just the objects of interest are found. A solitary H, S and V may not be appropriate for all sort of images. At the point the chosen plant leaf object of interest is totally segmented and the HSV changes can be halted for additional processing.

GLCM Feature Extraction
In this feature extraction method we have used GLCM as statistical method and it will consider spatial relation between plant leaf image pixels. The GLCM textures portray the surface of a plant leaf image by computing how

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frequently matches of pixel with explicit qualities and in a predefined spatial relationship happen in a input image and then separating factual measures from this co-occurrence matrix. The filter function of GLCM texture can provide the statistical, of input leaf image. Utilizing GLCM inputs are naturally certain as colour, texture and shape features arrangement. In this proposed method we have used the GLCM feature are contrast, correlation, energy, dissimilarity homogeneity and the mathematical expression of used feature extraction are mentioned as below.

Classification Model

Classification Model of linear SVM:

In this work, SVM linear classifiers utilizes the kernel technique to map the input leaf images into a higher-dimensional space prior to addressing the machine learning procedure as a curved improvement issue in which optima are found scientifically rather than heuristically. the support vector that have various labels share the input space in a way that prevent a direct hyperplane from accurately isolating the various labeled plant leaf classes associated with this disease classification task. Attempting to become familiar with a nonlinear isolating limit in the information space builds the computational prerequisites during the optimization phase. in our proposed model The SVM classifier maps input plant data by utilizing predefined linear kernel function. The SVM classifier in linear separation can be segregate between the various plant leaf classes.

Classification Model of Naïve Bayes

It is the popular machine learning techniques to classify the plant disease identification and characterization of plant leaf classes used in this proposed model. It is a portrayal procedure reliant upon Bayes' theorm with an assumption of different indicator. In another terms, a Naïve Bayes classifier expects that the presence of particular plant leaf features in a class is irrelevant to the presence of some other extracted part. The complicated AI characterization method of Naive Bayesian model will perform based on Bayes theorm gives to order each pair of plant leaf features with autonomous of each class and permit to working out posterior probability P (D|B) from P(D), P(B) and P(B|D) . The resultant mathematical expression is mentioned in equation 7

$$P(A / B) = P(B / A)P(A) / P(B) \qquad 7$$

Where P (A/B) denoted the posterior probability of target plant leaf class. P(A) signifies the prior probability of plant leaf class . P (B/A) and P (B) are likelihood probability of plant leaf class. P (B) is the marginal probability of plant leaf class.

Classification Model of Decision Trees

The classification decision tree is all the more remarkable plant disease identification. There are two stages in this methods fabricating a tree and applying the tree to the dataset. There are no of famous decision tree algorithms are CART, ID3, C4.5, CHAID, and J48. To classify the diseased plant leaves the J48 technique is utilized for this proposed model. J48 calculation utilizes pruning strategy to construct a tree. Pruning is a method that diminishes size of tree by eliminating over fitting information, which prompts unfortunate precision in predications. The J48 calculation recursively identify the plant input data until it has been characterized as target labeled plant leaf classes. This method is most appropriate model to training plant leaf data in low time consumption. The general idea is to fabricate a tree that gives equilibrium of adaptability and precision.

Performance Metrics

To evaluate the machine learning models like SVM, Naïve Bayes and Decision tree ,we have utilized the performance metrics such as accuracy, ,precision , F1 score and sensitivity , the formulation of these measure are mentioned as follows.

Accuracy = $\frac{(TP+TN)}{(TP+FN)+(FP+TN)}$ 8

Precision = $\frac{(TP)}{(TP+FP)}$ 9

F1 – Score = $\frac{(2*Precision*recall)}{(Precision+recall)}$ 10

Sensitivity = $\frac{(TP)}{(TP+FN)}$ 11

Here, TP (True Positive) and TN (True Negative) are the number of correctly classified healthy and diseased images of leaves. FP (False Positive) and FN (False Negative) are the incorrectly classified healthy and diseased images of leaves, respectively.

Experimental Result and Discussion

In this proposed approach, we conducted a set of experiments using a real dataset of groundnut banana and mango leaf diseases obtained from the periyakuruchi and muthani at Cuddalore district, Tamilnadu. We have tested the three kind of plant leaves consist of 23644 images capture by Canon EOS 1500D 24.1. The collected image has applied for preprocessing, segmentation by using resize tool, medial filter and HSV histogram. To prepare the machine learning classifier, GLCM feature extraction has been used. The feature extraction of target plant leaves further trained with proposed supervised machine learning model such as SVM, Naïve Bayes and Decision Tree. The plant disease classification 15 types of plant leaf classes have been processed with image processing tool MATLAB 2020.the plant leaf disease affected ratio of groundnut plant in power plant region and Non-Power plant Region has shown in table 1. From the table 1 we can state that, the early leaf spot disease of groundnut is mostly affected in both power plant region and Non-Power plant Region. The banana and mango plant leaf disease affected ration in both regions has been tabulated in table 2 and table3. According to the table 3 and 4 we can state that the plant leaf classes, leaf spot in Banana and anthracnose in Mango are mostly occurred in both region. The disease affected ratio of three plants shows that the highest number of diseased leaves has presented in (Periyakuruchi) power plant region and highest number of healthy leaves presented in non power plant region (Muthanai). when evaluate the performance of machine learning algorithm in plant leaf classification of target plant leaf classes, the classifier SVM has highest accuracy 90 % mentioned in table 4 .from the table 4, it is clear that the classification model of Decision tree has lowest accuracy rate of 52.5 % and the second highest performance machine learning model is naïve bayes with accuracy percentage of 81.48 %.

CONCLUSION

To improve quality and productivity of agriculture product the prevention of the plant disease occurrence due to development of industrialization is the mandatory task. Thus we conducted a set experiment on three kind plant leaf in power plant industries area and Non power plant region by using machine learning algorithms such as SVM, Naïve Bayes and Decision tree. To analyze plant disease occurrence, we have collected real time capture plant leaf data in both region by using CANON digital camera. The image processing tool such as, medial filter, HSV segmentation and GLCM feature extraction are used in better way for conducting this machine learning experiment effectively. As per the experimental result, the most of the plant diseases are presented in periyakuruchi nearby power plant area. The proposed machine learning classifiers are evaluated by using performance metrics accuracy, precision, F1 score and sensitivity. Among the three machine learning techniques, the Linear SVM has proved suitable method to classify the plant leaf classes and obtained highest accuracy percentage of 90 % .similarly the classifier Naïve bayes and decision tree are obtained accuracy percentage of 81.48 % and 51 % respectively. based on our proposed experimental result we intent in our future work to focus different plant leaf disease in different environmental area.

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Table 1: The Mathematical Expression Of GLCM Texture Features

S. no	GLCM features	Formula	Eqnno
1	Contrast	$\sum_{i,j=0}^{N-1} P_{i,j}(i-j)^2$	2
2	Correlation	$\sum_{i,j=0}^{N-1} P_{i,j}\left[\dfrac{(i-\mu_i)(j-\mu_j)}{\sqrt{(\sigma_i^2)(\sigma_j^2)}}\right]$	3
3	Energy	$\sum_{i,j=0}^{N-1} P_{i,j}^2$	4
4	Dissimilarity	$\sum_{i,j=0}^{N-1} P_{i,j}\,|i-j|$	5
5	Homogeneity	$\sum_{i,j=0}^{N-1} \dfrac{P_{i,j}}{1+(i-j)^2}$	6

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Table 2. Groundnut Plant Disease Affected Ratio between Power Plant Zone and Non Power Plant Zone

Plant leaf classes	Total no Images tested	Power Plant zone	Non power Plant zone	Ratio
Healthy	3250	1600	1650	32:33
Alternaria	437	327	110	327:110
Anthrrnocose	371	277	94	277:94
Early Leaf Spot	1214	687	527	687:527
Late Leaf Spot	1236	715	521	715:521
Rust Infection	510	397	113	397:113
Stem Root Sickness	162	122	40	61:20

Table 3. Banana plant Disease affected ratio between power plant zone and non-power plant zone

Plant leaf classes	Total no Images tested	Power Plant zone	Non power Plant zone	Ratio
Healthy	5950	2750	3200	55:64
Bacterial Wilt,	455	360	95	72:19
Black Sigatoka	465	387	78	129:26
Leaf Spot	1062	687	375	229:125

Table 4. Mango leaf Disease affected ratio between power plant zone and non power plant zone

Plant leaf classes	Total no Images tested	Power Plant zone	Non power Plant zone	Ratio
Healthy	5750	2500	3250	10:13
Anthracnose	1297	756	541	756:541
Gall Midge	1011	678	333	226:111
Powdery Mildew	474	398	76	199:38

Table 5. performance metrics result of machine learning classifiers

ML algorithms	Accuracy	Precision	F1 score	Sensitivity
SVM	90	93.2	91.8	90.5
Naïve bayes	81.4815	86.7	85.1	83.6
Decision Tree	52.5	71.6	62.1	54.8
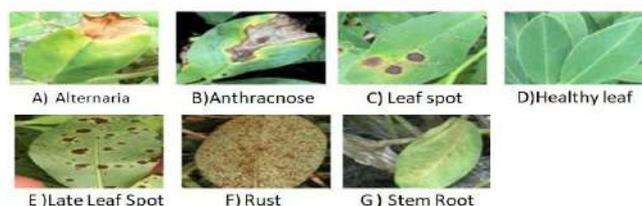
Fig1. Groundnut Plant Leaf Classes

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Fig 2. Banana Plant Leaf Classes
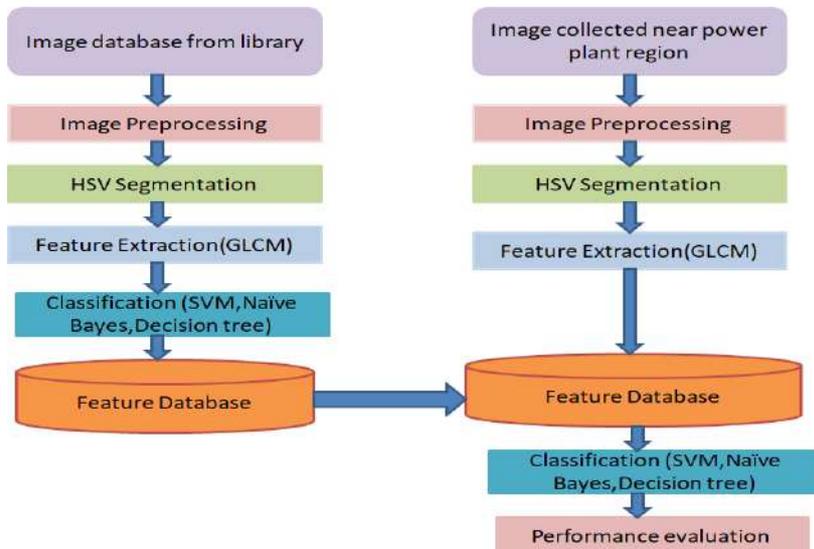

Fig 3. Mango Plant Leaf Classes

Fig 4 The Work Flow Diagram Of Proposed Classification Model

Nanoparticulate Lipid based Carriers System: Promising Advances in Drug Delivery

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ABSTRACT

Enhancement in oral bioavailability with conventional dosage form can be enhanced by any suitable novel drug delivery system such as prod rug concept or using a novel lipid-based system such as lipid nanoparticles compared to other nanoparticles. LNPs gain some advantages in less toxicological risk because of natural origin lipids and hence a special interest during last few decades. Solid lipid nanoparticles (SLNs) and nanostructured lipid carriers (NLCs) are two major types of Lipid-based nanoparticles. SLNs were developed to overcome the limitations of other colloidal carriers, such as emulsions, liposomes and polymeric nanoparticles because they have advantages like good release profile and targeted drug delivery with excellent physical stability. In the next generation of the lipid nanoparticle, NLCs are modified SLNs which improve the stability & having solid lipid and liquid lipid matrix that creates a less ordered or imperfect structure which helps in improving drug loading and decreasing the drug expulsion from NLCs during storage period. It focus on the potential perspectives for drug delivery using SLN and NLC. The most known formulation among LNPs is solid lipid nanoparticles (SLNs), which were developed in the emergence of the 1990s. This delivery system was developed as a substitution of former carrier systems such as emulsions, liposomes, and polymeric nanoparticles due to their numerous advantages. Capability of the preparation methods and scaling-up process, the GRAS (generally recognized as safe) status of all formulation materials, and absence of utilize of organic solvents are the features that make SLNs recommended over liposomes and polymeric nanoparticles. The major goal of this review was to shed a light on overview of SLNs and nano structured lipid carriers (NLCs), different preparation methods, and the best strategies for upcoming developments.

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INTRODUCTION

Lipidic drug delivery systems for instance Solid Lipid Nanoparticles (SLN) and Nano Lipid Carriers(NLC) have achieve the attention of researches in the past few years due to their non immunogenicity, biocompatibility as differentiate to polymeric and inorganic nanoparticulate delivery systems, in addition to their potential of permeating physiological barriers, specifically the blood-brain barrier (BBB) due to their lipophilic character. Further, eco-friendly, ease of preparation, cost-effectiveness, and the achievability of large-scale production is making these delivery systems more alluring. NLCs are a new generation of Solid Lipid Nanoparticles that were developed to overcome the limitations of SLN. However, instead of using only a solid lipid, a portion is replaced by an oil subsequent in a less ordered lipid matrix providing enhanced drug loading and preventing leaching out of the drug for the time of storage[1]. NLC carrier was developed in 1999/2000 by Muller and it took 5 years to launch the first two products NanorepairQ10 cream (Dr.Rimpler, Wedemark, Germany) and Nanorepair Q10 serum (Dr.Rimpler, We demark, Germany)in Munich/Germany in 2005. The third product Nano lipid CLR Restore(Chemisches Laboratorium, Berlin, Germany)was launched within half a year (Muller et al., 2007). NLC one of the nanocarriers with the shortest time between invention and market introduction. In the span of 12 years more than thirty products are available commercially NLCs are the second-generation lipid nano carriers composed of solid lipid matrix that are incorporated with liquid lipids (Zauner *et al.,* 2001). NLCs have the ability to strongly immobilize drugs and prevent the particles from coalescing by virtue of the solid matrix as compared to emulsions (Souto & Muller,2007; Shidhaye *et al.,* 2007[2]. Solid lipid nanoparticles (SLNs) offer an amalgamating effect of several carrier systems such as liposomes and niosomes.

Similar to other carrier systems, SLNs are also constituted by biocompatible excipients that are physiologically accepted and homology to polymeric nanoparticles. The solid matrix in SLNs also proposes to protect the loaded therapeutic molecules against the rough biological environment and also shield the other chemical degradations with maximum feasibility to alter the release profiles of the therapeutic molecule. Altogether, these proficiencies make the SLNs an exceptional carrier system (Dasand Chaudhury, 2011)[3]. Solid lipid nanoparticles (SLN) constitute an attractive colloidal drug carrier system. They are an alternative system to emulsions, liposomes, microparticles and nanoparticles based on synthetic polymers for numerous application routes because of their numerous advantages[4]. Fig1: Structure of liposome (A), Nano emulsion (B), solid lipid nanoparticles(SLN)(C),and nanostructured lipid carriers (NLC) (D)Distinctive LNP formulations embrace liposomes, emulsions, solid lipid nanoparticles (SLN), and nanostructured lipid carriers (NLC) SLN are nanostructures composed of solid lipids (solid at room temperature) and surfactants/emulsifiers. NLC share analogous structures with SLN, except that the solid lipid core is substituted by a mixture of solid lipid and liquid oil. Orally administered LN have abundant benefits, including excellent biocompatibility, efficient permeation enhancement, and enhanced bioavailability [5].

Advantages Of Lipid Based Nanocarriers
• Control and targeted drug release.
• Enhance the stability of pharmaceuticals.
• High and enhanced drug content (compared to other carriers).
• Feasibilities of carrying together lipophilic and hydrophilic drugs.
• Most lipids being biodegradable, SLNs have outstanding biocompatibility.
• Aquatic based technology (avoid organic solvents).
• Calm to scale-up and sterilize.

- More affordable (fewer expensive than polymeric/surfactant based carriers).
- Easier to validate and obtain regulatory approval[6].

Methods For Preparation of Solid Lipid Nanoparticles and Nanostructured Lipid Carriers
High-Pressure Homogenization
The first time SLNs were formed was concluded high-pressure homogenization (HPH). In this technique liquid passes through a fine gap a few micrometres in size with high pressure ranging from 100 to 2000 bar, consequential in the small and uniform size particles dispersion [10].Most industries have already assumed the HPH techniques for various applications [16]. The main benefit is effective particle size attenuation and low contamination and probability for industrial needs, such as low cost and large-scale production. Depending on the conditions, HPH has mainly two temperature types, hot and cold [24]. SLNs are prepared by amalgamation of the targeted substance into lipid by dissolving or dispersing in a melted lipid mixture

Hot High-Pressure Homogenization
HPH accomplished above the lipid melting point is called hot HPH, which stretches an emulsion phase. Homogenizers can grind samples up to 2 L at a maximum of 24,000 rpm. The rotor stator is a broadly used homogenizer. The effectiveness of homogenization is restrained by the degree of shearing and time the substance is in the shearing area[8,11]. The high temperature is suitable for decomposition of API and carrier, namely drug and lipid. The sum of cycles also touches the final products and it is adequate to use three to five cycles with pressure at 500e1500 bar [25]. It is a general reflection that with increase in cycle size, the particles also rise. Acceleration of fluids to a very high velocity in a rapid distance and very high shear stress outcome in cavitation energy, which disruptions down the particles to the nano/microscale level [26]. Fig 2: Hot high pressure homogenization method

Cold High-Pressure Homogenization
The optimal between hot and cold HPH lies in the composition of the lipid; for example, cholesterol is cast-off in cold HPH and Compritol is cast-off in hot HPH [11]. Different compositions affect the API's release profile. The first step of HPH is the identical for both processes; it is dissolving the API in the lipid. But in cold homogenization, after dissolving the substance in lipid, it is hurriedly cooled to make a homogeneous dispersion of the substance in the lipid matrix. However, in together cases the temperature should be sustained above the melting of the lipid during the first step. SLNs are distributed in a very cold emulsifier solution[8,11,27]. The benefit of cold HPH is that it overpowers the limitations of temperature-sensitive drug degradation [29].fig 3: Cold high-pressure homogenization method. Fig 4: Schematic overview of hot and cold homogenization technique.

Ultrasonication or High-Speed Homogenization
One of the green skills for nanoparticle production is ultrasonication, which is also suitable for preparation of SLNs. Homogenization consuming ultrasonication/probesonication effectively reduces the size of the particles and advances the uniformity and stability regardless of soft or hard composition [29]. There are a number of hearsays on decreasing accumulation of particles in the presence of sonication. In the procedure of sonication, actual reduction of size can be explained by the cavitations phenomenon. Cavitations diminishes pressure and induces phase transition rapidly. When high intensity and low pressure are functional to liquids, the consequence is the formation of small bubbles, which raise with time up to a certain restriction. Once they influence the maximum possible size they quickly collapse and high energy is released. The released energy generates high-pressure and high-speed liquid jets. These phenomena will procedure through the liquid and are accountable for forceful collisions between particles, resulting in the development of very small particles with uniform size and stability [30]. The rewards of ultrasound chemistry/technology are no mechanical forces and a calm to accomplish and clean process. The sonication chiefly depends on only a limited experimental parameter, which can be observed easily and are constant during the process[30,33]. It is an easy progression to scale up with possibility for industrial submissions. Related with mechanical homogenization, sonication can yield smaller SLNs . Compared with the surfactant Tween 80, Poloxamer 407 produces SLNs with smaller size [31].Furthermost researchers have employed sonication along with high-speed

homogenization to accomplish ultra small particle size. Fig 5 : High shear homogenization or ultra-sonication method

Solvent Evaporation Method
Lipid nanoparticles can be organized by emulsification tracked by solvent evaporation [9]. In the first step of this method liquid is dissolved in an organic solvent that is non-miscible with water. Then the mixture is mixed with water, and below reduced pressure evaporation of the organic solvent outcomes in the dissolvation of the lipid in the aqueous phase and in conclusion the formation of a lipid nanoparticle suspension in the aqueous phase [35]. Reliant on the concentration of lipidparticle size varies. The advantages of this process are that it is continuous, scalable,a nd industrially feasible[37].

Microemulsion Method
For preparation of lipid nanoparticles, a more exciting technique is the micro emulsion method. This method is appropriate for low-melting lipids/fatty acids, emulsifiers, coemulsifiers, and active ingredients [36]. The hot homogeneous transparent melted mixture of ingredients is dispersed in cold water under dynamic stirring, consequential in a lipid nanoparticle micro emulsion. Then by freeze-drying a solid powder of lipid nanoparticles is attained. This powder can be used in the formulation of tablets [34]. The exclusion of a high concentration of water may be a drawback. However, by accumulation of the hot melted mixture to cold water, a rapid and fast crystallization takes place, which also avoids aggregation. However, associated with HPH, solid loading is less

MembraneContractor
This is an innovative method that is achievable for mass-scale production of lipid nano-particles based on the membrane contractor. The droplets of lipid are formed by pressing the lipid phase from the membrane pore at temperature advanced than the lipid melting point and departure of the lipid droplets by the aqueous phase. Lipid nanoparticles are designed by controlled cooling to room temperature. This technique is very controlled with a choice of constraints that help to regulate the physicochemical assets of the lipid nanoparticles [23].

Supercritical Fluid Method
In this process a supercritical fluid is used as the extracting solvent, and the most usually used supercritical fluid is CO_2 . Ethanol or methanol can be used as a cosurfactants in nearly cases. Lipid nanoparticles are mined at above the critical temperature and pressure, which are 31C and 74 bar, respectively, for CO_2. This method harvests lipid nanoparticles in the form of a solid powder or dry particles [22,21].

Spray-Drying Method
Spray-drying is a substitute technique to lyophilization that is also right for preparation of SLNs. It is appropriate for lipids that have a melting point higher than70C. A 1% SLN concentration in a solution of trehalose in water or 20% trehalose in an ethanol water mixture was described [20].

Double-Emulsion Method
The drug is overloaded with a stabilizer to avoid the drug segmentation during evaporation of the solvent in the peripheral aqueous phase of a water/oil/water emulsion [19].

Film Ultrasound Dispersion
Revolution and evaporation of an organic solvent from an organic solution of lipid and drug outcomes in the establishment of a lipid film [18].

Precipitation Method
A lipid solution of organic solvent diverse with an aqueous phase to emulsify consequences in lipid nanoparticle precipitation on evaporation of the organic solvent. Then diffusion and the occurrence of probe sonication results in the development of small and uniform SLNs [17].

Secondary Production Stages
Freeze-Drying
Lyophilization is a auspicious technique to rise the lipid nanoparticle's physical and chemical stability. Freeze-drying results in the establishment of larger SLNs with broad size distribution due to accumulation caused during the water exclusion. The adding of cryoprotectant during freeze-drying can stop the aggregation of the SLNs [14,15].

Sterilization
Sterilization is a method to make nanoparticles organized for parenteral delivery. But it rises the size of the particles [12].

Spray-Drying
This is a more significant technique for expressing a dry powder of SLNs from dispersion. It is an alternate to and inexpensive than lyophilization. Spray-drying increases the stability for a long dated of time. The subsequent granules are suitable for intravenous administration [13].

Application Of Lipid Nanoparticles Ingene Delivery
The possible in novel treatment approaches by gene delivery systems remainders unsatisfied because of DNA's negative charge, high molecular weight, vulnerability to enzymes, lability to biologic fluids, and rapid abolition of plasmids and siRNAs. To overcome the abovementioned challenges, several nano carriers have been verified for actual gene delivery. Lipid-polymer hybrid nanoparticles (LPHNPs)have been cast-off in this case, predominantly for the delivery of oligonucleotides and siRNA [40]. The exterior of LPHNPs is usually adorned with cationic lipids or polymermoieties. This modification permits formation of a complex sandwiched between positively charged LPHNPs and anionic DNA molecules, which mains to the formation of a complex termed lipoplex and has the advantage of integrating large DNA over endocytosis [41,42,43]. Cationic SLNs are also measured proper non viral gene delivery vectors for systemic delivery; they can straight bond with DNA and can be cast-off for gene transfection [29]. Furthermore, NLCs can be used as innovative non viral gene transfer vectors that offer a hopeful approach for gene therapy [44].

Application Of Slns And Nlcs In Cancer Healing
A New Hope For A Cancer-Free World
1. SLNs loaded with miR-34a and paclitaxel were successfully occupied up by stem-like cancer cell line B16F10-D44þ and efficiently enhanced the antitumor response modifiable CD44 expression (miR-34a activity) escorted by the toxicity of PTX to all of the cancer cells (PTX activity),prominence the advantages of the convincing strategy of a dual-drug delivery system [45].
2. Tumor-targeted liposomes comprehending siRNA molecules and Q-dots were obtained and then adapted with anti-EGFR aptamers for specific delivery resolutions. The theranostic liposomes were assessed for their imaging capacity and anticancer comebacks in human breast adenocarcinomaMDA-MB-231(No. HTB-26), human breast metastatic carcinoma MDA-MB-453, and to endinmice. The outcomes of this research demonstrated the importance of multifunctional nanocarriers in cancer treatment[46].
3. SLNs comprising the plasmid pCMS-EGFP were arranged and categorized in one study. The in vitro results recommended a novel gifted nanocarrier with adequate features, and further intravenous administration of the drug also long-established the required safety and accretion of the nanoparticles in the liver and spleen [47].

Application of Lipid Nanoparticles in Protein and Peptide Delivery
In one study finished by Marina Gallarate et al., insulin and leuprolide were compressed within SLNs, and the attained nanoparticles showed a sustained release profile in vitro [48]. Many studies have been done to examine the feasibility of SLNs in peptide/protein delivery. It has been initiating that SLNs can be modified to be "stealth NPs," so they can escape from immune recognition, consequential in longer blood circulation. They have also been initiated to be "targeted NPs." By engaging specific modifications, SLNs are talented to deliver a peptide/protein to the proposed tissues and cells such as lung[49], and brain[50]. Dissimilar kinds of peptide/proteins have been

surrounded within SLNs or absorbed on to SLNs, and the attained nanoparticles confirmed high stability and transfection efficiency (e.g., bovine serum albumin [51], human serum albumin [52], cyclosporine[53], insulin [54], and thymopentin [55].

Application of Lipid Nanoparticles in Oral Drug Delivery

The oral route is the most ideal route for drug administration. The enthusiasm of SLNs and NLCs as alternative drug delivery systems is growing in the oral application. Lipid-based drug delivery systems have occurred as exciting vectors for oral application because of their latent to progress solubility, absorption of poorly water-soluble drugs and lipophilic drugs, slowing down drug chemical as well as enzymatic degradation, and so refining oral bioavailability [56]. Furthermore, initial works in this context illustrated that these formulations are useful for sustained release and targeted drug delivery[57]. Another significant characteristic is the high surface area of NLCs, which would permit them to exhibit great resistance toward enzymatic attack by intestinal lipases and defense of the drugs from the hostile atmosphere of the gastrointestinal tract [23].Contempt their numerous advantages, NLCs are contesting various interruptions on the way of emerging cost-effective marketed formulations that establish more reimbursements than conventional dosage forms. Furthermore, NLCs are still grateful to be inspected in clinical trials to demonstrate their oral efficacy [57].

Application of Lipid Nanoparticles in Brain Drug Delivery

In a study, paclitaxel-encumbered SLNs were established and administered intravenously. Both pegylated and non-pegylated paclitaxel-loaded SLNs exhibited higher and prolonged plasma levels due to low uptake by liver and spleen and improved passage through the BBB [59].Similarly, pegylated and non-pegylated doxorubicin-loaded SLNs described higher levels of doxorubicin in the brain and lower cardiac toxicity following intravenous administration in two tested species (rats and rabbits)[60]. Apolipoprotein is a blood protein that is adsorbed on the outward of SLNs and may facilitate adherence to the BBB's endothelial cells and uptake of SLNs by the brain [61]. Exploiting this approach, Kreuter et al. reported that Tween 80 estabilised polymeric nanoparticles could effectively delivery larg in to the brain [62,63]. Apolipoprotein E (Apo E) adsorbs onto the Tween 80adapted nanoparticle surface and enables the uptake of the particles into the brain [63,64].It is reported that if the SLN encompasses cationic lipids or surfactant, the core of cationic SLNs assists as a reservoir for hydrophobic drugs, while the positively charged surface allows better cellular internalization. This results in an improved tumour targeting and penetration over the BBB [65].

Application of Lipid Nanoparticles in Topical drug delivery

By using SLNs, the quantity of molecular sunscreen can be reduced by 50% in the formulation, preserving the protecting level of the conventional emulsion [66]. The amalgamation of titanium dioxide in SLNs has been endeavored in several studies. Both SLNs and NLCs have been used in topical application of numerous pharmaceutical actives such as tretinoin [67], isotretinoin [68], flurbiprofen[69], psoralen[70], vitamin A [71,72], cyproterone acetate [73], nonsteroidal anti-inflammatory drugs like celecoxib [74] and valecoxib[75], ketoprofen and naproxen [76], and anaesthetics like benzocaine and lidocaine[77].

Application of Lipid Nanoparticles in Ocular Drug Delivery

SLNs and NLCs could be intended to treat the most significant ocular disorders, such as ocular inflammation, infection, glaucoma, or even diseases disturbing structures from the posterior eye. So, abundant anti infectious, anti-inflammatory, and antiglaucoma agents are administered as eye drops with these drug delivery systems. In a current study the feasibility of using SLNs for ocular delivery of voriconazole was assessed. The results established that SLNs prepared by ultrasonication method were more appropriate than microemulsion technique, without causing any momentous effect on corneal hydration level [58].In a study showed by Balguri *et al.,* indomethacin-loaded SLNs and NLCs were produced to explore their possible use in topical ocular delivery. The results specified that NLC formulations established increased drug-loading competence and enhanced entrapment and delivery of the drug to anterior and posterior segments of the eyes [58,38].

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CONCLUSION ANDFUTUREPERSPECTIVE

Easy scale up of the formulation method is also an striking feature of lipid based formulation. Physiochemical assets of drug and lipid matrix components could be augmented to accomplish the precise requirement of particle size, encapsulation efficiency and release profile. Characterization of the LNP is also critical requirement due to complexity of the system and colloidal size of the particles. However, appropriate characterization of the formulations is obligatory to control the product quality, stability, and release kinetics. LNPs are considered as smarter generation of nanoparticles which possess enhanced properties for drug loading, modulation of the delivery profile, and stable drug assimilation throughout the storage period. Due to the lipophilic nature of the matrix produced, Lipid based nanoparticles are considered markedly useful for the administration of lipophilic drugs. In addition to this LNPs are biocompatible, biodegradable, non-irritating and non-sensitizing. LNPs can be designed conferring to the physicochemical properties of active pharmaceutical ingredients, over and above to the administration route and targeting sites. Thus, the LNPs have a very auspicious future as nearly 40% of the novel drug compounds are lipophilic. During the last 5 years the statistics of research groups employed with LNP as well as the number of publications in this area have distinctly increased. It reflects that more and more scientists in academia have realised the possible of the LNPs and have started to develop it.. It seems that more drug products will be formulated as LNP because of the noticeable advantages for the pharmaceutical companies in the very near future. However, more pre-clinical and clinical studies need to be accomplished in near future to establish these formulations in the market on the basis of low risk/high benefit ratio as compared to high risk/low benefit ratio in their present forms. In recent years, SLNs have proved to be a blockbuster in nanotechnology because LNPs are one of the innocuous vehicles in pharmaceutical drug delivery history. Moreover, they offer numerous advantages, and they have succeeded to successfully resolve problems related with previous drug delivery systems, such as emulsions, liposomes, and polymeric nanoparticles. More and more drugs with dissimilar routes of administration are encapsulated within these delivery systems. Though there is a long way ahead of us in the track of commercialization of these nano formulations, these delivery systems are most agreeable to commercialize between other nanoparticles because SLNs improve therapeutic performance of actives as carriers meaningfully. Further research needs to be constant in this path to develop drug deliveries with enhanced drug loading and reduce drug toxicity encounters associated with this delivery system.

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CONFLICT OF INTEREST
The authors declare no conflict of interest

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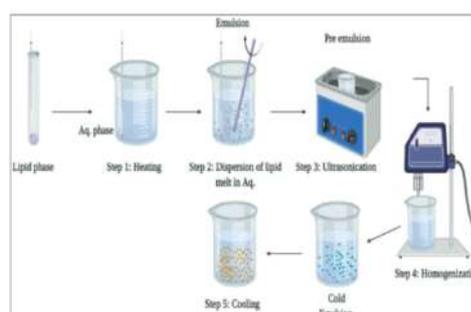
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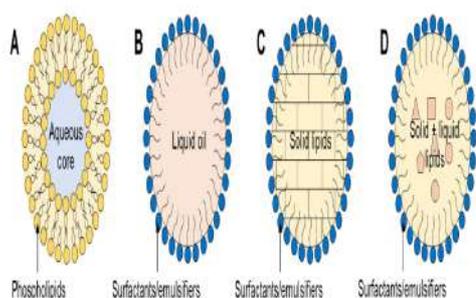
Fig.1: Structure of liposome (A).Nano emulsion (B).solid lipid nanoparticles (SLN) (C) and nanostructured lipid carriers (NLC) (D)

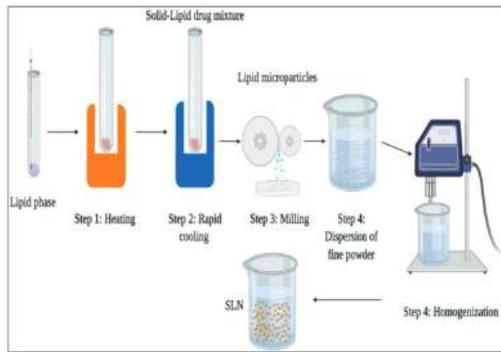**Fig.2: Hot high pressure homogenization method**

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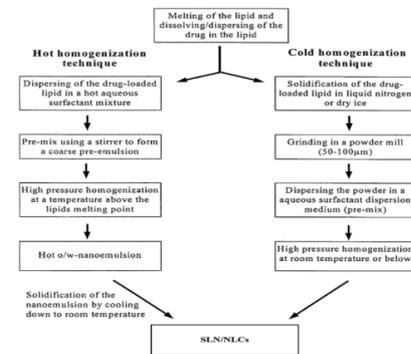
Fig.3: Cold high-pressure homogenization method

Fig.4: Schematic overview of hot and cold homogenization technique.

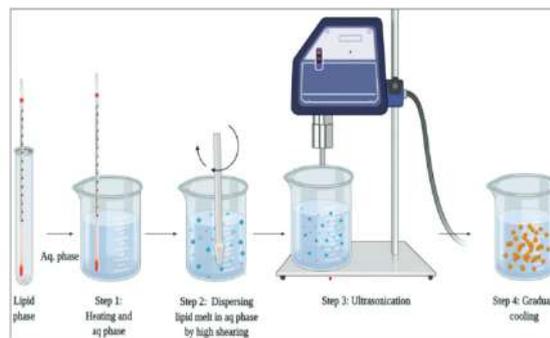**Fig.5: High shear homogenization or ultra-sonication method**

REVIEW ARTICLE

An Overview of Effect of Fluorosis on Cognitive Health of Children and Its Outcome: an Approach towards SDG 3

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ABSTRACT

Pure water is critical for a sustainable development, including environmental reliability and the eradication of malnutrition and poverty. Safe water plays a crucial role concerning human health and well-being. Our global challenge is to tackle the problem of inaccessibility of pure and safe drinking water. Rapid growth in population and urbanization, rapid industrial development, and increasing and expanding food production are all posing burden on water resources. However, fluoride consumption above the standard value can adversely impact on the central nervous system prior to triggering dental or skeletal fluorosis. Neurodevelopment disabilities, as well as other cognitive deficiencies, have an undesirable effect on children globally. This presents a global risk to human health and well-being, having both instant and long-term consequences for efforts to decrease the adverse impacts along with supporting the integrity of the right to live. In the present study, a systematic assessment was undertaken using the Pubmed and Embase databases. The study area, the age of subjects, sample size, sources and levels of fluoride in urine, water, serum and controls for confounding factors and type of cognitive tests performed by various investigators are taken into consideration to access the severity of fluoride on neurological well being. Subsequently, a demographic assessment regarding severity of fluorosis, and its intake through contaminated water, food and beverage reveals about various factor that have considerable impact on socially marginalised age-groups.

Keywords: Fluoride; cognitive function; neurological health; meta-analysis

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INTRODUCTION

As indicated by WHO (2016), 748 million people still rely on unsafe drinking water. Approximately 27 countries and 200 million individuals face problems of fluoride contamination in water. The target for achieving sustainability in environmental conditions targeted to divide, by 2015, the number of individuals lacking safe drinking water accessibility. We have recently crossed the 'United Nations Decade of Water for Life' from 2005 to 2015 still for a large number of individuals in fluorosis affected areas, the right to safe water still remains untouched. Now we are witnessing, 'Decade of Action on Nutrition (2016-2025)' as announced by the United Nations from 2016 to 2025, there is an essential requirement to eradicate malnutrition, poverty, anemia in females, micronutrient deficiencies. According to the study conducted by Ayoob and Gupta (2006) two hundred million populations, in twenty-five, nations are affected due to fluorosis. They have inferred that there is a basic connection amongst poverty and fluorosis as lack of nutrition is found to assume an influential part in its seriousness. As per Mumtaz *et al.* (2015, 2017), fluoride contaminated water may cause fluorosis and it is more observed in socially marginalized populations of developing countries. Diesendorf *et al.,* (1997) revealed that children less than 12 months who rely on milk formula prepared by fluoride containing water are also suseptible to fluorosis. Supporting this fact WHO (2002) also explained about the exposure of fluoride and its bioaccumulations in blood, renal tubules, and blood-plasma. Ekstrand *et al.* (1981, 1984) and Gedalia (1961) recommended that the fluoride transportation from a pregnant woman to the fetus is facilitated by placental control, and however, fluoride is just ineffectively transported from plasma to brain. A study conducted in by Hamilton (1990) reveals that regarding the biochemical consequences of fluoride on oral bacteria. Ekstrand et al. (1978, 1984) enunciated regarding the bioavailability of fluoride after intravenous and oral administration and its effect on excretory system along with the distribution of fluoride to human breast milk. (Spak et al, 1983).

METHODOLOGY

The present study was based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach, (Moher et al. 2009) which summarizes the participants, interventions, comparisons, outcomes, and study design (PICOS) in context with systematic assessment using the Embase and Medline databases . The study area, the age of subjects, sample size, sources and levels of fluoride in urine, water, serum and controls for confounding factors and type of cognitive tests performed by various investigators are taken into consideration to access the severity of fluoride on neurological well being. The Flow sheet representing literature review and selection protocol (PRISMA approach, Moher et al. 2009) is mentioned in Fig. 1 as follows: On the basis of chronological prevalence of fluorosis and its impact on cognitive output including the characteristics of 41studies conduct within 2 decades in China (29), India (7), Iran (4), and Mexico (1) as follows in Table 1:

RESULTS

By opting Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach the outcome of the literature survey for assessing the effect of fluorosis on cognitive health of children reveals that during the span of 1991-2017 corresponded to 2 decades 41 observational studies including 8849 children. In addition the assessment concludes that the concentration of fluoride exposure adversely affects the neurological development of children. Similarly, the diversity in the age of children observed reveals that the effect of age was potential variable. It is evident from the studies that socially marginalised and financially backward population is facing the most adverse impact of fluorosis. Based on 41 studies conducted; with 95% confidence the population mean is between 178 and 299 having a confidence interval: 238.533 ± 60.9. The source of contamination was majorly due to burning of coal revealed by the observational studies done by Guo X, *et al.* (1991), Li XS, *et al.* (1995), Li XS, *et al.* (1995), Wang G, *et al.* (1996), Wang S, *et al.* (2005). Only the study conducted by Li Y, *et al.* 1994 focused on food contaminated by coal smoke. The concentration of fluoride in Serum was revealed in two of the observational study conducted by Guo X,

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et al. (1991) corresponding to the value of 0.1483 + 0.0473 ppm and by Xu Y, *et al.* (1994)having maximum conc. 1.8 ppm. The Urinary concentration of excess fluoride was revealed by Lin Fa-Fu, *et al*(1991), Yang Y, *et al.*,(1994), Li XS, *et al.* (1995), Lu Y, *et al.* (2000), Wang X, *et al.* (2001), Xiang Q, *et al.* (2003), Fan Z, *et al.* (2007), Wang SX, *et al.* (2007), Li F, *et al.* (2009), Ding Y, *et al.* (2011), Bai Z, *et al.* (2014), Choi A, *et al.* (2014), Zhang S, *et al.* (2015).

CONCLUSION

The extensive survey of literature reveals the fact that exposure of excess fluoride influences neural development and cell division in the cerebrum leading to disrupted child intellectual development. Fluoride can worsen central nervous lesions and somatic developmental disturbance caused by iodine deficiency. Excess fluoride causes deficits in memory, concentration, response time and it also increases the toxicity and worsens the occurrence of thyroid inflammation. It is also evident that the most applied cognitive test for assessing intelligent quotient is Raven's test propound by Raven et al. (1998) contributing to 60 % of the total investigations undertaken. In perspective of the way that fluorosis especially lies in rural and suburb regions of various countries, the concept of inclusive development hand in hand with integrated fluorosis mitigation can prove to be a reliable alternative. Water quality improvement along with best available fluoride removal technique can improve the physic-mental growth of children in a fluoride affected areas. The assessment of various sources of fluoride exposure including dietary intake should be taken into account. Nutrient supplementation including consumption of Vitamin C, Calcium and Iron rich foodstuffs can reduce the affects and outcomes of fluorosis and save the children from a crippled future.

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Table 1: Chronological occurrence of fluorosis and its impact on cognitive output

Year of Study	Investigator	Study Area	Number of Children	Age (years)	Sources	Concentration of fluoride			Type of Cognitive Tests	Inference
						Urine	Water	Serum		
1989	Ren D, *et al.*	Shandong Province, China	160	8 to 14 years old	Water	Not reported	Not reported	Not reported	Wechsler	"From the results, it is evident that disrupted child intellectual development is among the effects on the human body from a harmful environment containing both high fluoride and low iodine, and this disruption is clearly much more serious than the effects of iodine deficiency alone."
1990	Qin LS, Cui SY.	Jing County, Hubei Province, China	141	9 to 10.5 years old	Water	Not reported	Up to 4.0 mg/L	Not reported	Raven	"All of these findings serve to indicate that both high and low fluoride can affect the normal development and function of the cerebrum as well as the entire nervous system causing a decrease in intellectual ability."
1991	Chen YX, *et al.*	Linyi County, Shanxi Province, China	320	7 to 14 years old	Water	Not reported	Min. conc.= 0.89 mg/L ・ Max. Conc. = 4.55 mg/L	Not reported	Chinese Raven Test	"The results of this study indicate that there is a significant difference between the intellectual ability of the 7–14-year-old children from the fluorosis endemic area and those of the control, and moreover that the average IQ of the children from the endemic area is clearly lower."
1991	Guo X, *et al.*	Xinshao County, Hunan Province, China	60	7 to 13 years old	Burning of Coal	Not reported	Less than 0.1 ppm	0.1483 ± 0.0473 ppm	Chinese Binet Intelligent quotient Test	"In summary, although diminished intellectual ability can result from a multitude of factors (both innate and acquired) that influence neural development and cell division in the cerebrum, the comparison conducted in this study of two areas where the other environmental factors are basically the same shows clear differences in IQ, and it is probable that this difference is due to a high fluoride environment."

1991	Lin Fa-Fu, *et al*	Xinjiang, China	250	7-14 years old	Water	Up to 2.56 ppm	Less than 1 ppm	Not reported	Rural Combined Raven Test	"The significant difference in IQ among these regions suggests that fluoride can exacerbate central nervous lesions and somatic developmental disturbance caused by iodine deficiency."
1991	Sun M, *et al.*	Guizhou Province, China,	196	6.5-12 years old	Not reported	Not reported	Not reported	Not reported	Shigeo Kobayashi Drawing test	"From these results, it can be concluded that excessive consumption of fluorine and aluminum in the early stage of development directly impacts the development of the human brain, which causes the delayed intellectual development seen in children living in the endemic areas."
1992	An J, *et al.*	Xingshun xi Town, China	121	7-16 years old	Water	Not reported	Max. conc. F ranges from 2.1 ± 7.6 ppm	Not reported	Wechsler	"The results show that the level of intelligence of primary and secondary students from the high fluoride area and that of primary and secondary students from the non-high fluoride area had very significant differences, proving that high fluoride has adverse effects on the mental development of students. The higher the water fluoride is, the lower the level of IQ."

1994	Li Y, *et al.*	Sichuan Province, China	107	12-13 years old	Food contaminated by coal smoke	Not reported	Not reported	Not reported		Mental capacity assessment	"As shown in this study, the early, long-term exposure to excess fluoride causes deficits in memory, attention, and reaction time but 12– 13-year-old children with only recent exposure show no major effects. Studies on human fetuses have already shown that the developing brain is one of the ripest targets for disruption by fluoride poisoning. Given that before six years of age the human brain is in its fastest stage of development, and that around seven and eight basic structural development is completed, therefore the brain is most vulnerable to damage from excess fluoride intake before this age."
1994	Xu Y, *et al.*	Shandong Province, China	330	8-14 years old	Water	Not reported	Min. conc. Ranges from 0.38 to 0.5 ppm –	Max. conc. 1.8 ppm	Not reported	Bient Siman	"The number of children whose level of intelligence is lower is significantly increased in regions of high fluoride/iodine, regions of high fluoride only, regions of high fluoride/low iodine against their respective comparative groups. This could be demonstrative of the fact that fluoride acts to increase the toxicity and worsen the occurrence of thyroid swelling."
1994	Yang Y, *et al.*	Shandong Province, China	30	8-14 years old	Water	2.08±1.03 ppm	2.97 ppm	Not reported		Chinese Comparative Scale of Intelligence Test	"An excess of fluoride and lack of iodine in the same environment has been shown to have a marked effect on child intellectual development, causing a more significant intellectual deficit than lack of iodine alone."
1995	Li XS, *et al.*	Anshu and Zhijin counties, Guizhou Province, China	681	8-13 years old	Coal burning	Up to 2.7 ppm	Not reported	Not reported		China Rui Wen's Scaler	"A high fluoride intake was associated with a lower intelligence."

1996	Wang G, et al.	Shehezi, Xinjiang Province, China	230	4-7 years old	Water & Coal-Burning	Not reported	Up to 8.6 ppm	Not reported	Wechsler Scale	"The results show that a high fluoride intake has a clear influence on the IQ of preschool children, manifesting itself primarily as damage to performance intelligence."
1996	Yao Y, et al.	Chaoyang City, Liaoning Province, China	266	8-12 years old	Water	Not reported	Up to 11 ppm	Not reported	Raven's test	"The results of the intelligence tests show that a high level of fluoride influences children's IQ, which is consistent with some previous data. It is worth mentioning that the higher the degree of dental fluorosis, the more negative the impact on the children's intelligence level. This is an issue which merits utmost attention."
1996	Zhao L B, et al.	Shanxi Province, China	320	7-14 years old	Water	Not reported	Up to 4 ppm	Not reported	"Official intelligence quotient (IQ) tests lasting 40 minutes"	"The results of this study indicate that intake of high fluoride drinking water from before birth has a significant deleterious influence on children's IQ in one of two similar villages."
1997	Yao Y, et al.	Chaoyang City, Liaoning Province, China	509	7-14 years old	Water	Not reported	Up to 2 ppm	Not reported	Raven test	"These results show that water improvement and defluoridation can improve the mental and physical development of children in a fluorosis area."
1998	Zhang J, et al.	Kuitun region, Urumqi, China	164 children	4-10 years old	Water	Not reported	Less than 0.1ppm	Not reported	Shigeo Kobayashi method	"Even though there were differences in the results from the 10-year-old subjects from the normal comparative group, in contrast to subjects from the high fluoride high arsenic group and the high fluoride group, these results might not be overtly representative as less number of subjects from the high fluoride group has been tested."
2000	Lu Y, et al.	Tianjin, China	118	10-12 years old	Water	Up to 5 ppm	Up to 3.5 ppm	Not reported	Raven's Test	"The findings of this study thus replicate those of earlier studies and suggest that a real relationship exists between fluoride exposure and intelligence."

2001	Hong F, *et al.*	Shangdong Province, China	205	8-14 years old	Water	Not reported	Up to 2.9 ppm	Not reported	Raven's Test	"The IQ results of this study show no significant difference between the average IQs of those children from the high fluoride only areas and the high fluoride/high iodine areas, however the result from the high fluoride/low iodine group show statistically significant differences as compared to that of the low fluoride/low iodine group. In short, it appears that the presence or lack of iodine is a more significant factor in both the prevalence of goiter and average IQ."
2001	Wang X, *et al.*	Shandong Province, China	513	8-12 years old	Water	Up to 3.2 ppm	Up to 3.5 ppm	Not reported	Raven's Test	"High iodine and high fluorine have a certain influence on children's intelligence and thyroid function."
2003	Li Y, *et al.*	Baotou, China	936	6-13 years old	Water	Not reported	Not reported	Not reported	Raven's Test	"In our study, we found that the average IQ of children in a fluoride endemic area was somewhat lower than the control, but the result was not statistically significant (p > 0.05). The percentage of children with fluorosis, however, was higher as compared to the control, and this was very significant statistically."
2003	Xiang Q, *et al.*	Sihong County, Jiangsu Province, China	512	8-13 years old	Water	Up to 3.5 ppm	Up to 4 ppm	Not reported	Raven's Test	"In endemic fluorosis areas drinking water fluoride levels greater than 1.0 mg/l may adversely affect the development of children's intelligence."
2005	Wang S, *et al.*	Zhijin County, Guizhou Province, China	176	7-12 years old	Coal burning	Up to 1.7 ppm	Not reported	Not reported	Raven's test	"High fluoride burden has a definite effect on the intellectual and physical development of children."
2006	Seraj B, *et al.*	Iran	126	Unspecified	Water	Not reported	2.5 ppm	Not reported	Raven's test	"Based on the findings of this study, exposure of children to high levels of fluoride may carry the risk of impaired development of intelligence."

2007	Fan Z, *et al.*	Pucheng County, Shaanxi Province, China.	79	7-14 years old	Water	Up to 4.8 ppm	Up to 3 ppm	Not reported	CRT-C2 intelligence module	"Exposure to high levels of fluoride is likely to cause a certain level of harm to a child's level of intelligence."
2007	Rocha-Amador D, *et al.*	Mexico	132	6 to 10 years old	Water	Up to 8.3 ppm	Up to 9.4 ppm	Not reported	Wechsler Intelligence test	"Exposure to F in urine was associated with reduced Performance, Verbal and Full IQ scores before and after adjusting for confounders. The same pattern was observed for models with F in water as the exposure variable. The individual effect of F in urine indicated that for each mg increase of F in urine a decrease of 1.7 points in Full IQ might be expected."
2007	Trivedi, *et al.*	Gujarat, India	190	12-13 years old	Water	Up to 6.7 ppm	Up to 5.9 ppm	Not reported	Stanford-Binet Intelligence test	"In agreement with other studies elsewhere, these findings indicate that children drinking high F water are at risk for impaired development of intelligence."
2007	Wang SX, *et al.*	Shanyin County, Shanxi Province, China	720	8-12 years old	Water	Up to 5ppm	Up to 8.3 ppm	Not reported	Raven's Test	"This study indicates that exposure to fluoride in drinking water is associated with neurotoxic effects in children."
2009	Li F, *et al.*	Xinhua County, Hunan Province, China	60	8-12 years old	Coal burning	Up to 3 ppm	Not reported	Not reported	Raven's Test	"High exposure to fluoride most definitely has an adverse effect on the development of intelligence in children, in particular on the capability of abstract inference."
2011	Ding Y, *et al.*	Hulunbuir, Inner Mongolia, China	331 children from four sites	7-14 years old	Water	Up to 1.5 ppm	Up to 1.8 ppm	Not reported	Raven's Test	"In conclusion, our study suggested that low levels of fluoride exposure in drinking water had negative effects on children's intelligence and dental health and confirmed the dose-response relationships between urine fluoride and IQ scores as well as dental fluorosis."

2011	Eswar P, *et al*.	Karnataka, India.	133	12-14 years old	Water	Not reported	Up to 2.45 ppm	Not reported	Raven's Standard Progressive Matrices Test	"Though there was a trend in this study towards lower IQ in a greater number of children from high F village than in the low F village, probably the small sample size of the present study failed to establish a statistically significant difference."
2011	Poureslami HR, *et al*.	Iran:	120	7-9 years old	Water	Not reported	Up to 2.38 ppm	Not reported	Raven's test	"Based on the findings, chronic exposure to high levels of fluoride can be one of the factors that influence intellectual development."
2011	Shivaprakash PK, *et al*.	Karnataka state, India	160	7-11 years old	Water	Not reported	2.5-3.5 ppm	Not reported	Raven's Colored Progressive Matrices Test	"Previous studies had indicated toward decreased Intelligence in children exposed to high levels of fluoride and this study also confirmed such an effect."
2012	Saxena S, *et al*.	Madhya Pradesh, India.	173	Unspecified	Water	2-7 ppm	1.5-4.5 ppm	Not reported	Raven's test	"This study indicates that exposure to fluoride is associated with reduced intelligence in children. We have found a significant inverse relationship between intelligence and the water fluoride level, and intelligence and the urinary fluoride level. After adjusting for confounders, urinary fluoride was the significant predictor of intelligence."
2012	Seraj B, *et al*.	Makoo, Iran.	293	6-11 years old	Water	Not reported	Up to 5 ppm	Not reported	Raven's Color Progressive Matrices (RCPM)	"Since all potentially confounding factors were adjusted, the difference in IQ scores may reveal the potential effect of high fluoride exposure on the intellectual development of children."

2012	Trivedi, *et al.*	Gujarat, India	84	Unspecified	Water	Not reported	Up to 3 ppm	Up to 2.5 ppm	Stanford-Binet Intelligence test	"The present investigation concludes that the three villages of Chhasara, Gundala, and Mundra, are F-contaminated villages. Because of high F concentrations in the groundwater, children in these villages have greater exposure to F that may lead to low IQ as compared to the nearby villages of Barol, Zarpara, and Pragpar, which have low F in their groundwater."
2014	Bai Z, *et al.*	Shaanxi Province, China.	303	8-12 years old	Coal combustion	"The median urinary fluoride levels for children 8–12 years old in the areas of significant, minor and no morbidity were, respectively, 1.96, 0.81 and 0.54 mg/L."	Not reported	Not reported	Not reported	"Exposures to fluorine and arsenic are deleterious to the development of intelligence and the development of growth in children"
2014	Choi A, *et al.*	Southern Sichuan Province, China.	51	7 years old	Water	Up to 5.8 ppm	Up to 4 ppm	Not reported	Wechsler's test	"This study reveals about the safety of elevated systemic exposure to fluoride from high concentrations in the drinking water. While topical fluoride treatment confers benefits of reducing caries incidence, the systemic exposure should not be so high as to impair children's neurodevelopment especially during the highly vulnerable windows of brain development in the uterus and during infancy and childhood and may result in permanent brain injury."

2014	Karimzade S, *et al.*	Iran.	39	9-12-years old	Water	Not reported	Up to 4 ppm	Not reported	Raymond B Cattell test	"The study found that children residing in a region with a high drinking water F level had lower IQs compared to children living in a low drinking water F region (p<0.001). The differences could not be attributed to confounding educational, economic, social, cultural, and general demographic factors."
2014	Singh VP, *et al.*	Jaipur, Rajasthan (India)	42	9-14 years old	Water	Not reported	Up to 6.8 ppm	Not reported	Raven's Test	"It is observed that reduced AChE activity in the high fluoride area which may be directly correlated with the reduced intelligence score of the subjects."
2015	Zhang S, *et al.*	Tianjin City, China	180	11 years old	Water	Up to 1.4 ppm	Up to 2.5 ppm	Less than 1 ppm	Raven's Test	"Catechol-O-methyltransferase gene polymorphism is linked with cognitive aspect in endemic fluorosis areas."
2017	Razdan *et al.*	Mathura, India	219	12-14 years old	Water	Not reported	Upto 4.99 ppm	Not reported	Raven's Test	Concentration of Fluoride in the ingested water was significantly associated with the IQ of children
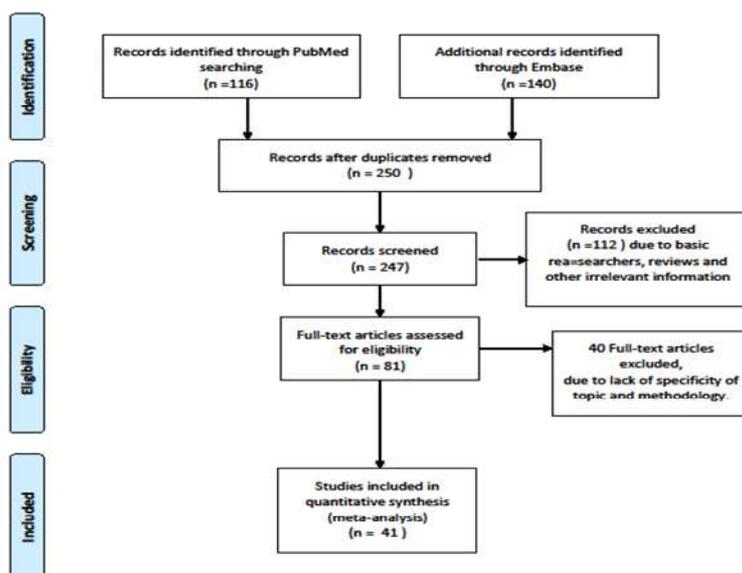
Fig 1: Flow sheet representing literature review and selection protocol (PRISMA approach, Moher *et al.* 2009)

RESEARCH ARTICLE

Parallel Summable of Interval Valued Range Symmetric Fuzzy Matrices

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ABSTRACT

We discuss the parallel summable of interval valued range symmetric matrices are interval valued range symmetric in (IVFM) and explore some additional properties of parallel summable of interval valued range symmetric matrices analogous to that of complex matrices in this study.

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Keywords: Range symmetric, Interval valued fuzzy matrix, Regular fuzzy matrix, Parallel summable.

INTRODUCTION

We deal with interval valued fuzzy matrix ($IVFM$) that is, matrices whose entries are intervals and all the intervals are subintervals of the interval$[0,1]$. Recently the concept of ($IVFM$) generalization fuzzy matrix was introduced and developed by Shyamal and Pal [4] . In [8], Meenaskshi and kaliraja have represented($IVFM$) as a interval matrix of matrix of its lower and upper limit fuzzy matrices. Let $\mathcal{F}_{mn}$be the collection of all $m \times n$ fuzzy matrices with the support $[0,1]$ over the fuzzy algebra. $c + d = max\{c, d\}$ and$c . d = min\{c, d\}$ for every element$c, d \in \mathcal{F}$[6].Let$A^T, A^+, A^*, R(A), C(A), N(A), \rho(A)$ indicate the transpose of matrix$A$, generalization of inverse matrix$A$, row space of A , column space of A , null space of A ,Conjugate transpose and the rank of A respectively. If $A \in \mathcal{F}_n$ is stated to range symmetric matrix $\Leftrightarrow$ $R(A)$ $= R(A^T)$ [10].A solution X of the equation $AXA = A$ is denoted by A^- (Generalized inverse of$A$) [2].For$A \in \mathcal{F}_n$, the Moore Penrose inverse A^+ of A is the unique solution of the equation $AXA = A, XAX = X, (AX)^T = AX , (XA)^T = XA$ [1].A matrix A is called EP matrices if $R(A)$ $= R(A^*)$.Anderson and Duffin [3] has defined the parallel sum of real matrices. A pair of matrices A and B are said to be Parallel summable if $A(A + B)^- B$ is invariant under choice of the generalized inverse$(A + B)^-$.If A and B are Parallel

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summable then the parallel sum is defined by $A:B = A(A + B)^- B$ under certain conditions the invariant of the matrix product $CA^- B$ for all choice of g-inverse of a regular fuzzy matrix A is discussed by Meenakshi and Sriram[9] .We have extended the notation of parallel summability for a pair of fuzzy matrices whose sum is an interval valued range symmetric matrix and derive some properties of parallel summable of interval valued range symmetric matrices analogous to that of complex EP matrices [5].

2. Preliminaries

Definition 2.1

For a pair of fuzzy matrices $G = (g_{ij})$ and $H = (h_{ij})$ in $\mathcal{F}_{mn} \ni G \leq H$, Now let us describe the interval matrix indicate as $[G, H]$, where ij^{th} entry is the interval with lower (bottom) limit g_{ij} and upper (higher)limit h_{ij}, it can be represent that $[g_{ij}, h_{ij}]$. In specific, For G = H, $IVFM$ [G,G] simplifies to the fuzzy matrices $G \in \mathcal{F}_{mn}$.For A = $(a_{ij}) = ([a_{ijL}, a_{ijU}]) \in$ $(IVFM)_{mn}$.Assume that $A_L = a_{ijL}$ and $A_U = a_{ijU}$ are defined. Clearly A_L and $A_U \in \mathcal{F}_{mn}$ so that $A_L \leq A_U$.As a result,A can be stated as A = $[A_L, A_U]$ where A_L and A_U are the lower and upper limits respectively.

Definition 2.2 [11]

A matrix $A = [A_L, A_U] \in IVFM_{nn}$ is stated to be interval valued *range* symmetric if $R(A_L) = R(A_L{}^T)$ where $R(A_L) = \{x /xA_L = 0 \text{ and } x \in \mathcal{F}_{n \times 1}\}$. $R(A_U) = R(A_U{}^T)$, where $R(A_U) = \{x /xA_U = 0 \text{ and } x \in \mathcal{F}_{n \times 1}\}$

Definition 2.3

A pair of matrices A and B are said to be parallel summable if $A(A + B)^- B$ is invariant under choice of the generalized inverse $(A + B)^-$. If A and B are parallel summable then the parallel sum is defined by $A:B = A(A + B)^- B$

Properties: 2.4

Let A and B be a pair of parallel summable matrices .Then the following statements holds

(P 2.1.1) $A:B = B:A$

(P 2.1.2) A^* and B^* are parallel summable and $(A:B)^* = A^* : B^*$

(P 2.1.3) If U is non singular then UA and UB are parallel summable and $UA:UB = U(A:B)$

(P 2.1.4) $R(A:B) = R(A) \cap R(B); N(A:B) = N(A) + N(B)$

(P 2.1.5)$(A:B):C = A:(B:C)$ if all the sum operations involved are defined.

Lemma: 2.5

Let A and B be a parallel summable EP matrices such that $A + B$ is Hermitian. Then there exist nonsingular matrices H and K such that $(HA:HB)^* = KA:KB$

Theorem: 2.6

Let A and B be a parallel summable EP matrices such that $A \geq -B$ then the following holds

(1)$A \geq KA:KB$ for some $K \in C_{n \times n}$

(2)$A + B \geq T(A:B)$ for some $T \in C_{n \times n}$

Definition 2.7

If $A \in \mathcal{F}_{nn}$ is stated to range symmetric matrix $\Longleftrightarrow R(A) = R(A^T)$

Theorem: 2.8 [7]

The following statements are equivalent for $A \in \mathcal{F}_n$

(1) $\rho(A) = r$ and A is a *range* symmetric and

(2) $C(A^T) = C(A)$

(3) For some fuzzy matrices $AH = KA = A^T H$,K and $\rho(A) = r$

(4) PAP^T is *range* symmetric matrix of rank of r for some permutation matrix P

Lemma: 2.9 [1]

For $A, B \in \mathcal{F}_n$, $R(B) \subseteq R(A) \Longleftrightarrow$ if B = XA, for some $X \in \mathcal{F}_n$, $C(B) \subseteq C(A) \Longleftrightarrow$
ifB = XA, for some $X \in \mathcal{F}_n$

Definition 2.10

For $A \in \mathcal{F}_{mn}$ a matrix $X \in \mathcal{F}_{mn}$ is said to be generalized inverse are g- inverse of A if

(1) $AXA = A$

X is said to be {1,2}- inverse or semi inverse of A if

(2) $AXA = A$ and $XAX = X$

X is said to be {1,3}- inverse of A or a least square g- inverse of A if

(3) $AXA = A$ and $(AX)^T = AX$

X is said to be {1,4}- inverse of A or a minimum norm g- inverse of A if

(4) $AXA = A$ and $(XA)^T = XA$

$X$is said to be Moore-Penrose inverse or a fuzzy inverse of Aif

(5) $AXA = A$, $XAX = X$, $(AX)^T = AX$ and $(XA)^T = XA$ are denoted asA^+

3. Parallel summable of Interval valuedRange Symmetric Fuzzy Matrices

We have acquired few results on Parallel summable interval valued range symmetric fuzzy matrices in this section.

Definition 3.1

A pair of $A, B = [A_L, A_U], [B_L, B_U] \in IVFM$ are said to beparallel summable of interval valued if $A_L + B_L$, $A_U + B_U$ are regular and $A_L(A_L + B_L)^- B_L$, $A_U(A_U + B_U)^- B_U$is invariant under the choice of g – inverse $(A_L + B_L)^-$, $(A_U + B_U)^-$ of $A_L + B_L$, $A_U + B_U$.If A and B are parallel summable of interval valued then the parallel sum of A and B denoted as $A_L : B_L$, $A_U : B_U$.is defined as $A_L : B_L = A_L(A_L + B_L)^- B_L$, $A_U : B_U = A_U(A_U + B_U)^- B_U$

Henceforth, by A and $B$are parallel summable of interval valued we mean that $A_L + B_L, A_U + B_U$ is an interval valued regular fuzzy matrix, $R(A_L) \subseteq R(A_L + B_L), R(A_U) \subseteq R(A_U + B_U)$ and $C(B_L) \subseteq C(A_L + B_L), C(B_U) \subseteq C(A_U + B_U)$

Proposition: 3.2

Let A and B be a pair of parallel summable of interval valued fuzzy matrices in$IVFM$.Then the following holds

$(P.3.1) R(A_L) \subseteq R(A_L + B_L)$, $R(A_U) \subseteq R(A_U + B_U)$ and $C(B_L) \subseteq C(A_L + B_L), C(B_U) \subseteq C(A_U + B_U)$

$(P.3.2) A^T = [A_L{}^T, A_U{}^T]$ and $B^T = [B_L{}^T, B_U{}^T]$ are interval valued parallel summable and

$B_L{}^T : A_L{}^T = (A_L : B_L)^T$, $B_U{}^T : A_U{}^T = (A_U : B_U)^T (P.3.3) A_L + B_L \geq A_L : B_L, A_U + B_U \geq A_U : B_U (P.3.4)$

For theinterval valued fuzzy matricesA, B, U, V with U, V and $A_L + B_L, A_U + B_U$.

interval valued regular fuzzy matrix, if $U U^- = I = VV^-$ then

$UA_L V : UB_L V = U(A_L : B_L)V$, $UA_U V : UB_U V = U(A_U : B_U)V$

Theorem 3.3

For $A, B \in IVFM$ if $A_L + B_L$, $A_U + B_U$ is regular then the following are equivalent

1) $R(A_L) \subseteq R(A_L + B_L)$, $R(A_U) \subseteq R(A_U + B_U)$ and $C(B_L) \subseteq C(A_L + B_L), C(B_U) \subseteq C(A_U + B_U)$

2) $A_L = A_L(A_L + B_L)^-(A_L + B_L)$, $A_U = A_U(A_U + B_U)^-(A_U + B_U)$

$B_L = (A_L + B_L)(A_L + B_L)^- B_L$, $B_U = (A_U + B_U)(A_U + B_U)^- B_U$ for all $(A_L + B_L)^-$ of $A_L + B_L$, $(A_U + B_U)^-$ of $A_U + B_U$

3) $A_L(A_L + B_L)^- B_L$ is invariant, $A_L + A_L(A_L + B_L)^-(A_L + B_L)$ and $B_L = B_L + (A_L + B_L)(A_L + B_L)^- B_L$

$A_U(A_U + B_U)^- B_U$ is invariant, $A_U = A_U + A_U(A_U + B_U)^-(A_U + B_U)$ and $B_U = B_U + (A_U + B_U)(A_U + B_U)^- B_U$

4) $A = [A_L, A_U]$ and $B = [B_L, B_U]$ are parallel summable of interval valued matrices

5) $A^T = [A_L{}^T, A_U{}^T]$ and $A^T = [B_L{}^T, B_U{}^T]$are parallel summable of interval valued matrices

Proof

$(1) \Rightarrow (2)$

Consider A_L

$R(A_L) \subseteq R(A_L + B_L) \Longleftrightarrow A_L = X_L(A_L + B_L)$ [By Lemma 2.8]

$\Longleftrightarrow A_L = X_L(A_L + B_L)(A_L + B_L)^-(A_L + B_L)$ [By Definition 2.3]

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$\Leftrightarrow A_L = A_L(A_L + B_L)^-(A_L + B_L)$
and
$C(B_L) \subseteq C (A_L + B_L) \Leftrightarrow B_L = (A_L + B_L)(A_L + B_L)^- B_L$ for all $(A_L + B_L)^-$ of $A_L + B_L$
$(2) \Rightarrow (3)$
$A_L(A_L + B_L)^- B_L = A_L(A_L + B_L)^-(A_L + B_L)(A_L + B_L)^-(A_L + B_L)(A_L + B_L)^- B_L$
$\qquad\qquad = A_L(A_L + B_L)^-((A_L + B_L)(A_L + B_L)^-(A_L + B_L))(A_L + B_L)^- B_L$
$\qquad\qquad = A_L(A_L + B_L)^-(A_L + B_L)(A_L + B_L)^- B_L = A_L Y B_L$
Where $Y = (A_L + B_L)^-(A_L + B_L)(A_L + B_L)^- \in (A_L + B_L)\{1\}$

Hence $A_L(A_L + B_L)^- B_L$ is invariant
Since under fuzzy addition,
$A_L + A_L = A_L$ we $A_L = A_L + A_L(A_L + B_L)^-(A_L + B_L)$.
Similarly $B_L = B_L + (A_L + B_L)(A_L + B_L)^- B_L$
$(3) \Rightarrow (2)$
Since $A_L = A_L + A_L(A_L + B_L)^-(A_L + B_L) \Rightarrow A_L \geq A_L(A_L + B_L)^-(A_L + B_L)$
Suppose $A_L > A_L(A_L + B_L)^-(A_L + B_L)$ then $A_L(A_L + B_L)^- B_L > A_L(A_L + B_L)^-(A_L + B_L)(A_L + B_L)^- B_L > A_L Y B_L$
where $Y = (A_L + B_L)^-(A_L + B_L)(A_L + B_L)^- \in (A_L + B_L)\{1\}$
which contradicts the invariance of $A_L(A_L + B_L)^- B_L$
$\therefore A_L = A_L(A_L + B_L)^-(A_L + B_L)$
Similarly $B_L = (A_L + B_L)(A_L + B_L)^- B_L$
$(4) \Leftrightarrow (5)$
If A and B are parallel summable of interval valued fuzzy matrices then by $(P\ 2.1.2) A_L{}^T$ and $B_L{}^T$ are parallel summableof interval valued fuzzy matrices
$(4) \Leftrightarrow (1)$
A and B are parallel summable interval valued fuzzy matrices by Definition (3.1) it follows that
$R(A_L) \subseteq R(A_L + B_L)$ and $C(B_L) \subseteq C (A_L + B_L)$
Similarly $\therefore A_U$ is also holds.
Hence the theorem.

Lemma 3.5
For $A, B \in IVFM$ with $R(A_L) = R(B_L), R(A_U) = R(B_U)$ and $C(A_L) = C(B_L), C(A_U) = C(B_U)$. A is an interval valued range symmetric $\Leftrightarrow B$ is an interval valued range symmetric.

Proof
$A = [A_L, A_U]$ is an interval valued range symmetric
$\Leftrightarrow R(A_L) = R(A_L{}^T) = C(A_L), R(A_U) = R(A_U{}^T) = C(A_U)$
  [By Definition 2.7]
$\Leftrightarrow R(B_L) = C(B_L) = R(B_L{}^T), R(B_U) = C(B_U) = R(B_U{}^T)$
$\Leftrightarrow B = [B_L, B_U]$ is an interval valued range symmetric.
  [By Definition 2.7]
Hence the theorem

Remark: 3.6
Both the condition in Lemma (3.5) are essential. The following examples demonstrate this.

Example: 3.7

Let $A = \begin{bmatrix} [0.5\,,0.5] & [0.5\,,0.5] \\ [1\,,1] & [0.3\,,0.6] \end{bmatrix}$, $B = \begin{bmatrix} [1\,,1] & [0.5\,,0.5] \\ [0.5\,,0.8] & [0.3\,,0.6] \end{bmatrix}$

Any element (x, y) in $R (A_L)$ is of the form,

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$(x, y) = \alpha\,(0.5, 0.5) + \beta\ (1, 0.3)\ for\ \alpha, \beta \in \mathcal{F}$

$(x, y) = \big(\alpha(0.5), \alpha(0.5)\big) + \big(\beta, \beta(0.3)\big)$

$x = sup\ \{\alpha\,(0.5)\,, \beta\,\}$

$y = sup\ \{(0.5)\,, \beta\,(0.3)\}$

Hence $R(A_L) = \{(x, y) : 0 \le x \le 1, 0 \le y \le 0.5\}$

$R(B_L) = \{(x, y) : 0 \le x \le 1, 0 \le y \le 0.5\}$

$C(A_L) = \{(x, y) : 0 \le x \le 0.5, 0 \le y \le 1\}$

$C(B_L) = \{(x, y) : 0 \le x \le 1, 0 \le y \le 0.5\}$

Similarly A_U is also holds

Here $R(A_L) = R(B_L), R(A_U) = R(B_U)$ but $C(A_L) \ne C(B_L), C(A_U) \ne C(B_U)$

$\therefore B$ is symmetric hence interval valued range symmetric

$R(A_L{}^T) = \{(x, y) : 0 \le x \le 0.5, 0 \le y \le 1\} \ne R(A)$. A is not interval valued range symmetric

Hence the theorem fails.

Theorem 3.8

For $A, B \in IVFM$ if $R(B_L) \subseteq R(A_L) \subseteq R(A_L + B_L), R(B_U) \subseteq R(A_U) \subseteq R(A_U + B_U)$

and $C(B_L) \subseteq C(A_L) \subseteq C(A_L + B_L), C(B_U) \subseteq C(A_U) \subseteq C(A_U + B_U)$

Then A is interval valued range symmetric$\Longleftrightarrow A_L + B_L, A_U + B_U$,is an interval valued range symmetric

Proof

Consider A_L

$R(B_L) \subseteq R(A_L) \Longrightarrow B_L = X_L A_L$ for some $X_L \in IVFM$ [By lemma 2.8]

Then $A_L + B_L = A_L + X_L A_L$

$\qquad\qquad = (I + X_L)A_L$

This implies $R(A_L + B_L) \subseteq R(A_L)$ Together with given condition,

$R(A_L) \subseteq R(A_L + B_L)$ yields $R(A_L) = R(A_L + B_L) \ldots\ldots\ldots\ldots (3.1)$

Similarly

$C(B_L) \subseteq C(A_L) \Longrightarrow B_L = A_L Y_L$ for some $Y_L \in IVFM$ [By lemma 2.8]

Then $A_L + B_L = A_L + A_L Y_L$

$\qquad\qquad = (I + Y_L)A_L$

This implies $C(A_L + B_L) \subseteq C(A_L)$

$C(A_L) \subseteq C(A_L + B_L)$ we get $C(A_L) = C(A_L + B_L) \ldots\ldots\ldots\ldots$ (3.2)

Similarly A_U is also holds

By using (3.1) and (3.2) in Lemma 3.5 we get $A = [A_L, A_U]$ is interval valued range symmetric$\Longleftrightarrow A_L + B_L, A_U + B_U$,is an interval valued range symmetric

Hence the theorem

Theorem 3.9

Let A and B are an interval valued range symmetric with $R(A_L) = R(B_L), R(A_U) = R(B_U)$ .If A and B are an interval valued parallel summable then $A_L + B_L, A_U + B_U$ is an interval valued range symmetric

Proof

Let A and B are an interval valued range symmetric$\Longrightarrow R(A_L) = R(A_L{}^T), R(A_U) = R(A_U{}^T)$

and $R(B_L) = B(A_L{}^T), R(B_U) = R(B_U{}^T) \ldots\ldots\ldots\ldots$ (3.3)

Since $R(A_L) = R(B_L), R(A_U) = R(B_U)$ along with (3.3) we get

$C(A_L) = C(B_L), C(A_U) = C(B_U) \ldots\ldots\ldots\ldots$ (3.4)

$A = [A_L, A_U]$, $B = [B_L, B_U]$ is an interval valued parallel summable$\Longrightarrow R(A_L) \subseteq R(A_L + B_L), R(A_U) \subseteq R(A_U + B_U)$ and $C(A_L) \subseteq C(A_L + B_L), C(A_U) \subseteq C(A_U + B_U)$ follows from the Definition (3.1) $\ldots\ldots\ldots\ldots$ (3.5)

By using,(3.4) *and* (3.5) we get

$R(B_L) \subseteq R(A_L) \subseteq R(A_L + B_L), R(B_U) \subseteq R(A_U) \subseteq R(A_U + B_U)$

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$C(B_L) \subseteq C(A_L) \subseteq C(A_L + B_L), C(B_U) \subseteq C(A_U) \subseteq C(A_U + B_U)$

Thus $A_L + B_L, A_U + B_U$ is an interval valued range symmetric follows from Theorem (3.7)

Theorem 3.10

Let A and B are an parallel summable interval valued range symmetric matrices

$R(A_L : B_L) \subseteq R(A_L), R(A_U : B_U) \subseteq R(A_U)$ and $C(A_L : B_L) \subseteq C(B_L), C(A_U : B_U) \subseteq C(B_U)$

Then $(A_L, A_U : B_L, B_U)$ is an interval valued range symmetric

Proof

Let A and B are parallel summable interval valued fuzzy matrices by definition

$R(A_L : B_L) \subseteq R(B_L), R(A_U : B_U) \subseteq R(B_U)$ and $C(A_L : B_L) \subseteq C(A_L), C(A_U : B_U) \subseteq C(A_U)$

along with the given conditions

Consider for A_L

$R(A_L : B_L) = R(A_L) \cap R(B_L)$

$\qquad = R(A_L^T) \cap R(B_L^T)$ ［A and B are an interval valued range symmetric］

$\qquad = R(A_L^T : B_L^T)$

Similarly A_U is also holds

$(A_L, A_U : B_L, B_U)$ is an interval valued range symmetric

Lemma:3.11

Let A and B are parallel summable interval valued range symmetric matrices such that

$A_L + B_L, A_U + B_U$ is symmetric. If there exist fuzzy matrices H and K such that

$H^- H = I = KK^-$ then $(HA_L : HB_L)^T = K(B_L : A_L), (HA_U : HB_U)^T = K(B_U : A_U)$ and $(A_L K : B_L K)^T = (B_L : A_L)H$,

$(A_U K : B_U K)^T = (B_U : A_U)H$

Proof

Since A and B are an interval valued range symmetric matrices by theorem 2.7,

$A_L^T = HA_L, A_U^T = HA_U$ and $B_L^T = KB_L, B_U^T = KB_U \dots\dots\dots$　　　　　　　　(3.6)

Consider for A_L

$(HA_L : HB_L)^T = [H(A_L : B_L)]^T$［$By\ P\ 2.1.4$］

$\qquad = (A_L : B_L)^T H^T$

$= (B_L^T : A_L^T) H^T$［$By\ P\ 2.1.2$］

$= B_L^T (B_L^T : A_L^T)^- A_L^T H^T$［$By\ Definition\ 3.1$］

$= KB_L(B_L^T + A_L^T)^- A_L$　［$A_L + B_L\ is\ symmetric$］

$= K(B_L : A_L)$　［$By\ Definition\ 3.1$］

$(A_L K : B_L K)^T = (B_L : A_L)H$ can be proved in the same manner.

Similarly A_U is also holds

Hence the proof.

Theorem 3.12

For $A, B \in IVFM$ be a parallel summable interval valued fuzzy matrices such that $A_L + B_L, A_U + B_U$ is symmetric. If

there exist H and $K \in \mathcal{F}_n$ such $H^- H = I = KK^-$ then the following hold.

(1) $A_L \geq K(B_L : A_L), A_U \geq K(B_U : A_U)$ and $B_L \geq (B_L : A_L)H, B_U \geq (B_U : A_U)H$ for some H and $K \in \mathcal{F}_n$

(2) $A_L + B_L \geq K(B_L : A_L) + (B_L : A_L)H, A_U + B_U \geq K(B_U : A_U) + (B_U : A_U)H$ for some H and $K \in \mathcal{F}_n$

Proof

Consider for A_L

Since A and B are an interval valued range symmetric matrices By theorem (2.7)

$A_L^T = HA_L, A_U^T = HA_U$ and $B_L^T = B_L K, B_U^T = B_U K$

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A and$B$ are an interval valued parallel summable

$\Rightarrow R(A_L) \subseteq R(A_L + B_L)$

$\Rightarrow A_L = A_L(A_L + B_L)^-(A_L + B_L)$

$\Rightarrow A_L = A_L(A_L + B_L)^- A_L + A_L(A_L + B_L)^- B_L$

$\Rightarrow A_L \geq A_L(A_L + B_L)^- B_L$

$\Rightarrow A_L \geq A_L : B_L$

and $C(B_L) \subseteq C(A_L + B_L)$

$\Rightarrow B_L = (A_L + B_L)(A_L + B_L)^- B_L$

$\Rightarrow B_L = A_L(A_L + B_L)^- B_L + B_L(A_L + B_L)^- B_L$

$\Rightarrow B_L \geq A_L(A_L + B_L)^- B_L$

$\Rightarrow B_L \geq A_L : B_L$

Thus $A_L \geq (A_L : B_L)$

Premultiply by H and using $A_L{}^T = HA_L$ we get

$\Rightarrow HA_L \geq H(A_L : B_L)$

$\Rightarrow A_L{}^T \geq HA_L : HB_L$

$\Rightarrow A_L \geq (HA_L : HB_L)^T$

$\Rightarrow A_L \geq KB_L : KA_L$ [By lemma 3.11]

$\Rightarrow A_L \geq K(B_L : A_L)$

Since $B_L \geq A_L : B_L$

Post multiply by H and using $B_L{}^T = B_L K$ we get $B_L \geq (B_L : A_L)H$

On addition we get

$A_L + B_L \geq K(B_L : A_L) + (B_L : A_L)H$ for some H and $K \in \mathcal{F}_n$

Similarly A_U is also holds

Hence the theorem

CONCLUSION

In this study, we have investigated the parallel summable of interval valued range symmetric matrices are an interval valued range symmetric matrices. In addition,we have derived some Proposition of parallel summable of interval valued range symmetric with examples.

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RESEARCH ARTICLE

Psychosocial Conditions of Healthcare Workers during Fight against COVID-19

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ABSTRACT

Healthcare workers fighting against the deadly corona virus which is popularly called as Covid-19 induced pandemic are under tremendous pressure, which puts them at an increased risk of developing psychological as well as social problems. Since the outbreak of the virus in 2019, Healthcare Workers (HW) in India have suffered an immeasurable amount of stress. The current study views the psychosocial conditions of healthcare workers during the Covid-19 pandemic which includes the prevalence of stress, anxiety, burnout, and depression as well as the accompanying risk factors that predict psychosocial morbidity and how the Indian government has dealt with the pandemic using intervention targets. The also depicts the atrocities faced by healthcare workers during the Covid-19 pandemic.

Keywords: Healthcare Workers, COVID-19, Psychosocial Condition, Pandemic

INTRODUCTION

The COVID-19 pandemic has wreaked havoc on almost every country or territory on the planet. The United States of America, India, Brazil, Italy, Spain, and Germany are among the most afflicted countries in the world, with thousands of people killed as a result of the uncontrollable scenario. The United States of America continues to have the highest death rates in the world. More than 29 million people have been infected, according to estimates. Meanwhile, in order to respond quickly and combat the pandemic, all governments have implemented a number of preventative measures. Despite all of the urgent steps, India has also been continuously experiencing an increase in the number of Covid patients, which has now reached about 4.8 million. However, those who are tasked with the most difficult tasks during this outbreak are receiving less attention in return for their efforts. They are none other

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than our country's healthcare workers. They are on the front lines of the Covid response and are at the greatest risk of infection and susceptibility. Furthermore, according to the World Health Organisation (WHO), other dangers may provide obstacles, including pathogen exposure, lengthy working hours, psychological discomfort, exhaustion, professional burnout, stigma, and so on [23]. Isolation and quarantine also limit their ability to spend time with their families, children, friends, and loved ones. Taking care of infected patients has always been a difficult task for medical personnel. Healthcare workers are frequently exposed to infectious diseases[15, 18]. WHO (2003) also stated that healthcare workers who have direct contact with diseased patients are at the greatest risk of infection. It has also been observed that, during the early stages of the Covid-19 outbreak, Health Care Workers made up 29% of all infected patients[19] Nurses, in particular, are vulnerable and are under a lot of pressure to keep working during a pandemic. According to Wheeler, they are subjected to a great deal of mental and emotional stress as a result of their occupations. Many of the staff in intensive care units (ICUs) are exposed to a variety of dangers because they are expected to perform certain tasks [20].

According to previous studies, healthcare personnel who are tasked with containing outbreaks experience occupational fatigue, mental weakness, anxiety, and despair [18]. Mhango et al. (2020) discovered a number of major concerns that healthcare personnel was confronted with, including a shortage of Personal Protective Equipment (PPEs), exposure to infected patients, overburdening of work, poor infection control, and pre-existing medical conditions [13]. The results also exacerbate their anxiety, which spreads to their family and coworkers [4,11,2]. Hence, given the current circumstances and the scarcity of literature on knowledge, attitude, and practice among healthcare workers, locating existing literature on the subject is difficult. Much research was undertaken at the start of the pandemic, including the epidemiology of the disease and its repercussions, as well as a major focus on disease propagation. There has been limited research on the difficulties faced by healthcare staff in the fight against COVID-19. This research aims to highlight the types of psychosocial concerns that our healthcare personnel suffers as a result of the COVID-19 outbreak.

Healthcare Workers and Covid-19
COVID-19 was declared a global pandemic by the World Health Organization (WHO) in March 2020 [23] and it caused a slew of health and psychological issues in people of all ages, including stress, anxiety, and depression [8]. The pandemic has wreaked havoc on people's lives all around the world. Problems posed by the health sector notably for the arrangements and accommodation of the patients and for quarantine centers. Eventually, healthcare personnel began to confront a variety of obstacles in providing their services, as well as being subjected to various forms of violence and abuse. During the fight against COVID-19, healthcare personnel was paying a high price. A section of the population has expressed concern about physical abuse and violence directed at healthcare employees. People's aggressive actions were observed in Delhi when two doctors went out to buy fruits around this time. Nurses' overtime and overworked working hours have also been noted. Because of the unexpected behaviour and attitude of the individuals demonstrated towards the healthcare employees, all of these incidents induce concern among the family members of healthcare workers. Nurses and doctors were pelted with eggs and physically assaulted in a case in Mexico [16]. They have been the target of violence in a number of countries, including India. Healthcare professionals in India have been attacked, threatened, and thrown stones because they have been completely exposed to COVID - 19 patients and the risk of spreading the virus to the general public [21]. In India, healthcare professionals have been attacked while collecting samples from suspected COVID-19 patients [5]. Other cases are highlighted by Rajratnam & Bhargav (2020) in their paper about attacks on physicians at Gandhi Hospital Hyderabad twice, once when a 49-year-old Covid patient died and the other time when a person admitted on medical leave died. Burnout, stigma, loneliness, and violence are just a few of the serious difficulties that healthcare workers face, and they all have a significant impact on their psychosocial well-being. Some psychological disorders, such as fatigue and cynicism, develop in reaction to the presence of a high degree of stress at work [5]. Healthcare personnel also faced the challenges of discrimination with the matter of protocols of isolation and self-quarantine because of the fear of the spread of disease among ordinary people. Various nations, like the United Kingdom and the United States, have reported an increase in the number of positive cases among front-line healthcare personnel [7]. When we mention the psychosocial impact on healthcare employees, we're talking about things like long duty

hours and mandated quarantines for nurses who have recovered from illness. The disease was transmitted among health professionals in early February 2020 due to overcrowding and a lack of segregated room facilities [7]. All of these factors have a bigger impact on healthcare workers' mental health and psychological well-being. According to research published by Shaukat and co-authors found that 53 (23.04 percent) of 230 healthcare workers experienced psychosocial issues as a result of the COVID-19 epidemic [13]. Similarly, cross-sectional research by Giusti and co-authors stated that of 235 health workers concentrating on the psychological impact of the Covid-19 outbreak, it was discovered that 88 (26.8%) had clinical levels of depression, 103 (31.3%) had anxiety, and 113 (34.3%) experienced Stress[2]. According to the study, HCWs reported high levels of psychological symptoms during the Covid-19 disaster, with clinical levels of sadness, anxiety, and stress exceeding 25%. Further, A Systematic review and meta-analysis study conducted by Pappa co-authorson 12 studies which were done in China and Singapore during the Covid-19 outbreak found that depression and anxiety prevalence among HWs was 22.8% and 23.2% [25]. In the same year, another comparison study in Singapore among 470 medical health workers (physicians and nurses) and non-medical health workers (allied health staff, administrative staff, and maintenance workers), 68 (14.5%) participants screened positive for anxiety, 42 (8.9%) for depression, and 31 (6.6%) for stress, indicating that the prevalence of anxiety was higher among non-medical HW's than medical workers [24]. In contrast to the above research, there was another study titled "The psychological influence of Covid-19 on HWs" which was studied in the United States, with a control group of 90 age-matched samples and 90 HWs. The findings revealed a current state of general anxiety as well as greater degrees of depressive symptoms. When compared to individuals who were not HCWs, this was due to past and prospective evaluations of Covid-related Stress[9].

The response toward Healthcare workers
The Government of India has taken several adequate measures to protect our healthcare workers, including supplying nearly 5.11 lakh PPEs and 30.32 lakh N95 masks to central and state hospitals in the initial stages, as well as an accidental insurance cover of Rs. 50 lakhs for 2212 lakh health workers announced by the Ministry of Health and Family Welfare. In addition, the Ministry has established a toll-free helpline-0804610007 service primarily to give psychosocial support to healthcare workers in collaboration with various experienced professionals and psychiatric departments during this period. Further, the Indian Supreme Court urged the government to ensure that enough security personnel is available for all healthcare workers and adopted an ordinance making all violence against healthcare workers a cognizable and non-bailable offence under the Epidemic Disease Act, 1897 [14].

CONCLUDING DISCUSSIONS

Mental health is critical to their capacity to perform efficiently, especially when exposed to harsh environments. Such exposure may have detrimental mental health repercussions, affecting the functioning and productivity of HCWs. As a result, the mental well-being of HWs is important for effective functioning[17]. Maintaining positive interactions with patients as well as coworkers' mental health is a priority for HWs[1]. Therefore while working under such strain, healthcare employees' psychosocial well-being is critical since it can lead to mental illness, distress, tension, worry, and a fear of stigma, among other things. The question is how stigma may be linked to their mental health throughout this time. Because of the nature of the virus's dissemination and the fear of the stigma associated with it, people may face avoidance in their family or community, according to WHO. Such behaviour could put them in jeopardy of continuing to provide services and combating the Covid-19 problem. In addition to providing psychosocial assistance, practitioners such as social workers, psychologists, social work educators, and trainers can use Tele-counseling and Virtual Counseling to collaborate with other experts. They may also be recommended to maintain contact with their friends, family, and loved ones, as well as the other way around. Maintaining the protocol of social separation may provide a sense of mental stability in their practice contexts. Thus, in hospital settings, establishing a Tele-counseling and/or Virtual Counseling center would provide a platform for healthcare service providers to deal with this scenario.

During this pandemic, professional and trained counsellors and psychologists should take appropriate actions to assist our healthcare workers in regulating their stress levels, which may considerably develop their coping mechanisms. Various volunteer service organizations, NGOs, and other Civil Society Organizations can provide mental, emotional, and social support to individuals working in healthcare. This would be able to provide a good working environment for healthcare personnel in a variety of scenarios. The general public can also raise awareness and thank healthcare providers for their tireless efforts to help Covid-infected persons. Because healthcare professionals are subjected to high levels of stress and are in danger of psychological harm. A suitable balance between supplied efforts and received incentives becomes a key aspect in motivating healthcare professionals in their work environments. It is not that someone is attacking healthcare personnel; rather, it is that they are causing damage to the system, which is impacting all societies. For those healthcare workers who provide their services without hesitation, such a situation would be humiliating. According to Talaee (2020), healthcare staff should not put off dealing with a health catastrophe. Healthcare workers should be provided with a consistent supply of PPE material and other protective equipment on a regular basis. Healthcare employees should be praised and rewarded for their unselfish contributions and services. Recognizing the value of healthcare personnel will strengthen them in the face of sickness and pandemics [18] In a setting like this, it's critical to promote study into the mental health of healthcare personnel.

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RESEARCH ARTICLE

Studies on the Silkworm's *Bombyx mori* (L.) (*Lepidoptera: Bombycidae)* Fed with Control and V-1 Mulberry Leaves Treated with Copper Nanoparticles (CuNps)

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ABSTRACT

The following studies have been taken into consideration for estimating the growing amount of the larval and pupa characteristics of the silk worm *B.mori* feed on V-1 mulberry leafs treated with Copper Nanoparticles (CuNps). CuNp was created using a chemical reduction process and diluted to various concentrations, including Twenty five percent Fifty percent, Seventy percent, & Hundred percent (Without dilution). Each concentration of new mulberry leaves (*M.indica* L.) was sprayed over silkworms of the third, fourth, and fifth in stars, which were fed five times per day. As a control, group T1 larvae were given distilled water-sprayed V-1 mulberry leaves. Groups T2, T3, T4, and T5 larva were given Twenty five percent Fifty percent, Seventy percent, & Hundred percent CuNps-sprayed mulberry leafs, respectively. When compare to those feed on control (Group T1) V-1 mulberry leafs and further group, silkworm larva feed on *Morus indica* (V-1) leafs sprayed with 25 percent concentration of CuNps (Group T3) had considerably longer, wider, and heavier cocoons (T2, T4 and T5). Therefore, 25% CuNps was determined to be the efficacious dose. In the current study, it was found that leaves treated with 25% CuNps (group T2) and given to silkworms produced more silk than control leaves did at the larval and pupal stages.

Keywords: B*ombyx mori, Morus indica*, copper nanoparticles (CuNps), V-1 Mulberry leaves.

INTRODUCTION

Sericulture is the practice of raising silkworms to generate cocoons, which are used as the starting point for the manufacture of silk. Even today, silk remains the most prized of all textiles, along with a variety of man-made fibers of unmatched excellence as the "Queen of Textiles" (Saleem Ahamad *et al.,* 2016). Being an agriculturally based hut business, sericulture is noted for its ability to produce great incomes & employ (Jolly, 1987). According to P.A. Bothikar and colleagues (2014), sericulture is a rural agro-based sector with significant employment potential and foreign exchange profits. India has about 4 million individuals working in sericulture either directly or indirectly (Chowdhary, 1984). Many people's lives depend on the traditional Asian industry of raising silkworms, *Bombyx mori.* Improved finances for this company & the ability to meet manufacture demands would result from increased larva growth & cocoon value and amount. As a outcome, an essential component in increasing cocoon formation is enriching mulberry leaves with additional chemicals (Ponraj Ganesh Prabu, *et al.,* 2011). Numerous studies and publications have been conducted and published on this subject (Etebri, 2002; Etebari *et al.,* 2004; Islam *et al.,* 2004).It was discovered that adding complimentary compounds to mulberry leaves increased the larvae increase and post-cocoon features (Etebari, 2002; Etebari and Fazilati, 2003). Numerous illnesses afflict silkworms, which can occasionally lead to significant crop losses. Many different compounds are used to keep illnesses from attacking silkworms, increasing the yield of silk in the method (Thilagavathi, *et al.,* 2013).

In silkworms, nutrition act on important role in controlling growth. The monophagous insect *Bombyx mori* mostly consumes mulberry leaves. The creation of artificial diets marked the beginning of significant developments in the study of silkworm nutrition (M.Meeramaideen, *et al.,* 2017). For healthy development and survival, the silkworm needs a number of important carbohydrates, proteins, amino acids, fatty acids, and vitamins. These crucial elements are required for the development of the silk gland & increased manufacture of seeds & silks. The mulberry leaf provides the silkworm, *B. mori*, with all the nutrients necessary for its development. The capacity and value of mulberry leafs, as well as the surrounding environment, affect how well the silkworm produces silk. Age, position, maturity, soil fertility, pruning, agronomic procedures, and environmental conditions are said to affect the quality of mulberry leaves. For a very long time, production animals have been used as growth promoters when given high dietary levels of copper (Cu). A pre-absorption effect (local and antimicrobial) and a post-absorption effect (systemic) have both been proposed as potential modes of action. Cu is often delivered in the feed as a sulphate source ($CuSO_4$), while there are other sources available. It is widely known that boosting $CuSO_4$ supplementation to supra nutritive levels considerably improve piglet development performance. Since Ancient Egypt, when copper was used to sanities chest wounds and water, the antibacterial effect has been understood. Copper sulphate has been a common growth promoter in growing and finishing diets for swine production systems. According to recent studies, tribasic copper chloride can promote growth in nursery pig diets just as effectively as copper sulphate (C.W.Hastad et al., 2001).

The term "copper nanopowder" refers to a copper powder with particle sizes less than 100 nm that is used as a substitute for more affordable precious metals like gold and silver. Copper in its unadulterated form has excellent electrical & thermal conductivity property & is also antibacterial. Among the industrial uses for copper nanopowder are catalysts, conductive ink, conductive paste, anti-biotic, antimicrobial, and anti-fungal agents, sintering additives, lubricant additives, and anti-microbial and anti-fungal agents (Wahyudi, et al., 2018).CuNPs have been shown in numerous studies to be effective against a variety of microorganisms, including Gram-positive bacteria like *S. aureus*, *B.subtilis*, and *B.cereus*, Gram-negative bacteria like *E. coli*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *Klebsiella pneumonia*, and Enterobactor, Micrococcus, and rice pathogen X (*Trichoderma viride, Aspergillus Niger, Candida albicans* and Curvularia). When compared to various antibiotics (Chloramphenicol, Plantomycin, Streptomycin, Ampicillin, Cefepime hydrochloride monohydrate L-arginine, Ofoxin, and antifungal medicines), Cu NPs activity demonstrated excellent results of a defined inhibitory zone (Fluconazole and Ketoconazole). (Mostafa F., Al-Hakkani, 2020). A balanced concentration of microelement, antioxidant, matrix metallo proteinases, & further components are needed for the complex process of wound healing. One of the things preventing the healing of wounds is a copper deficiency

(A.A. Rakhmetova, *et al.,* 2009).Similar to other creatures, nutrition is crucial for the improvement of the increase and enlargement of the silk worm, *Bombyx mori L.* According to Legay (1958), the nutritional worth of mulberry leafs acting a very important part in developing high-class cocoons. Silk production is based on larval feeding. When feed on nutritionally enhanced leafs, Seki and Oshikane (1959) found that silkworm larvae grew and developed more favorably and produced better-quality cocoons. Mulberry leaves provide silkworms with all of their nutritional needs because they are monophagous and able to live full lives. The work is associated with research on the increase rate of *Bombyx mori* feed with control & treated with copper nanoparticles V-1 mulberry leafs. The purpose of this learning is to determine how copper nanoparticles affect *B. mori.*

MATERIALS AND METHODS

In Tamil Nadu, India, at the farmers training centre in Vatharayanthethu, Chidambaram Taluk, Cuddalore district, silkworm *Bombyx mori* LNB4, D2 (Local Bivoltine) race eggs be gathered. For hatching, the egg was placed in an incubator at a heat of 25 to 2℃ & relative moisture of 70% to 80%. Larva be separated from store culture after hatching. The larva be placed into five experimental groups, each with 6 larvae, including controls (distilled water controls). The larvae were raised in 22 x 15 x 5 cm cardboard boxes that were wrapped in polythene sheet and set up on an iron platform with ant well. The following treatments are practical to the larvae. CuNps be created via a chemical reduction process. It is dilute in distilled water at concentrations of Twenty five percent Fifty percent, Seventy percent, & Hundred percent (without dilution). Each concentration was used to spray fresh mulberry leaves, which were then allowed to air dry for ten minutes. Silkworms were given the extra leaves five times every day. Mulberry leafs sprayed with distilled water were given to group T1 larvae as a control, and group T2 larvae received Twenty five CuNps-sprayed mulberry leafs, group T3 larva accepted Fifty percent CuNps-sprayed mulberry leafs, group T4 larvae accepted Seventy five percent CuNps-sprayed mulberry leaves, and group T5 larvae accepted Hundred percent CuNps-sprayed mulberry leafs, respectively. The length, width, & weight of larvae in their third, fourth, and fifth instars as well as of cocoons were measured for each group.

Copper Nanoparticles Prepation (CuNps)
Cu (II) sulphate pentahydrate was used as a forerunner salt in the chemical reduction procedure to create the Cu nanoparticles, and starch served as the capping agent. Start by adding 120 ml of starch (1.2%) solution to 0.1 M copper (II) sulphate pentahydrate solutions and vigorously stirring for 30 minutes. The synthesis solution is mixed rapidly and continuously as 50 ml of a 0.2 M ascorbic acid solution is added in the second stage. The resulting solution was then slowly supplemented with 30 ml of a 1 M sodium hydroxide solution while being heated at 80℃ for two hours while stirring continuously. The solution's color changed from yellow to ocher. After the reaction was finished, the solution was removed from the heat and left to cool overnight. The supernatant solution was then removed by filtration, and the excess starch that had been bound to the nanoparticles was removed by washing the solution three times with deionized water and ethanol. Precipitates of ocher color are dried at room temperature. Nanoparticles were kept in glass vials for later analysis after drying.

Mulberry, Variety V-1 (*M. indica*)
V-1 variety is one of the mulberry variety chosen from the Vatharayanthethu sericulture farm in the Melbhuvanagiri Block of the Chidambaram taluk and Cuddalore district. The leaves are thick, succulent, thick oval and dark green in colour. Good agronomical traits include a high rooting ability (80%).

Copper Nanoparticles (CuNps) Applied to Mulberry (*M.indica*) V-1 leaves
Lee and Meisel state that the chemical reduction process was used to prepare CuNps (1982). It was diluted to concentrations of twenty five percent, fifty percent, seventy five percent, and hundred percent (without dilution). New mulberry plants were submerged in every concentration for fifteen minutes before being air-dried for ten. The silkworm *Bombyx mori* larvae in their third, fourth, and fifth in stars were fed on the treated leaves.

Statistic evaluation

Using commercially obtainable statistical software (SPSS® for window, V 16.0, Chicago, USA), information be analyze using one-way analysis of variance (ANOVA) and Duncan's multiple range test (DMRT). P values 0.05 were consider statistically important, and outcome were given as means standard deviation.

RESULT

Larval Characters

Morphometric Examination of Third , Fourth and Fifth instars larvae compared to controls

In the third in star of *B. mori* larvae, Table 1 displays the morphological data for the length, breadth, and weight of the larval parameter feed with control V-1 leaves & CuNps treat V-1 leaves. The 3rd instars larva of group T1 had average measurements of 1.7000±0.1414 cm, 0.3667±0.05164 cm, and 0.1133±0.0051 gm, respectively. The 3rd in star larvae of group T2 had mean sizes of (1.9500±0.1643 cm, 0.4167±0.05164 cm, and 0.1250±0.0104 gm), respectively. The third in star larvae of group T3 had mean measurements of 1.8667±0.1316 cm, 0.3500±0.05477 cm, and 0.1150±0.0104 gm, respectively. The 3rd in star larvae of group T4 were on average 1.900±0.1549 cm, 0.3667±0.0408 cm, and 0.1167±0.0117 gm in length, width, and weight, respectively. Larvae of group T5's third in star had mean measurements of 1.8833±0.1472 cm in length, 0.3833±0.0408 cm in breadth, and 0.1183±0.0117 gm in weight, respectively. In these five observations, 3rd instar larvae treated with 25% CuNps had considerably greater length, breadth, and weight than the other groups (T1, T3, T4 and T5). Table 2 displays the morphological measurements of the length, breadth, and weight of the *Bombyx mori* larvae feed with control V-1 leaves and CuNps treat V-1 leaves in the fourth instar. Larva of group T1's fourth instar had mean measurements of 5.7667±0.2422 cm in length, 0.5833±0.0983 cm in breadth, and 0.4267±0.0372 gm in weight, respectively. Larvae of group T2's fourth instar had mean measurements of 6.0667±0.1643 cm in length, 0.6667±0.0516 cm in breadth, and 0.5533±0.0413 gm in weight, respectively. 4.4667±0.1966 cm, 0.6333±0.0817 centimeter, & 0.4400±0.0395 gm, respectively, were the average lengths, widths, & weights of group T3's 4th instar larvae. 5.4333±0.2066 cm, 0.6167±0.0758 centimeter, & 0.4200±0.0335 gm, respectively, were the average lengths, widths, & weights of the larvae in their fourth instars belonging to group T4.

4.4833±0.1835 cm, 0.6167±0.0758 centimeter, & 0.4200±0.0335 gm, respectively, were the average lengths, breadths, & weights of group T5's 4th instar larvae. When compared to the other groups (T1, T3, T4, and T5) in these 5 observations, the twenty five CuNps-treated 4th instar larvae's length, breadth, & weight were significantly improved. Table three show that the Morphological data of length, breadth and weight of larval parameter of *Bombyx mori* feed with control V-1 leaves & CuNps treat V-1 leaves in 5th instars larva of *Bombyx mori.* Instar 5 larvae of group T1 had mean measurements of 6.7667±0.3933 cm in length, 1.0667±0.1751 cm in width, and 2.8417±0.1497 gm in weight, respectively. 7.3000±0.1414 cm, 1.1500±0.0837 centimeter, & 3.5667±0.2338 gm, respectively, were the average lengths, breadths, & weights of group T2's 5th instar larvae. The 5th instar larvae of group T3 had mean sizes of (7.0167±0.1169 cm in length, 1.0333±0.1211 cm in breadth, and 3.0967±0.2729 gm in weight, respectively). The average dimensions of group T4's 5th instar larvae were 6.96670±0.1366 cm in length, 1.0336±0.1211 cm in breadth, and 3.2083±0.3137 gm in weight, respectively. Larvae in the fifth instar of group T5 had mean dimensions of 6.7667±0.3933 cm in length, 1.0000±0.0635 cm in breadth, and 2.9700±0.3910 gm in weight, respectively. In these five observations, the length, breadth, and weight of the 5th instar larvae treated with 25% CuNps were considerably higher than those of the other four groups (T1, T3, T4 and T5).

Criteria for cocoon

Table 4 demonstrates that the mean length, breadth, & weight of the cocoon of the *Bombyx mori* larva feed on CuNps-treated V-1 leaves be found to be greater than those of the larva feed on control V-1 mulberry leaves. It was discovered that the average length, breadth, and weight of the T1 larva produced cocoon be (3.4167±0.3764 centimeter, 2.1500±0.1643 centimeter, & 1.5500±0.1049 grams), correspondingly. The average length, breadth, and weight of the cocoon that the T1 larvae generated were determined to be (3.4167±0.3764 cm in length, 2.1500±0.1643 cm in breadth, and 1.5500±0.1049 gm in weight, respectively). The average dimensions of the T2 larvae-produced

cocoon were measured to be (3.7333±0.1751 cm in length, 2.4333±0.0817 cm in breadth, and 2.2150±0.1713 gm in weight, respectively). The average dimensions of the T3 larvae-produced cocoon were measured to be 3.3667±0.1633 cm in legth, 2.1000±0.0895 cm in breadth, and 1.5667±0.1211 g in weight, respectively. The average dimensions of the T4 larvae-produced cocoon were measured to be (3.3000±0.2251 cm in length, 2.0833±0.0983 cm in breadth, and 1.3933±0.1108 gm in weight, respectively). The T5 larva produce cocoon's average length, breadth, and weight be measured to be (3.4000±0.2757 centimeter, 2.2000±0.1265 centimeter, & 1.6333±0.2160 gram), correspondingly. In these 5 observations, the 25% CuNps-treated larva generated cocoons that are noticeably longer, wider, and heavier than those of the other four groups (T1, T3, T4 and T5).

DISCUSSION

In the current study, certain groups had considerably larger larva & cocoon length, Breadth, & weight. Numerous studies have demonstrated that varied concentrations of supplementary chemicals, such as ascorbic acid, folic acid, thiamine, vitamin B complex, etc., improve the characteristics of larvae. AgNps compound has been demonstrated to improve the food ingestion, growth, & exchange efficiency of silkworms by Valantina Sangamithirai, A. *et al.,* (2013). In the current study, it was found that silkworm fed with a specific dose of CuNps had increased larvae length, Breadth, & weight, & the characteristics of the cocoon were concurrently increased from the 3 to the 5 instars, suggesting that CuNps were stimulating silkworm to fed additional nutrients than the control. This work is supported by Nirwani & Kaliwal's (1996) hypothesis that folic acid phagostimulation was responsible for the increase in larvae & cocoon length, Breadth, & weight. According to Thilagavathi, G. *et al.,* (2013), treatment with the antibiotic amoxicillin at a concentration of 0.4% may have positive effect on the growth of silkworm larvae & pupal length, Breadth, and weight. It may also increase the amount of silk produced by improving the financial parameter compared to control. Additionally, a number of publications noted this effect of ascorbic acid (Dobzshenok, 1974; Ito, 1978; Singh and Reddy 1981; El-Karkasy and Idriss, 1990). According to M. Meeramaideen *et al.,* (2017), lysine supplementation has been shown to have more growth-stimulating action & can be use to boost silk give up in marketable silkworm rearing. Although vitamins work as cofactors to help the metabolic process, the majority of these multivitamin combinations contain ascorbic acid, leading one to believe that the rise in larval weight is caused by an improvement in feeding activity in treated larvae. Similar results have been seen in the current investigation, which shows that CuNps operate as vitamins to increase silkworm feeding activity. CuNps can thereby enhance food digestion and raise the length, width, and weight of larvae and cocoons.

In this study, various treatments had an impact on cocoon properties. It was previously claimed that adding some vitamins to mulberry leaves could boost the output of cocoons. According to Senthamarai Selvi, E. *et al.,* (2014), the silkworm *Bombyx mori* dramatically increased morphological parameters such larvae length, Breadth, & weight when exposed to Twenty five percent concentration of *Spinacia oleracea* treat MR2 mulberry leafs. According to Nirwani and Kaliwal (1996), folic acid significantly raises economic indicators like the weight of the female and male cocoons. According to Evanglista *et al.,* (1997), treatment with multivitamins causes an increase in the length, Breadth, & weight of the larvae and cocoons. According to Chand Asaf and Mahavishnu's (2018) research, spirulina-treated leaves improve the quality of cocoons and silk in terms of features like pupal weight, shell weight, and cocoon weight. These insects' increased weight, width, and length as a result of the enhancement of mulberry leafs with CuNps were attributed to metabolism other than protein synthesis. In conclusion, CuNps could raise a quantity of biological character in silkworms, other than this augmentation could economically develop sericulture. It is expected that dietary fortification supports the metabolism of carbohydrates and fats. CuNps treatment at a concentration of 25% in the current study may have favourable impacts on the length, Breadth, & weight growth of the silkworm larval and pupae as well as enhanced the number of silk manufacture by improving feed efficiency compared to control. Therefore, the growers can be advised toward use this supplement to produce more silk.

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Table 1. Morphological data of different CuNps concentration treat with V-1 mulberry leafs on the length, Breadth & weight of *B. mori* Third-instars larva.

Third instar larva			
Group	Length(centimeter) (Average ± Standard Deviation)	Breadth(centimeter) (Average ± Standard Deviation)	Weight (gram) (Average ± Standard Deviation)
Control (T_1)	1.7000±0.1414	0.3667±0.0516	0.1133±0.0051
V-1 mulberry + 25% CuNps (T_2)	1.9500±0.1643	0.4167±0.0516	0.1250±0.0104
V-1 mulberry + 50% CuNps (T_3)	1.8667±0.1316	0.3500±0.0547	0.1150±0.0104
V-1 mulberry + 75% CuNps (T_4)	1.9000±0.1549	0.3667±0.0408	0.1167±0.0103
V-1 mulberry + 100% CuNps(T_5)	1.8833±0.1472	0.3833±0.0408	0.1183±0.0117

Values are Average Standard Deviation of 6 observations. $P<0.05$ (DMRT) indicates a substantial different between value in the similar column with dissimilar superscript letters (a&b).

Table 2. Morphological data of different CuNps concentration treat with V-1 mulberry leafs on the length, Breadth & weight of *B. mori* Fourth-instars larva.

Fourth instar larva			
Group	Length(centimeter) (Average ± Standard Deviation)	Breadth(centimeter) (Average ± Standard Deviation)	Weight (gram) (Average ± Standard Deviation)
Control (T_1)	5.7667±0.2422	0.5833±0.0983	0.4267±0.0372
V-1 mulberry + 25% CuNps (T_2)	6.0667±0.1643	0.6667±0.0516	0.5533±0.0413

V-1 mulberry + 50% CuNps (T$_3$)	5.4667±0.1966	0.6333±0.0817	0.4400±0.0395
V-1 mulberry + 75% CuNps (T$_4$)	5.4333±0.2066	0.6167±0.0758	0.4200±0.0335
V-1 mulberry + 100% CuNps(T$_5$)	5.4833±0.1835	0.6167±0.0758	0.4200±0.0335

Values are Average Standard Deviation of 6 observations. $P<0.05$ (DMRT) indicates a substantial different between value in the similar column with dissimilar superscript letters (a&b).

Table 3. Morphological data of different CuNps concentration treat with V-1 mulberry leafs on the length, Breadth & weight of *B. mori* Fifth-instars larva.

Fifth instar larva			
Groups	Length(centimeter) (Aerage ± Standard Deviation)	Breadth(centimeter) (Average ± Standard Deviation)	Weight (gram) (Average ± Standard Deviation)
Control (T$_1$)	6.7667±0.3933	1.0667±0.1751	2.8417±0.1497
V-1 mulberry + 25% CuNps (T$_2$)	7.3000±0.1414	1.1500±0.0837	3.5667±0.2338
V-1 mulberry + 50% CuNps (T$_3$)	7.0167±0.1169	1.0333±0.1211	3.0967±0.2729
V-1 mulberry + 75% CuNps (T$_4$)	6.9667±0.1366	1.0333±0.1211	3.2083±0.3137
V-1 mulberry + 100% CuNps (T$_5$)	6.7667±0.3933	1.0000±0.0635	2.9700±0.3910

Values are Average Standard Deviation of 6 observations. $P<0.05$ (DMRT) indicates a substantial different between value in the similar column with dissimilar superscript letters (a&b).

Table 4. Morphological data of different CuNps concentration treat with V-1 mulberry leafs on the length, Breadth & weight of *B. mori* Cocoon.

Bombyx mori Cocoon			
Groups	Length(centimeter) (Average ± Standard Deviation)	Breadth(centimeter) (Average ± Standard Deviation)	Weight (gram) (Average ± Standard Deviation)
Control (T$_1$)	3.4167±0.3764	2.1500±0.1643	1.5500±0.1049
V-1 mulberry + 25% CuNps (T$_2$)	3.7333±0.1751	2.4333±0.0817	1.2150±0.1713
V-1 mulberry + 50% CuNps (T$_3$)	3.6667±0.1633	2.1000±0.0895	2.5667±0.1211
V-1 mulberry + 75% CuNps (T$_4$)	3.3000±0.2251	2.0833±0.0983	1.3933±0.1108
V-1 mulberry + 100% CuNps(T$_5$)	3.4000±0.2757	2.2000±0.1265	1.6333±0.2160

Values are Average Standard Deviation of 6 observations. $P<0.05$ (DMRT) indicates a substantial different between value in the similar column with dissimilar superscript letters (a&b).

RESEARCH ARTICLE

Research and Knowledge Production in Rural Tourism Entrepreneurship: A Bibliometric Analysis and Visualisation

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ABSTRACT

Entrepreneurship has garnered more attention in tourism research, indicating the critical role of entrepreneurs and new business start-ups in driving innovation and value creation in the tourism industry. The literature on rural tourism entrepreneurship is somewhat fragmented, despite its growth. It encompasses a variety of issues, perspectives, and approaches, and little congruent knowledge has been developed thus far. The present study aims to review the relevant literature using a bibliometric approach. The field structure is identified using bibliometric indicators such as citations, and the main trends in this region are mapped using the VOS viewer software. One hundred and four seminal articles from the Scopus database were systematically selected, and bibliometrically analysed.

Keywords: Rural tourism entrepreneurship, Rural tourism, Entrepreneurship, Rural tourism entrepreneur, Bibliometric Analysis, Vosviewer

INTRODUCTION

Entrepreneurship is the process of attempting to generate value by identifying business possibilities, managing acceptable risk-taking, and mobilizing the people, financial, and material resources required to finish a project. Entrepreneurship is derived from the French words "entreprendre" and the German word "unternehmen," which

both mean "to undertake." According to Schumpeter, enterprise is the process of forming new groups, and the entrepreneur is the one tasked with carrying it out. An entrepreneur is a person who takes on a new challenge and accepts some responsibility for the inherent risks. Going out on a limb and facing challenges is part of being good to go or being a businessperson. Rural tourism entrepreneurship is a type of business that is growing in rural tourism destinations. Creating commercial endeavors in provincial areas pertains to rural sector. Rural tourism industrialisation is identical with rural tourism entrepreneurship. Rural tourism entrepreneurship is becoming increasingly important as it provides numerous benefits in the growth of a tourism destination. Individuals who complete entrepreneurial activities in the rural economy by establishing mechanical and specialist units are known as rural tourism entrepreneurs. Building up business units and industries in rural areas alludes to country business at the end of the day. Simply said, rural tourism entrepreneurship denotes an increase in commerce in rural tourism areas.As part of the rural economic system, tourism entrepreneurs create and deliver significant tourism experiences, resulting in additional local revenue, improved tax revenues, and stimulation for other sectors of the local economy. Their efforts and businesses are essential because rural communities have typically seen a fall in their traditional primary industries, resulting in economic and social hardship. There is no denying that tourism can contribute to economic benefits by providing employment opportunities (Sharpley et al. 2002), as well as income generation (Briedenhann et al. 2004) and establishing new entrepreneurship fields (Ahmed et al. 2013).

It can reduce the unemployment rate in the local community by engaging in tourism activities (Fons et al., 2011) and so lessen the prevalence of poverty (Fons et al., 2011). According to Akunaay et al. (2003), community participation in the tourist sector is one of the measures for poverty reduction. By stressing the rural economy as the engine of economic growth that will drive the growth of the pro-poor, the rural development plan also highlighted tourism as a vital weapon for alleviating poverty. People's poverty rates should be reduced to guarantee that their quality of life is improved. As a result, the tourist sector's potential is considered to have the ability to improve the community's quality of life and well-being (Aref et al., 2010). Despite the potential market and increase of interest of scholars and practitioners on this issue, the current literature has no detailed account of how rural tourism entrepreneurship has been studied and understood in rural development. This research makes a contribution by presenting a bibliometric approach for synthesising prior published literature on rural tourism entrepreneurship. Previous tourism literature studies support the use of the bibliometric technique to map the structure and development of various types of tourism (Khanra et al., 2021; Ruhanen et al., 2015). This study illustrates the field's scientific development, knowledge area, and structure by reviewing and monitoring published papers. The relevance of entrepreneurship in rural tourism has resulted in an increase in publications on the subject. Previous study on this topic, however, has not included bibliometric analysis. As a result, this study will seek to bridge a knowledge vacuum in the literature by offering more in-depth information on rural tourism entrepreneurship and its evolution. Data for this study were gathered from the Scopus database and analysed using the VOS viewer software created by van Eck and Waltman (2010). The VOS viewer was chosen since it has been verified in numerous academic research and is straightforward and easy to use. Furthermore, the VOS viewer is the most widely used software tool in tourism studies and a variety of other fields (Mavric et al., 2021; Retmenolu et al., 2022). In the results and discussion section, the outcomes of the analysis are provided in detail.

METHODS AND MATERIALS

Bibliometrics is a methodology that is quite innovative compared to a traditional systematic literature review (De baker et al., 2015). The bibliometric analysis analyses the publication patterns of scientific production in a particular discipline to evaluate quantitatively, through statistical calculations, the communications published about a specific field (Koseoglu et al., 2016). Due to the significant expansion in the number of studies and scholars' growing interest in quantifying research performance, bibliometric analysis has become increasingly important in the tourism literature (Sainaghi& Baggio, 2020). It is a quantitative examination of academic literature that presents the description, appraisal, and monitoring of published research using bibliographic data. The bibliographic data for this study was obtained from Scopus, the world's largest abstract and citation database. This database was chosen

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because it has a much higher coverage of tourism publications (Wijesinghe et al., 2019) and has been used for bibliometric analysis in the tourism industry (Agapito, 2020; Jiang et al., 2019). The search protocol utilised was '("Rural Tourism") AND ("Entrepreneurship" OR "Entrepreneur" OR "Enterprise" OR "Family Business" OR "Startup").' These criteria were used to search and extract the publications related to rural tourism entrepreneurship. The initial search yielded 316 documents based on the given parameters, which were then subjected to a selection process using exclusion criteria to limit the search to document type (articles) and language (English). To ensure the quality of the review, only papers were included, and this sort of document passes through a rigorous review procedure. Because English is the most extensively used language in scientific publications, only articles written in English were examined for this study (Cisneros et al., 2018). Later, only articles published in tourism-indexed journals were chosen to narrow the scope of the study (Jiang et al., 2019). This filtration technique reduced the number of articles to 104. For bibliometric analysis, a CSV file of these documents was obtained from the database.

The final query was saved and subsequently searched. Next, the researchers screened the titles, abstracts, and keywords to identify the relevant publications. For final recommendations, the article should be related to rural tourism entrepreneurship, and it should be studied in the context of tourism and hospitality only. These criteria finally resulted in 104 seminal articles for the analysis. The PRISMA flow chart of the article selection process is shown in Figure 1. Bibliometric analysis is complex and often requires numerous and diverse software to analyse the bibliographic data. However, the majority of these programmes do not adhere to the complete science mapping methodology that is required (Aria & Cuccurullo, 2017).The Vosviewer software was used to build the bibliometric mapping for ease of data processing, building, and visualisation of bibliometric networks (Van Eck & Waltman, 2010). The software has been used to study various scientific disciplines (Río-Rama et al., 2020). It is a software tool for generating and visualising bibliometric networks based on co-citation, bibliographic coupling, or co-authorship links, with journals, researchers, or individual publications as actors (Van-Eck & Waltman, 2010). It also has text mining features for creating co-occurrence networks of key terms collected from a corpus of scientific literature. About visualisation capabilities, this software provides three visualisation options: i) network, ii) overlay, and iii) density.

RESULTS

Descriptive Analysis
Annual scientific production on Rural Tourism entrepreneurship
The final record of articles consisted of 104 Scopus indexed documents, and their year-wise distribution is shown in Figure 2. Though it is an emerging research area, there has been an increasing interest in rural entrepreneurship in recent times. However, relatively little has been written in this related field. The first article related to rural tourism entrepreneurship that was identified in the Scopus database is from 1992, and it was published in the Journal of "Tourism and the environment" with the title "Rural tourism and rural development" by Keane M. This article aimed to" How different approaches to the organisation and delivery of the rural tourism product can impact the types of outcomes that are obtained in a given area". Publications on the subject became regular in 2009 when six articles were published, and the number of publications has grown substantially ever since. From the year 2018, there was an increase in publications as the number of publications jumped from 3 to 10. From 1992 to 2021, the average number of papers published per year was 3.58, and the average number of papers published from 2018 to 2021 was 10.75, indicating that it is a rising topic with more articles projected to be published soon.

Rural tourism entrepreneurship research by the Journal
The distribution of articles by Journal (Figure 3) shows that Sustainability Switzerland (S.S.), Tourism Management (T.M.), Journal of Travel Research (JTR), and Journal of Sustainable Tourism published more articles. The rural tourism entrepreneurship-related papers were published in a wide range of tourism and hospitality journals of various scopes. These four journals were the most influential and productive sources for publishing rural tourism entrepreneurship research, accounting for about 37% of all publications, with the remaining 32 journals accounting

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for 63%. There are 16 journals with only one issue, accounting for almost 47% of all publications, indicating that they are not specialised journals in the field. Another 30% of journals have published two papers, 8.3% have published three, 5.5 percent have published four, and 19.3% of journals have published five or more articles. Figure 4 depicts the five most important journals in terms of citations and published papers, and Table 5 depicts how they have changed over time. The top 5 journals have published articles, representing 42.3% of the papers in the sample. The Journal of Sustainability Switzerland is the leader in the number of papers, and the Journal of Tourism is leading in the number of citations per year. Monitoring the evolution of each source, as shown in Table2, reveals that the Sustainability journal has recently taken the lead in terms of published papers, but this uniqueness has not allowed it to obtain a significant number of citations. When looking at their citations, Tourism Management produces a relatively consistent quantity of publications relevant to sustainability. This demonstrates the Journal's quality and effect; in fact, the Journal is ranked top in the Scimago (Scopus) and JCR rankings for tourisms, leisure, and hospitality management (Journal Citation Reports). Table 2 shows that a few journals published articles on this topic ten years ago. It is now clear that it is a research line with a large variety of intriguing outlets.

Most productive scholars, countries, and institutions
The most productive contributors (author, Country, and institution) are essential criteria in a bibliographic study for identifying the prolific contributors. For practitioners and researchers, it has a variety of ramifications. It aids them in recognising and establishing collaboration and academic exchanges in a specific area, according to Liao et al. (2019). The most productive scholars, countries, and organisations are depicted in Figures 5,6 and 7. There were a total of 160 writers identified in the examined documents. Polo Pea, A.I. is the most productive author among the authors, with the most publications of 4. This author is responsible for 3.84 percent of all rural tourism entrepreneurship publications, followed by Fras Jamilena D.M, Getz D, Hernández-Maestro R M, and Yachin J.M., whom each has three. Regarding countries, Canada,China, Spain,and Sweden are the top four active and dominant source countries, contributing more than 33 articles. This suggests that these country authors have invested significant resources in highlightingthe importance of rural tourism entrepreneurship research in tourism. In terms of institutions Högskolan Dalarna, Falun Dalarna, Sweden, and Universidad de Granada, Granada, Spain, and Mid Sweden University, Ostersund Sweden, all three ranked the top with four documents each. Following the geographic distribution, it was revealed that there is a global interest in rural tourism entrepreneurship, as 40 nations have published at least one paper on the subject, with a total of 160 authors contributing to this issue. This indicates that it is a global topic that has attracted the attention of authors from all over the world.

Documents by Subject Area
Most of the papers were published in the subject areas of business management and accounting, accounting for 40.55 percent of all documents, and social science, accounting for 37.7% of all documents. This analysis reveals that rural tourism entrepreneurship is mainly related to business and social science. Because the environment is a primary concern while developing rural tourism, a considerable number of articles were also produced in the area of Environmental Science, accounting for 13.5% of total documents.

Analysis by Funding Sponsors
According to the figures, China is in the lead in this regard, with the National Nature Science Foundation receiving the most funds, followed by the European Commission and the National Office for Philosophy and Social Sciences.

Network Analysis
Co-authorship Analysis
Co-authorship in terms of Authors:
This analytical parameter is examined in conjunction with three other parameters. For this parameter, the authors, organisations, and nations are taken into account. This study excludes documents with a significant number of authors. This figure is thought to be 25. For the minimum number of documents produced by an author, the threshold is set at two. It can be seen that 27 authors out of 238 matched the criteria. With the help of additional authors, the total strength of the co-authorship is calculated. The link strengths are obtained using this method. Polo

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Pea, A.I. found the highest link strength of 5, with the total number of citations to be 73 for four different documents. . In this case, three authors were found to have a co-authorship relationship. As a result, these are solely depicted in the diagram.

Co-Authorship in terms of Organisations

Co-authorship in the unit of organisations is computed using a minimum of 02 documents in organisations without taking into account citations; five organisations out of 210 total organisations match the criterion. The faculty of marketing and tourism, Edith Cowan University, Australia, has the highest link strength of 2 and the most number of citations with 443. (with 2 documents).

Co-authorship in terms of Country

Co-authorship is also possible in terms of the Country. There are 40 nations in which these databases are available. After taking into account a country's minimum of two documents, 25 countries met the requirement. The United States was discovered to have the most citations, at 1016. With seven links, Canada has the strongest link strength of all. In terms of the number of documents, China, Canada, and Spain have the most, each with 11 documents.

Network Analysis of Co-occurrences
Co-occurrence analysis in terms of all keywords

Different keywords are evaluated while analysing co-occurrences. The minimum number of keyword occurrences is determined to be 5. Only 24 keywords out of 507 fit the criteria. The weights of the nodes are represented by the size of the nodes and words in Figure 5. The weight is proportional to the size of the node and word. The intensity of a relationship between two nodes is reflected in the distance between them. A lesser distance indicates a stronger relationship. A line connecting two keywords indicates that they have appeared together. The thicker the line, the more likely they are to appear together. The nodes with the same colour belong to a cluster. VOS viewer divided the keywords of rural tourism entrepreneurship-related publications into 6 clusters. The keyword "rural tourism" has the highest frequency of 62. Other keywords with a high frequency include "tourism development" (29), "rural area" (28), and "entrepreneur" (20). The frequency of co-occurrence is measured by the connection strength between two nodes. It can be used to portray the relationship between two nodes as a quantitative index. The sum of a node's link strengths over all other nodes is the node's total link strength. The node, "rural tourism", has thicker lines with "rural area" (22)"tourism development" (18),"entrepreneur" (11), "tourism economics" (9), "tourism" (9), "tourist destination" (8), "entrepreneurship" (6). These are all the nodes whose link strengths are greater than 5. The relationships between "rural tourism " and " tourism development", "rural area" as well as "entrepreneur" imply the close integration of rural tourism and tourism development.

Network Analysis of Citations

The units of analysis used in this analysis are documents, sources, authors, Country, and organisation.

Citation Analysis of Documents

A minimum of 5 citations per document is regarded a threshold out of a total of 104 papers. As a result, 84 documents passed the test. Getz D. (2000) has the most citations (344), as well as the strongest link strength (18) of the group.

Citation Analysis of Sources

The criterion of 5 citations per source is used to obtain a citation analysis of sources. Only six of the 37 sources satisfied the criteria. 'Tourism Management' journal has got maximum citations of 2047 with 12 documents and total link strength of 27, followed by the 'Journal of Travel Research' with 713 citations. As the visualisation illustrated in Figure 11, each cluster has a colour that indicates the group to which the cluster is assigned. We can see that all these journals are divided into three clusters. The red cluster contains Tourism Management, Journal of Travel research and tourism planning and development. The green cluster contains the Scandinavian Journal of Hospitality and

Tourism and the Journal of sustainability Tourism. The blue cluster contains the Journal of Sustainability (Switzerland).

Citation analysis by Authors
Three citations per author is the criterion used here. Among the total of 238 contributors, 5 authors met the requirement. Getz D. has the most citations, with 466, followed by Hernadez-Maestro R.M., who has 82.

Citation analysis by the organization
With a minimum of two documents per organisation as a criterion, only five organisations out of 210 met the requirement. Edith Cowan University's School of Marketing and Tourism has the most citations with 443.

Citation analysis by Country
Out of 40 countries, 18 countries met the minimal document criteria of three documents per country. Among all countries, Canada has the highest total link strength of 50.

Network Analysis of Bibliographic Coupling
A) Bibliographic Coupling of Documents
Considering five documents per author as a minimum threshold value. Out of a total of 104 authors, 84 authors met the threshold criteria.

B) **Bibliographic coupling of Authors**
As a minimum, three documents per author should be considered. Only five of the 238 authors met the minimum requirements.

DISCUSSION AND CONCLUSIONS

Entrepreneurship and rural tourism are interrelated concepts. Both researchers and practitioners have recognised the mutual importance of these concepts. The above analyses of the 104 research-related articles on rural tourism entrepreneurship provide a solid theoretical basis for a fuller understanding of this field of research. The present research helps to understand the state of the art of the research in the area of rural tourism entrepreneurship. It helps identify countries and institutions that publish the most, journals specialising in rural tourism entrepreneurship, the trends in the covered subjects based on keywords, and the relevance of publications from the co-citation networks. We explored some interesting results concerning the entrepreneurship-related publications, which can be summarised as follows: The first article related to rural tourism entrepreneurship identified in the Scopus database is from 1992. The publications related to this field fluctuated low from 1992 to 2007. However, after 2008, the number of publications multiplied. In terms of institutions, Högskolan Dalarna, Falun Dalarna, Sweden, Universidad de Granada, Granada, Spain, and Mid Sweden University, Ostersund, Sweden, have the highest number of documents. Canada, China, Spain, and Sweden are the top four active and dominant source countries, contributing more than 33 articles. The Journal of Sustainability Switzerland is on top in terms of the number of papers. The Journal of Tourism is leading in the number of citations per year. The United States was found to have the highest number of citations. Canada has the highest link strength. China has a good number of publications, while Chinese scholars should pay attention to the quality of their papers and need to work in collaboration with other countries of the world. Most of the selected articles were published in tourism-specialised journals and business economics-specialised journals. Only a few articles were published in entrepreneurship specialised journals. Furthermore, the participation of scholars in rural tourism entrepreneurship research is relatively low. Polo Pea, A.I. is the most productive author among the authors, with the most publications of 4. This author is responsible for 3.84 percent of all rural tourism entrepreneurship publications, followed by Fras Jamilena D.M, Getz D, Hernández-Maestro R M, and Yachin J.M., whom each has three. The connection between rural tourism with a particular focus on entrepreneurship practices lacks a more profound study in its varied intersections and dynamics. Therefore, more research is needed to

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understand more about this phenomenon. Finally, there are certain limitations to this research: The first is the usage of a single database (Scopus) without taking into account other databases commonly used in academia, such as Web of Science or Dimensions. Second, the focus is on a single form of material (articles) rather than broadening knowledge through the use of books, book chapters, and conference papers, among other things. Third, simply taking into account articles written in English, which, despite being the majority, may leave out considerable contributions written in other languages. However, the study gives a rigorous process for the selected papers and the usage of a database that is widely regarded as reputable by experts worldwide. The number of documents utilized and the phrases used to allow for the presentation of a research effort can be used as a reference for future researchers in the field of rural tourism entrepreneurship. Future research could profitably extend our analytical approach to another language (e.g., Chinese, German, French, and Spanish), develop a comprehensive global vision of the literature, and also include other types of documents.

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Table 1. No. of documents published by top five journals

Source Title	Articles
Sustainability Switzerland	13
Tourism Management	12
Journal Of Travel Research	7
Journal Of Sustainable Tourism	6
Scandinavian Journal of Hospitality And Tourism	6

Table 2. Cite score publication per year

Source ↓	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Tourism Management	5.5	5.5	6.5	7.1	6.9	7.7	9.2	10.9	12.8	16.5
Sustainability	1.4	1.4	1.9	1.6	1.7	2.1	2.5	2.8	3.2	3.9
Scandinavian Journal of Hospitality and Tourism	1.4	1.6	1.8	1.4	1.6	1.9	2.5	4.2	5.3	5.9
Journal of Travel Research	3.1	3.5	3.9	5.2	6.1	6.9	7.9	9.2	10.9	13.3
Journal of Sustainable Tourism	3.4	5.1	6	5.7	5.3	5.6	5.8	5.7	6.4	8.3

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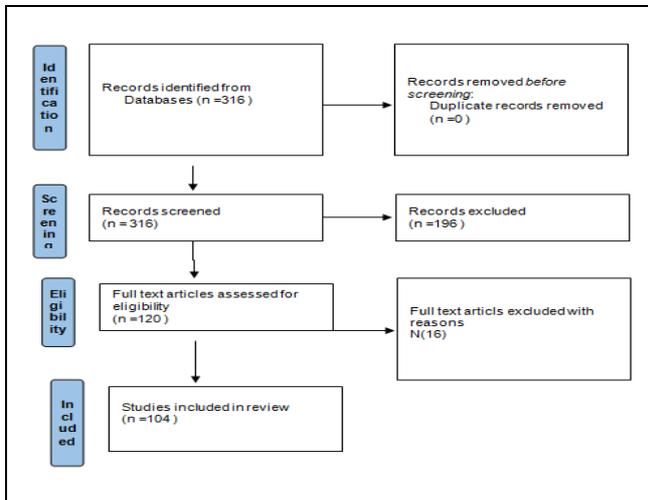
Figure 1. PRISMA diagram.
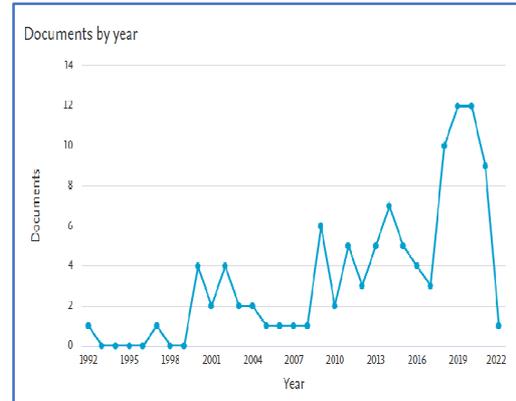
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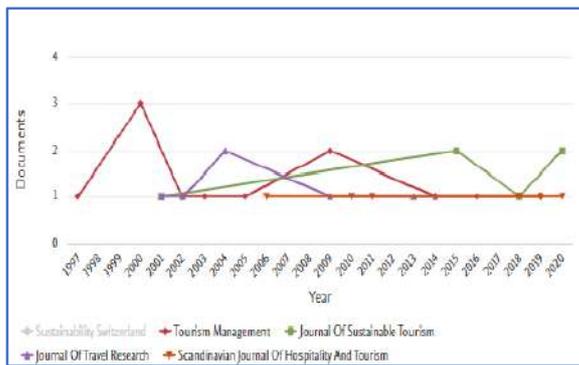
Figure 3. Documents per year by source.
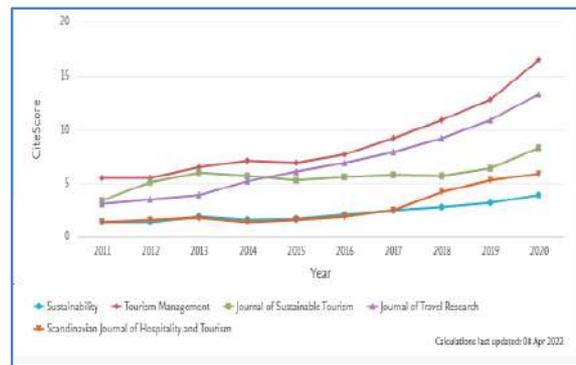
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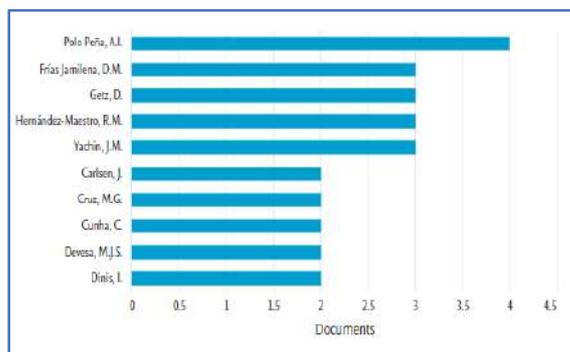
Figure 5. The number of documents by author.
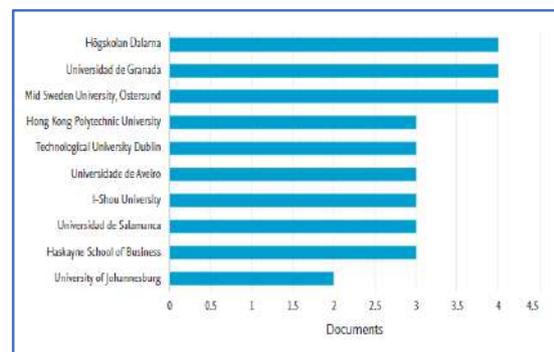
Figure 6. Number of Documents by Institutions.

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Figure 7. Number of documents by Country

Figure 8. Documents by subject area.

Figure 9. Documents By funding Sponsor

Figure 10.Co-Authorship in terms of Authors

Figure 11. CO-authorship in terms of Organisations

Figure 12. Co-Authorship in terms of Country
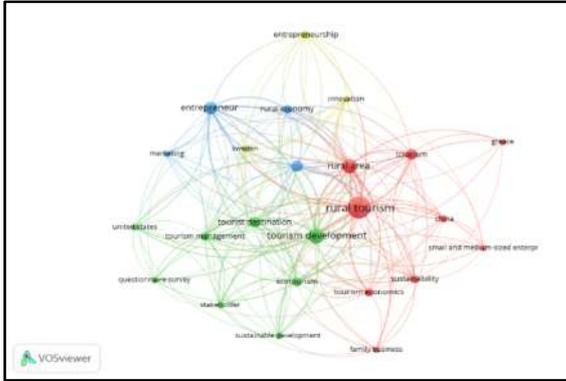
Figure 13. Co-occurrence analysis in terms of all keywords
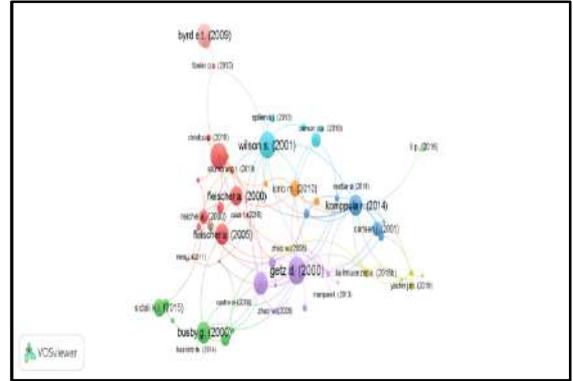
Figure 14. Citation Analysis of Documents
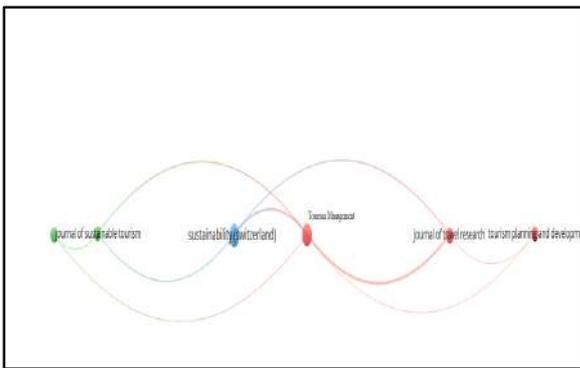
Figure 15. Citation Analysis of Sources
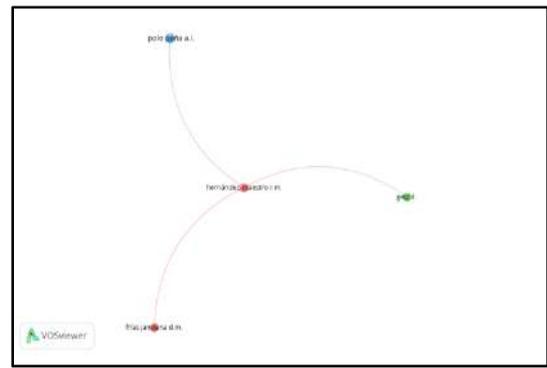
Figure 16. Citation analysis by Authors
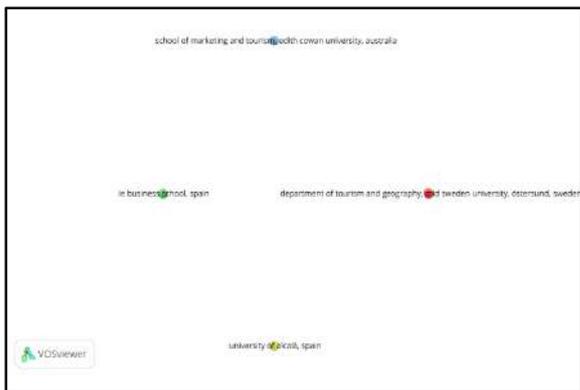
Figure 17. Citation analysis by the organisation.
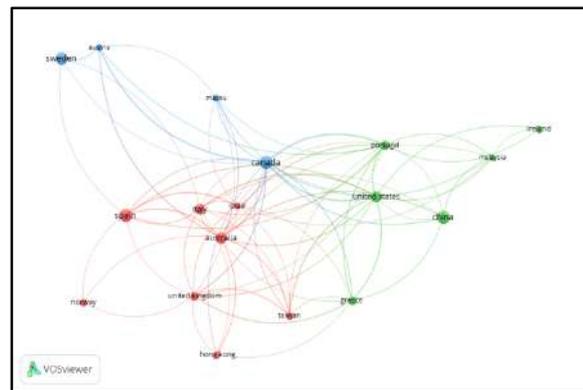
Figure 18. Citation analysis by Country

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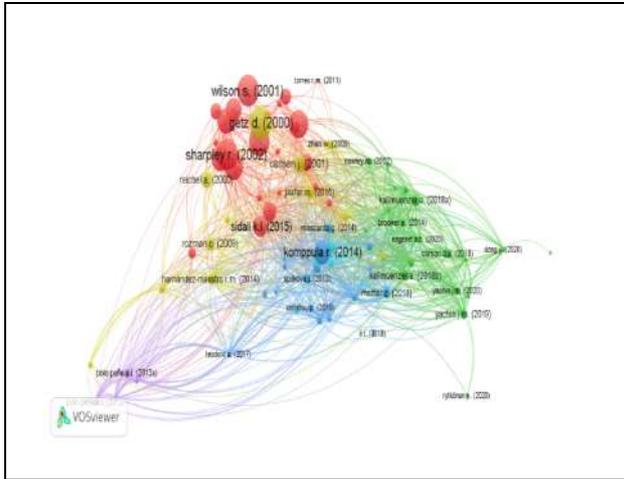
Figure 19. Bibliographic Coupling of Documents	**Figure 20. Bibliographic coupling of Authors**
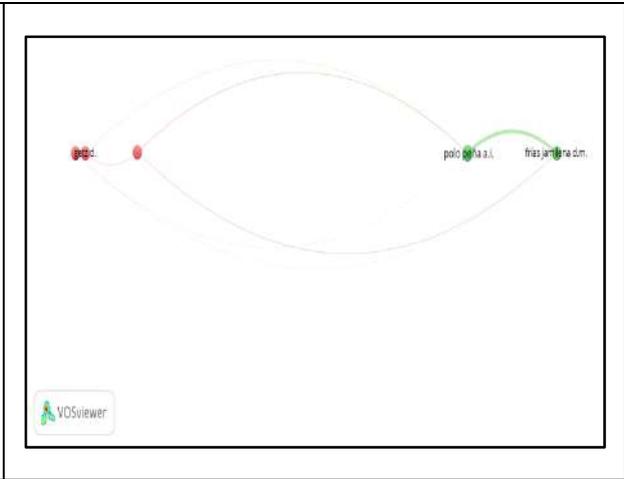
RESEARCH ARTICLE

Predicing the Severity of Disease by using Data Mining Techniques Based on Healthcare Information System

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ABSTRACT

The common use of healthcare information system is a technology-driven system that makes the process of sharing protected health information between organizations and providers. The data mining and data analytics are the main tool for healthcare decision and attempt for awareness. The report generations from the big data improve the delivery of healthcare services, there appear no effort for assess and synthesize the accessible in sequence. The big data process has contributed to better outcome for the liberation of healthcare services. This paper aims to analyses the methodically review by categorizing and evaluating the related studies on healthcare operations and data mining frameworks. The outcome of this research work explores the stages of severity of the diseases mentioned in the previous research works and it also explains the methodology that adopted for prediction.

Keywords: Healthcare Operation Management, Predictive Analytics, Data Mining Systematic Literature Review

INTRODUCTION

The everlasting and large growth of data usually identified as big data, generate from a variety of industry software applications. Big data can be mainly successfully used to create new insight to recover process and to support management supervisory. The big data is data that contains greater range, incoming in rising volumes and with more velocity. Data mining and predictive analytics aims to disclose pattern and policy by relating advanced data

analysis technique on a huge set of data for colorful and predictive purposes, data mining as the 'nontrivial mining of hidden, formerly unheard of and potentially useful information from data' only if a strong basis for informed decision making. Recently there has been modifying towards exploring potential of utilizing data mining tools and techniques for designing and managing operations. By using data mining methods one can survey into the history of the disease, and predict the diseases by using the techniques like classification, clustering, association rules, summarizations, regression. The main objective of this research work is to predict diseases using classification algorithms, in the early stage of disease.

Problem Definition

The main objective of this research work is to predict diseases using classification algorithms namely finding the efficient algorithm. The Related works that discussed in this paper were differentiated based on the algorithms that used for the prediction of disease. The proposed methodology is given and analyzes the experimental results and gives conclusion by predicting the disease using the assure said methods the disease can be predicted and the necessary steps taken, the methods used are Decision trees, couple of disease such as Covid19, Cancer, Neonatal Jaundice, Acute Renal Failure have been identified and finally a particular pestilence is taken for further study

LITERATURE REVIEW

Classification techniques have been used for evaluate the prospect of disease to healthcare sector Some of the previous works done by the research experts based on a survey of the literature healthcare prediction, the techniques used in one of the following categories Logistic Regression, Random Forest, Naive Bayes, Decision trees, Performance Analysis.

A. Applying Data Mining techniques to improve diagnosis in Neonatal Jaundice
Specific Domain: Neonatal jaundice
Data set: Total of 227 newborn infants included into the study of 35 cases
Methods: Classification techniques
▪ 　　　Classification models,
▪ 　　　Decision tree,
▪ 　　　Neural networks,
▪ 　　　Naïve Bayes(a naïve bayes classifier using estimative classes).
Evaluation Parameters: Accuracy, Standard Deviation
Pros: Decision Trees and artificial neural networks are makes advantage to be more easily accepted by the medical community.
Cons: An AUC of 0.74 compared to the 0.69 presented in that study, although the difference are not statistically significant.

Flow:
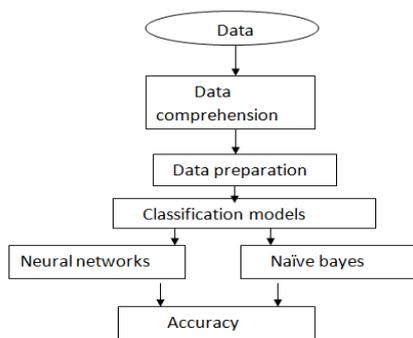
Rajitha and Santhana Megala

Experimental Results: At 24 hours of life of newborns the accuracy for the prediction of   hyperbilirubinemia

Data mining and analysis of scientific research data records on Covid 19 mortality, immunity, and vaccine development - in the first wave of the Covid-19 pandemic
Specific Domain: Covid-19
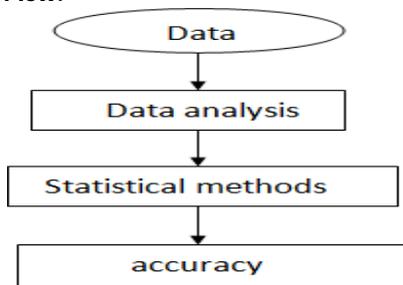**Data set:** 276 records on covid-19
Methods: Classification techniques
Evaluation Parameters: Accuracy, Recall, Median
Pros: Covid 19 Mortality, Covid 19 Vaccine, Covid 19 Immunity, we performed three different searches on the web of science collection
Cons: Standard dataset was not used.
Flow:

Experimental Results: Analyzed the conceptual structure maps with factorial analysis and multiple correspondence analysis and identified multiple relationship between keywords symptoms and concept

Applying Data Mining for the Analysis of Breast Cancer Data
Specific Domain: Breast cancer
Data set: 699 records acquired from the breast cancer patients at the University Of Wisconsis
Methods: Classification techniques:
- The artificial neural network,
- Decision tree, logistic regression and
- Genetic algorithm

Evaluation Parameters: Accuracy
Pros: The results revealed that the accuracies of Logistics Regression, Neural Network and the Genetic Algorithm.
Cons: The average predicted accuracy of the decision tree model was 0.9435 which was the lowest of all four predictive models

Flow:

53090
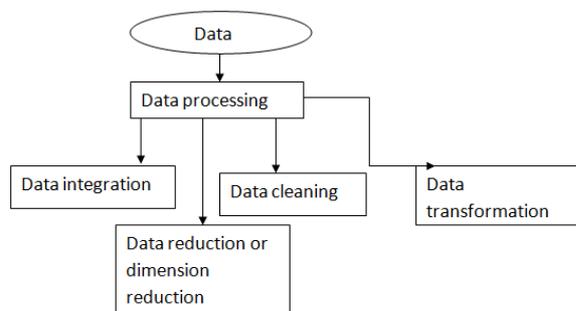
Rajitha and Santhana Megala

Experimental Results: Three performance measures: accuracy, sensitivity and specificity where TP, TN, FP and FN denotes True Positives, True Negatives, False Positives and False Negatives respectively

DATA MINING CLASSIFICATION ALGORITHMS FOR KIDNEY DISEASE PREDICTION:
Specific Domain: Kidney disease
**Data set:** Dataset contains 584 instance and 6 attributes are used in their comparative analysis
Methods: Classification techniques:
- Classification,
- Naïve Bayes classifier algorithm
Evaluation Parameters: Accuracy, precision, Recall
Pros: To predict kidney disease using classification algorithms such as naïve bayes and support vector machine
Cons: The performance of the SVM is better than the Naïve Bayes classifier algorithm

Flow:
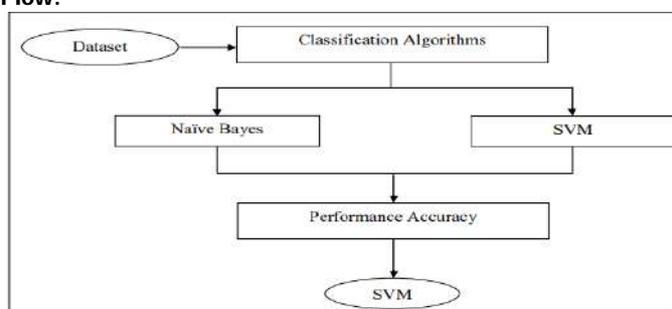
Experimental Results: The experimental comparison of classification algorithms are done based on the performance measures of classification accuracy error rate and execution time

CONCLUSION

The outcome offered in this study is useful in providing a holistic view of how data mining and predictive analytics have contributed to healthcare services. From the detailed literature review, data mining in healthcare has got a greatest scope of a research with great potential. While some areas of health care services have concerned more algorithms like Classification, Association, Naïve Bayes, Svm, Decision Tree, Regression of Clinical Pathway, but there is scope for using Naïve bayes and SVM. These methods were generating to recover process analyses and Healthcare services to improve patient's recovery in the earlier stage itself. Finally, this study will predict an ordered approach by the literature.

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RESEARCH ARTICLE

Isolations and Identification of Biosurfactant Producing Marine Yeast *Saccharomyces* sp (CAS 09) from Karaikal Fishing Harbor, Puducherry

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ABSTRACT

Microbial surfactants are eco-friendly products with amazing properties and spectrum of applications. Evaluation of hydrocarbon degrading potentials and emulsifying activities indicated that biosurfactants were produced by newly isolated yeast strain, *Saccharomyces* sp, obtained from a from Karaikal harbor, Puducherry. Twenty-five of the isolates were isolated from the sediment sample and their identification was carried out by using morphological and microscopically observations. The yeast isolates were tested for biosurfactant production using various screening methods such as oil displacement assay, drop collapse assay, determination of surface tension reduction, and emulsification index. This strain was able to grow effectively on crude oil and Diesel as sole sources of carbon and energy. Yeast extract at 0.6 %(w/v) concentration and 1% (w/v) glucose supplement yielded maximum biosurfactant. Conclusively, isolates CAS09 was marked as promising biosurfactant producers and were subjected to identification. Based on microscopic examination and biochemical peculiarities, isolateCAS09 might be identified as

Saccharomyces sp. These strains produce biosurfactant that have potential for use in a variety of biotechnological and industrial processes particularly in the pharmaceutical industry.

Keywords: Biosurfactant, Emulsification index, Marine yeast, *Saccharomyces sp.*

INTRODUCTION

*Biosurfactants are surface active biomolecule substances produced by microbes (Bacteria, Fungi and Yeast) are recently used for the production of biosurfactants since, it has several advantages over the chemical surfactants, such as lower toxicity, higher biodegradability, better environmental compatibility, higher foaming, high selectivity and specific activity at extreme conditions such as temperatures, pH and salinity (Shekhar et al., 2014).*These compounds comprise wide range of chemical structures, such as glycolipids, lipopeptides, polysaccharide-protein complexes, phospholipids, fatty acids and neutral lipids (Ismail et al., 2021). Biosurfactants from microbial origin are heterogenous group of secondary metabolites with surface activity. These biomolecules can be produced either extracellularly or on the living cell surfaces of various microorganisms including bacteria, yeasts, and fungi (Yalçın *et al.,* 2018). *They play an important role in various fields like bioremediation, biodegradation, oil recovery, food, pharmaceutics, and many other applications in different industrial sectors (*Sen *et al.,* 2017*).* Yeasts, being eukaryotic in cell organization, have cell wall comparatively rigid and less prone to damage by biosurfactants and therefore, can produce biosurfactant in higher concentrations. Yeasts are considered good producers of biotechnologically important molecules. However, few yeast strains are described in literature as producing biosurfactants, including *Cyberlindnera saturnus* (Balan *et al.,* 2019), *Pseudozyma tsukubaensis, Rhodotorula babjevae* (Sen *et al.,* 2017), *Starmerella bombicola* (Claus *et al.,* 2022),*Wickerhamomyces anomalus* (Souza *et al.,* 2017), *Meyerozyma guilliermondii* (Sharma *et al.,* 2019), *Saccharomyces cerevisiae* and *Candida albicans* (Ilori *et al.,* 2008) (Monteiro *et al.,* 2009).Although most of the microbial biosurfactant productions have been reported in bacteria so far, the pathogenecity of the bacteria often restricts its application areas. Considering GRAS (generally regarded as safe) status of the yeasts and the importance of their metabolites with potential applications in numerous fields of diverse industries(Yalçın *et al.,* 2018).This makes the application of yeast economically more feasible at industrial level for production of biosurfactants (Sharma *et al.,* 2019). The present investigation focuses on isolation, screening and identification of biosurfactant-producing yeast and optimization of process parameters for the improvement of the biosurfactant production by yeast *Saccharomyces* sp. isolated from a hydrocarbon polluted site of Karaikal harbor, Puducherry.

MATERIALS AND METHODS

Collection of soil sample
Soil samples were collected using pre-sterilized spatula in unused plastic covers from oil contaminated marine sediment sample from Karaikal harbor, Puducherry, India.

Isolation of biosurfactant producing microorganisms
Soil samples were serially diluted, processed and suitable dilutions were spread on the surface of BH agar (Bushnell Hass Agar) containing 1% crude oil and incubated at 35°C for 7 days. Levofloxacin to avoid bacterial contamination, pure colonies obtained were maintained Rose Bengal Agar slants and used for further research.

Screening of the isolates for biosurfactant production
Hemolytic activity
The isolated stains were inoculated to the BHA broth and incubated for overnight. The blood agar plates were prepared. Then the medium in the plates were punchered with the help of a gel puncture. 0.1ml of overnight cultures were inoculated in to individual wells and incubated at 28±2°C for 48 hrs. The plates were visually inspected for zone

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of clearance around the wells. The diameter of the clear zone was taken as an indicator of biosurfactant production. The strain showed maximum zone of clearance was taken as the highly potential strain (Mulligan *et al.*, 1984).

Determination of oil spreading capacity
Oil spreading technique for biosurfactant production was performed according to the method of Anandaraj and Thivakaran, 2010. 30ml of distilled water was taken in the pertiplates. 1 ml of crude oil, petrol, diesel, and kerosene and engine oil was added to the centre of the plates containing distilled water. Now 20μl of the supernatant of the culture was added to the water to the center. The biosurfactant producing organism can displace the oil and spread it in the water.

Estimation of emulsification activity
Cell free extract (1ml) was dissolved in 5ml of Tris buffer (pH 8.0) in 30ml screw capped test tubes. To the above solution 5ml of crude oil was added to each tube and shaken well for 20 min. in a shaker at 150 rpm and the mixture was allowed to stand for 20 min. The optical density of the mixture was measured at 610 nm and the results were expressed as D_{610} (Rosenberg *et al.*, 1979). The most potential strain was tested for kerosene, diesel and petrol also.

Identification of isolated fungi
Using the lacto phenol cotton blue straining method followed by Oyeleke *et al.* (2015), fungal isolates were identified based on their morphology. Each fungus' aerial mycelia were taken out of the fungal cultures, placed on a clean slide, covered with a clean cover glass, and stained with a drop of lacto phenol. 10x and 40x magnifications of the light microscope were used to see the slide (Klich *et al.*, 2002 and Samson *et al.*, 2007).

Optimization of growth of potential strain
Based on the hemolytic activity, oil spreading technique, emulsification activity and, the most potential biosurfactant producing isolate was selected for the optimization studies. Optimization for growth was carried out and different physicochemical parameters such as incubation periods (0-72 hrs) with the interval of 6 hrs, pH (5.0, 6.0, 7.0, 8.0, 9.0, 10.0), temperature (25, 30, 35 40 and 45°C), salinity (NaCl concentration - 0.5, 1.0 1.5, 2.0, 2.5 and 3%), different carbon sources (sucrose, glucose, maltose, fructose, lactose and starch); ideal carbon source was tested at different concentrations (0.5, 1, 1.5, 2.0 and 2.5%) and nitrogen sources (peptone, beef extract, yeast extract, tryptone and ammonium nitrate); ideal nitrogen source was tested at different concentrations (0.2, 0.4, 0.6, 0.8 and 1.0%) using crude oil as substrate (1%) were tested.

Mass scale culture and biosurfactant production
Using optimized parameters, mass scale culture was done in 1L shake flask with 750ml medium. As the production of biosurfactant was seemed to be growth dependent; biosurfactant production was estimated in the mass scale broth. Biomass in the mass scale medium was estimated. Broth culture was taken and allowed to stand for 20 min. When the oil phase gets separated, the bottom phase with cells was siphoned out and filtered through a 0.45μm sized Millipore filter paper. Then the paper with cells was dried at 80°C in a hot air oven and weighed. Biomass was quoted in terms of g/L (dry weight) (Li *et al.*, 1984).

RESULTS

Isolation of biosurfactant producing microbes
Collected soil samples from oil contaminated marine sediment sample collected from Karaikal harbor, Puducherry, India with showed a density of 1.9×10^3 CFU/ml was observed (Fig.2).

Screening for biosurfactant production
Screening for biosurfactant production was done based on the hemolytic activity, oil spreading technique, emulsification activity and BATH assay (Figs. 2-3). The biosurfactant production from the isolated strains and

maximum activity of 63% was observed. Among the three isolates; strain (CAS 09) which showed the maximum activity in hemolytic assay (26 mm) with oil spreading capacity, emulsification activity was selected as the highly potential isolate for the biosurfactant production. Oil spreading technique and emulsification activity also confirmed the biosurfactant potential of the strain and this strain was selected for the further study.

Identification of potential biosurfactant producing isolate
The selected yeast (CAS 09) was subjected to morphological, cultural and various sugar assimilation tests to identify the species. On Bushnell Hass Agar plate the colony was found to be white, shiny and round. The potential strain was identified as *saccharomyces sp*. This strain was used for further study (fig:2).

Optimization of growth of potential strain
Optimization for growth was carried out and different physicochemical parameters such as incubation periods (0-72 hrs), pH (5-10), temperature (25-45°C), salinity (0.5-3%), different carbon and nitrogen sources using crude oil as substrate (1%). In the present study 42 hrs of incubation period where the highest growth of 1.128 OD was observed. Likewise, the maximum growth was observed at pH-8 (1.12 OD), temperature - 35°C (1.11 OD), salinity (NaCl concentration) - 1% (1.132), 1% glucose (1.16 OD) as carbon source and 0.6% yeast extract (1.22 OD) as nitrogen source were seem to be important factors for the and maximum growth of (CAS 09) *Saccharomyces sp.*(Figs.5-12). In the mass scale medium, under the optimum conditions the growth of 3.8 OD with the biomass of 4.1 g/L (on dry weight basis).

DISCUSSION

Biosurfactants are surface-active compounds from biological sources, usually extracellular, produced by bacteria, yeast or fungi. Research on biological surfactant production has grown significantly due to the advantages they present over synthetic compounds such as biodegradability, low toxicity, diversity of applications and functionality under extreme conditions. Although the majority of microbial surfactants have been reported in bacteria, the pathogenic nature of some producers restricts the wide application of these compounds A growing number of aspects related to the production of biosurfactants from yeasts have been the topic of research during the last decade. Amaral *et al.*, 2008 had given the industrial importance of yeasts and their potential to biosurfactant production. Mancnaughton *et al.,* 1999 pointed out the microbial communities within contaminated ecosystem tend to be dominated by those organisms capable of utilizing and surviving at that particular contamination. In the present study Bushnell and Hass medium was used for the isolation and optimization for the production of biosurfactants and the degradation studies for crude and the results are in accordance with the work of Iqbal *et al.*, 1995) were among the first to demonstrated bacterial production of biosurfactants by isolating strains of *Saccharomyces sp* in a mineral media, containing Cresol, mineral oil or paraffin. As in the present study, Domingues *et al.,* 2020 studied biosurfactant production in sub-oxic conditions detected in hydrocarbon-degrading isolates from marine and estuarine sediments. Kurniati*et al.,* 2019 isolated and screened biosurfactant producing bacteria from hydrocarbon contaminated soil in Jakarta Bay. Biosurfactant producing bacteria from groundnut oil cake dumping site (Chittepu, 2019). Wu *et al.,* 2019 isolated an oil degrading potential biosurfactant producing bacteria from a marine environment.

Crude oil contains hydrocarbons that are not resistant to attack by microorganisms, Collected soil samples from oil contaminated marine sediment Chennai Ennore harbor with showed a density of 3.9×10^{3}CFU/ml was observed. Biosurfactant production was screened using oil spreading technique, emulsification activity, hemolytic activity and BATH assay. BATH assay refers to the percentage of adherence of yeast to the oil particles which is a pre requisite for oil-in-water emulsion formation. In the present study, morphologically different colonies were tested for hemolytic activity, oil spreading technique, emulsification activity maximum activity was observed. Biosurfactant producing capacity in liquid medium was found to be associated with hemolytic activity and appears

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to be a good screening criterion for surfactant-producing strains (Carrillo *et al.,* 1996). Hemolytic activity has been used for the isolation of glycolipid biosurfactants (Mulligan *et al.,* 2005)

The strains showing the activity in the hemolytic assay were considered for the oil spreading, emulsification activity, to ascertain and conformation of the biosurfactant production from the isolated strains and maximum activity of 63% was observed. The strain which showed the maximum activity in hemolytic assay (26 mm) and BATH assay with 63% was conformed as the highly potential strain for the biosurfactant production and the oil spreading technique and emulsification activity also confirmed the biosurfactant potential of the strain . This strain was selected for the further study. High affinity of cells with crude oil was revealed by BATH assay for *Proteus inconstans* was reported as 95.3% (Thavasi *et al.,* 2007). In the present study, optimization for growth was carried out and different physicochemical parameters such as incubation periods (0-72 hrs), pH (5-10), temperature (25-45°C), salinity (0.5-3%), different carbon and nitrogen sources using crude oil as substrate (1%).

In the present study 42 hrs of incubation period where the highest growth of 1.128 OD was observed. Likewise, the maximum growth was observed at pH-8 (1.12 OD), temperature - 35°C (1.11 OD), salinity (NaCl concentration) - 1% (1.132), 1% glucose (1.16 OD) as carbon source and 0.6% yeast extract (1.22 OD) as nitrogen source were seem to be important factors for the and maximum growth. In the mass scale medium, under the optimum conditions the growth of 3.8 OD with the biomass of 4.1 g/L (on dry weight basis). Moshtagh*et al.,* 2018 produced biosurfactant from *B. Subtilis* N3-1P by using brewery waste as the carbon source. Tripathi *et al.,* 2019 observed 740±28.3 mg L^{-1}of a rhamnolipid biosurfactant biosurfactant after 96 h of growth of a marine isolated *Marinobacter* sp. MCTG107b strain. The best environmental conditions for *R. ruber* AC 239 growing in M2 were 37°C, 200 rpm, initial pH 7.0 and 1% Diesel (v/v) (Bicca *et al.,* 1999). Observed growth and degradation of alcohol and hydrocarbons at different concentrations ranged from 0.13% to 2.0% and found better growth rate at 0.5% (Zinjarde and Pant, 2002). Thavasi *et al.,* 2007 reported biodegradation of crude oil by *Candida maritime* showed maximum degradation of crude oil (85.15%), followed by *Bacillus megaterium* (78.5%), *Corynebacterium kutscheri* (76.4%) and *Lactobacillus delbrueckii* (71.6%) and similar results were obtained with bacterial strains namely *Rhodococcus rhodochrous* KUCC 8801 (93.1%), *Rhodococcus* sp. Iso 1 (81.1 %), *Acinotebacter calcoaceticus* IRO7 (91.2%) and *Pseudomonas putida* IR32 (47.6%) with 5 days of incubation (Sorkhoh *et al.,* 1990).

CONCLUSION

Biosurfactant are surface active agent that are produced extracellularly or as part of the cell membrane by bacteria, yeast and fungi. In the present study soil samples were from oil contaminated marine sediment karaikal harbor, Puduchery, India with showed a density of 3.9×10³CFU/ml was observed. Based on screening for biosurfactant, the strain (*CAS-09*) which showed the maximum activity in haemolytic assay (26 mm)with oil spreading capacity, emulsification activity and 63% of adherence capacity hydrocarbons (BATH assay) was selected as the highly potential strain for the biosurfactant production. Oil spreading technique and emulsification activity also confirmed the biosurfactant potential of the strain and this strain was selected for the further study. The potential strain was biochemically identified as *Saccharomyces sp* (CAS 09). This isolate was used for further study. When growth optimization was carried out for different physicochemical parameters; 42 hrs of incubation period with the highest growth of 1.128 OD was observed. Likewise, the maximum growth was observed at pH-8 (1.12 OD), temperature - 35°C (1.11 OD), salinity (NaCl concentration) - 1% (1.132), 1% glucose (1.16 OD) as carbon source and 0.6% yeast extract (1.22 OD) as nitrogen source were seem to be important factors for the and maximum growth of *Saccharomyces sp* (CAS 09).(Figs. 5-12). In the mass scale medium, under the optimum conditions the growth of 3.8 OD with the biomass of 4.1 g/L (on dry weight basis).

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ACKNOWLEDGMENT

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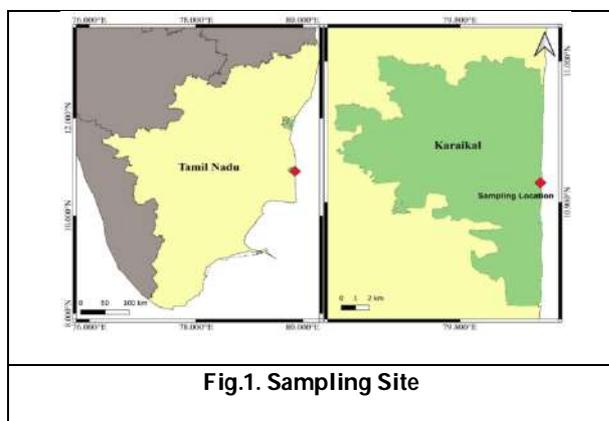
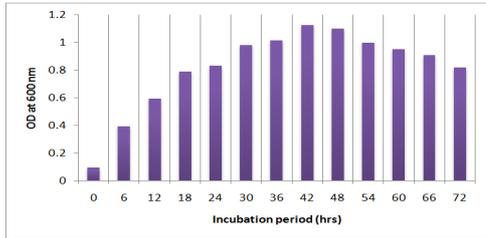| **Fig.1. Sampling Site**	**Fig. 2. Isolation and microscopic identification of *Saccharomyces sp***

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Fig. 3: Effect of incubation periodon growth of *Saccharomyces sp.*(CAS 09).
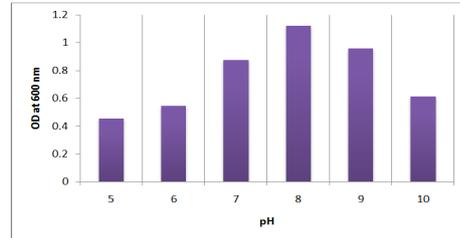

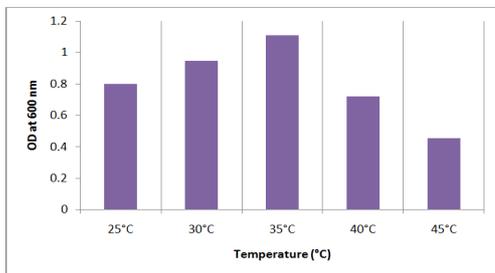**Fig. 4: Effect of pH on growth of** *Saccharomyces sp.*(CAS 09).

Fig. 5: Effect of temperature on growth of *Saccharomyces sp.*(CAS 09).
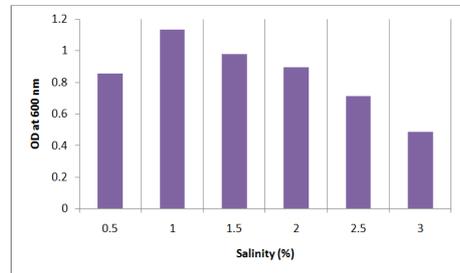

Fig. 6: Effect of salinity (NaCl concentration) on growth of *Saccharomyces sp.*(CAS 09).
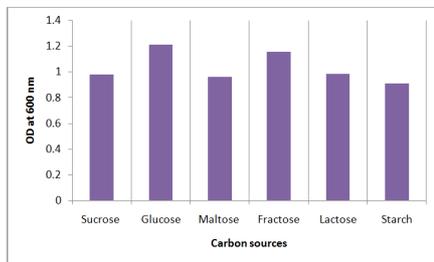

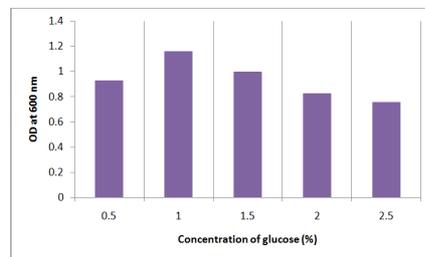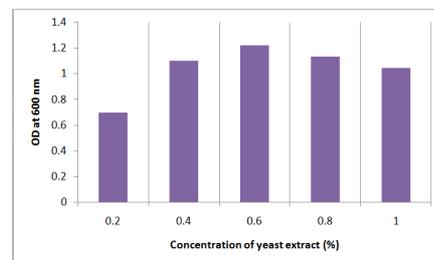**Fig. 7: Effect of carbon sources on growth of** *Saccharomyces sp.*(CAS 09).

Fig. 8: Effect of concentration of carbon source on growth of *Saccharomyces sp.*(CAS 09).
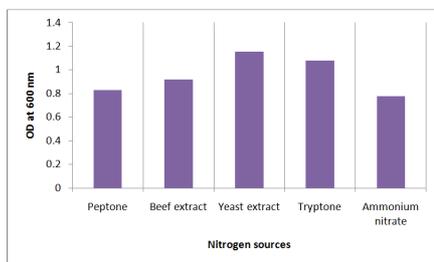
Fig. 9: Effect of nitrogen source on growth of *Saccharomyces sp.*(CAS 09).

Fig. 10: Effect of concentration of nitrogen source on growth of *Saccharomyces sp*(CAS 09).

RESEARCH ARTICLE

Assessment of Antagonistic Activity of Nitrogen Fixing Bacteria against Plant Pathogens

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ABSTRACT

Study was carried out to find out the antagonistic activity of nitrogen fixing bacteria against plant pathogens. Three plant pathogens *Alternaria solani, Magnaporthe grisea, Cercospora zea–maydis* were isolated from diseased plant parts of tomato, rice, maize respectively. The isolated pathogens were tested against five bacterial strains. The bacterial strains (PGPR-1, PGPR-2, PGPR-3, PGPR-4, PGPR-5) were isolated from rhizosphere of rice. It was confirmed from the result that all the five bacterial strain have the capability to fix atmospheric nitrogen. It was observed that percentage inhibition of PGPR-3 against *Alternaria solani* was highest (46.7%). Moreover, PGPR-5 showed 27% inhibition against *Magnaporthe grisea* and PGPR-2 showed 25% inhibition against all the three pathogen. PGPR-3 and PGPR-4 also showed 25% inhibition against *Magnaporthe grisea* and *Alternaria solani* respectively. Similarly, PGPR-1 showed 17% inhibition against *Cercospora zea-maydis* and PGPR-1, PGPR-3, PGPR-4, PGPR-5 showed 6.7-8% inhibition against all the pathogens.

Keywords: Antagonism, Phytopathogen, Rhizobacteria, Nitrogen fixer

INTRODUCTION

Soil is the store house of microbial activity. Microbial communities in the rhizosphere play a key role in the functioning of plants by influencing their physiology and development. While many members of the rhizosphere microbiome are beneficial to plant growth, also plant pathogenic microorganisms colonize the rhizosphere striving to break through the protective microbial shield and to overcome the innate plant defense mechanisms in order to cause disease (Mendes *et. al.,* 2013). Several microorganisms promote plant growth. Such bacteria are generally called as Plant growth promoting rhizobacteria (PGPR). The beneficial effects of these rhizobacteria on plant growth can be

direct or indirect. To exert their beneficial effects, bacteria usually must colonize the root surface efficiently. There are several mechanisms by which microbes can act beneficially on plant growth such as biofertilization, stimulation of root growth, rhizoremediation and plant stress control. Mechanisms of biological control by which rhizobacteria can promote plant growth indirectly, i.e., by reducing the level of disease, include antibiosis, induction of systemic resistance and competition for nutrients and niches (Lugtenberg and Kamilova, 2009). Plants are affected by different disease and these diseases are mainly caused by bacteria, fungi, virus etc. Identification of these diseases in the early stage of infection and curing them is essential to prevent plant from destruction. Several substances produced by PGPR have been related to pathogen control and indirect promotion of growth in many plants, such as siderophores and antibiotics (Beneduzi *et. al.*, 2012). PGPR confer benefits to host plants including growth promotion and disease suppression. PGPR taxa vary in the ways whereby they curtail the negative effects of invading plant pathogens (Wang *et. al.,* 2021). Research has demonstrated that inoculating plants with PGPR can be effective strategy to stimulate crop growth. Furthermore, it can improve crop tolerance for the abiotic stresses likely to become more frequent as climate change conditions continue to develop. They keep the soil environment highly enriched in all kinds of micro and macronutrients which indirectly benefits plant health. PGPR may influence plant growth either directly or indirectly. Direct pathway through PGPR involves either the provision of bacteria synthesized compounds to support the uptake of multiple parameters of crop development, whereas in indirect pathway PGPR decreases or antagonizes the deleterious effects of one or more phytopathogens. PGPR produce substances that also protect them against various diseases. PGPR may protect plants against pathogens by direct antagonistic interactions between the biocontrol agent and the pathogen, as well as by induction of host resistance. PGPR that indirectly enhance plant growth via suppression of phytopathogens do so by a variety of mechanisms. These include the ability to produce siderophores that chelate iron, making it unavailable to pathogens, the capacity to synthesize antifungal metabolites such as antibiotics, fungal cell wall lysing enzymes or hydrogen cyanide, which suppress the growth of fungal pathogens, the ability to successfully compete with pathogens for nutrients or specific niches on the root and the ability to induce systemic resistance. In cognizance with the above a study was carried out to assess the antagonistic activity of nitrogen fixing bacteria against plant pathogens.

MATERIALS AND METHODS

Isolation of fungal pathogens from disease plant parts: The diseased leaf sample of tomato, rice and maize were collected from the field. Infected leaves were cut into small pieces. After washing the tissues thoroughly in sterile water, the causal fungi were isolated from plant tissues exhibiting clear symptoms. The infected tissues along with adjacent small unaffected tissue was cut into small pieces (2-5 mm squares) and by using flame-sterilized forceps, they were transferred to sterile Petridishes containing 0.1% Mercuric Chloride solution, used for surface sterilization of plant tissues. The plant parts were transferred to Petri dish containing Potato Dextrose Agar (PDA) media and incubated for 5 days for the complete growth of fungi (Thilagam et. al., 2017). After incubation, fungal colonies were identified based on colony characteristics, hyphal structure, morphological characteristics of spores etc., by consulting taxonomic monograph. For isolation of PGPR, rhizospheric soil of rice was transferred to the laboratory for isolation. Isolation was carried out by standard serial dilution method (Ben-Davida and Davidson, 2014). Luria Bertani Agar Medium was used for isolation of PGPR. After isolation of the isolates were tested for their nitrogen fixing ability. For this all the isolated strains were grown in nitrogen free medium (NaCl 5gm, Yeast extract 3gm, Agar agar 15gm, Distilled water 1000 ml). After isolation and confirmation of the bacterial strain as nitrogen fixer, the bacterial cultures were tested for their antagonistic activities against the isolated plant pathogen by dual culture plate assay (Fotopoulas, 2008). The antifungal activity was evaluated against fungal pathogen through dual culture plate assay containing 1:1 ratio of PDA and Nutrient Agar Medium. Petri dishes were incubated for a period of 7 days. After incubation, the percent inhibition in fungal colony growth was calculated by using the following formula.

$$\text{Percent (\%) inhibition} = 1 - \frac{FG}{CG} \times 100$$

FG = diameter (mm) of fungal mycelium growing on antagonistic plate, CG = diameter (mm) of fungal mycelium growing on control plate.

RESULT

Pathogens from the infected leaves of tomato, rice and maize were isolated and identified. *Alternaria solani* was isolated from tomato leaf, *Magnaporthe grisea* was from rice and *Cercospora zea-maydis* isolated from maize leaf (Table 1).From the rhizospheric soil, five different PGPR strain were isolated and after assessing nitrogen fixing ability, we have confirmed that all are nitrogen fixer i.e. all five bacteria have capability to fix atmospheric nitrogen (Table 2). After confirmation, all the PGPR strains were tested for their antagonistic activity towards the isolated fungal pathogens. It was observed that percentage inhibition of PGPR-3 against *Alternaria solani* was highest (46.7%) followed by PGPR-4 and PGPR-5 against *Magnaporthe grisea* and *Cercospora zea-maydis* (33%) respectively. Moreover, PGPR-5 *grisea* showed 27% inhibition against *Magnaporthe* and PGPR-2 showed 25% inhibition against all the three pathogen. PGPR-3 and PGPR-4 also showed 25% inhibition against *Magnaporthe grisea* and *Alternaria solani* respectively. Similarly, PGPR-1 showed 17% inhibition against *Cercospora zea-maydis* and PGPR-1,PGPR-3,PGPR-4, PGPR-5 showed 6.7-8% inhibition against all the pathogens. However, no inhibition takes place by PGPR-1 against *Alternaria solani* (Table 3).

DISCUSSION

In the current study PGPR strains isolated the rhizospheric soil showed antagonistic activity against phyto-pathogenic fungi *Alternaria solani*, *Magnaporthe grisea*, *Cercosporazea-maydis.* Duel culture of PGPR strain with the pathogen inhibits the hyphal growth. In a study, El-Sayed et. al. (2014) reported that out oftotal 66 selected isolates of PGPR strain 44.09% of tested isolates had a wide range of antagonistic activity against the plant pathogen *Fusarium oxysporum* while about 62.37% exhibited an antagonistic activity against *Sclerotinia sclerotiorum.* Further they reported that among all isolates, 69.9% were found to be presumptive nitrogen fixers. Bloemberg and Lugtenberg (2001) reported that PGPR can indirectly induce plant growth by protecting plants against soil borne pathogens. Wang et. al. (2019) also reported that plant growth promoting rhizobacteria *Paenibacillus jamilae* HS-26 is highly antagonistic activity against several soil borne pathogens can be used as a potential alternative strategy for biocontrol of soil borne diseases. Similarly, antagonistic potential of *Pseudomonas* showed significant inhibition for the phyto pathogens *Aspergillus niger* and *Aspergillus flavus* (Geethapriya and Krishnaveni, 2012).

CONCLUSION

Nitrogen fixing bacteria isolated from the rhizospheric soil of agriculturally important crops were found antagonistic activity against the plant pathogens *Alternaria solani*, *Magnaporthe grisea*, *Cercospora zea-maydis.* These antagonistic strains of bacteria with their broad spectrum of in vitro nitrogen fixing abilities and antagonistic potentials against harmful plant pathogens make them good candidates as growth supporting agents for many important crops. As in vitro study generally considered as base prior to any green house and field studies, therefore the present study provides an evidence that nitrogen fixing bacteria associated with rhizosphere of agriculturally important crops do possess in control of many harmful plant pathogens.

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Table1: Fungi isolated from the diseased leaves

Name of the plant	Diseased plant part	Isolated species	Name of the disease
Tomato	Leaf	*Alternaria solani*	Late blight of tomato
Rice	Leaf	*Magnaporthe grisea*	Blast of rice
Maize	Leaf	*Cercospora zea – maydis*	Corn grey leaf spot

Table 2: Isolation of PGPRs from the soil and their assessment for Nitrogen fixing ability

Sl. No.	Isolated bacterial species (PGPR)	Nitrogen Fixing ability
1	PGPR-1	Positive
2	PGPR-2	Positive
3	PGPR-3	Positive
4	PGPR-4	Positive
5	PGPR-5	Positive

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Table 3: Evaluation of antagonistic activity of isolated nitrogen fixing bacteria against some plant pathog

Interaction	Diameter of hyphae(μm)	Percentage inhibition (%)
F1 (Control)	6	-
F2(Control)	7.5	-
F3(Control)	6	-
F1xPGPR-1	6	0
F1xPGPR-2	4.5	25
F1xPGPR-3	4	46.7
F1xPGPR-4	4.5	25
F1xPGPR-5	5.5	8
F2xPGPR-1	7	6.7
F2xPGPR-2	4.5	25
F2xPGPR-3	4.5	25
F2xPGPR-4	5.0	33
F2xPGPR-5	5.5	27
F3xPGPR-1	5.0	17
F3xPGPR-2	4.5	25
F3xPGPR-3	5.5	8
F3xPGPR-4	5.5	8
F3xPGPR-5	4.0	33

F1: *Alternaria solani*, F2: *Magnaporthe grisea*, F3: *Cercosporazea-maydis*

REVIEW ARTICLE

Bamboo – An Asset for Phytoremediation: A Review

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ABSTRACT

Heavy metals are among the most significant types of environmental pollutants. As a result of global industrialization, toxic heavy metal contamination is becoming a major problem. Conventional methods for reclaiming such soils are costly and unfriendly to the environment. An emerging class of technology called phyto remediation uses green plants to remove toxins from the environment, and it has been promoted as a less expensive and non-intrusive option to traditional engineering-based remediation techniques. Phytoremediation comes in a variety of forms, including phyto immobilization, phyto stabilization, rhizofiltration, phyto volatilization, and phyto extraction - the latter of which is the most commonly used to treat soils contaminated with harmful heavy metals. This paper aims to review the phyto remediation potential of Bamboo species in the remediation of heavy metal-contaminated soils, along with the future perspectives in making phyto extraction an economically feasible phyto remediation technique involving Bamboo.

Keywords: Phyto remediation, Phyto extraction, Environmental pollutant, Heavy metal, Bamboo

INTRODUCTION

The rapid development of the industrial sector has increased the pollution of heavy metals such as copper, lead, zinc, cadmium, chromium, and arsenic due to their increasing need for use in manufacturing industries and agriculture. Heavy metals are the natural inhabitants of soil, but contamination occurs only when their concentration exceeds the

standard limit due to several industrial processes (Tchounwou *et al.* 2012). Heavy metal pollution become a global problem as heavy metals have the chance of entering the food chain and, upon inhalation of particulate matter, can cause severe respiratory problems in humans (Ali *et al.* 2013). Plants and associated soil microbes are used in phytoremediation to lower the level of pollutants in the environment (Ali *et al.,* 2013). Phytoremediation has gained the attention of researchers as it is a cost-effective, eco-friendly, and easy-to-apply remediation method for soil remediation (Cristaldi *et al.* 2017). Heavy metals may exist in the soil, such as free metal ions and soluble metal complexes. Besides, they can also precipitate hydroxides, oxides, and carbonates and embed them into a silicate mineral structure. The bioavailability of heavy metals is essential to having an effective phytoremediation process. Phytoremediation includes Phytoextraction (also Phytoaccumulation), Phytostabilization, Phytofiltration, Phytovolatilization, etc. (Singh and Prasad, 2011; Ali *et al.,* 2013). Phytoextraction is the most successful and important of these phytoremediation procedures, as it removes heavy metals and metalloids from polluted soil. (Sarwar *et al.,* 2017). Several bamboo species (e.g., *Arundinaria fortunei, Sasa auricoma, Indocalamus latifolius,* and *Moso bamboo*) have demonstrated great endurance in heavy metal-contaminated soils with unique heavy metal absorption capacities. (Yan *et al.,* 2015; Emamverdian *et al.,* 2018; Jiang *et al.,* 2019). This review evaluated the factors that determine the Phytoextraction potential of bamboo as a species for the Phytoremediation of heavy metal-contaminated soils. Several elements that influence the uptake mechanism were also looked at. The future of bamboo research is also examined in addition to its prospective opportunities.

BIOREMEDIATION OF HEAVY METALS
Sources and Effects of Heavy Metals in the Environment
Elements having metallic properties and an atomic number greater than 20 are conventionally defined as Heavy metals. The most common heavy metal contaminants present in nature are Cd, Cr, Cu, Hg, Pb, and Zn. To minimize negative consequences and guarantee a safe and sustainable environment for human life, soil remediation will be required. (Cristaldi *et al.* 2017).

Current Trends of Heavy Metal Bioremediation
Heavy metal-contaminated soil is currently remedied using a variety of approaches including soil replacement, thermal desorption, chemical leaching, and electrokinetic remediation.

The soil replacement method dilutes the concentration of the contaminant in the soil and then increases the soil's environmental capacity. It involves i) *Soil spading,* the process of excavating and spreading contaminated soil to allow it to break down naturally and lower contamination concentrations. (Derakhshan Nejad *et al.* 2018; Yao *et al.* 2012); and ii) New soil importation, a way of diluting the concentration of contaminated soil by adding a significant volume of clean soil, covering it, and mixing with it. This method reduces the toxic effect of heavy metals effectively, but it is expensive, requires a significant working volume, and is suitable only for small-scale soil treatment (PazFerreiro *et al.* 2018; Yao *et al.* 2012).

Thermal desorption is a method that carries out soil remediation by volatilizing heavy metals such as mercury and metalloid arsenic by heating the contaminated soil at a temperature between 320 and 560 °C (high-temperature desorption) or a temperature between 90 and 320 °C(low-temperature desorption) using a microwave, steam, and infrared radiation. The volatilized heavy metals are then collected and removed by negative vacuum pressure or carrier gas (Derakhshan Nejad *et al.* 2018; Paz-Ferreiro *et al.* 2018). This method is simpler to carry out but the devices used to carry out thermal desorption are expensive and require a long desorption time (Yao *et al.* 2012). Soil washing or chemical leaching is a remediation technique that leaches the contaminant from the soil. This method uses chelating agents, fresh water, and other solvents to wash the contaminated soil with mechanical processes (Tampouris *et al.* 2001; Yao *et al.* 2012). This remediation method requires multiple automated processes to remove the contaminants in the soil. (DerakhshanNejad *et al.* 2018; Paz-Ferreiro *et al.* 2018; Yao *et al.* 2012). Electrokinetic remediation is a soil treatment method that uses an electric field gradient to remediate the contaminated soil. A low electric field is established by placing two electrodes in contaminated soil, which is then driven by electromigration, electrophoresis, or electroosmotic flow that transports toxins from soil to electrodes (Derakhshan Nejad *et al.* 2018)**.**

When the contaminants get adsorbed or precipitated at the electrode they will be removed easily. This treatment can be applied to soil with low permeability and is cost-effective, and easy to install and operate (Acar and Alshawabkeh1993; Virkutyte *et al.* 2002). As these remediation technologies have various limitations on cost, effectiveness, and environmentally friendly remediation issue, phytoremediation will be advantageous because of its efficient, cost-effective, and eco-friendly remediation capacity. (DerakhshanNejad *et al.* 2018; Yao *et al.* 2012).

PHYTOREMEDIATION STRATEGIES

Living green plants are used in phytoremediation to reduce in-situ risk and remove chemicals from contaminated soil, water, sediments, and air. Heavy metal uptake by plants through phytoremediation involves one or more of the following strategies: phytoextraction, phytostabilization, rhizofiltration, and phytovolatilization.

Phytostabilization

Phytostabilization is the process of reducing heavy metal mobility in the soil through the use of soil additives that immobilize metals with the help of plants. Phytostabilization is mainly used for the remediation of soil surfaces polluted by mining operations or by aerial depositions of metals from metal smelters. Plants used in phytostabilization should be metal-tolerant and should not accumulate pollutants in aboveground sections that humans or animals could consume. They need a shallow root system to support the soil and absorb toxins from the water.

Rhizofiltration.

Rhizofiltration is a type of phytoremediation in which contaminated groundwater, surface water, and wastewater are filtered through a mass of roots to remove hazardous chemicals and excess nutrients. The contaminated water is collected and transported to the plants from a disposal site.

Phytovolatilization

Phytovolatilization is a process wherein plants absorb pollutants from the soil and release them into the atmosphere as volatile forms through transpiration. Water is transformed and modified as it flows from the roots to the leaves through the vascular system of the plant. Phytovolatilization has been used to remove mercury, with the mercuric ion being transformed into elemental mercury, which is less toxic. There are two types of phytovolatilization: direct phytovolatilization caused by plant uptake and indirect phytovolatilization caused by contaminant transfer. In contrast to indirect phytovolatilization, direct phytovolatilization entails an increase in volatile pollutant flow from the subsurface as a result of plant root activity. These processes cause profound changes in subsurface chemical fate and transport.

Phytotransformation

 Phytotransformation, also known as phytodegradation, is the breakdown of organic pollutants by plants either through internal metabolic processes or through the action of enzymes produced by plants. Phytotransformation can be used to clean up organic-contaminated locations and eliminate toxins from petrochemical plants. Phytotransformation can be used in conjunction with other remediation treatments or as a polishing treatment in specific cases.

Phytostimulation

The breakdown of organic pollutants in the soil via increased microbial activity in the plant root zone is known as phytostimulation. Living plants develop a specialized rhizosphere habitat that inoculates microorganisms on plant seeds, allowing certain organisms to enter the growing rhizosphere. The rhizosphere provides a particular niche for soil microorganisms to live. This niche is continuously expanding as roots grow and penetrate new soil zones. Root exudates improve the growth and activity of microorganisms.

Phytoextraction

The most important phytoremediation technology for removing heavy metals and metalloids from polluted soil is phytoextraction (Ali *et al.,* 2013; Sarwar *et al.,* 2017). Phytoextraction is a sub-process by which plants absorb pollutants from the soil or water, translocate them, and store them inside their aboveground biomass (Salt *et al.,* 1995; Jacob *et al.,* 2018). Compared to other phytoremediation strategies, phytoextraction promises a permanent solution for removing heavy metals from polluted soil. Therefore, it is more suitable for commercial applications. The following steps are involved in heavy metal phytoextraction: (i) Heavy metal mobilization in the rhizosphere, (ii) Heavy metal uptake by plant roots, (iii) Heavy metal ion translocation from roots to aerial parts of the plant, and (iv) Heavy metal ion sequestration and compartmentation in plant tissues (Ali *et al.,* 2013).

Heavy metal accumulation and distribution in bamboo plants
Ultra structure

Bamboo plants are mainly composed of roots, rhizomes, stems, branches, leaves, and shoots. The levels of heavy metals differ among the different bamboo tissues and accumulate at higher concentrations in the roots (Fig.1). Bian *et al.* (2017) discovered that the Cu content in the tissues of *Moso bamboo* was in the following order: roots >rhizomes >leaves >branch >stems; Zn was predominantly concentrated in the branches and leaves, and the rhizomes had the lowest levels in a polluted natural environment. Cadmium is primarily concentrated in the roots, and the lowest levels were found in the branches. Translocation from the soil to the aboveground organs is dependent on the rate of trapping in different compartments of root cells, and the long-distance transport of toxic metal elements between organs occurs via the xylem and phloem (Clemens and Ma, 2016). Chen *et al.* (2015) found that Cu in cells was largely concentrated in the vacuole, followed by the cytoplasm, and finally the cell wall, using transmission electron microscopy combined with energy dispersive X-ray analysis (TEM-EDX) technology. Vacuoles are the main Cu-collecting organs in *Moso bamboo* and play an important role in its Cu tolerance. Li *et al.* (2016) found that the cytoplasm was the leading site for the accumulation of Cd in *Moso bamboo* (Table 1). Excessive heavy metal supply may affect the cellular components of bamboo. Liu *et al.* (2014) revealed that the cell structure, root tips, and organelles were significantly altered by less than 200 mM Zn stress. The cell walls, vacuoles, mitochondria, plasmalemma, tonoplast, and xylem parenchyma of root cells showed certain abnormalities. Liu *et al.* (2015) found that the addition of excessive Pb (400 mM) caused abnormally-shaped chloroplasts, the disappearance of endoplasmic reticulum, shrinkage of the nucleus and nucleolus, and loss of thylakoid membranes. The cell wall, vacuole, and cytoplasm were all found to contain heavy metals (Table -1).

Mechanism of Heavy Metal Uptake in Bamboo

The plants can act both as "accumulators" and "excluders" (Sinha *et al.,*2015). Despite concentrating pollutants in their aerial tissues, accumulators biodegrade or biotransform the pollutants into inert forms. Contaminant uptake into their biomass is limited by the excluders. Even when present at low ppm levels, plants have evolved highly precise and efficient methods to acquire necessary micronutrients from the environment. Phytoremediation is hence very essential in micronutrient uptake pathways. Proton pumps, cotransporters, antitransporters, and ion channels are the major transport systems responsible for ion uptake and translocation in plant cells. A variety of ions are eventually taken up by each transport pathway. Metal ions are transferred from the roots to the shoots in a variety of ways, but little is known about them. Plants rarely acquire trace elements beyond their immediate metabolic requirements. Trace element concentrations of 10 to 15 ppm are sufficient for most purposes. One of the most important mechanisms of hyperaccumulation operates through the storage of heavy metals in the vacuole. Evaporating water from plant leaves acts as a pump, allowing nutrients and other soil components to be absorbed into plant roots. This mechanism, known as evapotranspiration, is also responsible for transporting contaminants into plant shoots. Heavy metals such as Cd, Zn, Co, Mn, Ni, and Pb can be concentrated up to 100 or 1000 times by metal-accumulating plant species compared to non-accumulator (excluder) plants (Figure.1).

CONCLUSION AND FUTURE PERSPECTIVES

Phytoremediation becomes a better choice of technology to remediate heavy metal–contaminated soil due to the limitations of physical and chemical remediation methods. To improve the effectiveness and success rate of phytoremediation technology, several factors such as plant species selection, medium qualities, metal bioavailability, and the addition of chelating agents are essential. Bamboo is a fast-growing woody grass species capable of high biomass productivity in short rotation. Bamboo species have additional advantages over many woody plants used to remediate heavy metal contaminated soil, in that they have a high heavy metal tolerance and considerable absorption capacities. Bamboo tissues can accumulate a large number of heavy metals, mainly in the root system. However, high levels of heavy metals can harm bamboo plants by causing oxidative stress. Therefore, some additional active methods, such as the utilization of tolerant species, intercropping patterns, fertilization, exogenous amendments, and endogenous chemicals, should be employed to boost the phytoremediation capability of bamboo. Although bamboo is not a hyperaccumulator, its high output, short rotation, and high economic value make it an attractive candidate for phytoremediation. More research at the physiological, cellular, molecular, genetic, and microorganic (bacteria and fungi) levels will help us understand the elements that influence the phytoextraction capability of bamboo. A better understanding of the processes of heavy metal uptake, transport, and detoxification is essential to improve phytoextraction efficiency. Finally, more studies have to be carried out to find the best ways to use remediator biomass derived from heavy metal-contaminated soils, such as bamboo biochar and biofuel.

Advances in this field of research will have a significant impact on the phytoextraction potential of bamboo. Alternative strategies for modifying the plant rhizosphere to increase metal bioavailability may be made possible by identifying specific exudates linked to the solubilization of metals in soils. Exploring the dynamics of metal chelates present in the rhizosphere in chemically aided phytoextraction is necessary, either to avoid the risks associated with synthetic chelators or to maximize the use of more biodegradable compounds. Additionally, to determine the target metal for phytoextraction, researchers and policymakers must analyze the chemical pools of metals in soils. Although it is generally agreed that total concentration does not correspond with bioavailability, the majority of soil remediation laws focus on total metal concentrations in soils. Metals closely connected to oxides, which make up significant metal fractions in polluted soils, can be extracted only using reactive chemical amendments. A full knowledge of plant metal tolerance will be required to develop genetically designed methods that improve the capacity of plants to accumulate metals. Expression of their metal-accumulating genes in fast-growing, high-biomass plants is a promising method for generating plants for phytoextraction technology because the majority of known hyperaccumulator species mature slowly and have minimal biomass. Agronomic techniques for successfully cultivating plants toward phytoextraction goals also require additional study.

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**Table 1: The concentration of heavy metals in different tissues of Moso bamboo.**

Bamboo species	Environmental pollutant concentration (mg kg—1)	Plant Parts (mg kg—1)				Reference
		Roots	**Stems**	**Leaves**	**Rhizomes**	
Moso bamboo	Cu 600	340	60	23		Chen *et al.* (2015)
Moso bamboo	Pb 400	4283	482	149		Liu *et al.* (2015)
Moso bamboo	Cd 120	159	132	46		Li *et al.* (2016)

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Moso bamboo	Zn 400	8642				Liu *et al.* (2014) Yan *et al.* (2015)
Moso bamboo	Cr 58				0.04	Bian *et al.* (2017)
Moso bamboo	Cu/Zn/Cd 99/3608/11	59/1645/4.6	17/1571/4.1	26/1867/4.4	36/1468/4.4	Chen *et al.* (2015)
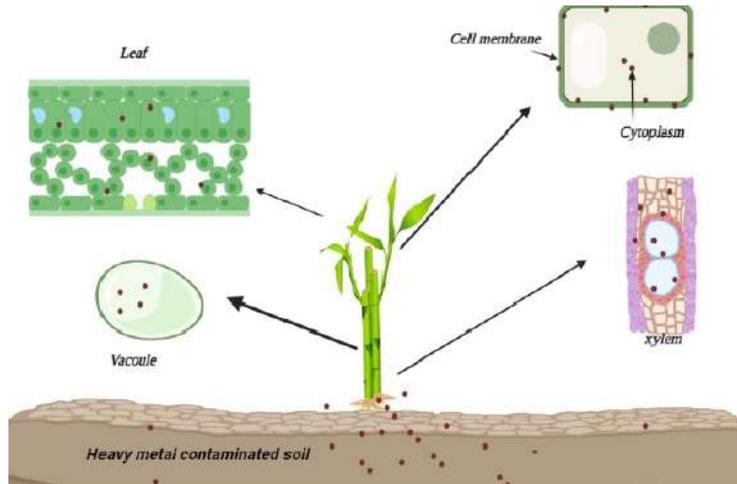
Fig.1. Accumulation of heavy metals in Bamboo

RESEARCH ARTICLE

MATLAB based Automatic Speech Recognition using MFCC

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ABSTRACT

In this paper a novel process of Automatic speech recognition technique using Mel Frequency Cepstrum Coefficient (MFCC) is presented. Speech recognition is a procedure of transforming signal of speech to a word sequence. Now a days the important challenges in research and development is, designing a more accurate speech recognition system, it consists of several constraints including representation of speech, speech classifier, feature extraction and feature matching. In this work, a MATLAB code is developed to analyze the relation between linear frequency and Mel frequency, frequency characteristics of speech signal using Mel- Frequency Cepstrum Coefficient (MFCC), feature vector of the given speech signal. By comparing of two speech signals the similarity has been calculated.

Keywords: Speech recognition, HMM, MFCC, Feature Extraction, Feature matching, Mel frequency.

INTRODUCTION

Basic communication is in the form of speech. It plays vital in the development of emotional and social skills. Speech is produced by the biologic organs of human vocal tract and articulators. Each has its own frequency for a particular person are affected by emotional, gender etc. Various speech recognition methods are used for different types of accents, pronunciation and roughness of voice that includes dynamic programming. Phoneme is a basic unit of sound and it is a minimal unit that can be used to differentiate meanings of words [2]. Speech recognition is basically dividing into two types.

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i) Speaker Recognition
ii) Speech Recognition
Speaker Recognition is the method of finding out the speaker who has been convey the particular speech and it does not any training [9]. Speech recognition is the process of calculating the parameters of speech wave such as fundamental frequency, amplitudes, power etc. and it needs the training of signal [3][4]. A basic speech recognition system begins with a pre-processing stage whose input is a speech signal and processes the signal and produces a feature vector which gives the necessary information required for recognition. Section II represents literature survey, section III explains the speech recognition system based on Hidden Markov Model (HMM), section IV describes the realization of speech recognition system, simulation results are described in section V section and VI describes the conclusion.

Literature Survey
The speech recognition basic concepts were begun in 1960's with investigation of voice print analysis that was close to fingerprint concept. In 1980's Mel Frequency Cepstrum Coefficients (MFCC) representation for speech recognition was described by Davis & Mermelstein as a useful approach to speech recognition and it becomes a widely used technique for feature extraction [1]. In 1984 George Orwell's describes that a machine can
identify the human voice [6].

Hidden Markov Model (Hmm) Based Speech Recognition System
Speech signal can be converted into computer readable signal by using automatic speech recognition system (ASR), to obtain this a continuous speech signal converted into discrete parameter vector sequence. Speech recognition systems are described by Hidden Markov Models and these are statistical models that can generate series of symbols or quantities [6][7].
HMMs are utilized in speech recognition because
1) Speech signal can be represented as a 10 – 25 m sec of piecewise stationary signals.
2) Speech signal are quite simple and train automatically to perform calculations.
HMM output consists of a series of n- dimensional real valued vector (n must be a small integer i.e.,10) and generating one of these for every 25msec.

Proposed Methodology
The schematic approach of Automatic speech recognition system using HMM is shown in Fig1. Two main blocks of speech recognition system are feature extraction and feature matching. Feature extraction section will transform speech signal into another form of representation that will process and generate message, this extracted data is referred as feature vector. There are three basic methods for extracting feature vector, namely MFCC (Mel-Frequency Cepstrum Coefficient), LPC (Linear Predictive Coding) and perceptual linear prediction (PLP). In modern speech Recognition technique, commonly used feature extraction methods are MFCC and PLP. In feature matching, the extracted feature vector from unknown voice signal is tested with respected to the acoustic model and the model with maximum score is considered as recognized word. Feature matching is done by using two methods, namely VQ (Vector Quantization) code book and Gaussian mixture model (GMM).

MFCC (Mel-Frequency Cepstrum Coefficient)
The performance of speech recognition system is examined with extricating and choosing the relevant parameters of the speech signal. A compact representation of the set of coefficients resulting from the real logarithmic cosine transformation of the short-term energy spectrum expressed on the Mel frequency scale is produced [10]. The MFCC algorithm is routinely used to find the relationship between critical bandwidth and human ear frequencies. The analyses and extraction of feature vectors is done with this algorithm. Flowchart of MFCC is shown in Fig 2, the operations of MFCC that will perform on speech signal are Pre-emphasis, Framing and blocking, Windowing, DFT, Mel filter bank, DCT and Delta and energy spectrum . A continuous speech waveform is divided into frames of fixed length with overlapping. To derive a set of feature vectors from each frame, different signal processing operations have been performed at different stages of MFCC algorithm. The process of MFCC is shown in

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Pre-emphasis

The main task of pre-emphasis is to suppress the high-frequency components of the speech signal that were conquer by the human sound production system. Speech spectrum is flattened by using pre-emphasis filter priori to spectral analysis. A high pass filter takes an audio input x(n) and produces the output y(n) is given below.

$$y(n) = x(n) - a * x(n-1) \text{-------(1)}$$

Fig2, and explained in detailed in below [11]. where a is a constant and its values ranges between 0.9 and 1.0. By applying z-transform to equation (1), H(z) is

$$H(z) = 1 - a * z^{-1} \text{--------- (2)}$$

Framing

Speech signals are non-stationary signals and continuously varies. A speech signal is split into a series of frames and each frame is examined separately and viewed by only one feature vector. The audio wave is divided into frames of M samples, with adjoining frames isolated by N samples. where M is always greater than N. The next frame has N samples after the first frame and overlaps M-N samples and each frame overlaps with two subsequent frames. A typical value for M and N is 256,100.

Windowing

Since each frame should have steady motion, the trade-off for achieving frame blocking is to use 40 ms windows given at an interval of 25 ms (frame rate is 100 frames/ seconds, and the overlap between adjoint windows is about 25%). A tapered window is applied to each to minimize discontinuities in the audio wave at the corners of each frame. The Hamming window is frequently used. The output of Hamming window is

$$x(n) * w(n) \text{ -------- (3)}$$

Where x(n) is signal of input speech and w(n) is window function and it is defined by

$$w(n) = 0.54 - 0.46 \left(\frac{2\pi n}{N-1}\right) \text{------ (4)}$$

Where n ranges from 0 to N-1.

Fast Fourier Transform (FFT)

The frequency domain representation of each frame obtained is by applying Fourier Transform. Equation of DFT is given by

$$X(k) = \sum_{n=0}^{N-1} x(n) e^{-j2\pi kn/N} \text{ -------- (5)}$$

Where $0 \le k \le N-1$.

The FFT (Fast Fourier transform) is computationally more efficient algorithm to find the Discrete Fourier transform (DFT). In general, the length of FFT is powers of 2 (N=2 n) if not zero padding technique is used to make it. The frequency response of each frame is obtained by applying FFT and then calculate the magnitude response. FFT output consists of both the real and imaginary parts Re(X(k)) and Im(X(k)). Only real data is used in speech recognition system. The speech signal magnitude response is obtained by using equation (6). Each frame spectral magnitudes are stored in one matrix as row with 256 columns. The undesirable frequency responses of each frame can be solved by multiplying with Hamming window.

$$|X(k)| = \sqrt{(Re(X(k)))^2 + (Im(X(k)))^2} \text{ ---- (6)}$$

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Mel Frequency Filter Bank

Analysis of speech signal by Mel-frequency is depends on human perception experiments. The human ear is delicate and has better resolution at low frequencies than at high frequencies. The Mel filter bank was developed to emphasize low frequencies over high frequencies. An audio wave does not accompany a linear scale, but spreads out over a frequency range. The Mel frequency scale is linearly spaced below 1000 Hz and logarithmically spaced above 1000 Hz. The Melscale frequency is proportional to the linear frequency and is given by equation (7).

$$Mel(f) = 2595 log_{10}(1 + \frac{f}{700}) \text{--------(7)}$$

The output is given by the sum of its filtered spectral components [5].

Discrete Cosine Transform (DCT)

Transform the logarithmic power spectrum to the time domain using the discrete cosine transform (DCT), resulting in Mel-frequency cepstrum coefficients (MFCC). DCT consists of most of the information in lower order coefficients, which results in cost reduction. When done by cepstrum analysis, it is good to represent the local spectral properties of the signal together with the frame analysis.

Implementation of Speech Recognition System

The Mel-Frequency Cepstrum Coefficients (MFCC) are measured from the speech wave specified by the vector S and sampled at FS (Hz). Applied speech wave is pre-amplified using a first-order FIR filter with coefficient of predistortion ALPHA. The pre-distorted audio signal performs short-term Fourier transform analysis with a frame duration of TW (ms), a frame shift of TS (ms), and an analysis window function specified as a function handle with window. This is followed by computation of the amplitude spectrum by filter bank design using M-triangular filters equally spaced on the mel scale between the lower and upper frequency limits denoted by R (Hz). A filter bank is given to the magnitude spectral values to produce the filter bank energy (FBE) M for each frame [11]. The logarithmically compressed FBE is decorrelated by the DCT to produce the cepstral coefficients.

The basic idea behind the feature matching is that feature extraction output is comparing with the reference speech signal and the signal which matches maximum is recognized. The amount of similarity can be measured by using the simple method of cross correlation technique.

RESULTS AND DISCUSSION

The speech signal has been recorded using 'Audacity' software and audio read function in MATLAB to read the given input signal and produce its values and speech inputs are recorded in wave format. By considering different frequencies in Hz, obtain the Mel frequencies. The relationship between linear frequencies in Hz and Mel frequencies are plotted and is shown in Fig3.From the plot, non-linear relationship is existed between frequency in Hz and Mel frequencies. Mel frequency cepstral coefficients of audio wave has been obtained and are shown in Fig4. The simple cross correlation method is used to recognize the speech signal. The given input speech signal is compared with the reference signal. By using MATLAB software the similarity of two signals is calculated and is shown in Fig5.

CONCLUSION

The basic Hidden Markov Model with MFCC feature extraction has been discussed. The relation between linear frequencies and Mel frequencies are plotted. The Mel frequency cepstral coefficients of speech signal are obtained and are plotted using MATLAB. The comparison of speech signal with reference signal has been done and the amount of similarity is also calculated.
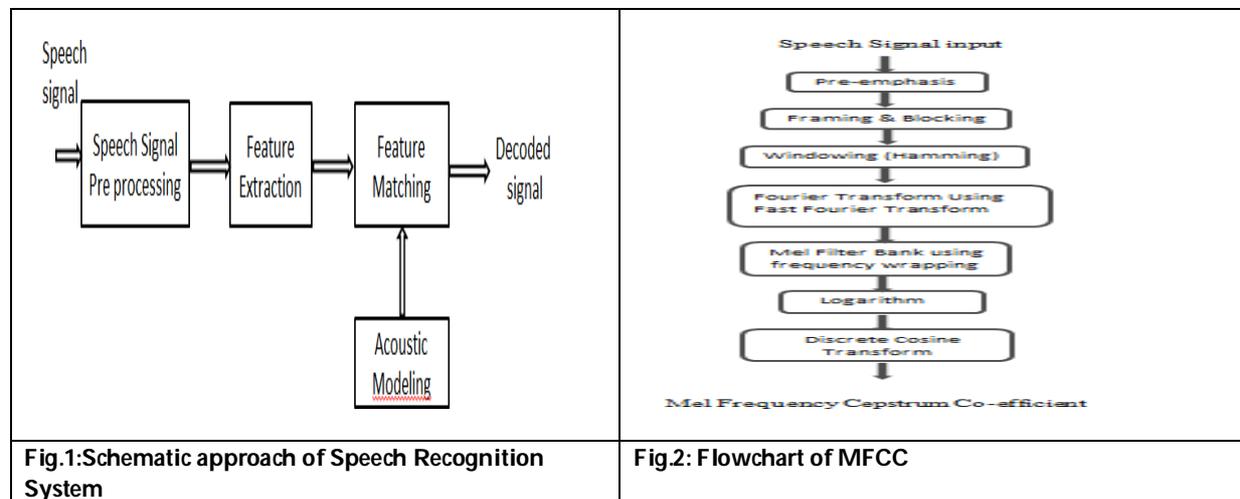
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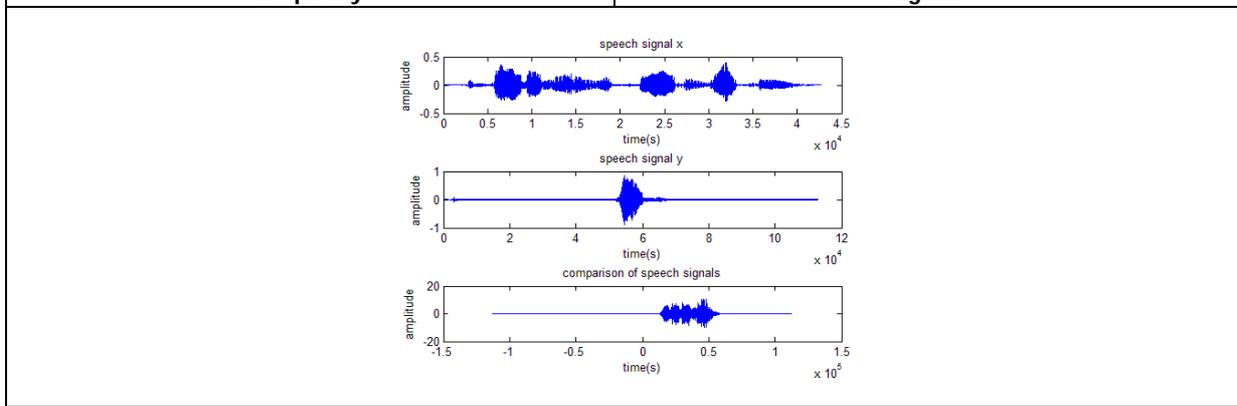
Fig.1:Schematic approach of Speech Recognition System	Fig.2: Flowchart of MFCC

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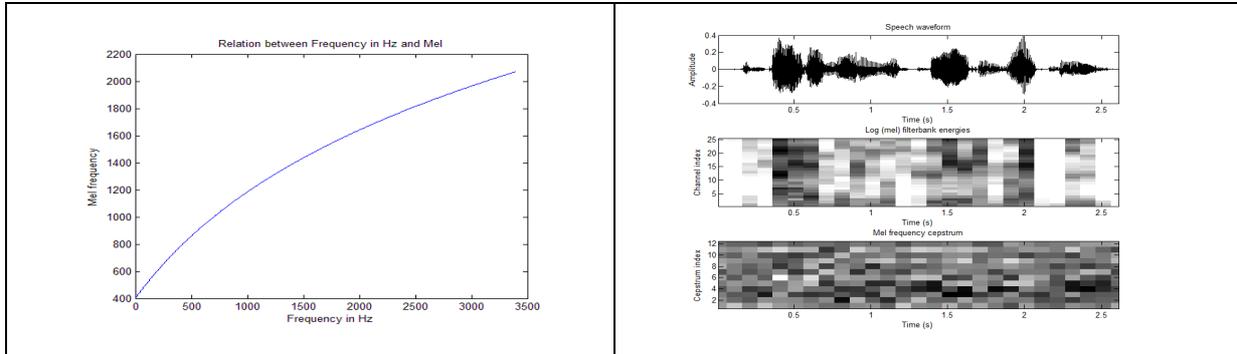
Fig.3: Relation between linear frequency and Mel frequency

Fig.4: Mel frequency cepstral coefficients of speech signal.

Fig.5: Similarity of two speech signals

REVIEW ARTICLE

A Review on Hepatitis A Virus

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ABSTRACT

A virus called hepatitis can cause serious morbidity and, in rare situations, death by causing a broad infection. Feces are one way the virus is known to propagate. HAV can therefore spread in unhygienic settings where people practice poor personal hygiene. Despite the fact that there has been a decline in the overall prevalence of the hepatitis A virus since the development of the HAV vaccine, there have been numerous outbreaks, which have resulted in a large number of people needing hospitalization and a few fatalities. The Hepatitis A virus is posing a new public health issue as a result, necessitating that emergency physicians have additional expertise in the recognition and treatment of patients who present to the emergency department with an infection or who are at risk of contracting the disease. The hepatitis

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A virus causes fever, nausea/vomiting, and abdominal pain, which are all followed by jaundice. Health care instructions should maintain basic precautions for all suspected HAV infection patients, as well as contact precautions in unusual circumstances. Infected individuals should be comforted to avoid food preparations and close contact with sensitive populations. Infected patients should be comforted to stay away from food preparation and close contact with susceptible populations, and warm water should be utilised to lessen infection. Therapies based on herbs have been utilised to treat liver problems. There are numerous types of herbal preparations. The four constituents of Liv 52, *Phyllanthus*, *Silybum marianum* (milk thistle), and glycyrrhizin (licorice root extract) are discussed in this article. People who are more likely to be exposed to HAV should get vaccinated, and emergency care staff should notify their local public health agency of any suspected cases.

Keywords: Virus, Liver, Hepatitis, Infections, WHO, Treatment.

INTRODUCTION

The hepatitis A virus (HAV) is a common infectious etiology of acute hepatitis worldwide. HAV is most commonly transmitted through the oral-fecal route via exposure to contaminated food, water, or close physical contact with an infectious person. According to the World Health Organization (WHO), infection rates in developed countries are low. The seroprevalence of antibodies to HAV has declined since World War II in many countries, but large epidemics do occur. For example, an outbreak of hepatitis A associated with the consumption of clams in Shanghai in 1988 resulted in almost 300,000 cases(1). Hepatitis A has an incubation period of about four weeks. The virus replicates in the liver. Relatively large quantities of virus are shed in the feces during the incubation period before the onset of clinical symptoms, and a brief viremia occurs. The severity of illness ranges from asymptomatic to anicteric or icteric hepatitis. The virus is non-cytopathic when grown in cell culture. Its pathogenicity *in vivo*, which involves necrosis of parenchymal cells and histiocytic periportal inflammation, may be mediated by cellular immune responses. By the time of onset of symptoms, excretion of virus in the feces has declined and may have ceased and anti-HAV IgM increases in titer. Anti-HAV IgG may be detected one to two weeks later and persists for years(2). However, high-risk groups include injection-drug users, men who have sex with men, people traveling to endemic areas, and isolated communities. HAV does not cause chronic liver disease unlike hepatitis B or C. Acute hepatitis usually presents as a self-limited illness; development of fulminant hepatitis is rare. Typical symptoms of acute infection include nausea, vomiting, abdominal pain, fatigue, malaise, poor appetite, and fever; management is with supportive care. Alternate clinical patterns include cholestatic, prolonged, and relapsing disease. Vaccination against HAV is recommended for children 12 months or older and adults with the risk of exposure including travelers to endemic countries, men who have sex with men, illicit drug users, potential occupational exposure, and/or chronic liver disease(1)(2)(3)(4). The rates of HAV have decreased due to improvements in public healthcare policies, sanitation, and education, but infection rates of other hepatitis viruses appear to be increasing. This review provides an up-to-date and in-depth overview of HAV and the acute inflammatory hepatic infection it causes in humans, including recently recognized aspects of its molecular virology, evolution, natural history, pathogenesis, epidemiology, and prevention(4).

Epidemiology
HAV is endemic in India, such that most of the population is infected asymptomatically in early childhood with life-long immunity(5). Several outbreaks of hepatitis A in various parts of India have been recorded in the past decade; children from rural and semi-urban areas of the state of Maharashtra (2002–2004), and an explosive outbreak among adults from Kerala involving 1,137 cases (2004). and over 450 cases in children and adults in Shimla (2007). Analysis of 1612 subjects representing 55 cities from different parts of India (Kolkata, Cochin, Indore, Jaipur, and Patna) showed that anti-HAV positivity varied from 26 to 85%. Almost 50% of children between the ages of 1–5 y were

found to be susceptible to HAV. Interestingly, municipal water supply and not family income were associated with exposure to HAV(6). A recent study from Delhi has reported that the frequency of HAV infection among children has increased from 8.4 to 12.3% over five years, with the frequency of HAV infection having increased in adults also from 3.4 to 12.3% during the same period(7). Similarly, outbreaks of epidemics of hepatitis A have been reported from Kottayam, Kerala State; the infection was traced to the presence of a sewage treatment plant that was overflowing and getting mixed with a canal(8).Recent reports from India also have shown a variable prevalence of HAV exposure in middle and upper socioeconomic strata(9)(10). A study shows exposure to HAV among the children reached 97% by the age of 12 y(11). where they reported > 95% HAV exposure by late childhood. Improved sanitation and personal hygiene will remain an effective interventions to control the transmission of HAV. In India, the hepatitis A vaccine is available for the people who can afford it, but the government of India should give this vaccine as a priority in the national immunization schedule. Duration of immunity is an important concern for developing countries. If the policy of childhood immunization is adopted, in the absence of desired long-term immunity, exposure to HAV in adulthood would lead to severe clinical disease, especially because circulation of HAV continues in a substantial proportion of the population(12).

Etiology

HAV is one of the most common causes of acute hepatitis infection worldwide. The WHO estimates that approximately 1.5 million people are infected with HAV each year. Endemic rates are high in developing countries with low socioeconomic conditions and poor sanitation and hygiene practices. Exposure in these developing countries usually occurs in childhood. Three of every four individuals infected with HAV are symptomatic. Adults often have more symptoms than children Most cases of transmission are from person to person and limited to close contacts. Blood transfusion is a very rare cause of hepatitis A.

Risk factors for HAV include
- Institutionalization
- Close personal contact
- Travel to a foreign country Occupation
- Parenteral drug abuse
- Homosexuality(15).

Pathophysiology

The most widely accepted pathophysiologic mechanism through which recurrence develops is that in which the HAV is not eliminated in the first phase of hepatitis and thus is capable of having a new replication and causing a second disease episode. That could be explained in patients that have an immunity alteration with a decrease in the capacity to produce adequate antibody titers, essential for achieving complete serum clearance of the virus and reducing the liver damage it causes(13)(14).Studies on patients infected with human immunodeficiency virus that presents with acute HAV have shown that they have lower levels of transaminasemia, but higher HAV viral burdens and more prolonged viremia, compared with patients that do not have the human immunodeficiency virus. Such results mean that the activation of the immune system probably plays a role in the liver necrosis developed during acute hepatitis(15)(16). A relatively new theory postulates that immunoglobulin A (IgA) is a hepatotropic transporter of HAV, speculating that said mechanism contributes to the different or atypical clinical outcomes of HAV infection(16). The HAV-IgA immunocomplexes efficiently reached the hepatocyte through an enterohepatic pathway mediated by reverse transcytosis via the polymeric immunoglobulin receptor (pIgR) across the intestinal epithelium(17). There could be continuous endogenous reinfection of the liver through that mechanism. The cycle mediated by IgA ends when serum immunoglobulin G (IgG) levels, present in advanced phases of infection, increase, given that they competitively replace the IgA in the HAV-IgA complexes. However, in cases of compromised immunity, that can contribute to lower IgG synthesis and therefore a prolonged illness or recurrent courses of HAV infection(17).

Clinical Manifestations

Typical Clinical Manifestations

The clinical spectrum of HAV infection ranges from asymptomatic infection to fulminant hepatitis. Clinical manifestations of hepatitis A are dependent on the age of the patient. In children younger than 6 years of age, about 70% of infections are asymptomatic; in contrast, infection is usually symptomatic, with jaundice and remarkably high levels of serum aminotransferases, in more than 70% of adult patients(18). Following a 2–7-week incubation period, typical symptoms develop, including fever, malaise, nausea, vomiting, abdominal discomfort, dark urine, and jaundice. Less common symptoms include myalgia, pruritus, diarrhea, arthralgia, and skin rash. There is no evidence of chronic liver disease or persistent infection after acute hepatitis A. However, some patients show prolonged disease or relapsing disease lasting up to 6 months, with prolonged excretion of HAV. Laboratory tests have shown elevated total bilirubin (mean peak 7 mg/dl), alkaline phosphatase (mean peak 319 IU/l), serum aspartate aminotransferase of 1,754 IU/l, and alanine aminotransferase of 1,952 IU/l. Clinical illness and laboratory abnormalities recover within 2 months from the onset of illness(19).

Atypical Clinical Manifestations

Atypical manifestations following hepatitis A have been reported. These include relapsing hepatitis, prolonged cholestasis, complicated cases with acute kidney injury as well as rare autoimmune hepatitis. Relapsing hepatitis A was characterized by a biphasic peak of serum aminotransferase elevation with 4–7-week intervals between the first and the second peak. Prolonged cholestatic hepatitis A was characterized by pruritus, fatigue, loose stools, and weight loss accompanying prolonged cholestasis(18). Compared to typical cases, prolonged cholestatic cases can be predicted by detection of plasma HAV RNA after 20 days of illness, while relapsing hepatitis remains unpredictable based on plasma HAV determination(15). Acute kidney injury complicating nonfulminant hepatitis A was found in 1.5–4.7% of hepatitis A patients. Proposed mechanisms of renal damage include pre-renal factors associated with anorexia, nausea, vomiting, diarrhea, and fever as well as nephrotoxic effects of hyperbilirubinemia, immune complex-mediated nephritis, interstitial nephritis and (rarely) massive intravascular hemolysis. One study reported that the independent predictors for acute kidney injury development in hepatitis A included lower hematocrit, presence of coagulopathy, high CRP concentration, and higher peak bilirubin levels(20).

Pregnancy Hepatitis

A during pregnancy is associated with a high risk of maternal complications and preterm labor, despite the relatively mild features of the disease. Significant associations were observed between preterm labor and the presence of both fever and hypoalbuminemia, and hepatitis cases were clustered in the third trimester. There was no evidence of mother-child transmission of hepatitis A virus infection, and fetal outcome was benign despite prematurity. Therefore, HAV serology and maternal vaccination during pregnancy evaluation should be considered in areas where susceptible adult populations exist(21).

- Nausea, loss of appetite, and vomiting.
- Abdominal pain and diarrhea.
- Fever.
- Malaise and fatigue.
- Joint pain.
- Jaundice, a yellowing of the skin and whites of the eyes.
- Dark-colored urine and pale stools(22).

Diagnosis

Various serologic tests are available for hepatitis A, including immune electron microscopy, complement-fixation, immune adherence hemagglutination, radioimmunoassay, and enzyme immunoassay. Immune adherence hemagglutination, which had been widely used, is moderately specific and sensitive. Several methods of radioimmunoassay have been described; of these, a solid-phase type of assay is particularly convenient, very sensitive, and specific. Very sensitive enzyme immunoassay techniques are used widely. Only one serotype of

hepatitis A virus has been identified in volunteers infected experimentally with the MS-1 strain of hepatitis A, in patients from different outbreaks of hepatitis in different geographic regions, and random cases of hepatitis A(23). Isolation of virus in tissue culture requires prolonged adaptation and it is, therefore, not suitable for diagnosis(24).

Treatment

No specific treatment is needed for most patients with acute, uncomplicated HAV infection beyond supportive care. Complete recovery from symptoms may take several weeks to months. In the rare case of fulminant hepatitis from HAV infection, liver transplantation may be a life-saving measure. Extrahepatic complications are managed routinely(23)(24)(25). According to the WHO, the most effective way to prevent HAV infection is to improve sanitation, food safety, and immunization practices. In the United States, vaccination against hepatitis A is available as inactivated, single-antigen vaccines (HAVRIX and VAQTA) or in combination with hepatitis B (TWINRIX). The Centers for Disease Control and Prevention recommends vaccination for children 12 months or older, travelers to endemic countries, gays, illegal drug users, individuals with occupational risk exposure, and persons with clotting factor disorders or chronic liver disease. Standard adult dosing recommends the administration of two doses of the vaccine 6 to 12 months apart. These vaccines are highly efficacious were seroconversion rates approaching 100%(26). Until more recently, immunoglobulin was the only treatment for post-exposure prophylaxis again HAV. However, animal studies and clinical trials demonstrated the efficacy of post-exposure immunization with an inactivated HAV vaccine has led the CDC to recommend the vaccine instead of immunoglobulin for exposure to HAV in healthy individuals aged 1 to 40 years. For individuals 41 years and older, immunoglobulin administration is preferred due to the risk of more severe clinical presentation and limited evidence of vaccine efficacy in this age group. Children less than 12 months, individuals with chronic liver disease, and immunocompromised persons should also receive immunoglobulin(26)(27)(28). For a long time, herbal remedies have been utilized to treat liver problems. There are a variety of herbal preparations on the market. Four commonly used herbal concoctions are discussed in this article: (1) *Phyllanthus*, (2) *Silybummarianum* (milk thistle), and (3) glycyrrhizin (licorice root extract), and (4) Liv 52 (herbal combination)(29). There are no notable side effects from *Phyllanthus*, and there are no data from randomized controlled studies on clinically important outcomes, such as progression of chronic hepatitis to cirrhosis and/or liver cancer, or survival(29) (30). Silymarin does not appear to lower mortality or improve biochemistry or histology in patients with chronic liver disease, although it is safe and well-tolerated(30)(31). Stronger neominophagen C (SNMC) is a Japanese supplement with 0.2 percent glycyrrhizin, 0.1 percent cysteine, and 2% glycine. SNMC is generally used as an anti-inflammatory or cytoprotective medication and does not have antiviral characteristics. It improves liver functions in individuals with sub acute liver failure, chronic hepatitis, and cirrhosis, and reduces mortality in patients with sub acute liver failure. With activity, SNMC does not reduce mortality in cirrhotic individuals. In individuals with chronic hepatitis C, SNMC may inhibit the development of hepatocellular carcinoma, but prospective data are lacking(30)(32).In the treatment of alcohol-induced liver disease, Liv 52, an Ayurvedichepatoprotective drug, is ineffective. Herbal medicine standardization has been a challenge, and there are few prospective, randomized, placebo-controlled clinical trials to back up their efficacy (33).

CONCLUSION

The hepatitis A virus is a highly contagious infection that can cause major morbidity and, in some cases, death. Since the discovery of the hepatitis A virus vaccine, the general prevalence of the infection has decreased in developed countries. The identify-isolation-inform tools will be a useful tool for health care clinicians to employ when assessing and managing patients who have a viable hepatitis A virus infection. *Phyllanthus* has no known side effects, and there are no data from randomized controlled trials on clinically important outcomes such as chronic hepatitis development to cirrhosis and/or liver cancer. Although it is safe and well-tolerated, silymarin does not appear to cut mortality or enhance biochemistry or histology in patients with chronic liver disease. SNMC is a Japanese supplement that contains 0.2 percent glycyrrhizin, 0.1 percent cysteine, and 2 percent glycine. SNMC is primarily utilized as an anti-inflammatory or cytoprotective agent; Liv 52, an Ayurvedic hepatoprotective medication, is unsuccessful in the treatment of alcohol-induced liver damage.

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RESEARCH ARTICLE

A Study on Key Drivers of Online Impulse Buying Behaviour among Youth in Odisha

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ABSTRACT

Study aims at identifying factors which lead to impulse buying behaviour among customers while shopping online. Study is conducted in Bhubaneswar with 416 young respondents who are online shopper's. For analysis 33 variables were put under study, out of which 10 relates to impulse buying behaviour and other relates to reason for impulse buying and post purchase disposition of impulse buying. Factor analysis technique is applied to 23 variables which extracted 8 factors for impulse buying behaviour of consumers. Regression analysis was used test the effectiveness of extracted factors in predicting dependent factor impulse buying. All 8 factors found to be predictors of impulse buying behaviour with significant f value of .00 and r square value of .932.Limitations of the study remains with small sample relating only to youth population of Bhubaneswar. Study can be extended to larger sample and effect if different moderators can also be taken into account like age, gender, income level. The study will help both academicians and practitioners to identify, understand and implement the factors in future.

Keywords: Impulse buying, consumer behaviour, online shopping, regression, factor analysis

INTRODUCTION

Internet has become a basis of life these days. People have become so much dependent on internet that one cannot expect a life without internet even for a single day. Whether it relates to knowing of the latest financial, political news, exchange of information with friends, making your day to day payments online, managing your banking

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services, buying important stuff through online shopping, or finding your way to a new location, internet will do all for you. The Internet has given boost to traditional ways of bonding with friends, collecting information and news, and even data analysis. It has become the basis for personal life, economic, and political advancement. With Internet, we could share nearly every subject, such as knowledge, expertise, and experience straight to others' computer regardless of the geographic location. Internet could be used by the consumers 24 hours a day. They could shop online any time they want, browse anything they are interested, and attain all kinds of information, they need. According to the Internet World Stats published online in 2012, the Internet users have increased 566.4% from 2000 to 2012 and 34.3% of the world population uses the services of Internet. Increase in online shopping has given boom to impulse buying as well as consumers in their free and leisure time can do shopping while sitting in their homes. The rapid increase in online shopping sites and online buying habits of consumers have aroused a lot of interest of researchers in this field. Most shoppers occasionally engage in impulse buying [1]. More than half of mall shoppers were found to purchase on impulse [2], and over one third of all department store purchases have been made on impulse [3], indicating that impulse purchases are critical to a retailer's profit [4] in their research related impulsive buying with hedonic factors working as stimuli. Chan et al., [5] in their paper concluded that most of the researches on online impulse buying is based upon "Stimulus-Organism-Response (SOR)" and the "Technology Acceptance Model (TAM)" as theoretical base for empirical studies.

Other study like Huang[6]have identified a number of elements in the stimuli and organism related factors that drive online impulse buying. At a broad level, these elements can be classified into website stimuli, marketing stimuli and internal consumer stimuli at the stimuli level and cognitive and affective reactions at the organism level. Sun and Wu[7] have found that a consumer trait model can provide an explanation for online buying impulsiveness. The trait drivers include internet addiction, task orientation, self-efficacy, emotional instability, conscientiousness, materialism and need for arousal. Lo et al., [8] found that Herzberg's two factor theory could be used as a framework to explore online impulse buying. They found that motivators such as promotional offers, gifts, discounts; and hygiene factors such as easy to use websites, security, nice fonts, member centres and product categorization were important factors in stimulating online purchase. In a study carried out in India, Badgaiyan and Verma [9] explored the impact of personality traits on online impulsive buying behaviour. They found that extroversion, collectivism, shopping enjoyment, materialism and impulsive buying tendency had a positive influence on online impulsive buying while the trait of conscientiousness had a negative influence.

Literature Review

Many researches in previous years have equated impulse buying to unplanned purchases [10, 11, 12]. Rook and Gardner [13] concluded that impulse buying is an unplanned behaviour which occurs due to desire of immediate possession of product. Beatty and Ferrell [14] defined impulse buying as immediate purchases without pre planning or prior objective of purchase. It specifically excluded those purchases which consumer required but remembered at time of purchase only. Bayley and Nancarrow [15] defined impulse buying as a "immediate, compulsive, and pleasurable buying behaviour in which the urge of an impulse decision is of prime importance than thoughtful and deliberate consideration. Block and Morwitz [16]also shared same opinion as of [15]. Kacen and Lee [17] defined impulsive behaviour as more irresistible but less deliberative when compared to planned purchasing behaviour. Weinberg and Gottwald [18] described the concept of impulse buying involves great amount of pleasure, excitement and delight as compared to planned purchases. Wood[19] described the impacts of socio-economic factors like income level of individuals on impulse buying behaviour. Youn and Faber [20] suggested that impulse buying behaviour do get effected by both positive and negative emotions. Zhou and Wong [21] found that retail store environment and ambience plays major role in impulse buying behaviour decision. Luo [22] did an interesting study where he found out that people tend to indulge more in impulse buying when they are with peers and urge for impulse buying reduces when they shop with family members. Park et al.[23] found out in his study that fashion oriented people seeks more pleasure in shopping and hence engage more in impulse buying. Sharma et al. [24] in their study showed that variety seeking people involves more in impulse buying. This same view was also represented by Hawkins et al., [25]. According to The Economist [26], almost a quarter of Amazon. com's sales were made because of impulse purchases through product recommendations. As per the convenience and round the clock

availability of online shopping impulse buying is even more likely to take place specially with respect to apparels [3] and is also one of the most popular product categories sold online [27]. With the growing number of online shoppers that are purchasing apparel online Lebo [28], many shoppers are likely to engage in an impulse buying situation. Although impulse purchases are likely to be more prevalent in online shopping, but very less research work has been done till yet on this aspect. Much of previous research has focused on impulse-buying behaviour in traditional brick and mortar shopping [15, 29, 13]and television shopping Park and Lennon [30]. With the tremendous growth potential of online shopping and the prevalence of impulse buying today, more research is needed to understand consumer impulse-buying behaviour online.

According to Verhagen and Dolen's [31] study, the positive emotional and affective status of individual can have positive impact on impulsive buying behaviour. Whereas when we talk about online impulse buying, the website designs such as attractive look and feel, ease of use, enjoyment of the website and website communication style could be the indirect factors that affect impulsive buying behaviour as these factors only have directly influence on emotion. Furthermore, Jeffrey and Hodge [32] also in his study suggested that people who are in positive affective states spends more time on website and thus enhances the chance of impulse buying. Another important aspect that comes in picture is when we talk about impulse buying it is normative evaluation it refers to judgement of the appropriateness of impulsive purchase decision which may also take part in influencing impulsive purchase to some researchers [33]. Usually the earlier mind-set of people about impulsive purchase is that it is irrational and thoughtless and inappropriate purchase decision. However, different buying situations can influence normative evaluation to be either negative or positive to same goods. The online promotional strategy is slightly different with in-store promotion which is more tailored and aggressive to consumer such as the sudden pop out "advertisement". However, the types of promotions are similar with actual store such as buy-one-get one deals, coupons and membership discounts. There still have some new types of promotion such as free shipping fees [34]. This can cause consumer to impulsively purchase more than usual[35]. Harmancioglu et al.[36] is first study conducted on impulse buying behaviour of new product and suggested in case of new product: product knowledge, consumer excitement and consumer esteem –drive impulse buying behaviour. Impulse buying scores were calculated on basis of ten statements depicting impulse buying behaviour were added and reliability is established. Impulse buying tendency scale developed by Merdin-Uygur [37] is used for measuring impulse buying factor consisting of 10 variables.

Objectives Of The Study
1. To find out factors which effect impulse buying behaviour of consumers.
2. Study the extent to which extracted factors can predict the impulse buying behaviour.

Research Methodology
The main segment of respondents for the study is youth population, age group varying from 20-35 years, mainly college students and young professionals. Total 430 questionnaires were circulated online out of which 416 responses were received and deemed to be fit and complete for analysis. Convenience sampling technique was used to collect data, all data collected through online sources. For fulfilling the first objective 23 statements were collected based upon literature review and used for factor analysis. Reliability test was also done to check the reliability and internal consistency of the data. For sample adequacy KMO and Bartlett's test was done and results found to be appropriate for conduction of factor analysis.

Data Analysis And Results
Reliability analysis
[Table1: Near here]
[Table 2: Near here]
Cronbach alpha value is found to be .813 which suggests that items have internal consistency. Refer to table 1 and table 2. [Table 3: Near here]. KMO Bartlett's test showed a value of . 721 which is considered as good with respect to social science researches. It proved that data structure is suitable for factor detection. [Table 4: Near here]. For exploration of factors principal component analysis was used. Varimax rotation extracted 8 factors whose scores was

saved for further regression analysis. Table 4 shows the variance explained by factors extracted. Total 8 factors are extracted and cumulative variance explained by these factors is 67% which is considered good for the study.[Table 5: Near here]. Rotated component matrix shows which variables accounted for specific factors. Items are clubbed under factors which they show max value. Values rounding to .5 or more are considered for clubbing them under different factors.

Factor 1= v13, v14, v15, v16, v20,v21,v22

Factor 2= v3, v7,v8,v9

Factor 3= v4,v5,v10,v11

Factor4= v1,v23

Factor 5= v12,v19

Factor6= v6

Factor7= v2,17

Factor 8= v18

[Table 6: Near here]

We named the factors as:

Factor 1: Hedonic factors

Factor 2: Website experience& Shopping behaviour

Factor 3: Ease of online shopping

Factor 4: Consumer Esteem

Factor 5: Variety seeking

Factor 6: Normative Evaluation

Factor 7: Product and brand specific

Factor 8: Promotional offers and Advertisement

objective 2

Factor scores were saved in SPSS for further regression analysis of factors in predicting impulse buying behaviour. For regression analysis impulse buying behaviour is considered as dependent variable and eight extracted factors were considered as independent variables. Impulse buying scores were calculated on basis of ten statements depicting impulse buying behaviour were added and reliability is established. Impulse buying tendency scale developed by Ezgi Merdin Uygur (2018) is used for measuring impulse buying factor consisting of 10 variables. [Table 7: Near here]. Reliability score for 10 variables considered for impulse buying is .837 which considered good for the study. Total score of these 10 variables taken together as score of dependent variable and put to regression analysis against 8 factor scores derived and saved from factor analysis. [Table 8: Near here]. The table 8 shows that r square value is .932 which depicts that 93% of the total variation in dependent variable is explained by independent 8 factors. So model is perfect fit. [Table 9: Near here]. Table 9depicts the F value found to be significant at .000 which means independent variables reliably predict dependent variable I.e. impulse buying behaviour. [Table 10: Near here]. Table above shows that all factors are found significant in predicting impulse buying behaviour with p value of .000.

CONCLUSION

Paper contributes to the understanding of impulse buying behaviour concept and factors influencing the impulse buying behaviour. Factors which were explored with help of qualitative and quantitative techniques are named as Hedonic factors, Website experience and shopping behaviour, Ease of online shopping, Consumer Esteem, Variety seeking, Normative Evaluation, Product and brand specific, Promotional offers and Advertisement. Then to predict dependent variable of impulse buying a simple regression model is used taking eight extracted factors as independent. All factors found to be significant in predicting impulse buying behaviour. Paper shows strong fit between Impulse buying behaviour and extracted factors so its implications can be extended by testing these factors on specific industries for more specific results. This study has few limitations as well which can be used for future

research work. This study is entirely based on young respondents and regression model is used in future effect of moderators can also be taken into account.

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Appendix:
List of items as per factors

Sl.No.	Factor	Items
1	Hedonic factor	To me, shopping is an adventure Shopping relieves me from stress I feel a sense of thrill when I am trying and buying something new I feel excited when making a purchase I prefer keeping updated on current knowledge of new products I like to do navigate shopping sites in my free time shopping gives me immense pleasure and happiness
2	Website Experience& shopping behaviour	I usually do not shop with a planned list of items in my mind It interests me more if layout and design of website is attractive I usually tend to buy more than planned if website is easy to navigate Finding unique things online makes me excited
3	Ease of shopping Online	online shopping gives me more comfort so i tend to buy more I find it easy to shop online than to shop in store Compared to others shopping online gives much more pleasure I get access to most fashionable and recent trends online
4	Consumer self esteem	I like myself to be seen as trend setter and fashionista People think of me as good source of shopping feedback
5	Variety Seeking	Online shopping gives me option to explore and buy wide variety of products I can say that I am spendthrift
6	Normative Evaluation	Post Purchase I find most of my impulse purchases are useful

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7	Product and Brand related	I feel emotionally connected with my favourite brand so I buy more irrespective of need or not. I tend to buy anall-new products from a my preferred brand as I want to c myself first owning it
8	Promotional offers and advertisement	I usually buy more than planned when there are sales and discounts offered on sites

Impulse buying variables used as per Merdin-Uygur, E. (2018).

1- I immediately buy a product / service if I believe it is useful.

2- If I believe I need to use it, I can buy a product / service immediately.

3- I purchase more products / services on spot than I previously planned

4- I buy things without any previous intention to buy it that day.

5- I buy things I never thought about at all before shopping.

6- Sales people make me buy a product / service I have not thought about, before.

7- It makes me happy to shop unplanned.

8- I buy a product / service to lift my mood that moment.

9- It is fun to buy things spontaneously.

10- I buy things according to how I feel at the moment.

Table 1: Case Processing Summary

Cronbach's Alpha	Number of Items
0.813	23

Table 2: Sample cases summary

		N	%
Cases	Valid	416	100
	Excluded[a]	0	0
	Total	416	100

Table 3: KMO and Bartlett's Test Results

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.721
Bartlett's Test of Sphericity	Approx. Chi-Square	3062.82
	df	253
	Sig.	0

Table 4: Total Variance Explained

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.022	21.835	21.835	5.022	21.835	21.835	3.255	14.154	14.154
2	2.383	10.360	32.195	2.383	10.360	32.195	2.408	10.467	24.621
3	1.790	7.782	39.977	1.790	7.782	39.977	2.006	8.723	33.344
4	1.572	6.837	46.814	1.572	6.837	46.814	1.959	8.517	41.861
5	1.371	5.960	52.774	1.371	5.960	52.774	1.743	7.577	49.438
6	1.179	5.125	57.899	1.179	5.125	57.899	1.442	6.270	55.708
7	1.046	4.549	62.448	1.046	4.549	62.448	1.314	5.714	61.422
8	1.029	4.473	66.921	1.029	4.473	66.921	1.265	5.499	66.921
9	.963	4.188	71.109						
10	.771	3.354	74.463						
11	.749	3.255	77.719						
12	.697	3.028	80.747						
13	.599	2.606	83.353						
14	.586	2.549	85.901						
15	.546	2.374	88.276						
16	.517	2.249	90.525						
17	.428	1.859	92.384						
18	.393	1.708	94.092						
19	.328	1.426	95.518						
20	.301	1.311	96.829						
21	.259	1.125	97.954						
22	.249	1.084	99.038						
23	.221	.962	100.000						

Extraction Method: Principal Component Analysis.

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Table 5: Rotated component Matrix

Rotated Component Matrix^a

	Component							
	1	2	3	4	5	6	7	8
v1	.129	.124	.128	.817	.121	.108	.048	-.016
v2	.094	.215	.019	.211	-.223	.176	.713	-.029
v3	.034	.689	.054	.176	-.180	-.011	.016	-.127
v4	-.109	.251	.612	.126	-.151	-.233	-.022	-.171
v5	.094	-.235	.698	-.008	.018	.264	.085	.050
v6	.075	.231	.046	.154	.099	.775	.112	.007
v7	.043	.680	-.163	-.020	.088	.240	.208	-.090
v8	.036	.807	-.102	-.023	-.012	.117	-.016	.116
v9	.063	.667	.334	-.035	.167	-.072	-.070	.237
v10	.469	.147	.542	.069	.281	-.060	.063	.066
v11	.353	-.041	.590	.241	.299	.169	-.082	.174
v12	.145	-.034	.102	-.108	.784	.169	-.080	-.067
v13	.496	.142	-.361	-.003	.287	-.237	.136	-.058
v14	.831	.040	.048	.124	-.020	-.107	.107	-.052
v15	.756	-.043	.176	.053	.134	.130	.162	.020
v16	.495	-.198	.249	.217	.111	.267	.391	.148
v17	.237	-.030	-.171	.275	.278	-.281	.431	.361
v18	.068	.046	.049	.017	.021	.057	-.006	.903
v19	.005	.011	-.009	.313	.756	-.060	-.037	.132
v20	.513	.100	.215	.182	-.013	.437	-.048	.164
v21	.662	.140	-.048	.171	-.077	.214	-.401	.239
v22	.534	.135	-.098	.472	.160	.237	-.341	.143
v23	.168	-.049	.082	.759	-.001	.055	.207	.036

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 12 iterations.

Table 6: Individual Factor Reliability Calculated Are Listed Below

Factor name	Reliability	
	Reliability Statistics	
F1	Cronbach's Alpha	N of Items
	0.797	7
	Reliability Statistics	
F2	Cronbach's Alpha	N of Items
	0.706	4
	Reliability Statistics	
F3	Cronbach's Alpha	N of Items
	0.641	4
	Reliability Statistics	
F4	Cronbach's Alpha	N of Items
	0.666	2
	Reliability Statistics	
F5	Cronbach's Alpha	N of Items
	0.651	2
F6	Can't be calculated for single variable	
	Reliability Statistics	
F7	Cronbach's Alpha	N of Items
	0.561	2
F8	Can't be calculated for single item.	

Table 7: Reliability test statistics of impulse buying behaviour factor

Cronbach's Alpha	N of Items
0.837	10

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Table 8: Regression Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.965[a]	.932	.930	1.337

a. Predictors: (Constant), REGR factor score 8 for analysis 1, REGR factor score 7 for analysis 1, REGR factor score 6 for analysis 1, REGR factor score 5 for analysis 1, REGR factor score 4 for analysis 1, REGR factor score 3 for analysis 1, REGR factor score 2 for analysis 1, REGR factor score 1 for analysis 1

Table 9: ANOVA[a]

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9927.586	8	1240.948	694.698	.000[b]
	Residual	727.029	407	1.786		
	Total	10654.615	416			

a. Dependent Variable: IMPULSE

b. Predictors: (Constant), REGR factor score 8 for analysis 1, REGR factor score 7 for analysis 1, REGR factor score 6 for analysis 1, REGR factor score 5 for analysis 1, REGR factor score 4 for analysis 1, REGR factor score 3 for analysis 1, REGR factor score 2 for analysis 1, REGR factor score 1 for analysis 1

Table 10: Regression Coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	43.058	.066		657.081	.000
	REGR factor score 1 for analysis 1	3.149	.066	.622	47.999	.000
	REGR factor score 2 for analysis 1	.617	.066	.122	9.399	.000
	REGR factor score 3 for analysis 1	.289	.066	.057	4.400	.000
	REGR factor score 4 for analysis 1	2.526	.066	.499	38.509	.000
	REGR factor score 5 for analysis 1	.722	.066	.143	11.007	.000
	REGR factor score 6 for analysis 1	1.606	.066	.317	24.479	.000
	REGR factor score 7 for analysis 1	-1.085	.066	-.214	-16.545	.000
	REGR factor score 8 for analysis 1	1.697	.066	.335	25.864	.000

a. Dependent Variable: IMPULSE

REVIEW ARTICLE

Crude Oil Degradation by Pure and Mixed Bacteria and their Enzyme: A Review

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ABSTRACT

Crude oil (petroleum hydrocarbons) released into the environment pollutes the water and soil and is carcinogenic and environmentally harmful. Several chemical and physical approaches were used to alleviate the issue. Due to the high expense of these approaches, biologists are looking for more cost-effective, dependable, and safe biological alternatives. Microbes and their enzymes are used to gather this information. The use of a diverse consortia and the balance of environmental factors resulted in a faster rate of degradation. Many microbial enzymes involved in biodegradation, such as Cytochrome P450, Catechol 2, 3 dioxygenase, and Laccase, have shown promise for aliphatic and aromatic hydrocarbon degradation. Understanding the mechanism of biodegradation is essential to comprehending the problems of biodegradation. The overview here provides a more comprehensive and condensed explanation of the methods used, as well as environmental conditions, enzymes, and degradation mechanisms.

Keywords: Crude oil, Biodegradation, Mixed consortium, Bacillus species ,Bushnell Hass Agar

INTRODUCTION

Crude oil is a non-renewable natural resource that has caught the attention of the globe in a variety of ways. At the time, the greatest demand on the international markets is for motor vehicle fuel. Over the last century, its use has resulted in breakthroughs, and the world now benefits from crude oil-derived products, both directly and indirectly. However, most of the things we use to make our lives easier are harmful to the environment. The main cause of water and soil pollution is the liberation of hydrocarbons, whether accidently or as an outcome of human action[1].

Household food security could be reduced by 60% as a result of these oil spills. The prevalence of childhood malnutrition could rise by 24% as a result of this[2]. Polycyclic aromatic hydrocarbons are carcinogenic & environmentally toxic. The ominous consequence has prompted researchers to look for ways to improve the situation. Physical and chemical procedures have been used to remediate the effects of oil spills (soil cleansing, chemical reduction and oxidation of contaminants, volatilization and cremation), but these treatments have not shown to be cost-effective and do not return the environment to its former state. Furthermore, they contribute to secondary contamination by transporting pollutants and chemical reagents. As a result, the only alternative left is to deploy microorganisms to degrade these oil spills. Microorganisms decompose organic molecules into simpler molecules such as CO_2, H_2O and ammonia during biodegradation. This system is less expensive, more secure, and more dependable. There are still millions of bacteria to be discovered, and the majority of them live in a very unusual way, including microorganisms that degrade oil. This influence can be good, as when the viscosity of heavy crude oil is reduced, making it easier to exploit, or negative, as when drilling equipment corrodes owing to bacterial hydrogen sulphide generation. Under some conditions, crude oil may flow uncontrollably onto the lithosphere's surface, posing substantial environmental risks. Such occurrences usually involve spilled oil and oil by-products from the extraction, processing, and distribution of oil. Natural microorganisms found in crude oil may typically remove this form of contamination; they have the capability for crude oil-derived chemicals to metabolise [3, 4, 5, 6].The purpose of this evaluation is to provide a factual background that appears to be little but can result in erroneous or incomplete deterioration if not regulated or implemented appropriately. It also outlines some of the difficulties that microbial degradation must overcome in order to be effective.

Oil degradation by microbial activity

There are four broad categories of petroleum hydrocarbons: saturates, aromatics, asphaltenes (phenols, fatty acids, ketones, esters, and porphyrins), and resins [7]. Fernley and Evans reported on the bacterial metabolism of various PAHs in 1958 [8]. The main contaminant is saturated hydrocarbons, which are easily biodegraded in the soil environment, especially those with a lower molecular weight. Because large branched aliphatic chains are difficult to breakdown, they remain in the environment [9]. Additionally, soil is an efficient decomposer of aromatic hydrocarbons with 1- 3 aromatic rings. On the other hand, those with exceeding 4 rings resist degradation [10]. Bacteria are found everywhere and are engaged in the disintegration of a variety of materials, including hydrocarbons, pharmaceuticals, polychlorinated biphenyls (PCBs) found in coolant fluids, heterocyclic compounds, and many metals. Bacteria and fungi have been shown to breakdown organic molecules like cholesterol and lipids, oils, chitin, and keratin. Bacteria, on the other hand, play a crucial part in the breakdown of hydrocarbons. Their biodegradation is more substantial(80%) than fungal biodegradation(20%) [11,12,13]. These bacteria that breakdown crude oil have enzymes created by their genes or mechanisms that help them digest it and use it as a source of carbon and energy. Saturated hydrocarbons(n-alkenes) have been reported to be used by *Acinetobacter, Rhodococcus, Bacillus, Pseudomonas,* and *Sphigomonas* during the breakdown of petroleum oil [14,15,16]. Under ideal environmental circumstances, they deteriorate more quickly. *Acinetobacter sp.T4* can degrade alkanes and other hydrocarbons by creating specific metabolites. The finest crude oil degraders, the *Pseudomonas* species are known as "oil-eating bugs." They eat only crude oil components, which include aromatic chemicals, as their sole source of nutrition. *Bacillus* breaks down hydrocarbons by releasing bio surfactants, which speeds up the process. The strains 28A and 61B may actively contribute to the degradation of the petroleum with a decrease of 44.1% and 50.4% following 28 days of incubation, the weight of crude oil respectively [17]. Recent studies have discovered that bacteria from around 79 genera are capable of breaking down hydrocarbon compounds [18]; several of these bacteria such as *Achromobacter, Acinetobacter, Alkanindiges, Alteromonas, Arthrobacter, Burkholderia, Dietzia, Enterobacter, Kocuria, Marinobacter, Mycobacterium, Pandoraea, Pseudomonas, Staphylococcus, Streptobacillus, Streptococcus,* and *Rhodococcus* have been found to play vital roles in petroleum hydrocarbon degradation [19,20,21,22,23,24,25].

Mixed and Pure Culture

Long chains of consecutive carbon–carbon single bonds and double bonds in complex hydrocarbons typically necessitate the collaboration of multiple species. For example, natural rubber. Because these complex compounds are difficult to breakdown, a community of microbes must work together to start the process. Individual bacteria have

only a small amount of enzyme activity for a small number of hydrocarbons. When a mixed population is assembled, it might contribute a wide range of enzymatic capabilities, resulting in an increase in the degradation mechanism. Due to the complicated chemical structures of oil products, biodegradation of oil products by the microbiota *Lactobacillus* is more successful than isolated single cultures [26]. This is possible maybe because the microbial conglomerate that is used depend on whether or not additional species are present and get benefitted for a better degradation effect. They need this to exist on a finite energy supply and in a world of complicated carbons. This explains why a synergistic interaction involving a large number of suitable components can also destroy aromatic hydrocarbons. More research should be done to compare the performance of the efficiency strains that have been identified. Farinazleen Mohamad Ghazali *et al.* used consortium one containing 1 Bacillus strain and 2 Pseudomonas strains. Consortium two containing 3 *Bacillus sp.* Strain, 2 *pseudomonas aeruginosa* strains and 1 *Micrococcus sp.* Strain [27]. They reported that consortium two consisting of 6 bacterial strains were capable of degrading long and medium-chain alkanes more efficiently as compared to consortium one. This confirms that mixed cultures with the maximum number of isolates display metabolic versatility to the culture containing a limited number of isolates.

Methods implemented in studies

The usage of appropriate media is critical. For bacteria to grow, they need food, and these oil-degrading bacteria require specific medium. For the research, mineral salt medium and Bushnell haas agar are highly recommended. Many researchers have used a variety of methodologies, as seen in the table below (Table 1).

Factors influencing the degradation rate

Everything is everywhere but the environment selects is the general rule of microbial ecology (Baas–Becking hypothesis). The following factors can have an impact on microbial activity: Temperature, pH, microbial community, nutrients, water activity, physical and chemical state of oil and oxygen concentration. Many researchers have found that regulating these factors in the laboratory environment gives excellent result as compared to dissatisfactory results obtained in field scale test [32]. In addition, it is crucial to comprehend these characteristics, particularly in an industrial context where a considerable amount of biomass is required.

Temperature

Temperature is a very important factor for the increase and decrease of the degradation rate. If the temperature is too high it will result in the decrease in the rate of degradation, as high temperature will denature the proteins(enzyme). Similarly, lowering the temperature will also decrease the enzyme activity. At times when bacteria encounter a freezing temperature there is a chance of cell rupture, due to the formation of ice crystals. The oil degrading microbes are active when the temperature range is between 20ºC-35°C. the deterioration rate will be slower in cold environments. In high temperatures between 30° C and 40° C, the pace of hydrocarbon metabolism peaked[33]. One more possible reason for the selection of this temperature can be the viscosity factor. In low temperature, the viscosity of the crude oil in increased which ultimately results in delayed degradation process.

pH

Microbes, particularly bacteria, are extremely pH sensitive. As a result, the level of H^+ is an important component in evaluating whether or not a crude oil will be degraded by bacteria. Like in case of temperature the enzyme activity is affected. Protein structures denature or undergo ionic alterations (zwitterion), resulting in the loss of catalytic capabilities in enzymes. It can alter the cell membrane transport system as well and finally the metabolism is halted. Pawarmade a conclusion that the best pH for improved breakdown of overall polyhydrocarbons is 7.5[34]. Soil pH is a crucial parameter whose values can be altered for a better decomposition process. A suggestion made here is that the combination of consortium chosen for crude oil degradation should be very properly evaluated. Since bacteria's produce and excrete acid as they grow. Due to release of such acid the pH of the surroundings environment changes as a result it can be expected a rise in the acidity resulting in lower rate of degradation.

Microbial community

In deterioration, the presence of a microbial community rather than a single bacteria itself is evidence of advancement. The presence of a microbial consortia boosts the rate of bio-degradation according to [27]. It is recommended that the consortium's species be mixed properly. So that the result is substantial and effective, there should be a synergistic contribution among the species used. Tian et al. conducted an experiment in which mixed bacterial strains were examined, with the combination of six bacterial strains(*P.alcaligenes, Bacillus thuringiensis, Pseudomonas alcaligenes, Pseudomonas mendocino, Bacillus flexus* and *Lysinibacillus sp.*) demonstrated the best degrading capability[35]. Mutation can also be advantageous since it allows us to obtain diversity within a single oil-degrading bacteria.

Nutrients

The continuous growth of microorganisms in both the lab and their natural environments depends on nutrients, which are necessary for microbial growth. Energy-giving, carbon-containing, and other essential nutrients are needed. While implementing the mixed consortium in degrading, an issue could develop. Microbes have a limited energy source. Sufficient supply of nutrients (iron, phosphorus and nitrogen) is required for this to operate. Thus, microbial degradation of the pollutants required the addition of nutrients[36]. To transform 1kg of hydrocarbons in a bacterial cell, around 150g of nitrogen and 30g of phosphorus are consumed [37]. However, excess nutrients can stifle biodegradation activity [38]. Huge oil spills can result in a significant increase in carbon levels while lowering phosphorus and nitrogen levels. For successful degradation, a good nutritional balance must be maintained.

Water activity

Water availability has a direct impact on microorganism migration and growth. The water activity of soil may range from 0.1-0.99. Higher a_w substances always tend to support more microorganisms. Biodegradation in oil sludge was shown to be best when 30–90 percent water saturation was present, according to Dibbel[39].

Water activity (aw) = partial vapour pressure of water in a solution / partial vapour pressure of water

Physical and chemical state of oil

A mixture of both aromatic and aliphatic hydrocarbons makes up crude oil. Investing a lot of effort towards their degradation will have a huge payoff. Alkanes are incredibly water insoluble, and their solubility falls as their molecular weight rises [40]. Long chain alkanes are a deteriorating issue due to their limited water solubility, propensity to accumulate in cell walls, and the energy needed to activate the molecule. N-alkanes (C6-C40) and other hydrocarbons are the only carbon sources used by *Dietzia sp.* DQ12-45-1b[14]. Two or even more bonded aromatic rings organized in a straight, angular, or grouped configuration make up the PAH class of chemicals. *Arthrobacter sulphureus RKJ4*, *Bacillus cereus P21*, *Polaromonas napththalenivorans* CJ2 utilizes phenanthrene, pyrene and napthalene respectively [41, 42, 43]. Numerous monoaromatic as well as polyaromantic compounds respond favourably to *Achromobacter xylosoxidans* DN002[44].This strongly shows that different native organisms' involvement in polluting soil containing oil varies substantially, and that each of their catalytic enzymes is unique. Thus, petroleum hydrocarbon clean-up necessitates the cooperation of many fractioned microorganisms.

Oxygen

The initial stage in the breakdown of aliphatic, cyclic, & aromatic compounds by bacteria and fungi is the oxidation of the medium by oxygenase, which necessitates the presence of molecular oxygen. For this method of microbial oxidation of hydrocarbons in the environment, aerobic conditions are required. With different types of crude oil contaminated soil the oxygen requirement varies. Slit, clay coarse sand, and fine sand are common components of soil samples and with fine soil the degradation is limited. This could be because of the pore size. The pore size of fine soil is small, reducing the space and route for gas and water passage. Furthermore, adding fluid to soil causes the soil to become soggy. It's probable that the shortage of oxygen is causing the limited growth and deterioration. Therefore the degradation process is recommended when the soil sample is dry.

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Degradation of crude oil in low temperature:

The majority of earlier analyses of oil-degrading bacteria concentrated on conditions with a constant temperature. Native microbes are also anticipated to degrade petroleum hydrocarbon components in recent years in a variety of terrestrial and marine habitats, notably Arctic soils and sediments, mountains, and Antarctica. Concern about cold-adapted microorganisms is growing because they can adapt rapidly to polluted environments. In low temperature bacteria shows signs like increased short chain-fatty acids unsaturated fatty acids and enhancement of cell wall fluidity. These cold adapted bacteria produces degradation enzymes harbouring genes that can express themselves at low temperatures. This is done in order to improve the catalytic activity of the enzyme. Antifreeze proteins and cold protective compounds in these bacteria help to prevent protein denaturation and polymerization. When these microorganisms are exposed to cold temperatures, they create a considerable amount of cryprotein. Cryprotein expression may be accelerated by cell reactions such as transcription and translation. Because of their distinct physical and chemical characteristics, bacteria can frequently deteriorate at low temperatures [45,46,47]found that over 80% of the petroleum hydrocarbons in the soil of polar frozen zone remediation tests were eliminated by adding cold-adapted microorganisms. The processes by which these microbes adapt to severe environments, as well as the precise ways in which they destroy petroleum hydrocarbons, need to be investigated further.

CONCLUSION

Clean up of petroleum hydrocarbons in the soil ecosystem is an actual problem. Because the biodegradation process depends on local bacteria to change or mineralize organic contaminants, a fuller understanding of this process is crucial for the environment. The microbial decomposition process helps remove hydrocarbons from the environment after considerable amounts of oil have been removed by numerous physical and chemical methods. This is plausible given that microorganisms have enzymatic activities that can break down and use different hydrocarbons as sources of carbon and energy. Many factors contribute to biodegradation's limitations, and the conclusion reached here can be applied if more research is done in this area. The expenditure of time is one of the most significant obstacles that biodegradation faces. This could be because the elements that influence the rate require more attention. Selection of species for degradation and investigation of their synergistic effects takes more time. To save time, obtain a handy manual and ready-made data for species selection, which will speed up the procedure and boost the efficiency of the end result. There may be a lack of species diversity due to the dominance of a few species, particularly *Pseudomonas*. This might be caused by a malfunction in the nitrogen cycle, as there are significantly fewer species and operational genes related to nitrification. So, bacteria containing nitrification genes must be incorporated in the consortium used in order to achieve efficient degradation rate. As bacteria grow, acid is produced.

The pH of the surroundings is lowered whenever this acid is released. Bacterial growth will ultimately come to a stop unless another element in the environment balances the bacterial acid. To prevent condition like this implementation of a base is recommended on observing the presence of such acid producing bacteria. The rapid expansion of hydrocarbon degraders is accompanied by a reduction in critical nutrients (nitrogen, phosphorus, and iron), resulting in a microbial bloom decline. It is critical to maintain a correct nutritional balance. The actual necessary quantity of these nutrients is determined by the contaminated site's biochemical oxygen requirement. The biodegradation process can be accelerated by the introduction of urea-phosphate, N-P-K fertilizers, and ammonium and phosphate salts. The type of soil in which deterioration is carried out is important because fine soil particles provide less space and a conduit for water. As a result, the earth becomes saturated with water. Due to a shortage of oxygen in the soil, this can be a limiting factor. As a result, as the soil dries out, deterioration is suggested. By modifying the surface molecules of cells, we can improve their adhesion capacity. Surfactants producing bacteria may act as an emulsifiers. To create perfect strains or limit pollution, Techniques used in bioengineering such as molecular integration, protein alteration, and gene recombination can be used

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Table 1: Medias used and the result obtained

S. No	Media Used	Organisms Obtained	Reference
1.	Luria Bertani broth, nutrient agar, and Bushnell hass medium	Gram-negative *coccobacillus* strains, Gram-positive cocci, and Gram-positive *bacilli.*	[28]
2.	Mineral basal salt medium (0.1 $CaCl_2.2H_2O$ + 1.0 $(NH_4)_2SO_+$ 0.8 K_2HPO_4 + 0.005 $FeSO_4. 7H_2O$ + 0.2 $MgSO_4.7H_2O$ + 0.2 KH_2PO_4 and 1ml trace element) + crude oil	Gram-negative -*Sphingomonas koreensis*	[29]
3.	Nutrient agar, Mineral salt media (10g NaCl,2.0g of Na_2HPO_4,0.17g of K_2SO_4 , 2.0g of $(NH_4)_2SO_4$ 0.53g of KH_2PO_4 and 0.10g of $MgSO_4.7H_2O$) containing crude oil, and Bushnell hass medium containing crude oil	*Escherichia coli, Streptococcus anginosus, Lactobacillus sp.,* *Bacillus cereus,* and *Paracoccus sp.*	[2]
4.	Nutrient agar (primary isolation), Nutrient agar + various concentrations of diesel + isolates obtained from the primary Isolation	*Micrococcus and* *Staphylococcus*	[30]
5.	Nutrient agar and Mineral salt medium (1.0g NaCl,0.02 $CaCl_2$, 1.0g of KH_2PO_4, 1.0 g of NH_3NO_2, 0.002 $FeCl_3$, 0.002 $MnSO_4.H_2O$ and yeast extract 1.0 gm + crude oil	*Bacillus cereus*	[31]

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RESEARCH ARTICLE

Performance Enhancement of KNN Classifier for Guitar Chord Tonality Classification

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ABSTRACT

Machine learning is exhaustively being implemented in music recognition, recommendation and classification. Guitar chord classification based up on the tonality, though seems like a trivil problem but it requires intricate mathematics along with clear understanding and analysis of harmonics. In the quest of learning a musical instrument, many beginners prefer self-learning along with reference to online content. During this learning process, the work presented in this paper could be of great help. In this paper we have attempted to recognize the guitar chords as Major or Minor depending on the intervals between successive harmonics. To achieve this objective, we have picke dup kNN(kNearest Neighbour) machine learning algorithm and have improved its performance by hyper parameter tuning using Grid Search CV. The results presented clearly indicate the performance enhancement with an increased accuracy of 92.68%.

Keywords: Guitar chord, hyper parameter tuning, Machine learning, recommendation and classification.

INTRODUCTION

Music is a harmonized set of sounds produced by a musical instrument. 'Note' is the smallest unit of music. In music theory, there are 7 notes namely A,B,C,D,E,F,G. The musical distance or the interval between two consecutive notes is a 'Whole step' except for B-C and E-F notes. In case of B-C and E-F notes, the interval is a 'half step'. As the smallest interval is a half-step(due to B-C and E-F), intermediate notes exist at half step between every consecutive note. To understand, the note between A and B is either called A-Sharp(A#) or B-Flat(Bb). Once these are inserted between natural notes, the picture of musical notes changes to a total of 12 notes as shown in the figure below. One of the most interesting property associated with a note is its frequency. Every note has a set of fixed frequencies that basically defines that note. To elaborate, A note can have frequencies like 55hz,110Hz,220Hz,440Hzandsoon. Every time the frequency is doubled, we move one octave higher. Also, all the 12 notes as depicted in Figure 1 are equally

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spaced on alogarithmic scale. To go from A note to A# note we can simply multiply by a factor of 21/12.Further, a chord can be understood as several notes being played simultaneously instead of sequentially. Major chords and Minor chords are the most popular ones, both involve playing exactly 3 notes simultaneously. A root note is selected first. To play a Major chord, progression is 2 whole steps, followed by 1.5 steps from root note. On the other hand to play a Minor chord progression changes to 1.5 steps first and then 2 whole steps from the root node. In real life, musical sound waves do not exist as a single frequency but as harmonics which are integer multiples of base frequency. This implies that playing a particular note will contain all the integer multiple frequencies as its harmonics. Playing a chord will result in an overlapping of all the harmonics of individual notes thus creating music. Table 1 gives a clear distribution of harmonics (integral multiple of base frequency for a particular note)across8octaves.

KNN Classifier and Parameters

The k-Nearest Neighbours (KNN), one among the simplest machine learning algorithms for classification, is quite effective and has a lot of room for improvement. The algorithm's dependence on the value of makes it a sluggish method at times[1].The use of this algorithm for classification is widespread and classification problems ranging from electroencephalogram EEG[2] to KNN based text and document mining[3] are done. Text categorization or text classification automatically classifies a set of text documents in to various categories. KNN is effortlessly productive for both classification and regression, despite the fact that it has many weaknesses[4]. To overcome these weaknesses of the classifier many versions for improvements have been formulated. Locally adaptive KNN[5], weight adjusted KNN[6],improved KNN for text categorization[7], adaptive KNN[8],KNN with shared nearest neighbors[9], KNN with k- Means[10] and SVM-KNN[11]are the few examples where KNN is enhanced algorithmically by tweaking the hyper parameters. The different variants of KNN algorithms are extensively compared for performance analysis[12] for example to predict a particular disease.

METHODOLOGY

Guitar chord playing and learning has become an interesting filed of research for machine learning enthusiasts[13]. Every note and subsequently every chord played on a musical instrument has its own defining frequency and harmonics. In this research paper we have aimed to dig deeper in the field of music recognition and identification. We have precisely identified the chord played on a musical instrument vis-a-vis Major Chord or Minor Chord based on the deterministic features of musical sound wave. Also, we have attempted to improve the performance of kNN algorithm for chord identification by hyper parameter tuning. To achieve this objective, we have adopted the following work flow shown in Figure2. We have taken a publicdatasetfromkaggle.com. Data set consists of 859audio files in the wav format. Based on chord's frequency and harmonics, we have carefully identified the features which are deterministic for a particular chord. These features include the intervals between consecutive harmonics when a chord is played. Based on this observation, we have created a data frame using SciPy python package. We have identified KNN (K Nearest Neighbours)machine learning algorithm to train the dataset[1]. KNN is a machine learning algorithm that classifies the data sample based on a measure of similarity. There are different parameters associated with KNN algorithm which if tuned meticulously can maximize the accuracy and performance of the algorithm. Out of all the parameters, we have attempted the hyper parameter tuning of the following parameter s:n_neighbours, weight sand metric. For the weights parameter, we have tested the model for 'distance' and 'uniform' values. For the metric parameter, the model is tested for 'Manhattan' and 'Euclidean'. The value for 'n-neighbors' parameteris tunedfrom1 to 15.To accomplish this, we have used Grid Search CV.Grid Search CV runs through all the parameter sedan to the parameter grid and produces the best combination of parameters, based on a scoring metric. The challenge is to identify the parameters that could possibly enhance the performance of the algorithm, at the same time keeping the number well in limits so as not to increase the processing time and make the model sluggish.

RESULTS

We have tested 60 different possibilities as a result of tuning 3 hyper parameters vis-à-visn_neighbours, weights and metric. Table 2 shows all the permutation and combinations of the identified parameters for KNN algorithm. We have compiled all the possibilities and have presented the min the order of ranking along with the Mean Test Score. Mean Test Score is an indicator of Model's accuracy. KNN algorithm without hyper parameter tuning hadean accuracy of 79.04% but after hyper parameter tuning, we have achieved an accuracy of92.68%. Performance of KNN algorithm with hyper parameters tuning is closely studied. The results are plotted and shown in Figure 3. With the metric set to Euclidian and weights parameter set to uniform, we have observed a decrease in mean test score as the number of k neighbours is increased. With this combination of hyper parameters, the maximum mean test score obtainedis0.9052atkvalueof1. With the metric set to Euclidian and weights set to Distance, not much of a trend variation is observed, however maximum value of mean test score = 0.9085 is obtained at k=4.When we tune the parameter metric to Manhattan and weights to uniform, a downward trend is observed in mean test score when the number of k neighbours is increased. However, the maximum mean test score of 0.9068is obtained for k=1.Finally we observe the best performance of kNN algorithm with the metric set to Manhattan, weights set to distance and the value of k set at 5. With the hyper parameters tuned to these values, we have been able to achieve the mean test score of0.9268. Figure 4(a) is the confusion matrix for predicted values against the test values when no hyper parameter tuning is done. Figure 4(b) shows the confusion matrix with hyper parameter tuning. As visualised in Figure 5, we have been able to increase the model's accuracy by 13.64% and hence we have enhanced the performance of KNN classifier for guitar chord tonality.

CONCLUSION AND FUTURE SCOPE

Guitar chord classification problem refers to segregating the major chords from minor chords. As more complicated chords like barred chords or 7th chords are included in the datasets, the classification problems can become more tedious. This paper presents solution to the guitar chord tonality classification for major and minor chords using KNN algorithm. The performance of the classification algorithm is improved using hyper parameter tuning for KNN. The optimized results are presented for future reference.

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Table1: Frequency Distribution of Harmonics for musical notes

		Notes											
		A	A#	B	C	C#	D	D#	E	F	F#	G	G#
	0	55	58.3	61.7	65.4	69.3	73.4	77.8	82.4	87.3	92.5	98	103.8
	1	110	116.5	123.5	130.8	138.6	146.8	155.6	164.8	174.6	185	196	207.7
	2	220	233.1	246.9	261.6	277.2	293.7	311.1	329.6	349.2	370	392	415.3
	3	440	466.2	493.9	523.3	554.4	587.3	622.3	659.3	698.5	740	784	830.6
	4	880	932.3	987.8	1046.5	1108.7	1174.7	1244.5	1318.5	1396.9	1480	1568	1661.2
Octaves	5	1760	1864.7	1975.5	2093	2217.5	2349.3	2489	2637	2793.8	2960	3136	3322.4
	6	3520	3729.3	3951.1	4186	4434.9	4698.6	4978	5274	5587.7	5919.9	6271.9	6644.9
	7	7040	7458.6	7902.1	8372	8869.8	9397.3	9956.1	10548.1	11175.3	11839.8	12543.9	13289.8

Table2 : Frequency Distribution of Harmonics for musical notes

S.No	Rank	Metric	Weights	N-Neighbors	Mean-Test-Score
1	1	manhattan	distance	5	0.926851671
2	2	manhattan	distance	4	0.920207153
3	3	manhattan	distance	6	0.92018761
4	4	manhattan	distance	7	0.920168067
5	5	manhattan	distance	3	0.918546023
6	6	manhattan	distance	8	0.916826265
7	7	euclidean	distance	4	0.908579246
8	8	manhattan	distance	9	0.908501075
9	9	manhattan	uniform	1	0.906859488
10	9	manhattan	distance	1	0.906859488
11	9	manhattan	distance	2	0.906859488
12	12	euclidean	uniform	1	0.905217901
13	12	euclidean	distance	1	0.905217901
14	12	euclidean	distance	2	0.905217901
15	15	manhattan	distance	10	0.903537229
16	16	euclidean	distance	3	0.900273598
17	17	euclidean	distance	5	0.898573383

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18	18	euclidean	distance	8	0.89855384
19	19	manhattan	distance	13	0.898514755
20	20	manhattan	distance	12	0.895172953
21	21	manhattan	distance	11	0.893511823
22	22	euclidean	distance	6	0.891928865
23	23	manhattan	distance	14	0.891870236
24	23	manhattan	distance	15	0.891870236
25	25	euclidean	distance	9	0.88690639
26	26	euclidean	distance	7	0.885264804
27	27	euclidean	distance	12	0.880203244
28	27	euclidean	distance	14	0.880203244
29	29	euclidean	distance	13	0.880183701
30	30	euclidean	distance	11	0.878542115
31	31	euclidean	distance	10	0.876900528
32	32	euclidean	distance	15	0.876861442
33	33	manhattan	uniform	2	0.865233535
34	34	manhattan	uniform	3	0.856966973
35	35	euclidean	uniform	2	0.84696111
36	36	manhattan	uniform	5	0.835294118
37	37	euclidean	uniform	3	0.818760993
38	38	manhattan	uniform	7	0.816982607
39	39	manhattan	uniform	4	0.813660348
40	40	manhattan	uniform	6	0.813640805
41	41	manhattan	uniform	9	0.806996287
42	42	manhattan	uniform	8	0.806957201
43	43	manhattan	uniform	10	0.800351769
44	44	euclidean	uniform	5	0.790404534
45	45	euclidean	uniform	4	0.785401603
46	46	manhattan	uniform	13	0.780398671
47	47	manhattan	uniform	11	0.780379128
48	47	manhattan	uniform	12	0.780379128
49	49	euclidean	uniform	6	0.775434825
50	50	manhattan	uniform	14	0.77539574
51	51	euclidean	uniform	7	0.770470979
52	52	euclidean	uniform	9	0.767070549
53	53	euclidean	uniform	10	0.765389877
54	54	euclidean	uniform	8	0.763806918
55	55	manhattan	uniform	15	0.760445574
56	56	euclidean	uniform	12	0.750439711
57	57	euclidean	uniform	11	0.748778581
58	58	euclidean	uniform	13	0.740433848
59	59	euclidean	uniform	14	0.730447528
60	60	euclidean	uniform	15	0.718780535

Figure1 : Musical Notes

Figure2: Work Flow Graph

Figure3:Performanceof KNN algorithm with hyper parameters tuning w.r.t. number of kneighbours

Figure 4 (a) Confusion Matrix of kNN algorithm without hyper parameter tuning (b) Confusion Matrix of kNN algorithm with hyper parameter tuning
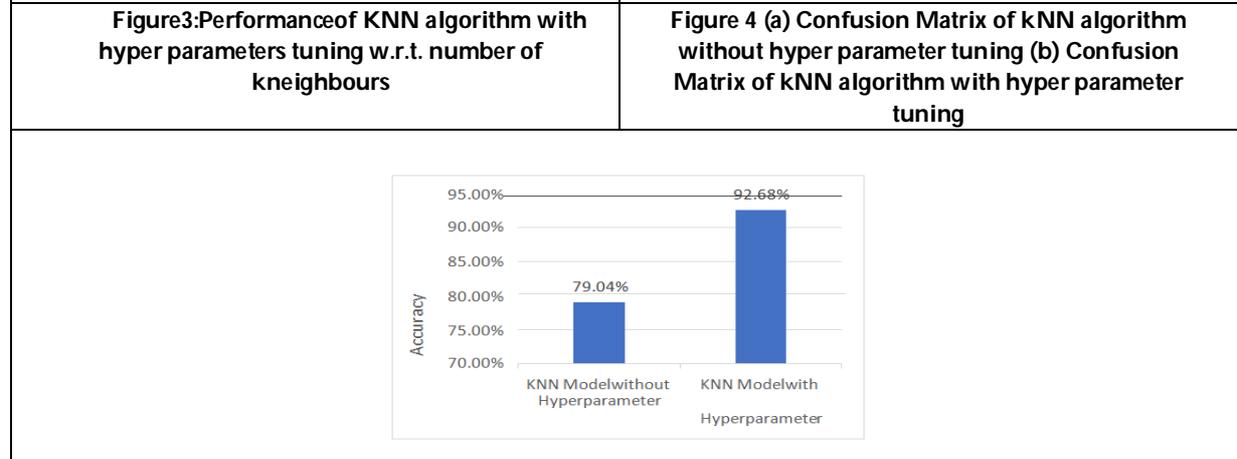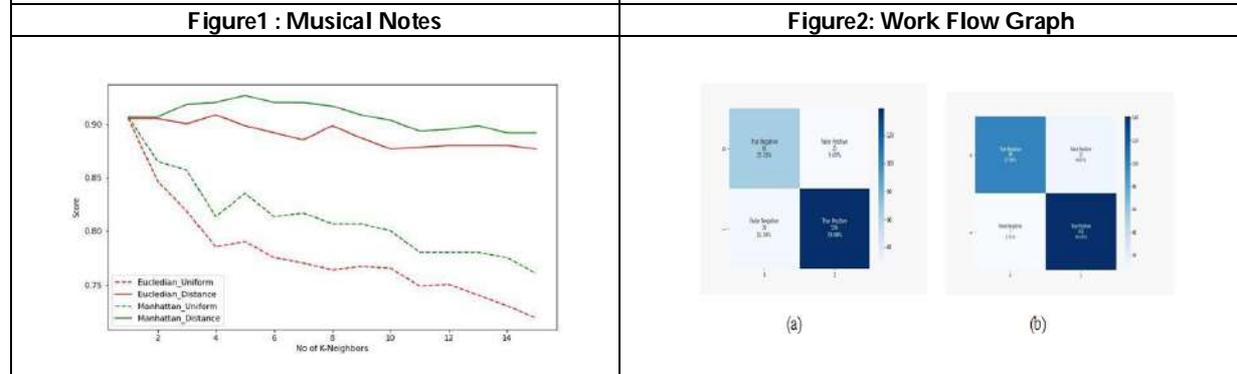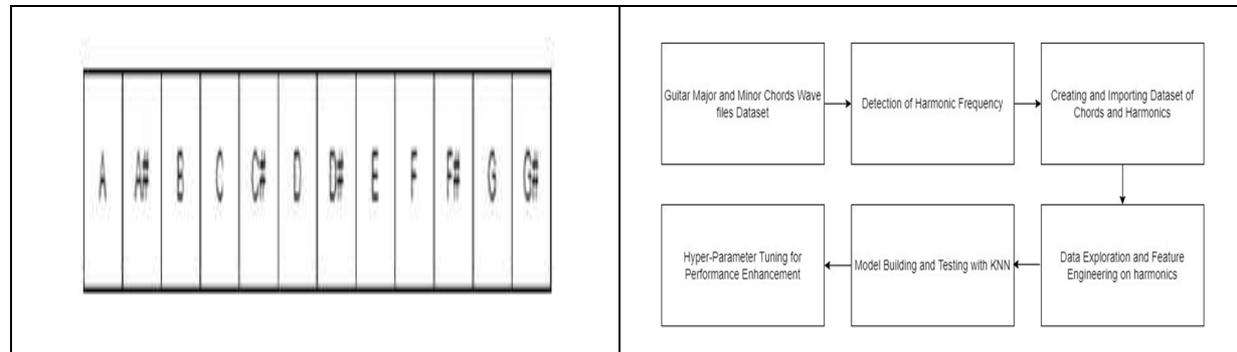
Figure5: Comparison of Accuracy with and without hyper parameter tuning of kNN algorithm

REVIEW ARTICLE

Cough Syrup Deaths a Toxicological Review of the Diethylene Glycol

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ABSTRACT

Alcohols such as glycerol are widely used in the food, pharmaceutical, and personal care industries. The property of glycerol (or glycerin) to act as a humectant, preservative, and emollient makes it an ingredient found in more than 2000 products, including teeth-whitening products, gargle, and analgesics. Glycerol is produced as a byproduct in the synthesis of biofuels from fats and oils. A sizable number of instances of glycerol adulteration have been discovered by various regulatory services worldwide. Due to the physical similarities and fact that it is three times less expensive than glycerol, diethylene glycol (DEG) is the most often reported adulterant. Due to DEG's toxicity, this fraudulent activity has resulted in deaths. This paper gives an overview of diethylene glycol, glycerol, and method to identify the adulteration of DEG in glycerol by GC.

Keywords: Diethylene glycol, Glycerol, Adulteration, Gas Chromatography.

INTRODUCTION

Diethylene glycol (DEG) serves as a solvent, an industrial lubricant, and braking fluid for automobiles. The chemical formula of diethylene glycol is HO CH2CH2 OCH2CH2OH, and its ends are terminated by hydroxyl groups. Several properties of the compound can be attributed to hydroxyl groups, including its strong solubility in water, absorbency, solvent properties, and compatibility with various organic compounds. The liquid is colourless, hygroscopic, and viscous with very low volatility. Dihydroxy ethyl ether, 2,2'-Dihydroxyethyl ether, glycol ethyl

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ether, di glycol, ethylene di glycol, 3-Oxapentamethylene-1,5-diol, 2-(2-hydroxyethoxy)ethanol, Bis(beta-hydroxyethyl) ether, Bis(2-hydroxyethyl) ether, and 3-Oxapentane-1,5-diol are all synonyms for DEG[1].The structure of diethylene glycol is shown in Fig.1. Human poisoning on a massive scale has been caused by the DEG contamination of medications and health items. The primary organ that DEG targets is the kidney. Additionally, it has a strong narcotic effect. Depression, vomiting, and diarrhoea are the earliest clinical symptoms, which are eventually followed by anuric renal failure. Two ethylene glycol (EG) molecules connected by an ether bond make up diethylene glycol (DEG). DEG has several physical characteristics with ethylene and propylene glycol. With a specific gravity of 1.118, this solvent is a viscous liquid. It is tasteless to kids and tiny animals, almost odourless, and colourless. In most species, DEG is more hazardous than propylene glycol but less dangerous than ethylene glycol. Hundreds of people have died as a result of it occasionally being used in medicinal preparations as a less expensive alternative to propylene glycol or glycerin[2]. Ethylene oxide and glycol are heated to produce two molecules of ethylene glycol joined by an ether bond, which is how diethylene glycol is produced commercially. Now understood to be metabolised to diverse metabolites other than ethylene glycol, diethylene glycol was once thought to be split into two ethylene glycol molecules[3].

Toxicokinetics

The liver, kidneys, spleen, brain, and adipose tissue all receive rapid absorption and distribution of diethylene glycol. The majority of the DEG goes to the kidneys. Although the amount of DEG dispersion in humans is unclear, it is around 1 l kg^{-1}in rats. Now that it is recognised that the ether linkages are very stable, it is no longer believed that DEG is converted to ethylene glycol and then to oxalic acid. Instead, alcohol dehydrogenase (ADH) converts DEG to 2-hydroxyethoxyacetic acid (HEAA) and di glycolic acid (DGA). Recently, it was shown that the main nephrotoxic metabolite in DEG poisoning is di glycolic acid. DEG has a dose-dependent half-life, and in rats, dosages of 6 ml kg^{-1}and 12 ml kg^{-1}resulted in half-lives of 8 and 12 hrs respectively. DEG seems to follow 1storder kinetics and has a half-life of 3.6 hours at higher dosages (>17.5 ml kg^{-1})[3]. Although there are little data on humans after data gathered from mass poisonings, the majority of information on the deadly dose of DEG comes from rat studies. It is yet uncertain what DEG dose is at the lowest related with morbidity and death. The mass poisonings in Haiti had a median toxic dose of 1-1.5 g kg-1. However, DEG levels of 0.5–1 g kg-1 have been linked to kidney damage. At hazardous doses, as low as 0.09 mg kg-1, the Panama disaster occurred. In rats, 15 g kg-1 has previously been listed as the LD50 dose[3].

Mechanism

Alcohol dehydrogenase breaks down DEG into hazardous byproducts, mainly HEAA and DGA. DEG has the potential to produce neurotoxicity, cortical necrosis leading to irreversible renal failure and metabolic acidosis with an anion gap. Recently, it was shown that DGA, not HEAA, is the main nephrotoxic substance responsible for the death of proximal tubule cells. It has only recently been reported that DEG poisoning causes neurotoxicity. The neurotoxicity manifests as a pattern of peripheral and cerebral demyelinating sensorimotor polyneuropathy. Although the accurate neurotoxicity mechanism is yet unknown, it does appear to be extended in the instances documented in the literature while also displaying signs of reversibility[3].

Diethylene glycol

⇩ ALDH

2-Hydroxyethoxyacetic acid

⇩ ADH

Diglycolic acid
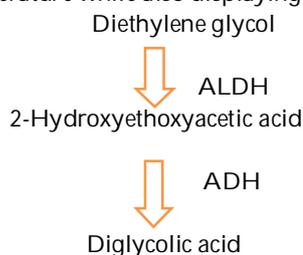
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Glycerol(Glycerin)

Glycerin is a thick, flavourless liquid that is commonly used in liquid medicinal, cosmetic, and food applications. It also has no smell or colour. In the foodstuff, medicine, and personal care industries, glycerol is a widely utilised alcohol. Due to its favourable qualities as a humectant, preservative, and lubricant, glycerol (or glycerin) is included in over 2,000 items, including Painkillers, mouth rinse, and dentifrices. Glycerin is made from fats and oils as well as a by-product of the creation of biofuel. Within the next four years, glycerol demand is anticipated to rise by 6.3% to $2.1 billion, with North America and Western Europe accounting for 64% of the market as the major providers[5].The structure of diethylene glycol is shown in Fig.2. Glycerin was used in food items (24%), personal care items (23%), oral care items (17%), and medicines (only 7%). Skin, hair, and soap products are personal care items. Manufacturers producing cigarettes, polyurethanes, alkyd resins, wrappers, dynamite, moisturizing ingredients, and lubricants receive29% of the total glycerin[6]. An outstanding oleochemical with distinct chemical and physical characteristics, glycerol (1,2,3-propanetriol) has a wide range of uses. Oleochemicals are substances made from naturally occurring oils and fats, whether they come from plants or animals[4]. It may be made using either natural or synthetic glycerin, which is a major by-product of the synthesis of biodiesel (Fig.3). Rather than the source (combination of vegetable/tallow), the crude natural glycerol quality is mainly dependent on the production method, and it is normally 80-95% pure. Glycerin may be refined and purified until it reaches 99.5% purity, and is the most common grade sold for human consumption. Petroleum is used to make synthetic glycerin, which is then processed using petrochemical building blocks. Both procedures provide a very pure and concentrated glycerin. Synthetic glycerin has a small market share[6]. The chemical formula of glycerin is $C_3H_5(OH)_3$, its molecular weight per mole is 92.09382g.Glycerin has a density and viscosity of 1.261 g/cm^3 and 1.5 Pa/s, respectively. Glycerin melts at 18.2ºC and boils at 290ºC. Food energy and surface tension of glycerin are 4.32 kcal/g and 64N/m respectively.

As was already noted, a variety of direct uses make use of glycerol's special qualities.
- Preparations for use in medicines
- Products for personal care
- Tobacco's humectant
- Animal feed conditioner
- Glycerin soaps
- Solvent (along with propylene glycol) in e-cigarettes
- Heat transfer liquid and coolant[4].

Adulteration of glycerol

Since the glycerin used for human consumption, history is filled with sad events, many of which resulted in fatalities. In 1937, over 100 Americans died in the US Elixir Sulfanilamide incident, which eventually led to the Federal Food, Drug, and Cosmetic Act of 1938.This disaster was brought on by the extremely high content of DEG in the elixir. Additional DEG poisoning events linked to pharmaceutical items have happened over time in various regions of the globe. The selling of fake toothpaste was the most recent incidence. The majority of the time, it is thought that DEG-based counterfeit items are to blame for the poisonings. Physical characteristics shared by glycerin, DEG, and ethylene glycol (EG) include inherent sweetness. This makes it easier to adulterate glycerin with more poisonous, less costly DEG[6]. A sizable number of instances of glycerol adulteration have been discovered by various regulatory services worldwide. Due to the physical similarities and fact that it is three times less expensive than glycerol, diethylene glycol (DEG) is the most often reported adulterant. Due of DEG's toxicity, this fraudulent activity has resulted in deaths. In Panama in 2006, DEG rather than glycerol was used in the production of cough syrups, which led to hundreds of reported fatalities. Additionally, toothpaste contamination incidences (1%–8% DEG) have been documented in Australia, America, and Europe. As a consequence, the items were recalled, and several health organisations implemented tougher guidelines for glycerol testing and usage[2].

Gas Chromatography For The Detection Of Glycerol adulteration With Diethylene Glycol

A sensitive and reliable screening approach using GC was created. Glycerin's limit for diethylene glycol and related chemicals prompted the development of the technique. Based on the total detectable area, the original approach

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could quantify DEG at a concentration of 0.1% (w/w) in glycerin and estimate the concentration of other related chemicals. The new GC technique's objectives were to improve method sensitivity and include a limit for EG, another possible glycerol impurity. The initial parameters of the chromatographic system will remain the same, such as the DB-624, fused silica capillary column (a 30-m0.53-mm)covered with stationary phase (3-m G43), helium as the carrier gas, and 220° and 250° for injector and detector temperatures, respectively[6]. The volume of analyte put into a column is often increased in chromatographic procedures to achieve improved sensitivity. This can be done by either increasing the injection volume or the concentration of the analyte in the test solution. Because glycerin has a high viscosity, using highly concentrated glycerin test solutions might be problematic. Consequently, we made the decision to raise the injection volume to 1L. The possibility of using methanol and isopropyl alcohol instead of water since GC liners struggle to confine growing solvent vapours. When methanol was utilised as the solvent, accuracy improved. Even though split-less injections showed improved sensitivity, the chromatography was challenging to interpret because of the abundance of unidentified peaks. EG and DEG with 0.025% of each were chromatographically separated with a split injection with a ratio of 10:1[6].

In any of the organic solvents, the reactions of EG and DEG were, on average, 25% greater when glycerin matrix was present. We compared pulse injection divided less and regular injection modalities in order to increase the recovery outcomes. The rise in injector temperature was a result of unsuccessful efforts to fix the recovery problem. The use of an internal standard was suggested as an alternative to changing the chromatographic settings in order to enhance the findings of EG and DEG recovery. 2,2,2-trichloroethanol was an acceptable candidate due to its inability to interfere with glycerin or unidentified peaks originating from the glycerin sample. According to GC analysis of a resolution solution, the theoretical plates for ethylene glycol, diethylene glycol and internal standard were 26,000, 53,000, and 46,000, respectively, and the tailing factors were 1.3, 1.3, and 1.0. Glycerin, DEG, and EG had resolutions more than 2. The chromatogram shown in Figure.5 demonstrates excellent chromatographic separation between the relevant peaks[6].

CONCLUSION

Glycerin is used in most of the cough syrup as solvent or thickening agent due its unique properties. However, there may be chance of adulteration, therefore tests must be done to make sure a raw material is the right one and has the proper grade or purity before it can be utilised in a procedure. Due to its ease of automation, the GC method is more efficient when handling several samples. It may be used to determine the concentration of EG and DEG in glycerin (glycerol). The strategy is especially effective when it's important to screen out potential economic adulterants. This straightforward and reliable technique may identify DEG adulteration in glycerol's basic material.

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Table.1: Some of Diethylene Glycol Mass Poisoning Incidences

Country	Year	Route	Medication
USA	1937	Oral	Elixir of Sulfanilamide
South Africa	1969	Oral	Sedative
India	1986	Unknown	Glycerin
Nigeria	1990	Oral	Acetaminophen
Bangladesh	1990	Oral	Acetaminophen
Argentina	1992	Oral	Propolis syrup
Haiti	1995	Oral	Acetaminophen
India	1998	Oral	Cough expectorant
India	1998	Oral	Acetaminophen
Panama	2006	Oral	Cough syrup
Nigeria	2008	oral	Analgesic

Fig.1: Chemical structure of diethylene glycol

Fig.2: Chemical structure of glycerin

Fig.3: Lipid hydrolysis and transesterification reactions

Fig.4: synthesis of glycerol by transesterification

Fig.5: Chromatographic separation of EG, DEG, Glycerin. *Peaks from solvent and glycerin.

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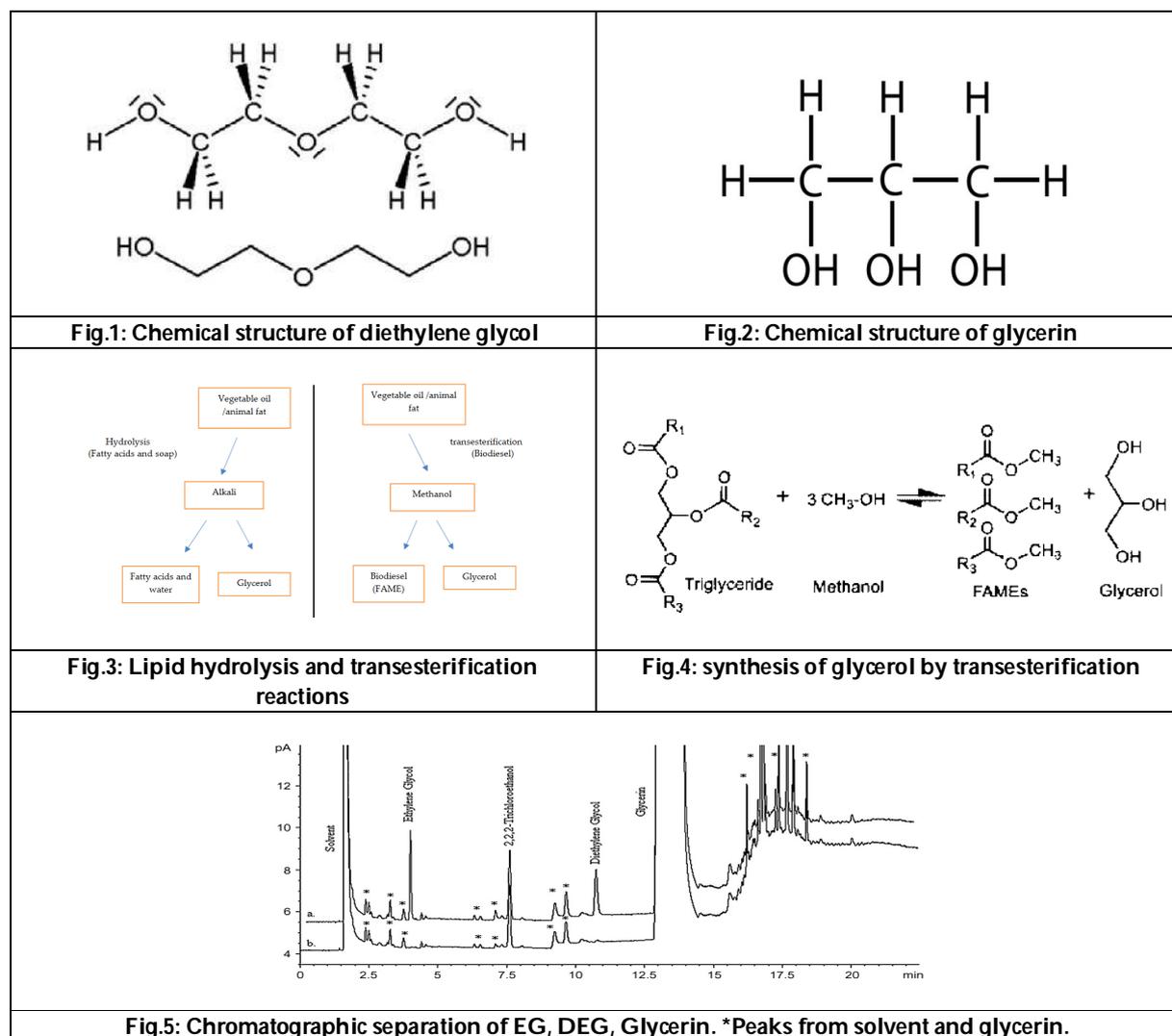
An Improved Region based CNN Model for RGB Color Detection in Plant Images

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ABSTRACT

Colour detection in plant images plays a predominant role to diagnose the plants growth factor. In particular, reference point prediction is essential while characterizing the colour, i.e. RGB colour with high saturation. In this paper, an improved regional neural network technique is used to detect colour anomalies in plant images based on similarity in the colour space of RGB. The dominant colour is evaluated in the initial stage based on the luminance and the colour information in the colour space of RGB. The similarity of the colour is computed with the suggested method for the computation of the colour components that generate the map of the colour class. The information of the relevant colour class map is used for the classification of the pixels. The outcomes of the proposed work show better RGB colour detection when compared with other existing approaches. The prediction mAP outcome of the proposed method is higher than other conventional methods.

Keywords: Colour characterization; anomaly detection; Internet of Things; accuracy; prediction

INTRODUCTION

Internet of Things (IoT) is the physical component that helps in the process of computing, which is merged with communication, computing and control is considered as the important generations of smart systems [1]. It is the interaction among the physical process via the interaction interface of the human and computer. Network space manipulates the physical entity in a reliable, secured, remote, real-time, and cooperative manner [2]. The future

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awareness of the ubiquitous environment, communication over the network, embedded computing, and control system engineering over the network makes the physical system have the communication, computing, specific control, collaboration in remote ways, and abilities carried out autonomously [3]. It is important to consider the concentration of the resources used for computing, and the close integration has the physical resources and the coordination, which are important for a few intelligent systems like intelligent navigation and robots [4]. In addition, physical system information is a new area of research in a relative way [5].The study in the real-time system has the processing of a digital image that is more essential IoT sensors are used widely in different areas like the satellite remote sensing, communication of image and in the biomedicine with the contiguous enhancement of the technology of network, technology related to the computer, and the theory based on mathematics [6].In addition, segmentation is an essential problem in the classic puzzle and computer vision problem. The studies are used in the identification system of the face, fingerprint identification, fire detection, medical imaging, machine learning and so on [7]. Computed tomography (CT) is used in hospitals that utilize the image's outcome to help diagnose the disease in patients efficiently and in the fastest way in real-time. In addition, the researchers' important considerations are machine vision and the face identification system. The colour images do not include brightness and have information related to colours like saturation and hue when compared with the images related to grayscale. In addition, the target information is not extracted in many cases from the image with the help of grey data. On the other hand, the human eye can identify thousands of colours to achieve the prediction by having information related to colour.

Hence, this is important to research the segmentation of the colour image with wide aspects. An image is very hazardous to the noise and light effects, where the noise variance and the changes in the light are considered during the prediction process [8]. The colour appearance of the image can change during the changes in the light. The detection inaccuracy takes place using the information related to colour alone about the information related to the brightness in a concurrent way. The proposed method has a better outcome in the detection of RGB colour. The Regional Convolutional Neural Network (R-CNN) is suggested in the proposed system to detect the RGB colour, which has the incorporation of the complement and consistent information among the two different modalities such as depth and RGB and also as the attractive model for the context mining globally and the discovery part of the discriminative object. The proposed RCNN model uses the fusion component of the feature to combine the extracted features from the feature maps as output for the two fully convolutional networks, such as having various sources of input to exploit the correlation between the modalities of depth and RGB. The proposed RCNN model learns the attractive context, and the discriminative parts of cereal images are explored, which depends on the fused features rather than using the fused features directly for the refinement of the object location and also for the classification. Both the discriminative parts and the attractive context, which are globally used in the proposed system and are used inside every region of a possible object, such as the proposal of the object, are critical for the cereal detection of RGB in the accurate form. The article is drafted as follows: section 2 gives a wider analysis of various existing approaches. In section 3, the RCNN methodology is elaborated widely for cereal detection. The numerical outcomes

Related works

The RGB images have object detection, which attracts increasing attention due to the sudden growth in the depth sensors, which are affordable and the conditions having different applications. Multiple successful algorithms are used in the suggested system, which is exploited the information efficiently from the data of RGB-D [9]. In addition, the benefits of having hand-designed features like many features of shape and SIFT that are presented for the object recognition of RGB-D in the depth channel. It is important to note that the two-stream CNNs are utilized to extracting features on Image Net from the RGB images. On the other hand, most of the research concentrates on the modality of RGB, and few latest types of research are dedicated to enhancing the performance of object detection using the consideration of depth information to have a concern. The geocentric embedding is suggested by De Castro et al. [10] for transforming every single channel depth map to the HHA image as a three-channel depth image having every pixel encoded with three information channels such as disparity in horizontal, height above the ground and angle in terms of gravity. In addition, the generalized method is used in the proposed system for the detector of R-CNN, which is used for the images of RGB and the large pre-trained CNNs are used in the proposed system on the images of RGV from HHA data for the extraction of features. The supervisions are transferred from the labelled

images of RGB to the unlabelled images of depth to learn the rich depth modality for the representations. The depth information is encoded and followed in the proposed system to the images of HHA to enhance the feature learning and consider the model [11] when the proposed system is compared with the baseline model. The object detection of the RGB is one more core problem in combing the features from various sources. There are previous strategies of fusion that are classified into two streams. They are (i) early fusion, which is the channel depth which is concerned as the added channel to the RGB images and this is concatenated having the channels of RGB for the feature extraction, and (ii) Late fusion, which has the features that are learned separately for every modality and the concatenation is done at the future phases for the classification of object [12] – [15]. The proposed system is the same as the late fusion technique. Yet, the attention model is used in the proposed method to the fused features for learning the best context in global and the parts of the discriminative object rather than using the concatenation of the features for the classification directly to obtain the recognition of the object in the more accurate way.

Methodology
This section provides a detailed analysis of the proposed RCNN model for RGB-based plant images detection.

Dataset description
The RGB images are included in the dataset, which is considered from approximate 1-metre height. The cell phone camera is used to take images the 10 megapixels. The processing of images is done to give the masks for the plants of carrot, weeds and grounds created after the initial acquisition. Fig 1 presents multiple images having the example from the dataset to represent. The presented images provide the observation of the variable conditions of the light. Thirty-nine images are included in the dataset with similar size of 3264 × 2448. Also, the dataset is divided into small images with the help of the sliding window technique since the image size is larger. The dataset has 311, 620, and 608 pixels, from which 18, 503, 308 weed, 266, 501, 219 ground pixels, and 26, 616, 081 carrot plant pixels. It is important to consider that there are more pixels of the carrot plants in the dataset than the plants of weed. The infestation of weeds is quite large in the images along with the imbalanced dataset and the higher overlap between the plants of carrot and the plants of weeds makes the detection task of weeds quite difficult. In addition, many classification algorithms are needed to balance every class distribution to train the classification model successfully. The benchmark outcomes of the pixel classification are attained using the proposed RCNN model.

METHODOLOGY

Fig 2 presents the architecture of the proposed framework. The RGB colour detection system depends on the attractive context learning of the proposed RCNN modal, which is comprised of four components: 1) fully convolutional networks (FCN) that depend on feature extraction; 2) fusion of the modal feature; 3) global context based on attention modelling, and 4) attention part of the fine-grained object. It is essential to consider Multi-scale Combinatorial Grouping (MCG), used in the proposed system with the RGB image. From the information of RGB, the number of proposals of the object and the original value of depth are created and encoded to the three channels for the HHA representation. The proposed model considers the input as the RGB image, where the HHA images and the object's relevant proposals for creating the class labels. Also, the refined bounding box for every object proposal is followed by the benchmark framework for object detection using RCNN. The module of the extraction of feature is presented, which is implemented on two individual FCNs based on the VGG16 for the RGB modality. Then, the AlexNet model detects the object with the D convolutional maps. In addition, the pooling operation of Region of Interest (ROI) is carried out on the two cubes of feature to achieve both the local features (object proposal) and the global feature (complete image) for the two modalities before giving to the fusion module of RCNN. In addition, both the local and global feature is fused for achieving the attractive global context of the relevant object proposal. On the other hand, the fused local feature has the treatment as the input to the attention part of the fine-grained object that creates the embedded local feature. In addition, the embedded local and global context feature concatenation is used for the ultimate detection of the object. At the same time, the local feature embedding is used for the regression of the bounding box.

Feature representation

The RGB modality is the RCNN complement integrated to enhance the RGB colour space detection performance. The extracted features are exploited in the proposed model for both local proposal feature description and modelling of global context from the two modalities. In addition, the simple and efficient sub-network is designed in the proposed system in a specific way for the fusion of the extracted features from both modalities. The representation of the fixed size feature is extracted in the proposed system for every proposal of an object with the help of ROI pooling in both modalities and is presented as F_{l_rgb} accordingly. This work also applies the pooling operation of two FCNs to produce the fixed feature cube size, expressed as F_{g_rgb}, respectively. The RGB modality-based feature fusion is represented using the below Eq. (1) & Eq. (2):

$$F_{l\_fused} = concatenation\ (F_{l\_rgb}) \tag{1}$$
$$F_{g\_fused} = concatenation\ (F_{g\_rgb}) \tag{2}$$

Here, the proposal feature of the local object and the global context feature is used as the F_{l_fused} and F_{g_fused} after the fusion accordingly, and the operation of the concatenation for the representations of the feature is indicated as $concat(.)$ with the axis of the channel. The two independent CNNs are used in the proposed system for extracting the features separately from both modalities, and the simple concatenation is performed directly for the last classification. The proposed fusion operation for feature representation is considered the generation step of the feature to model the global context and the embedding of the local feature before the final classification. In addition, the suggested representation of the feature in the proposed system is verified to create more efficient global and local information related to the context in the experiments, which greatly enhances the last classification's performance.

The global and local features $F_L\ and\ F_G$ are expressed as in Eq. (3) and (4):

$$p = softmax\ (f_{class}\ (concatenation\ (F_L, F_G) \tag{3}$$
$$t^* = f_{local}\ (F_L) \tag{4}$$

Here, $softmax\ (.)$ represents softmax operation, and f_{local} and f_{class} are fully connected layers with $C + 1$ and $4 * C$ units. The minimal objective function given in RCNN is expressed as:

$$L\ (p, u, t^u, v) = L_{class}(p, u) + [u \geq 1]L_{local}\ (t^u, v) \tag{5}$$

Here, u refers to the ground-truth value, v refers to target regression, L_{class} refers to log loss for ground truth, f_{Local} refers to smooth L_1, and the background class is labelled as 0.

Experimental outcomes

The proposed model is experimented with based on the proposed RCNN on the open-source framework for the RGB detection on MATLAB 202a. De Castro et al. [10] present the proposed fundamental network structure's architecture for extracting the convolutional feature map. The added convolutional layers and full connected are introduced arbitrarily with the standard deviations of 0.01 and 0.001 and zero-mean Gaussian distribution, respectively. It is important to consider that the Stochastic Gradient Decent (SGD) is used in the proposed system to fine-tune the model. Every mini-batch of SGD comprises 128 sampled proposals of objects randomly from the selected images in a random way. There are 25% of the ROIs as the foreground from the object proposal, which includes the intersection across the union (IoU) in every mini-batch with the overlap of at least 0.5 with the ground-truth bounding box. In addition, the balanced ROIs are sampled from the proposals of the object, which includes the maximal IoU having the ground truth in the [0.1, 0.5] interval and working with the ground truth label $u = 0$ as the background. It is obvious that the images are flipped horizontally with 0.5 as the probability for the data augmentation during the training, and no other augmentation is utilized. The approximate 10 epochs in SGD are used on the training set for fine-tuning the network parameters. Here, 0.9 is set as the momentum and learning rate is fixed as 0.001, and this is

minimized by 10 for every 5 epochs. The average time of training is approximated to 1.25 seconds for iteration. In addition, the testing process is effective, and 0.58 seconds are considered approximate, excluding the object proposal extraction to process the single image.

Performance comparison

The suggested model is compared to the latest modern methods of RGB detection, which performscolour space detection based on RGB-rich images and the model based on supervision transfer. It is important to note that the best validation is achieved in the supreme attention-related global context and the attractive part of the fine-grained colour space on the datasets of RGB. In addition, the RGB version is implemented in the proposed system, and the comparison is made. The existing suggested model follows the same concept and incorporates the local and global attractive contexts, which are fixed to improve the RGB detection performance. The RCNN technique is used in the implementation based using AlexNet to the RGB colour space modality and the regression of bounding box position. The results are averaged to attain the last outcomes from the RGB modality. Table 1 depicts the detection results with mAP metrics of the proposed with the existing models. The schematic representation is provided in Figure 3.
The following table 2 shows the comparisons of the proposed RCNN model in terms of RGB range and depth with other approaches reported for the RGB dataset.

Visual Comparison

Some visual comparisons are presented in the proposed system with the results of the RGB colour detection and a few effects of the attractive weights on the created maps using the proposed modelling component in the global context. The proposed model is capable of perceiving the colour regions which are most related to the particular cereal images. In addition, since the image of depth can give geometric information, the proposed model attains the most accurate attention weight maps using the fused information from the RGB modality. Consider an instance where the proposed system can attend to the cereal nearer to the target, like the similar geometric structures shared in the proposed system. The proposed model will focus on the background areas when the proposal does not include the objects that aim to make an accurate classification. Based on the colour feature, one can predict the expected regionas in figure 4.

$$r = \frac{R}{R + G + B} \qquad (6)$$

$$g = \frac{G}{R + G + B} \qquad (7)$$

$$Y = R + G + B \qquad (8)$$

The above expression shows that R, G, and B refer the original pixels. After the information extraction regarding the RGB characteristic, the statistical analysis should be satisfied. From the analysis, it is proven that the model fulfils the requirements.

CONCLUSION

The technique proposed is to learn the feature context efficiently for RGB colour space detection. The proposed system has context representations of the features from the RGB colour space modality. An attraction model has different network units used to obtain the context globally nearer to the proposal of the object. The proposed model chooses the many parallel processing of the discriminative parts in every proposal of the object for creating the improved context information locally. In addition, the results from the modern detection and the extensive experiments demonstrated well the efficiency of the proposed model in exploiting the contextual data. The mAP attained with the proposed RCNN is better which is comparatively higher than DCNN, ST, AC-CNN, and faster DCNN (with and without fusion). The major research constraint is the selection of a dataset for RGB colour space for cereal prediction. In future, a real-time dataset will be constructed for experimentation purposes.

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Table 1 Detection results

S.No	Approaches	mAP
1	DCNN	35.3
2	ST	43.9
3	AC-CNN	45.5
4	Faster DCNN (without fusion)	47
5	Faster DCNN (with fusion)	47.4
6	RCNN (without fusion)	53.2
7	RCNN (with fusion)	54

Table 2 Comparisons of the proposed RCNN model with other approaches

Method	RGB	Depth
Nonlinear SVM[16]	74.5.1±3.1	83.9±3.5
HKDES[17]	76.1±2.2	84.1±2.2
Kernel DESC[18]	77.71±1.9	86.2±2.1
CNN-RNN[19]	80.8±4.2	84.4±2.3
Upgraded HMP[20]	82.4±3.1	87.5±2.9
CNN features[21]	83.1±2.0	89.4±1.3
Proposed RCNN	84.1±2.7	90.1±1.9

Table 3 Colour recognition performance on image dataset on the proposed models

Colour	RGB	HSV
Yellow	0.9794	0.9450
White	0.9666	0.9624
Blue	0.9410	0.9576
Cyan	0.9645	0.9716
Red	0.9897	0.9866
Gray	0.8608	0.8503
Black	0.9738	0.9703
Green	0.8257	0.8215

Figure 1. Sample plant images	**Figure 2. Improved RCNN architectural model**
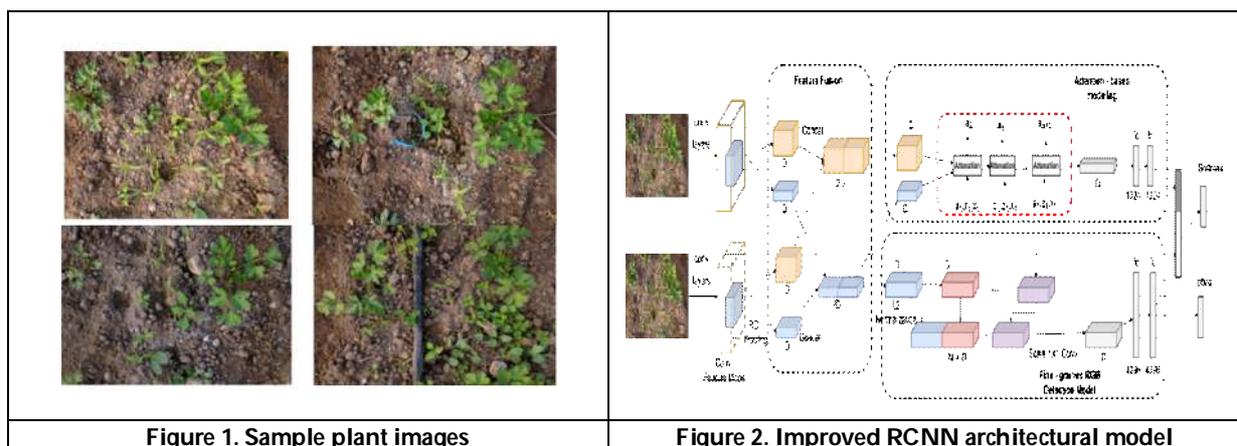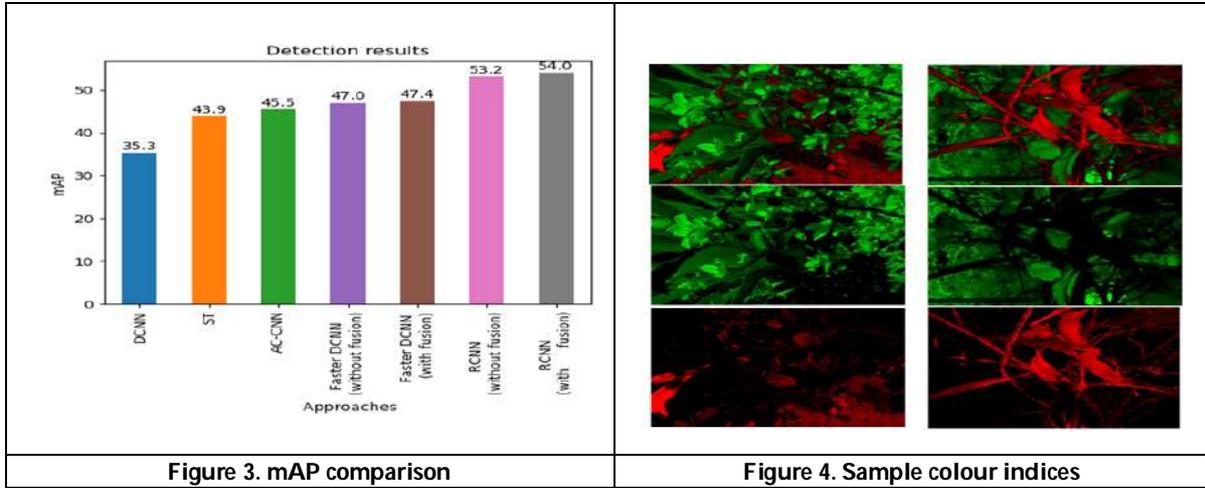
| Figure 3. mAP comparison | Figure 4. Sample colour indices |

REVIEW ARTICLE

A Brief Review of the Pharmacological Activity of *Curcuma caesia*

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ABSTRACT

Curcuma caesia is a herbaceous plant with bluish-black rhizomes and board leaves that belongs to the Zingiberaceae family. It is regarded as a great source of one-of-a-kind natural items, because of its unrivaled therapeutic capabilities, so this species of Curcuma has been steadily gaining in favour. So far, in-vitro and in-vivo research has revealed strong antifungal, smooth muscle relaxant, anti-asthmatic, antibacterial, antioxidant, and other pharmacological actions. Various factors that can induce oxidative stress and its anticancer, and anti-diabetes effects have been enumerated, questioned, and discussed. The goal of this article is to look at the phytonutrients, conventional uses, and medical advantages of this vital medicinal herb, as well as review previous studies.

Keywords: *Curcuma caesia*, Zingiberaceae family, rhizomes, medicinal properties, antioxidant.

INTRODUCTION

Plants are considered to be living biochemical factory that produces a wide variety of bioactive chemicals. About 35,000 species of plants are known around the world and are used for some medicinal purposes. Researchers in various disciplines have only examined a few plants for their pharmacological and phytochemical potential. [1]Indian medicinal plants are well-known as sources of a variety of pharmacologically active chemicals and compounds and have continuously been utilized to treat a variety of ailments.[2]As the incidence of fatal diseases increases, plants that have traditionally been ignored are receiving increasing attention for their therapeutic potential.[3]Turmeric is a frequently used spice in India, and it can be found in almost every home. Across 200

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species and variations of Haldi are found everywhere in the world.[2] *Curcuma caesia*, often known as "Kali Haldi," is a rhizomatous plant in the Zingiberaceae family. [5,2,6] It is a perennial herbaceous plant with bluish-black rhizomes with broad leaves and is also known as black turmeric. It has a strong camphoraceous flavour and is exploited in pharmaceutical businesses.[4-6]Due to its presumed pharmacological benefits, the rhizomes of black turmeric are quite valuable. Leprosy, asthma, hemorrhoids, epilepsy, cancer, fever, vomiting, wounds, menstrual problems, smooth muscle relaxation, anesthetics, aphrodisiacs, inflammation, hypogonadism, and other conditions are treated with it. [6-7] Almost all forms of turmeric possess antioxidant capabilities, and their pharmacological benefits and therapeutic potential have been studied for future clinical use. [8]*Curcuma caesia* use techniques are extremely important due to its vast variety of traditional and therapeutic applications. A few mini-reviews on it have been prepared because it is a traditional medicinal herb. As a result, the purpose of this article is to critically examine the phytochemistry, traditional usage, and medical benefits of this essential medicinal herb, as well as to highlight past research. This compilation will undoubtedly broaden the scope of future study into its possible therapeutic effects and aid in the development of successful tactics for its long-term use.

Geographical Distribution
It extends to various regions of Malaysia, Thailand, and Indonesia [9], and the North-eastern regions of India, Andhra Pradesh, Madhya Pradesh, and West Bengal.[10]Found throughout the Himalayas of India, central and northeast India. It is also thinly distributed in the Papihills of East Godavari, and the hills in northern Sikkim.[11]It thrives in damp deciduous woodland environments. The rhizomes are effective in treating sprains and bruises, and it is also used in making cosmetics. *Curcuma caesia* is widely grown in Ceylon, Indonesia, France, Belgium, South India, and Bengal, and it is utilized in Ayurveda and numerous cuisine preparations for its medicinal benefits.[12-13]

Morphological Characteristics: [13-14]
Plants range in height from 0.5 to 1 mm and are divided into large underground oval tuber rhizomes, often referred to as rhizomes, and upright aerial shoots with leaves and flowers.[14]

a) Rhizomes: The rhizomes are bulbous, with a camphor-like sweet scent, about a diameter of 2 to 6 cm, and comes in different shapes and sizes. The rhizomes are stemless, laterally flat, and covered with root scars, adventitious roots, and warts. In addition, surface of the rhizomes has disc-shaped vertical folds that give the appearance of nodes and internode zones, and surface of the rhizome (cork) is bluish-black, dark brown, or buffed. It shows aring-shaped arrangement of scaly leaf debris that gives the wrong impression of the growth ring. Branches ranches are more or less sympatric. (Figure 1)

b) Roots: The primary roots go unnoticed because the plants propagate on the rhizomes. However, yellow-brown, long-fiber, tapered adventitious roots can be seen on the entire rhizome surface. (Figure 1)

c) Leaves: Leaves are wide and divided into groups of 10-20, each leaf is elongated, spear-shaped, and hairless. In the central region, the thin layer shows a deep purple cloud of iron. The petioles are ivory-coloured and the petioles wrap around each other to form a pseudo-axis. The changes are parallel and are typical of monocotyledonous plants. (Figure 2)

d) Inflorescence: Dense spikes 15-20 cm long that occur long before the leaf opening, with green bracts, crimson bracts, and carmine turning red with age. (Figure 3)

e) Flowers: Pale yellow with crimson borders, smaller than bracts. Sepals: 10-15 mm long, dull, three-toothed, crown: elongated tubular, pale yellow lips-semi-oval with three leaves. (Figure3)

Chemical constituents
Curcuma caesia rhizomes have a bittersweet camphor-like scent reminiscent of camphor.[15]. It contains the largest curcuminoids, oils, flavonoids, phenols, various major amino acids, proteins, and high alkaloid content indicating the presence of these bioactive secondary metabolites that correlate with their efficacy[16]. Curcumin and two related dimethoxy compound demethoxycurcumin and bisdemethoxycurcumin, are the primary bioactive components in the rhizome [17]. Camphor (28.3 percent), ar-turmerone (12.3%), ocimeme (8.2 percent), ar-curcumene (6.9%), 1,8-cineole (5.3 percent), -elemene (4.8 percent), borneol (4.4 percent), and bornyl acetate(3.3%) were the primary components of the essential oil. Linalool (0.99), caryophyllene (3.15), borneol (4.3), camphene (1.67), anethole (1.79),

and cis-b-ocimene (14.54), [18]γ-curcumene (2.8 percent), -caryophyllene (2.6 percent), and endo-fenchol are some of the other essential oils identified (2.3 percent) [15] Aside from the rhizome's essential oil, the leaves include a-pinene (1.5%), myrcene (0.5%), 1,8-cineole (27.0%), camphor (1.68%), limonene (2.1%), linalool (2.8%), borneol (8.7%), a-terpenol (5.2%), eugenol (2.0%),b-pinene (6.3%) [19]. Only curcumin was present in the leaves, while there was an absence of dimethoxy compound. [20]

Traditional Uses

In ethno medicinal practice, traditional healers used the genus Curcuma to treat a variety of illnesses, the same as for the genus CaesiaRoxb. a little-known and almost untouched drug[20].*Curcuma caesia* rhizomes are widely used in cuisine and traditional medicine. InCentral and North-Eastern India, *Curcuma caesia's* dried leaves and rhizomes are used to treat fevers, infections, tumors, leprosy, asthma, piles, sensitivities, toothaches, and other disorders. The leaf or the rhizome are used in the treatment. *Curcuma caesia* extract has been shown to help with epilepsy, leukoderma, hemorrhoids, inflammation, and bronchitis. The rhizome is made into a paste that is used to treat rheumatoid arthritis, also used as an aphrodisiac and a treatment for impotency in some indigenous groups. Fresh rhizome decoction is used by the Adi tribes of Arunachal Pradesh (India) as an anti-diarrheic and stomach discomfort remedy. Some residents of Eastern Arunachal Pradesh use fresh rhizome pastes to treat insect, snake, and scorpion stings. The dried powdered rhizome is blended with crushed seeds of *Andrographis paniculata* as a promising herbal combination for insect and snake bites. Rhizomes are also used to treat fever, worm infection, cough, and diarrhoea. To stop bleeding and help speedy healing, crushed rhizome paste is applied to cuts and wounds.[21] *Curcuma caesia* rhizome is being used in Asian medicine in the treatment of wounds, pox, and tumors. In stomachache and bloating, powder from the tuber is generally administered with water. It's commonly utilized in Ayurvedic, Homeopathic, and Siddha therapy as a traditional pain reliever.[22]According to existing literature, the Khamti tribal people of the Lohit district use fresh rhizome pastes to treat snakebite and scorpion stings.[23]

Reported pharmacological activities

Antioxidant activity

Because of the content of phenolic and flavonoid compounds in its rhizome extract, research on Curcuma caesia has been established. To date, it has been found to have antioxidant action as well as a protective effect against toxicity and cancer. Phenolics are compounds that have a hydroxyl radical connected to the benzene ring, which allows them to serve as free radical scavengers. Other antioxidant methods revealed include chelation of redox-active metal ions, free radical scavenging, hydrogen or electron donation, gene expression regulation, and involvement with cell signaling networks. [24] Phenolics also work by inhibiting the oxidation of biomolecules. [25] When crude methanolic extracts of the rhizomes of11 species along with *Curcuma caesia*, were examined for the antioxidant property utilizing sulfur-free radical reactivity and curcumin was used as the control, it showed excellent radioprotection. Indicating, that *Curcuma caesia* is a potent antioxidant. [26]. *Curcuma caesia* and *Curcuma amada* were compared for their phenol content and were evaluated for their antioxidant property. *C. caesia* outperformed *C.amada* in terms of superoxide anion scavenging activity, and ABTS [2,2'-azino-bis (3-ethylbenzothiazoline-6-sulphonic acid) and DPPH radical scavenging. According to these data, the non-conventional *C. caesia* might be a financially feasible choice. [2]. Methanolic extract of *Curcuma caesia* (MECC)was evaluated for its antioxidant activity using the DPPH free radical scavenging assay by charting the percentages of inhibition vs concentration on a graph, and the IC 50 (Inhibitory concentration) was obtained. For 2 ml of 500 M DPPH, the IC 50 values of the extract and Butylated Hydroxytoluene were determined to be 862.35 g and 46.25 g, respectively. This implies that as compared to Butylated Hydroxytoluene, MECC has a lower IC 50 value.[28]. The methanolic extract of *Curcuma caesia* rhizomes (MECC)was studied for some in vitro antioxidant activity. In-vitro methods such as DPPH, nitric oxide, hydroxyl radical, hydrogen peroxide, superoxide anion, peroxynitrite, and hypochlorous acid were used to assess the effect of MECC on RNS (Reactive Nitrogen Species) and ROS (Reactive Oxygen Species). The content of total phenol and lipid peroxidation was also assessed using a conventional test technique. In a dose-dependent way, the extract exhibits considerable antioxidant activity. As per the observations, the MECC rhizome might be a natural antioxidant.[29]. In the rhizomes of *C. caesia*, the antioxidant activity assessment of enzymatic extracts and crude extracts utilizing DPPH and OH radical scavenging analysis demonstrated that crude extracts (non-enzymatic) had better

efficacy over enzymatic extracts. In conclusion, it's conceivable that *C.caesia* Roxb. would be a natural antioxidant source.[30]. In conclusion, *C. caesia* Roxb. is recommended to be a possible source of natural antioxidants that might be useful as a medicinal agent in the prevention or delaying aging and age-related oxidative stress-related debilitating diseases.[30]

Anticancer and antitumor activity

MECC rhizomes were assessed for their antioxidant status and antitumor activity in Ehrlich's ascites carcinoma (EAC)-treated mice. The Trypan blue method was used to perform an in-vitro cytotoxicity test. It was observed that the MECC notably reduced the weight, volume of tumor, viable cell count, and also the prolonged lifetime of EAC-treated mice. MECC has strong anticancer activities, which might be attributed to its direct cytotoxic action of antioxidant qualities. More study is being conducted to determine the active principle(s) that are responsible for its anticancer action. [11]. The MECC and the crude extract of *Aristolochia tagala* (AT) were analyzed qualitatively and quantitatively for constituents having anticancer activities using established procedures. Analysis in MECC and AT reported the presence of phytonutrients such as terpenoids, phenolics, flavonoids, and alkaloids. It was also claimed that MECC had anti-inflammation, anti-proliferative, and anti-cancer potential. TNF-mediated NF-B interaction may be involved in the anticancer actions of AT and MECC's active constituents. [31]

Anti-inflammatory activity

When compared to the standard, diclofenac sodium, *Curcuma caesia* leaf oil displayed a significant degree of anti-inflammatory action. The standard medicine had the best in-vitro anti-inflammatory effect against egg albumin denaturation test at 300 g/mL, while essential oil of *Curcuma caesia* leaf at 300 g/mL had the best inhibition. The IC50 value was found to be 182.5 g/mL, which is far less compared to the accepted standard of 906.5 g/mL. To summarise, *Curcuma caesia* leaf oil possesses anti-inflammatory properties that might be exploited to build natural drugs and other industrial products. [32]. To investigate the anti-inflammatory activity, lambda carrageenan was used as an animal model of inflammation. In the late phase of rat paw edema, which is mediated by prostaglandins and leukotrienes, the MECC was found to greatly suppress it. The presence of phenolic compounds in both models likely elucidates the extracts' anti-inflammatory activities. MECC reduced the number of fibroblasts and collagen and mucopolysaccharide synthesis in rats with cotton pellet-induced granuloma, which are typical proliferative activities in the creation of granulation tissue The anti-inflammatory properties of the extracts might be imputed to the presence of phenolic compounds in both models. [33]

Anti-anxiolytic and antidepressant activity

MECC rhizome was investigated for its CNS depressive properties. When compared to the conventional medication imipramine, MECC at 100 mg/kg demonstrated the most effective antidepressant-like effects, as shown by the longest reduced immobility duration[6]. *Curcuma caesia* is claimed to be a rich source of natural chemicals with medicinal value. Plant extracts at various concentrations (150, 300 mg/kg) were fed to mice orally for 30 days. Its antidepressant and anxiolytic activities were investigated. Animals' muscles relaxing action was also detected when *Curcuma caesia* was given to them. Though, Additional study and examination into the anxiolytic effect of *Curcuma caesia* are needed to establish its usefulness as an anxiolytic drug.[34].

Anti-helminthic activity

The anthelmintic efficacy of *Curcuma caesia* rhizome ethyl acetate extract was determined in-vitro by measuring the period of worm paralysis and death. The standard was albendazole (15 mg/ml).*Curcuma caesia* leaves were shown to be effective against the earthworm used in the study, demonstrating that it is an anthelmintic. Hence, its use as ananti-helminthic has been proven.[35]. The anthelmintic activity of extracts from two of the most widespread Curcuma species, *Curcuma amada* and *Curcuma caesia,* was evaluated at three different concentrations: petroleum ether, dichloromethane, ethanol, and aqueous extract. All extracts from both plants exhibited dosage-dependent efficacy. At three concentrations of each of the extract, the paralysis and death time of earthworms were determined. The study demonstrated that the EECC rhizome (150 mg/ml) was highly effective at causing earthworm

paralysis, while ethanolic extracts (150 mg/ml) and Dichloromethane extract (150 mg/ml) from both the Curcuma species were equally successful at generating earthworm death. [36].

Antibacterial and antifungal properties

Curcuma caesia has potent antibacterial, antifungal, and cidal properties. It has a protective effect against a variety of gram +ve and gram -ve bacteria, as well as C. Albicans fungal infection. The MECC rhizomes and the crude protein generated by the plant are responsible for the fungicidal and bactericidal activity. Its phytoconstituents give an enhanced defence that can be employed to help reduce the rising occurrence of foot amputations[4, 37]. The antifungal action of *Curcuma caesia* rhizomes essential oil has long been acknowledged by Banerjee and Nigam in 1976.[38]. The physical characteristics of *Curcuma caesia* stem, leaf, and root extracts were examined using aqua, methanol, acetone, and chloroform. *Bacillus cereus*, *Staphylococcus aureus*, *Escherichia coli,* and *Pseudomonas aeruginosa* were used to test the extracts for antibacterial efficacy against both gram +ve and gram-ve microorganisms. In the case of *Bacillus cereus* and *Klebsiella pneumoniae*, the greatest activity index was found in rhizomes methanolic and chloroform extracts, respectively. The findings were encouraging, justifying that the Bastarnative tribes and traditional healers had been using *Curcuma caesia* roots to treat a range of bacterial infections [39].

Smooth muscle relaxant and Anti-asthmatic Activity

Curcuma caesia hydroalcoholic extract was assessed for its tracheal relaxing action using guinea pigs. In depolarized rabbit aorta, the probable effect of the extract on calcium channel regulation was also studied. The extract inhibited the activity of numerous enzyme inhibitors, and receptor antagonists, including propranolol, methylene blue, 2, 5-dideoxyadenosine, glibenclamide, chymotrypsin and N-nitro-L-arginine (L-NNA). [7]. Methanolic *Curcuma caesia* extract when compared to chlorpheniramine maleate (standard) convulsions' latent length was considerably prolonged following exposure at a concentration of 500 mg/kg of histamine aerosol, suggesting its H1 receptor antagonistic action and supporting the plant's anti-asthmatic capabilities[40].

Anti-analgesic activity

MECC's analgesic efficacy was assessed using a hot plate model and an acetic acid-induced writhing test to describe peripheral and central analgesic action. Acetic acid generates a rise in PGE2 and PGF2a in the peritoneal fluid, making it a particularly sensitive approach for screening analgesic effects. It's been proven to work well for evaluating centrally acting analgesics like *Curcuma caesia*. The enhanced response time in the hot plate test implies *Curcuma caesia* has a central analgesic effect. It is possible that endogenous prostaglandins play a role in MECC's analgesic action[41]. Several extracts from *C. caesia* and *C. amada* rhizomes were tested for anti-pyretic and analgesic properties. The antipyretic and analgesic properties of *C. caesia* and *C. amada* rhizomes extracts were assessed using brewer's yeast-induced hyperthermia and acute pain in rats. The dose of 250 and 500 mg/kg, writhing and pyrexia were seen. Analgesic and antipyretic activities were found in both herbs. Overall compared to *C. caesia*, *C. amada* had a better reaction[42].

Antiulcer activity

The ethanolic extract *Curcuma caesia*(EECC)rhizomes were evaluated for the anti-ulcer activity using four groups of albino rats weighing 150-200 g (n = 5). The standard was employed (Ranitidine 150 mg/kg orally for 7 days and Aspirin 400 mg/kg orally on day 7). In the end, the animals were sacrificed and the guts were retrieved. The ulcer score, free and total acid content, pepsin activity, and the volume of the gastric secretion were all decreased considerably in groups III and group IV compared with the control group II.[43]

Thrombolytic activity:

The EECC rhizomes when assessed for clot lysis activity and were observed that it showed 49.18% clot lysis. *Curcuma caesia* has been shown to have thrombolytic action. However, this evidence isn't definitive, and more research with positive controls might be beneficial in the future[44].

Antidiabetic activity

Methanolic extract of *Curcuma caesia* (MECC) rhizome demonstrated anti-diabetic action. It inhibited alpha-amylase and alpha-glucosidase, preventing monosaccharide absorption in the intestine. It increased the absorption of glucose in yeast cells, indicating adequate glucose utilization. The extract has strong antioxidant properties, scavenging free radicals such as superoxide and hydroxyl radicles. After therapy, histological investigations of the pancreas revealed progressive recovery[45]. *Curcuma caesia* has shown promise in treatinga wide range of ailments, but no research on its effectiveness in diabetic neuropathy has been published yet. Its antioxidant effect will lower the degree of oxidative stress, which is the primary cause of the current issue. Apart from that, the anti-inflammatory action will prevent additional neuroinflammation, and the antibacterial function will stop the infection from spreading. When all of the criteria are considered, the plant can be used to treat diabetic neuropathy[20].

Antiemetic activity

When compared to domperidone in a chick model, EECC rhizome showed considerable antiemetic efficacy.[46].

CONCLUSION

Curcuma caesia has a large distribution throughout India. The herb appears to have a wide range of effects on a variety of diseases. Phytochemical research has been reported, but more work is needed. If these assertions are scientifically validated in a clinical setting, they can give effective treatments and aid mankind in a variety of ailments. The pharmacological investigations presented in this review support *Curcuma caesia*'s therapeutic value. However, there is limited information about this plant's clinical, toxicological, and phyto-analytical qualities. The plant has been pre-clinically evaluated to some extent, but more research is needed.

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Figure 1: Rhizome of *Curcuma caesia*

Figure 2: Leaves of *Curcuma caesia*

Figure 3: Flower of *Curcuma caesia*

RESEARCH ARTICLE

Impact of Fish Oil Consumption on Human Health

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ABSTRACT

Fish oil provides sufficient nutrition to humans as one of the dietary sources, Diverse nutrients in fish oil have an important nutrient source available easily across the globe. Fish oil proven to possess several health benefits, such as anti-oxidation, anti-inflammation, wound healing, neuroprotection, cardio protection, and hepatoprotection properties. Fish proteins, such as immunoglobins, act as defense agents against viral and bacterial infections and prevent protein-calorie malnutrition. Besides, fish oil constituents, Omega-3 polyunsaturated fatty acids (ω-PUFAs), such as EPA(Eicosapentaenoic acid) and DHA(Docosahexaenoic acid) regulate various signaling pathways, such as nuclear factor kappa B pathway, Toll-like receptor pathway, transforming growth factor-β (TGF-β) pathway, and peroxisome proliferators activated receptor (PPAR) pathways.

Keywords: Fish oil, Omega-3 polyunsaturated fatty acids (ω-PUFAs), EPA, and DHA

INTRODUCTION

The marine ecosystem presents great biodiversity of plants, animals, and microorganisms with a wide variety of bioactive compounds produced in response to adverse environmental conditions. Decades of research have led to the consideration of a variety of marine-derived compounds for potential health advantages in human diets. Food consumption is influenced by production and distribution, which in turn affects the population's health and nutritional state. Apart from providing nutrients, foods provide a host of other constituents that positively impact health. The choices we make impact how well human bodies adapt, develop, and function. This diet's inclusion of

nutrients is thought to be an environmental aspect that promotes development of the human body. In particular, these dietary guidelines could benefit those highly susceptible to pathological conditions and improve their metabolism. To formulate nutritionally suitable diets, a variety of foods are available within the range of common people. Amongst those foods with high nutritional value, fish and fish oil ranks top with enormous health-benefitting action through its nutrition arsenal. Fish oil is a virtually unique source of polyunsaturated fatty acids such as Eicosapentaenoic acid (EPA, 20:5 Δ 5,8,11,14,17) IUPAC name(5Z,8Z,11Z,14Z,17Z-eicosa- 5,8,11,14,17-pentenoic acid)Docosahexaenoic acid (DHA, 22:6 Δ 4,7,10,13,16,19) IUPAC name (4Z,7Z,10Z,13Z,16Z,19Z)Arachidonic acid (ACH, 20:4)IUPAC name (5Z,8Z,11Z,14Z)(Fig 1) which have a health-promoting function. It is a good source of vitamins A and D and has varied pharmacological properties. They are the primary sources of long-chain polyunsaturated fatty acids (LCPUFAs), particularly omega-3 fatty acids (ω-3), in the modern human diet.[1]Recently, several pharma industries focused on marine oils from fish and also mammals, such as whales and seals. But, at present, greater attention is given to smaller fish with relatively high-fat content, such as anchovies, sardines, pilchards, menhaden, herring, and sand eels, as raw materials in the fish oil industry.

Today, larger proportions of these oils are used as healthy additives and ingredients in many value-added (or fortified) food products health-food capsules.[2]. Historically, marine oils have been an essential part of life nutrition, and there is a growing demand for fish oil due to its medicinal properties. The significant amount of polyunsaturated fatty acids in marine oils has generated a huge interest in these sectors. In recent centuries, the food industry has used PUFAs as a source of fat, either fully or partially hydrogenated, in various foods as substitutes for fats, such as butterfat, lard, and tallow. There is an established market for dietary supplements, as well as a developing market for food ingredients produced from fish oils and concentrates of fish oil.[3]It is required to be added in minute quantities for optimum health benefits, cellular metabolism, and normal physiological functions [4]. Thereby Scientists came to know about many benefits of fish oils in the early 1970s when Danish physicians observed that Greenland Eskimos had an exceptionally low incidence of heart disease and arthritis although they consumed a high-fat diet. EPA and DHA, two of the fats they consumed in considerable amounts, were found to be particularly advantageous through extensive research. Fish oil has numerous beneficial effects on the human body. It prevents atherosclerosis, angina, heart attack, congestive heart failure, arrhythmias, stroke, and peripheral vascular disease. Clinical trials have shown that it is also effective in the treatment of many disorders including rheumatoid arthritis, diabetes, cancer, etc [5].The purpose of this review is to highlight the health benefits of fish oils that are anticipated to be digested in the human diet regularly.

Source of Fish Oil

Fish lipids are different from those of terrestrial origin in that the major unsaturated fatty acids belong to the omega - 3 family. These long, straight-chain molecules contain a series of c is double bonds, the first of which is between C-3 and C-4 counting from the methyl- or w C. The fatty acids which have attracted the most attention are cis-5,8,11,14,17- eicosapentaenoic acid (EPA; timnodonic acid) and cis-4,7,10,13,16,19-docosahexaenoic acid (DHA). [6] Fish and fish dishes provide 14% of the average daily intake of n-3 fatty acids [7]. Other major sources include cereal products (17%), meat (19%,) and vegetables (22%). Consumption of fish should help people to obtain the recommended provision of 7.5% of total energy by c is-PUFA but EPA and DHA can be consumed through fish oil. [8] The largest source of fish oils is that of body oils from pelagic species; 1 368 145 tonnes were produced in 1990 (Food and Agriculture Organization, 1992) corresponding to 97.9% of total fish oil production. Fish liver oils accounted for 1-7%, the remainder coming from marine mammals, squid, and various other species. The major fish oil-producing species include anchovy (*Engraulis spp.)*, capelin (*Mullotus villosus*), herring (*Clupea spp.*), horse mackerel (*Truchurus spp.*), menhaden (*Brevoorfia spp.*), mackerel (*Scomber spp*), Norway pout (*Trisopterusesmarkii*), sand eel (*Ammodytesfobiunus*), sprat (*Clupea spratus*), *Sardinops spp.* and others. Capelin and herring are found in polar or boreal waters, but the really large pelagic resources are found in temperate or subtropical waters. However, a very high proportion of the total catch of pelagic fish is taken over a very small proportion of the earth's surface, much of it close to land [9]. Japan is the largest single producer of fish oils and fats, averaging 29% of total world production from 1988 to 1990, inclusive. There is little difference in the average production in Asia (31.7%) and South America (304%) over the same period (Food and Agriculture Organization, 1992). Production in Europe is dominated by

Denmark, Norway, and Iceland, with the United Kingdom contributing only 0.5% to total world production. In Europe, fish body oils are produced either from small fish such as sprat or sand eel or from larger fish such as herring when there is excess, or from fish offal [10]. Fish meal and fish oil are generally made at the same time, fish oil being a by-product of the meal industry.

The most important factor in the production of high-quality crude fish oil is the condition of the raw material at the start of processing. Prompt handling of the fish and fish offal is critical. The raw material is first cooked, for 15 min at 90", to facilitate coagulation of the proteins, sterilization, and separation of oil. The cooked fish is then conveyed through a perforated tube whilst being subjected to increasing pressure, normally utilizing a tapered shaft on a screw conveyor. The oil and water mixture, known as press liquor, passes through the perforations while the solid, known as press cake, emerges from the end of the press. After screening to remove coarse pieces of solid material, the press liquor is centrifuged, in desludging or self-cleaning centrifuges, to separate the oil from the water. The fish oil is further refined by washing with water (100 ml/l oil) at 90-95" followed by centrifugal separation. At this stage, crude fish oil still contains some impurities. These include moisture, rust, dirt, proteins, free fatty acids, mono- and diacylglycerols, enzymes, soaps, trace metals such as Cu and Fe which promote oxidation, oxidation products, pigments, phosphatides, hydrocarbons, terpenes, resins, sterols, waxes, sugars and compounds containing halogens [11]. The season, location (which results in marine pollutants in the oil), and food, along with freshness of the fish only at time of extraction and its effectiveness of the refining process, were its natural phenomena that cause the impurities. The final product will still be subject to post-processing oxidation [12]. The nature and concentration of the oxidation products will vary with time and are critically dependent on how well the oil is stored.

Properties of Fish Oil

Fish oil is becoming one of the preferred raw materials for the food, feed, and pharmaceutical industries around the world [13]. In the following sections, the physical, chemical, nutritional, and pharmaceutical qualities of fish oil are compiled.

Physical Properties of Fish oil

Fish oils are very similar to one another in their physical nature. They are liquid at room temperature and are considered liquid oils. However, the oil is partially solid at 20 °C due to the presence of intermediate melting point triglycerides. When liquid oil is slowly cooled, solid triglyceride crystals are formed and the crystallization proceeds as cooling are continued [14]. This is the basis of fractionation by crystallization. The solid fraction is known as the stearin and the liquid fraction is the olein. Table: 1

Chemical Properties of Fish oil

Fish oil contains omega-3 PUFAs, whose concentration depends upon the type of fish, the body part for oil extraction and procedure followed. Fish oil contains long-chain fatty like saturated, monounsaturated, polyunsaturated fatty acids of carbon chains ranging from 14 to 22 carbon atoms. Approximately one-third of the fatty acids present in fish oil are omega-3 long-chain polyunsaturated fatty acids (LC-PUFAs). Omega-3 fatty acids possess carbon chains ranging from 18 to 22 carbon atoms possess a double bond located at the third carbon atom from the end of the carbon chain (i.e., the methyl or omega [ω] end). EPA has a 20-atom carbon chain; DHA has a 22-atom carbon chain. The ratio of fatty acids in fish oil depends on species and type of fish, geographic allocation of fish culture. Important omega-3 fatty acids found in fish oil are EPA, DHA, ALA, stearidonic acid, docosapentaenoic acid (DPA), and arachidonic acid. The omega-3 LC-PUFAs in fish oil are mostly EPA and DHA with some DPA have been linked to potential health benefits [15]. Other substances that occurs in associated with fish oils are the unsaponifiable matter, which includes hydrocarbons, sterols, glyceryl ethers, and fatty alcohols. It also includes minor quantity of pigments, vitamins, and oxidized matter[16]. Hydrocarbons are a principal component of the liver oils of sharks. For example, found that squalene made up about 90 % of the shark's liver. The body oils of herring have been found to contain around 0.05 % hydrocarbons. The hydrocarbon content of commercial fish oil is normally less than 0.2 %. Sterols are another important component of fish oils, and cholesterol is the most abundant group present in the oil of nearly all fish. The ethers found in the unsaponifiable matter are

primarily 1,2-diacylglycerol ethers. The fatty alcohols are derived primarily from wax esters. The pigments responsible for the red and yellow coloration in commercial fish oils are the carotenoids. Alpha- and gamma-carotene, zeaxanthin, violaxanthin, and xanthophyll were identified in menhaden oil, fucoxanthin, and xanthophyll in pilchard oil, and astaxanthin is responsible for the occasional pink colour of capelin oil. Even though carotenoids are present, the pigments encountered do not possess provitamin A activity.

Biological properties of Fish oil

The Increased interest in fish oil's PUFAs in human diets has led to the widespread use of fish oil in both human and animal diets. It is a great source of energy as well as has several health benefits. Most fish have vitamin A and D in their oil, but many species store large levels of vitamin A and D in their livers (cod, halibut, and tuna). The body oils of fish generally contain vitamins in minute amounts and are not consumed for that purpose. Fish oils contain varying amounts of vitamin E, which acts as an antioxidant. The tocopherol levels reported in crude fish oils are $30\mu g/g$ in menhaden oil, over $60\mu g/g$ in anchovy oil, and $25\mu g/g$ in capelin oil [17].

Pharmaceutical Properties of Fish oil

It has been proven that fish oil positively affects the biological activities in the body. To cater the needs of expanding market of health-conscious customers, more businesses are looking into the potential for incorporating fish oils in dietary supplements and functional meals. Many clinical studies are ongoing, and the pharmaceutical industry has shown interest in the therapeutic application of fish oil concentrates. Drug firms seek the purest, highest-quality fish oil from the fish oil business, and as a result, the fish oil processing sector has set standards[18]. Several fish oil products are now on the market and, typically, these products are promoted and advertised for their omega-3 and vitamin content. This includes everything from cod liver oil with vitamin D 3 (simple or with added flavour) and fish oil encapsulated in gelatin capsules to concentrate it with higher amounts of EPA and DHA, flavoured candies for kids, and designed products like emulsions with added flavour as well as vitamins. Omega-3 fatty acid monoesters and free fatty acid derivatives derived from fish oil are also available on the market [19]. A great demand has developed in the last few years for fish oil containing high amounts of omega-3 fatty acids, especially EPA and DHA. Although antioxidants have been added, these oils are highly unstable, and, therefore, most of these products are encapsulated in a soft gelatin capsule that protects the oil. Some companies have succeeded in marketing combinations of plant and fish omega-3 fatty acids targeting heart or prostate health. In addition, they provide highly purified pharmaceutical-grade fish oils for heart, joint, brain, eye, and inflammatory response health. A company in Canada has developed a high DHA oil (5:1 ratio of DHA:EPA) for the formulation of products aimed at mother and infant nutrition.

Processing of Fish oil

Fish oil is extracted from muscles and liver. Living fishes are caught for maintaining oil quality. For oil extraction fish are chopped in fine pieces, it is heated and steamed at 100°C for wet reduction. This steam and cooked material are then strained and sent to a press, and oil is separated from the pressed liquid fish mass. For obtaining fish oil liquid is allowed to centrifuge at high speed for 1-2 hrs. Now separated oil is washed with hot water for polishing[20]. After separation in pure form oil is filled in tanks for storage. The remaining fish solids are dried and used as fish meal. At this point in the process, the only additions to the fish oil are water, heat, and pressure. The waste streams from this process include emissions of the volatile organic compounds. Net yield obtained is about 20 -80 kilograms/ ton of fish. Further, fish oil is processed by hardening, and extracted oil is allowed treat with an alkaline solution e.g., sodium hydroxide, potassium hydroxide, or other alkali metal. It reacts with free fatty acids present in the oil and form soaps. The soaps are then removed from the solution by washing with hot water. For dietary use fish oil is filtered through carbon filter (e.g., dioxins/furans, polybrominated diphenyl ethers [PBDEs], polychlorinated biphenyl 309[PCBs], polycyclic aromatic hydrocarbons[PAHs]) to reduce contaminants. Selective hydrolysis is used to produce high-quality fish oil, which is then filtered. Both solvent extraction and supercritical fluid extraction (SFE) techniques are employed for ultimate purification.

Availability Of fish Oil

Fish oil is extracted from total fish body. The crude fish oil preparations contain 90% fatty acid triacylglycerols, 2–5% unsaponifiable matter containing sterols, fatty acid-esterified cholesterol, free fatty acids, minor quantities of vitamins A, D, and E, and some water-soluble amino acids, peptides, and minerals. These days fish oil is available in the form of a refined and purified liquid with different flavour. The use of antioxidants for encapsulation/microencapsulation of fish oil prevents oxidation and extends the shelf life of fish oil. The use of monoacylglycerol citrate in purified fish oil as a sequestering agent prevents trace metal contamination. FDA-approved fish oil preparation ''Omacor'' is developed in the United States. Many clinical trials on humans are going on using Omacor [21]. One-gram capsule of Omacor (n–3 acid ethyl esters) has 800–840 mg of the ethyl esters of n–3 fatty acids. The n–3 fatty acids in Omacor include ethyl esters of EPA (440 mg) and DHA (360 mg). In Europe and Asia, Omacor is marketed as Zodin1. Omacor is used for treating hypertriglyceridemia. Moderate Hypertriglyceridemia is a very common condition, and elevated triacylglycerols are a risk factor for coronary heart disease. In patients with triacylglycerol levels above 500 mg/ml, approximately 4 g/day of EPA and DHA reduce triacylglycerol levels by 45% and very low-density lipoprotein cholesterol levels by more than 50%. Omacor is effective as monotherapy, but its effect is potentiated when used in conjunction with statins. There is little interaction with other drugs, although a small increase in bleeding time may be seen with anticoagulants. In hypertriglyceridemia, low-density lipoprotein cholesterol levels may increase following Omacor treatment depending on the baseline triacylglycerollevel, but the net effect of EPA and DHA therapy is a reduction in non-high density lipoprotein cholesterol level. Both EPA and DHA are required for optimal human health. Studies on the comparison of pharmacological effects of commercially available preparations (DHA and EPA ethyl esters) and the naturally occurring DHA and EPA triacylglycerols present in fish indicate that purified commercially available preparations provide better health protection than naturally occurring ester found in fish not only because of contaminants (Hg2+ and DDT) but also because of rate of absorption through digestive tract. It is essential to build up stores of DHA and EPA in the body tissue for release of these fatty acids and their lipid mediators. This can be achieved through the sustained intake of commercially available fish oil preparation in the form of DHA and EPA ethyl esters [22].In contrast to rapidly absorbed triacylglycerols from fish, ethyl esters of DHA and EPA are taken up more slowly within 24 hrs.

Oxidative stability of fish oil.

Omega -3 Fatty acids are chemically unstable, so that marine oils rapidly oxidize during storage to a complex chemical soup of lipid peroxides, secondary oxidation products, and diminishing concentrations of unoxidized fatty acids [23]. As a result, the composition of a fish oil supplement cannot be simply inferred from the labelled EPA and DHA concentrations. n-3 LC-PUFAs are highly prone to oxidation due to their large number of double bonds and their position within the fatty acid chain. This makes them prone to oxidation because bisallylic carbons, those between two double-bonded carbon atoms, have a low activation energy for hydrogen loss and free radical formation. n-3 LC-PUFAs have more of these vulnerable bisallylic carbons (EPA: 4, DHA : 5) than the short n-3 PUFA (α-linolenic acid : 2) . A complex array of different peroxide molecules arises depending on the position of the oxidized carbon, and after undergoing cis-trans isomerisation and a shift of double bonds, conjugated dienes and trienes are produced which have different polarity and shape to the original fatty acid. Lipid peroxides are unstable and further degrade to form secondary oxidation products including aldehydes such as 4-hydroxyhexenal (HHE) and malondialdehyde (MDA). As the oil oxidizes over time, there is an initial exponential increase in the concentration of lipid peroxides. These later degrades and the concentration of potentially harmful secondary oxidation products increases as the lipid peroxides decrease. The oxidative states of retail oils are not routinely labelled and it is surprising that there has not been more formal evaluation of the oxidative stability of marketed omega-3 supplements. When over-the-counter supplements have been investigated, the frequency of excess oxidation was highly variable but not uncommon, affecting between 11%–62% of products[24]. Thus, consuming purchased supplements entails risk of exposure to unacceptably oxidized oil, and it is likely that the omega-3 supplements used in many clinical trials have also been significantly oxidized. Thus, it is crucial to comprehend how oxidised omega-3 LC-PUFAs affect health for both the greater part of supplement users, researchers, and doctors who evaluate the medical literature.

Dietary Recommendation of Fish Oil

Fish oil supplements have most often been used by adults in doses of up to 6 grams daily by mouth for up to 12 weeks. Fish oil products typically provide 180-465 mg of EPA and 120-375 mg of DHA per capsule. It is also available in prescription drugs, including Lovaza, Omtryg, and Epanova[25].

Health Benefits of Fish Oil

Cardiovascular Disease

The n–3 fatty acids in fish oil markedly effect human health. To achieve a significant increase in human tissues in vivo, intake high doses of fish oil is required because bioavailability of n–3 fatty acids from fish oil to neural cells involves not only digestion and transport but also metabolism. Furthermore, the efficacy of dietary intervention may also depend upon the health of the individual. For example, patients with gastrointestinal problems may not be able to absorb fish oil supplement. Daily use of n–3 fatty acids (3–5 g/day) by normal individuals may optimize the functions of human heart, brain, lungs, liver, spleen, and kidney. These fatty acids reduce cardiovascular disease, type 2 diabetes, hypertension, cancer, inflammatory and autoimmune diseases, and neurodegenerative diseases. Fish oil prevents the accumulation of triglycerides and further reduces the levels of excess triglycerides. Arachidonic acid derived from silver carp has a pronounced effect on blood pressure, serum lipid, and platelet function [26]. The incorporation of fish oil constituents, n–3 fatty acids, not only influences the physicochemical properties of membranes (fluidity, permeability) but also modulates the expression of many genes The n–3 fatty acids reduce proatherogenic cytokines, improve endothelial function, reduce vascular occlusion, and mitigate the course of coronary atherosclerosis. These fatty acids are also needed for vascular smooth muscle cell function.

The heart rate is reduced and heart rate variability is increased. An antiarrhythmic effect is also observed at the supraventricular and ventricular level [27].The n–3 fatty acids also modulate levels of plasma fibrinogen and coagulant factor VII levels Collective evidence suggests that n–3 fatty acids reduce leukocyte reactivity, atherosclerosis, and thrombosis. In addition, fish oil exerts its effect through several different cellular mechanisms including the effects on lipoprotein metabolism, haemostatic function, platelet/vessel wall interactions, antiarrhythmic actions, and also through the inhibition of proliferation of smooth muscle cells and therefore growth of the atherosclerotic plaque Fish oil intake also results in moderate reductions in blood pressure and modification of vascular neuroeffector mechanisms[28]. An adequate daily intake (about 1 gram) of EPA and DHA is essential to maintain a healthy heart. It is believed that fish oil can improve blood circulation along with reducing triglyceride and serum cholesterol levels. Haemodialysis patients have an exceptionally high incidence of death from cardiovascular problems. It is due to abnormalities of lipids and platelets. Eskimos have a low incidence of myocardial infarction and have a high dietary intake of fish, rich in ω -3 polyunsaturated fatty acids[29].Therefore, Fish oil also prevents myocardial infarction. Atherosclerosis increases the risk of stroke and heart attack.

Because part of the plaque on the inner wall of arteries may dislodge and block smaller arteries in the heart respectively and thus cut off the vital supply of oxygenated blood. So, strokes are caused by a blood clot or by a burst blood vessel. Consumption of fish and fish oils was first associated with decreased risk of cardiovascular disease almost 50 years ago. Since then, several epidemiologic studies have evaluated whether their consumption is specifically associated with stroke. Ecologic/ cross-sectional and case-control studies have generally shown an inverse association between consumption of fish and fish oils and stroke risk. Marik and Varon (2009) reviewed 11 RCTs' studies included patients after recent myocardial infarction, those with an implanted cardioverter defibrillator, and patients with heart failure, peripheral vascular disease, and hypercholesterolemia. The average dose of EPA/DHA was 1.8 ± 1.2 gm/day and the mean duration of follow-up was 2.2 ± 1.2 years. This meta-analysis demonstrates that dietary supplementation with fish oil Omega-3 FAs for a year or longer significantly reduces the risk of cardiovascular deaths, sudden cardiac death, all-cause mortality, and nonfatal cardiovascular events.

Brain development

The human brain is one of the largest "consumers" of DHA. DHA makes up 15 to 20% of the cerebral cortex and 30 to 60% of the retina. So, it is absolutely necessary for normal development of the foetus and baby. It's important to

get enough DHA and EPA during pregnancy and lactation. During this time, the mother must fulfil all of the baby's DHA and EPA requirements[30].The n–3 fatty acids enter brain from circulation across blood–brain barrier and are incorporated at the sn-2 position of glycerol moiety of glycerophospholipids. They are released through the action of phospholipase A2. The high levels of DHA in the retina and brain gray matter suggests that this fatty acid has important roles in retinal and neural function. Animal studies have shown that depletion of DHA from the retina and brain results in reduced visual function and learning deficits. Aging not only reduces levels of n–3 fatty acids in the brain but also decreases neural membrane neuroplasticity[31]. A decline in n–3 fatty acids with age is accompanied by loss of memory and learning. Reduction in n–3 fatty acid levels with age can be restored by DHA supplementation. The molecular mechanism associated with the loss of n–3 fatty acids from the neural membrane is not fully understood. However, it is proposed that the loss of DHA with aging may be due to the increased activity of plasmalogen-selective PLA2.

This increase in plasmalogen-selective PLA2 is also coupled with the loss of PlsEtn during aging. Dietary supplementation of DHA not only restores the levels of DHA but also increases cerebral choline and acetylcholine levels that improve passive avoidance performance in stroke-prone spontaneously hypertensive rats and also in rat hippocampus during aging Experts recommend that women get at least 500-600 mg of DHA every day during pregnancy and lactation. The easiest way is to take a good fish oil supplement daily. A normal adult human brain contains more than 20 grams of DHA. Low DHA levels have been linked to low brain serotonin levels which again are connected to an increased tendency to depression, suicide, and violence. A high intake of fish has been linked to a significant decrease in age-related memory loss and cognitive function impairment and a lower risk of developing Alzheimer's disease [32]. A recent study found that Alzheimer's patients given an omega-3- rich supplement experienced a significant improvement in their quality of life.

Diabetes
Fish oil has been linked with lowering glucose and it controls the insulin level. People suffering from type II diabetes often have high blood levels of triglycerides and are therefore prone to coronary heart disease [33].Fish oils are known to be effective in lowering triglyceride levels, but concern has been expressed that they may also increase low-density lipoprotein (LDL) levels and be deleterious to glucose control. Type 1 diabetes is a disease that frequently occurs during childhood due to an autoimmune reaction ω-3 fatty acids could safely prevent the development of type 1 diabetes in this high-risk group of children.

Immunity
Fish oil has the potential to enhance the immune system of humans. Regular consumption of fish oil increases our immunity. It helps to resist the incidence of common diseases such as cold, cough, and flu. ω-3 fatty acids present in fish oil benefit the immune system by affecting cytokines and eicosanoids present in our body. Fish oil is also beneficial to patients suffering from lupus, which is a disease characterized by the attacks of the immune system of the body on various organs and tissues[34]. Fish oil helps in reducing the pain and inflammation that may occur in joints, eyes, kidneys, heart, blood vessels, lungs, nerves, etc. It also helps in reducing associated fever, skin rashes, and fatigue.

Cancer
Recently, cancer has become the most dangerous disease. Every year a huge number of people die from various types of cancer like kidney, colon, pancreas, breast, etc. Several in vitro and animal experiments have clearly shown that the long-chain ω-3 polyunsaturated fatty acids (PUFAs), EPA, and DHA, the main components of fish oil, help inhibit the promotion and progression of cancer[35].These mechanisms include suppression of arachidonic acid (AA, 20:4n6)–derived eicosanoid biosynthesis, which results in the altered immune response to cancer cells and modulation of inflammation, cell proliferation, apoptosis, metastasis, and angiogenesis; influences on transcription factor activity, gene expression, and signal transduction, which leads to changes in metabolism, cell growth, and differentiation; alteration of Estrogen metabolism, which leads to reduced Estrogen-stimulated cell growth; increased or decreased production of free radicals and reactive oxygen species; and mechanisms involving insulin sensitivity

and membrane fluidity. The first transcription factor that was identified as being regulated by fatty acids was the peroxisome proliferator-activated receptor- α (PPAR), a member of the PPAR family, which also comprises PPAR (also referred to as PPAR) and PPAR (3 isoforms: 1, 2, and 3). A ligand-activated transcription factoris involved in cell proliferation, cell differentiation, and inflammatory responses[36]. The preferred natural ligands of PPAR are PUFAs, including LA, α-LNA, AA, and EPA. Endogenous ligands include 15d-PGJ2, 9(S)-hydroxy octadecadienoic acid, 13(S)-hydroxy octadecadienoic acid, and 15- hydroxy eicosatetraenoic acid. In addition to being a PPAR agonist, EPA, but not other fatty acids (α -LNA, DHA, and n-6 PUFAs), has been shown to significantly increase PPAR1 messenger RNA concentrations in isolated adipocytes. PPARcan be activated by fibrates (hypolipidemic drugs) and by various saturated and unsaturated fatty acids, including palmitic acid, oleic acid, LA, AA, conjugated LA and EPA. Known activators of PPAR are DGLA, EPA, AA, palmitic acid, and the prostaglandins PGA1 (derived from DGLA) and PGD3. PPAR is expressed in several epithelial tissues that are important in human cancers. Agonists of PPAR have been found to have antiproliferative effects both in vitro and in vivo. For instance, in phase II clinical study in patients with advanced prostate cancer, the PPAR agonist troglitazone blocked or reversed tumor progression, which led to a prolonged stabilization of or decrease in prostate-specific antigen in 50% of the patients. Furthermore, reduced concentrations of 15-hydroxyeicosatetraenoic acid, an endogenous ligand for PPAR in the prostate, contribute to increased proliferation of and reduced differentiation in prostate carcinoma. DHA was found to induce apoptosis in vascular smooth muscle cells by activation of PPAR, p38 mitogen-activated protein kinases, bax, and cytochrome c. Murata *et al* reported that EPA decreases the activity of mitogen-activated protein kinase and inhibits cell proliferation in HepG2 cells.[37]. Other studies have shown that a daily EPA + DHA intake above 2.3 grams decreases the production of superoxide. Besides fish oil lowers the risk of colon cancer by lowering the COX-2 enzyme level, whose over expression leads to colon cancer. Chemotherapy and other conventional medical treatments have proven ineffective in improving the quality of life and survival of patients with end-stage cancer. Now Greek medical researchers report that fish oil supplementation markedly increases the survival time for cancer patients with generalized malignancy[38]. Supplementation with dietary ω-3 polyunsaturated fatty acids, specifically fish oils with an antioxidant such as vitamin E may offer significant palliative support to cancer patients with end-stage metastatic disease.

Inflammation
Fish oil has anti-inflammatory properties; therefore, it is effective in reducing inflammation in blood and tissues. Regular consumption of fish oil supplements, tablets, pills, and capsules is helpful to those suffering from chronic inflammatory diseases. Fish oil is effective in treating gastrointestinal disorders, sprue, short bowel syndrome, and inflammatory bowel disease (IBD) including Crohn's Disease and ulcerative colitis, which are typical disorders of the intestine. Patients suffering from Crohn's disease find it difficult to absorb vitamins, fats, and essential supplements. Fish oil supplements are an effective diet for such patients. In ulcerative colitis, fish oil prevents the accumulation of leukotriene in the colon. It should be noted that the anti-inflammatory properties of fish oil are limited to reducing inflammation[39].

Arthritis
Fish oil is useful in treating arthritis, rheumatism [40], Raynaud's symptoms, and similar conditions. In the case of osteoarthritis, fish oil can help reduce the impact of enzymes that destroy cartilage. ω-3 fatty acid suppresses the production of inflammatory eicosanoids. So, they can reduce pain.

Neurological disorder
The brain contains phospholipids, sphingolipids, gangliosides, and cholesterol. These are involved in the structure and function of cell membranes in the brain. The glycerophospholipids in the brain contain a high proportion of polyunsaturated fatty acids (PUFA). This is derived from linoleic acid and alpha-linolenic acid. The main PUFA in the brain is docosahexaenoic acid (DHA), alpha-linolenic acid, and arachidonic acid derived from ω-3 fatty acids. Experimental studies in animals have shown that diets lacking ω-3 PUFA lead to substantial disturbances in neural function[41].This neural dysfunction can be restored by the inclusion of ω-3 PUFA in the diet. In the past 10 years, there has been an emerging interest in treating neuropsychological disorders (depression and schizophrenia) with ω

-3 PUFA. Due to the presence of ω-3 fatty acids, fish oil is good for relieving depression, sadness, anxiety, restlessness, mental fatigue, stress, decreased sexual desire, suicidal tendencies, and other nervous disorders. Fatty acids are effective in treating Alzheimer's disease.

Asthma

Asthma involves an inflammation of the airway (pharynx, larynx and lungs). Epidemiological studies have shown that populations with a high intake of fish oils have a lower incidence of inflammatory diseases such as asthma. Asthma is an increasingly common affliction in the Western world. It is estimated that between 20 and 25 per cent of all children suffer from one or more symptoms of asthma at some point[42]. Dietary intake of polyunsaturated fatty acids (PUFAs) may be effective in reducing asthma symptoms in many patients. Dietary supplementation with fish oils or other enriched sources of ω-3 PUFAs may be a viable therapy for asthma.

Eye Disorder

It is well known that fish oil is good for its ability to improve vision. One of the most common degenerative eye diseases is macular degeneration. It also helps in avoiding age-related macular degeneration. DHA in fish oil may be the most important nutrient when it comes to continued eye health, as a person ages. ω-3 fatty acids are a major component of the retina. DHA is very important as it accounts for 60% of the fatty acids in the retina [43].

Future Outcomes of Fish Oil

Both EPA and DHA are required for optimal human health. Studies on the comparison of pharmacological effects of commercially available preparations (DHA and EPA ethyl esters) and the naturally occurring DHA and EPA triacylglycerols present in fish indicate that purified commercially available preparations provide better health protection than naturally occurring esters found in fish not only because of contaminants (Hg^{2+} and DDT) but also because of the rate of absorption through the digestive tract[44]. It is essential to build up stores of DHA and EPA in the body tissue for the release of these fatty acids and their lipid mediators. This can be achieved through the sustained intake of commercially available fish oil preparation in the form of DHA and EPA ethyl esters. In contrast to rapidly absorbed triacylglycerols from fish, ethyl esters of DHA and EPA are taken up more slowly within 24 h. From the administration of 1 g/day of highly purified EPA+DHA ethyl esters (Omacor) to healthy volunteers, it is shown that EPA increased from 0.6% to 1.4% within 10 days while DHA increased from 2.9% to 4.3%. Baseline values can be obtained after the withdrawal of DHA and EPA within 10 days [45]. Like fish oil contains DHA and EPA, but chemical forms in which these fatty acids are present are different. In fish oil, DHA and EPA are found in the form of triacylglycerol. In esterified form, these fatty acids markedly outperform the effects of conventional fish oil DHA/EPA triglycerides in double-blind trials for premenstrual syndrome/dysmenorrhea and for normalizing blood lipid profiles. The studies on the impact of sources (from fish and fish oil) of n–3 fatty acids on their incorporation in serum, blood lipid composition, and on cellular activation indicate that fish consumption is more effective for increasing serum EPA and DHA than supplementing the diet with fish oil and cod liver oil. These days, consumption of large amounts of fish is accompanied by several adverse side effects due to the potential presence of environmental toxins such as mercury, polychlorinated biphenyls, dioxins, and other contaminants. The risks of exposure to these toxins with fish oil consumption are substantially reduced through purification processes used for the preparation of concentrated fish oil supplements and prescription preparations.

CONCLUSION

Currently, fish oil has unlimited usage for the treatment of different diseases, which could be considered omnipotent since it may benefit heart health, and brain function, reduce some cancer risks, and improve people's moods. Fish oil is an excellent and usually uncontaminated source of EPA and DHA, which the body uses to produce "calming" ω -3 fatty acids and keep the brain and heart healthy. Fish and fish oil supplements should be recognized as a potential treatment choice for various diseases. Eating a modest amount of fish oil ensures a direct supply of EPA and DHA. Clinical studies on various diseases also highlighted the huge scope of fish oil as a pharmacological agent alone or as a synergistic agent in combination therapy. The present article outlines the beneficial role of fish oil, in the treatment

of different ailments and can act as both aggressive and defensive. In conclusion, extensive research on fish oil is leading to a superior understanding of the pharmacology of fish oil in the treatment of terrible diseases is needed.

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Table:1 Physical Properties Of Fish Oil

Property	Value
Appearance	Amber coloured oil
Odour	Characteristic fish odour
Molecular weight	EPA :302.45, DHA 328.49, other oils vary
Melting point	10-15 degree C
Flash point(fatty acids)	Approximately 220 degree C
Boiling point	>250 degree C
Specifc gravity (30 degree C)	0.91

Table 2: Chemical Properties Of Fish Oil

Fatty acids	Lipid Number	% By Weight in Fish Oil
Omega-3 Fatty		
α-Linolenic acid/ ALA	C18:3 (n-3)	6.0%
Stearidonic acid	C18:4 (n-3)	-
Arachidonic acid	C20:4 (n-3)	-
Eicosapentoenoic acid/ EPA	C20:5 (n-3)	27.5%
Docosapentoenoic acid/DPA	C22:5 (n-3)	2.2%
Docosahexaenoic acid	C22:6 (n-3)	8.9%
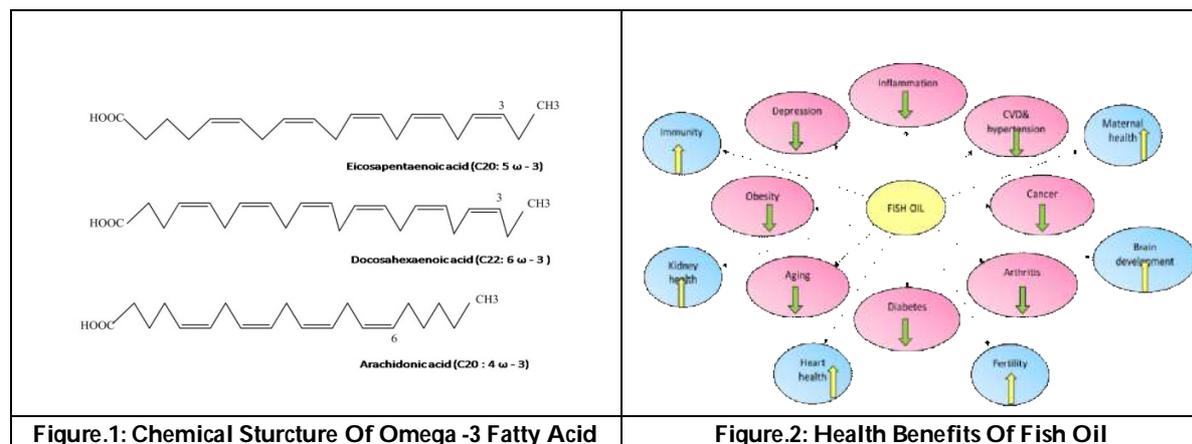
Figure.1: Chemical Sturcture Of Omega -3 Fatty Acid	Figure.2: Health Benefits Of Fish Oil

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RESEARCH ARTICLE

A Green Analytical Method for the Estimation of Letermovir and Its Application to Forced Degradation Studies by UPLC-MS/MS

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ABSTRACT

The current study reports the identification of degradation products of Letermovir by liquid chromatography-tandem mass spectrometry and development and validation of a stability-indicating reversed phase high performance liquid chromatographic method for determination of Letermovir in the presence in bulk drug. Letermovir was subjected to hydrolysis (acidic, alkaline and neutral), oxidation, photolysis and thermal stress, as per international conference on harmonization (ICH) conditions. The drug showed degradation under oxidative, and photolysis stress conditions. However, it was stable under Acidic, Alkaline, thermal and neutral hydrolysis stress conditions. The chromatographic separation was accomplished on an Intersil ODS-3 column (150 × 4.6 mm; 5 µm) with the mobile phase consisting of water (pH -7.0) and methanol (20:80%, v/v) in a isocratic elution mode at a flow rate of 0.6ml/min. The eluents were monitored by a mass spectrometer and quantitation limits were obtained in the range of 50–500 ng/mL. The developed method was validated as per ICH guidelines. No previous method was reported regarding the degradation behavior of Letermovir.

Keywords: Letermovir; Forced degradation, UPLC-ESI-MS/MS; Stability indicating.

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INTRODUCTION

Letermovir has a molecular formula of C29H28F4N4O4 and a molecular weight of 572.55. The chemical name for letermovir is (4S)-2-{8-Fluoro-2-[4-(3- methoxyphenyl)piperazin-1-yl]-3-[2-methoxy-5-(trifluoromethyl)phenyl]-3,4-dihydroquinazolin-4-yl}aceticacid and Letermovir is very slightly soluble in water. Letermovir inhibits the CMV DNA terminase complex (pUL51, pUL56, and pUL89) which is required for viral DNA processing and packaging. Biochemical characterization and electron microscopy demonstrated that letermovir affects the production of proper unit length genomes and interferes with virion maturation. Genotypic characterization of virus resistant to letermovir confirmed that letermovir targets the terminase complex. Cytomegalovirus (CMV) is a leading opportunistic infection in immune compromised patients, including allogeneic hematopoietic stem cell (HSCT) or solid organ transplant (SOT) recipients, where primary infection or reactivation is associated with increased morbidity and mortality. Antiviral drugs are the mainstay for the prevention of CMV infection and disease, most commonly with valganciclovir. However, valganciclovir use is often associated with adverse drug reactions, most notably leukopenia and neutropenia, and its widespread use has led to emergence of antiviral resistance. Foscarnet and cidofovir, however, are associated with nephrotoxicity. Letermovir, a novel CMV viral terminase inhibitor drug, was recently approved for CMV prophylaxis in allogeneic HSCT recipients. It has a favorable pharmacokinetic and tolerability profile [1-10].

The International Conference on Harmonization (ICH) guidelines Q1A (R2) require the use of a validated stability-indicating assay method for stability testing of a new drug substance or product . The ICH recommends the exposure of the drug to stress conditions of hydrolysis, oxidation, thermal and photolysis to generate information on degradation products liable to be formed under the influence of these conditions. The major trend in modern analytical chemistry is the development of greener protocols and when developing new analytical methods, consideration of the "green" aspects should be taken into account [12-15]. Since the drug is recently introduced into the market not much literature has been reported for it in context to analysis. Analytical method proposed included quantification of Letermovir by UPLC-MS/MS. So far to our knowledge, no stability-indicating method for the determination of Letermovir in presence of its degradation products has been reported [11]. Thus the aim of the study was to investigate the complete degradation behavior of Letermovir upon exposure to ICH recommended stress conditions using a validated stability indicating high performance liquid chromatography (HPLC) method and utilizing an optimized LC–MS-MS method for the identification of the degradation products [16].

MATERIALS AND METHODS

Materials
Chemical Resources
Letermovir (CHEMARC), Tenofovir disoproxil (CHEMARC), HPLC grade Methanol (Merck Pvt. Ltd, Mumbai), Ultra pure water (Milli - Q system, Millipore, Bedford, MA, USA), Hydrochloric acid, sodium hydroxide and hydrogen peroxide (3 % w/v) used for stress degradation studies are of analytical reagent grade. The chemicals and solvents were used in this study analytical and HPLC grade.

Instrument Resources
Chromatographic separation was performed on a QSight® Triple Quad UPLC-ESI-MS/MS system (Perkin Elmer) Combined with QSight LX50 UHPLC, data acquisition and processing were accomplished using Simplicity™ 3Q software. Micro balance (ME5 model Sartorius), variable range micro pipette (Eppendorf), Autosampler vials, variable size glass bottles, graduated measuring cylinders, volumetric flasks (Borosil), Ultrasonic bath (Pharmatek Scientifics), Vortexer (Spinix), Refrigerator (LG) were employed in the present investigation.

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Methods

Preparation of standard stock solution

Standard stock solution of Letermovir (1.0 mg/mL) and Tenofovir disoproxil (1.0 mg/mL) were prepared by accurately weighing about 10 mg and transferring in to 10 mL volumetric flask and dissolved in Methanol. All stock solutions were stored in refrigerated conditions (2-8°C) until analysis.

Preparation of Internal standard spiking solution:

The Tenofovir disoproxil (internal standard) spiking solution (100.00 ng/mL) was prepared from standard stock solution of Tenofovir disoproxil (1000.00 µg/mL) in mobile phase Internal standard spiking solution was stored in refrigerated conditions (2-8°C) until analysis.

Preparation of calibration standard solutions:

Standard solutions of different concentrations (50 to 550 ng/mL) of Letermovir (LV) were prepared from Letermovir stock solution (1000µg/mL) in mobile phase Water (pH: 7.0): Methanol, (20:80%, v/v). To each aqueous standard solution, 50 µL of 100.00 ng/mL of Tenofovir disoproxil (internal standard) was added and vortexed for 5 min and injected into the UPLC-ESI-MS/MS for analysis.

Method Development

The chromatographic conditions, especially the composition of mobile phase, were optimized to achieve good resolution and symmetric peak shapes for Letermovir and its degradation products. Upon looking for a solvent to use, in addition to solubility, polarity, and other selection criteria one should also choose a solvent higher on the green end of the solvent selection guide to develop a green method. Intially methanol and water was was chosen as they are environmental friendly solvents and are also compatible with the mass detector. Upon using this mobile phase in a ratio of (50:50, v/v) the chromatogram showed that the resolution and tailing factor of the peaks were poor. In order to improve these parameters, different ratios of methanol and water were tried. Increasing the ratio of water resulted in increasing the retention time of the drug and yet overlapping between peaks occurred thus increasing the total run time and producing more waste. Hence, to get acceptable separation between the drug and its degradation products with a short run time, a mixture of methanol and water in a ratio of (80:20, v/v) in isocratic elution mode and an Inertsil ODS-3 C18 (250 mm × 4.6 mm, i.d., 5 µm) column were used for successful separation of Leterrmovir and its degradation products. The flow rate was set at 0.6ml/min for better separation and ionisation. Tenofovir disoproxil was selected as IS (internal standard) due to its compatibility with analyte chromatographic conditions. The peak elution times for the Letermovir and Tenofovir disoproxil were found at 5.68 and 5.88 min.

Optimization of Mass spectroscopic Parameters

The pure drug of Letermovir and Tenofovir disoproxil were prepared in methanol (100.00 ng/mL) and injected with a flow rate of 5µL/min into positive ion mode mass spectrometer for optimization of mass parameters like source temperature, IS, heater gas, nebulizer gas, curtain gas, CAD gas (all gas channels were purged with ultra high pure nitrogen gas), EP, DP, CE, FP and CXP were optimized. Analysis was performed using MRM positive ion mode with mass transitions of m/z (amu) 573.31→381.12 and 288.10→176.10 for LV and TVIS. The mass spectras of parent and product ions were depicted in Fig.2.

Optimised Chromatographic conditions

Several systematic trials were performed by varying stationary phases and mobile phase ratios to achieve ideal chromatographic conditions. The chromatographic separation was achieved with Water (pH: 7.0): Methanol, (20:80%, v/v) using the Inertsil ODS-3 C18 (250 mm × 4.6 mm, i.d., 5 µm) gave the best peak shape and low baseline noise was observed. The total analysis time was 2.5 min and flow rate was set to 0.6 ml/min. The temperature was set to 40°C for the column oven. The sample volume for the injection into mass spectrometry was adjusted to 10 µl for better ionization and chromatography. After completion of several systematic trials, a sensitive, precise and accurate UPLC-MS/MS method was developed for the analysis of Letermovir (LV) using Tenofovir disoproxil (TVIS) as internal satndard. The chromatograms of blank (Mobile phase), LOQ and ULOQ standards were shown in Fig.3-5. This was followed by method validation.

Method Validation

The developed method was validated over a linear concentration range of 50.00–550.00 ng/ml. The validation parameters include selectivity and specificity, LOQ, Linearity, precision and Accuracy, Robustness, Recovery, Stability in solution was evaluated under validation section [16].

System suitability

Six replicate injections of aqueous standard 100% level (100.0 ng/mL) along with internal standard (100.0 ng/mL) were injected in to UPLC-MS/MS and %RSD was calculated.

Selectivity & Specificity

The selectivity of an analytical method is its ability to measure accurately and specifically the analyte of interest in the presence of components that may be expected to be present in the sample matrix. If an analytical procedure is able to separate and resolve the various components of a mixture and detect the analyte qualitatively the method is called selective. It has been observed that there were no peaks of diluents and placebo at main peaks. In order to test the interference at the retention time of Letermovir and Tenofovir disoproxil & blank samples (Mobile phase) were injected in to UPLC-MS/MS. Hence, the chromatographic system used for the estimation of Letermovir and Tenofovir disoproxil were very selective and specific. Specificity studies indicating that the excipients did not interfere with the analysis.

Linearity and Range

The linearity of calibration curve for Letermovir was assessed at 50 % to 150 % of the target concentration at different levels in the range of 50.0 ng/mL to 550.0 ng/mL in aqueous standards. Peak area ratios for each solution against its corresponding concentration were measured and the calibration curve was obtained from the least-squares linear regression presented with their correlation coefficient.

Precision

The intra-day data reflects the precision and accuracy of the method under the same conditions within one day. Intra-day accuracy and precision was obtained by analyzing ten replicates of three different standard samples (200, 300 and 400 ng/mL). Accuracy was determined by the regressed (measured) concentration represented as a percentage of the target (nominal) concentration. The percent relative standard deviation (% RSD) of the regressed (measured) concentrations was used to report precision. The inter-day precision and accuracy was verified by repeating the above procedure at three different days.

Limit of detection (LOD) and limit of quantification (LOQ)

Limit of detection (LOD) and limit of quantification (LOQ) of Letermovir was determined by calibration curve method. Solutions of Letermovir (LV) were prepared in linearity range and injected in triplicate. Average peak area ratio of three analyses was plotted against concentration. LOD and LOQ were calculated by using the following equations: $LOD = 3.3 \times \sigma / S$; $LOQ = 10 \times \sigma / S$;

Where σ is the standard deviation of y-intercepts of regression lines and S is the slope of the calibration curve.

Robustness

The robustness of a method is evaluated by varying method parameters such as percent organic solvent, pH, ionic strength, temperature and determine the effect (if any) on the results of the method. The evaluation of robustness should be considered during the development phase and depends on the type of procedure under study. Robustness was carried by carried out by varying the method parameters like flow rate (±5%), Column temperature (±5%) and pH (±2%). Six replicate injections of aqueous standard 100% level (300.0 ng/mL) along with internal standard was injected in to UPLC-MS/MS and %RSD was calculated.

Stability
Stability of Letermovir & Tenofovir disoproxil in aqueous standards was performed using six replicates of 300.0 ng/mL and 100.00 ng/mL at ambient and refrigerated conditions with different time intervals.

Solution Stability
A Letermovir at concentration of 300.0 ng/mL solution and Tenofovir disoproxil (IS) solution at 100.0 ng/mL of were prepared from fresh stock solutions. A portion of the freshly prepared standard solutions (Letermovir & Tenofovir disoproxil) were kept at ambient temperature (25°C) for 48 hours and then analyzed by the proposed method. A second portion of the freshly prepared standard solutions (Letermovir & Tenofovir disoproxil) were stored at refrigerated temperature (between 2°C and 8°C) for 48 hours and then analyzed. The results were compared with those obtained from samples analyzed at initial moment (0.0hours).

Filter validation (Filter Interference)
A Letermovir (LV) at concentration of 300.00ng/mL solution and Tenofovir disoproxil (TVIS) solution at 100.00ng/mL of were prepared from fresh stock solutions. Some portion of Letermovir (LV) and Tenofovir disoproxil (TVIS) standard solutions (300.00ng/mL and 100.00ng/mL) was filtered through three different filters namely 0.45µm PVDF filter, 0.45µm PTFE and 0.45µm Nylon filter and some portion was centrifuged and injected into the UPLC-MS/MS system.

Forced Degradation Studies
Preparation of un-stressed sample
Stock solution of Letermovir (1000 µg/ml) was prepared by dissolving an accurately weighed 10 mg of the sample and dissolved in 10 ml of the methanol in a volumetric flask. Letermovir (100 ng/ml) solution was prepared with mobile phase and injected to the UPLC-MS/MS System to study the unstressed sample.

Preparation of degradation Solutions
A total of six degradation samples were prepared for every stress condition. The samples were further diluted with mobile phase followed by filtration through 0.45 µ membrane filter before UPLC-MS/MS analysis.

Preparation of Acid induced degradation product
Weighed about 10 mg of Letermovir was taken in a 10 ml volumetric flask and dissolved 25 ml methanol and diluted with 0.1 N HCl. The solution was set aside for 72 h at ambient temperature. After degradation, solution was diluted with the mobile phase to get the final concentration 100 ng/mL and injected into UPLC-MS/MS system.

Preparation of alkali induced degradation product
Weighed about 10 mg of Letermovir was taken in a 10 ml volumetric flask and dissolved 10 ml methanol and diluted with 0.1 N NaOH. The solution was set aside for 72 h at ambient temperature. After degradation, solution was diluted with the mobile phase to get the final concentration 100 ng/mL and injected into UPLC-MS/MS system.

Preparation of hydrogen peroxide induced degradation product
Weighed about 10 mg of Letermovir was taken in a 10 ml volumetric flask and dissolved 10 ml methanol and diluted with 3% v/v H_2O_2. The solution was set aside for 72 h at ambient temperature. After degradation, solution was diluted with the mobile phase to get the final concentration 100 ng/mL and injected into UPLC-MS/MS system.

Preparation of Thermal (Dry heat) degradation product
The 10mg Letermovir was taken on Petri dishes (10 cm in diameter) and spread as a thin layer of 1 mm, and exposed to 80ºC for 72 hrs. After degradation, the degradation sample was dissolved in methanol and diluted with mobile phase to get the final concentration 100 ng/mL and injected into UPLC-MS/MS system.

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Preparation of Photolytic Degradation product

Weighed about 10 mg of Letermovir was taken in a 10 ml volumetric flask and dissolved 10 ml methanol. The solution was exposed to UV radiation (254 nm) at 1.2 million lux-hours for 72 h (using the photostability chamber Thermolab 400G, New Delhi, India). After degradation, solution was diluted with the mobile phase to get the final concentration 100 ng/mL and injected into UPLC-MS/MS system.

Preparation of Neutral Degradation product

Weighed about 10 mg of Letermovir was taken in a 10 ml volumetric flask and dissolved with methanol and diluted to 10mL with water. The solution was set aside for 72 h at ambient temperature. After degradation, solution was diluted with the mobile phase to get the final concentration 100 ng/mL and injected into UPLC-MS/MS system.

RESULTS AND DISCUSSION

Method development

In the proposed method, water and methanol are neither defined as PBT (persistent, bioaccumulative and toxic), nor hazardous by the EPA's Toxic Release Inventory (TRI). The pH of the samples and the mobile is about pH: 7.0, i.e., not corrosive. So according to these criteria, the proposed method passes the greenness profile [12-15].

Method validation
System suitability

System suitability parameter can be defined as test to ensure that the method can generate precise results. In this method %RSD value obtained was less than 2%.

Selectivity and Specificity

No significant response was observed at retention times of Letermovir and Tenofovir disoproxil in mobile phase. It can be concluded that the method is specific for estimation of Letermovir in presence of solvent. The chromatograms of blank samples (Mobile phase) Letermovir Standards were shown in Fig.3-5.

Linearity

Linearity was plotted as a peak area ratio (Letermovir peak area / Tenofovir disoproxil peak area) on the y-axis against Letermovir concentration (ng/mL) on the x-axis. The correlation coefficient for Letermovir over the concentration range of 50.0 to 550.0 ng/mL was 0.9960 (Tab-1 and Fig-6). The regression equation for Letermovir was, $y = y = 0.003x - 0.016$. Linearity was found to be quite satisfactory and reproducible.

Precision & Accuracy

The precision of the proposed method was evaluated at three different concentration levels and Accuracy and %RSD for each concentration values obtained was calculated. Intermediate precision was carried out by analyzing the samples by a different analyst on different days. No statistically significant difference was observed. The %RSD and accuracy was found to be 0.57 to 2.69 and 99.36 to 99.73% for intraday precision. Where as, for interday precision %RSD and accuracy was found to be 0.57 to 2.69 and 97.07 to 101.98%. The results was summarized in Tab.2.

LOD and LOQ

The detection and quantification limits were evaluated from calibration curve plotted in concentration range of 50.0 – 550.0 ng/mL. LOD and LOQ for this method were found to be 45.49 and 137.85 pg/mL respectively. These values indicated that the method was sensitive to quantify the drug.

Robustness

The %RSD of Letermovir was good under most conditions and didn't show any significant change when the critical parameters were modified and the components (Analyte and IS) were well separated under all the changes carried out (Tab-3). Thus the method conditions were robust.

Solution Stability

The processing and storage conditions of samples need to maintain the integrity of a drug or at least keep the variation of pre-analysis as minimal as possible. For this reason, stability studies play an important role in a analytical method development. In this study, the stability was assessed by considering stock solution stability for Letermovir and Tenofovir disoproxil (Tab-4) show that stable under the studied conditions (Ambient and Refregerated conditions). Since in all conditions, the % Differrence values were smaller than 2%.

Filter validation (Filter Interference)

The %Differrence values for Letermovir and Tenofovir disoproxil of different filter materials was found to be 0.17 to 1.39% and 0.45 to 0.94 (Tab-5**)** and no siginificant interference was obaservced.

Identification of major degradation product formed under stress conditions by UPLC-MS/MS

The fragmentation for the degradants was also carried out for Letermovir using product ion scan by UPLCMS/MS. In these stress studies, a total of two degradation products (D1 and D2) were observed for Letermovir in D1 (Peoxide) and D2 (Photolyic). Under oxidative and photolytic degradation, the percentage degradation of the drug was 100% and no degradation occurred for acidic and basic hydrolysis after 72 h. Under oxidative degradation, the Letermovir was degraded after 72 h with the formation of molecular ion. The degradation products of oxidative and photolytic were analyzed by UPLC–MS-MS, the total ion chromatograms of both degradates was showing molecular ions at m/z 554 and 471 indicating the presence of the degradation product in both cases. The oxidation stress conditions were studied using 3% v/v H_2O_2 up to 72 h at room temperature. It was found that, 3% v/v H_2O_2 was effective in oxidizing the drug even after 72 h. The degradant products of molecular ion at m/z 554 and 471 were shown in Figure-8. No Acidic, Basic, neutral and thermal degradation was observed for the solution and solid form of drug after exposure to the water, 80ºC, up to 72 h, respectively. It was confirm that drug was found to be stable solid as well as in solution forms under Acidic, Basic, neutral and thermal stress conditions. The respective degradation of m/z values of all degradate and their fragmentation ions was represent in Table-6 and Figure-7 to 9.

CONCLUSION

The quality of pharmaceutical products is of vital importance for patient's safety. The presence of degradation compounds or impurities may affect the efficacy and safety of pharmaceuticals. In this work, the forced degradation study on Letermovir has been carried out under ICH prescribed conditions as to study its degradation profile. A green, sensitive, accurate, precise and reproducible isocratic stability-indicating UPLC-MS/MS method was developed. The validation experiments proved the methods to be linear, precise, accurate, specific and selective to the drug in presence of degradation products. The drug has been found susceptible to oxidative and photolytic degradation at room temperature. The suggested method can be used for routine analysis of Letermovir in quality control laboratories without harming the environment.

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CONFLICT OF INTEREST:

Authors declare that, there is no conflict of interest.

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Table-1: Linearity of Letermovir (LV)

Linearity Level (%)	Nominal Conc. (ng/mL)	Letermovir (LV) Mean Peak Area (n=3)	Tenofovir disoproxil (TVIS) Mean Peak Area (n=3)	Mean Peak Area Ratio (n=3)
50	50	54321	352173	0.154
70	150	162902	331431	0.492
90	250	271611	362141	0.750
100	350	379232	352153	1.077
125	450	488781	350211	1.396
150	550	597533	327415	1.825
			Correlation coefficient	0.9960
			Y-Intercept	-0.016458
			Slope	0.00323
			Standard Error	-0.016458

Table-2: Precision and accuracy of Letermovir (LV)

Concentration (ng/mL)	Within-run (Intra-day)			Between-run (Inter-Day)		
	Mean Concentration measured (n=10;ng/mL;mean±S.D)	%CV	%Accuracy	Mean Concentration measured (n=30;ng/mL;mean±S.D)	%CV	%Accuracy
200.00	199.22±0.85	0.43	99.61	199.74±1.15	0.57	99.87
300.00	298.08±1.55	0.52	99.36	305.26±10.25	2.69	101.98
400.00	398.94±9.05	2.27	99.73	388.26±1025	2.64	97.07

Table-3. Robustness of Letermovir (LV)

Validation Sample	%RSD		
	Flow Rate(± 5%)	Column Temp (± 5%)	pH (± 2%)
Letermovir (300.0 ng/mL)	0.71	2.55	3.29

Table.4: Solution stability data of Letermovir & Tenofovir disoproxil

Stability Sample	Ambient temperature		Refrigerated Temparature	
	%Difference at 0.0Hours	%Difference at 48.0Hours	%Difference at 0.0Hours	%Difference at 48.0Hours
Letermovir (300.00ng/mL)	0.00	1.36	0.00	1.24
Tenofovir disoproxil (200.00ng/mL)	0.00	0.013	0.00	0.13

Table-5: Filter Interference results of Letermovir & Tenofovir disoproxil

Validation Sample	%Difference		
	0.45µm Nylon	0.45µm PVDF	0.45µm PTFE
Letermovir (300.00ng/mL)	0.76	0.17	1.39
Tenofovir disoproxil (100.00ng/mL)	0.450	0.616	0.945

53190

Table: 6. Letermovir mass degradation profile

S.No	Peroxide Degradation Fragment ions (m/z, amu)	Photolytic Degradation Fragment ions (m/z, amu)
1	554	471
2	523	457
3	495	381
4	392	325
5	201	162
6	175	135
7	134	51
8	**Degradation product-I (554)**	**Degradation product-II (471)**

Table: 7. Degradation behavior of Letermovir

Stress condition	Strength of stress	Temperature	Duration	% Degradation	Inference
Acid Hydrolysis	0.1M HCl	Ambient	72 h	0.00	Degradation not observed
Basic Hydrolysis	0.1M NaOH	Ambient	72 h	0.00	Degradation not observed
Oxidative/Peroxide degradation	3% v/v H_2O_2	Ambient	72 h	100.00	Complete degradation
Thermal	-	80ºC	72 h	0.00	Degradation not observed
Photolytic Studies (UV-Light)	UV lamp (254 nm) at 1.2 million lux-hours	Ambient	72 h	100.00	Complete degradation
Neutral (Water)	Water	Ambient	72 h	0.00	Degradation not observed

Fig.1: Chemical Structures of A) Letermovir (LV) B) Tenofovir disoproxil (TVIS)	**Fig.2: Parent ion mass spectra (Q1) and (Q3) of Letermovir (LV) B) Tenofovir disoproxil (TVIS)**
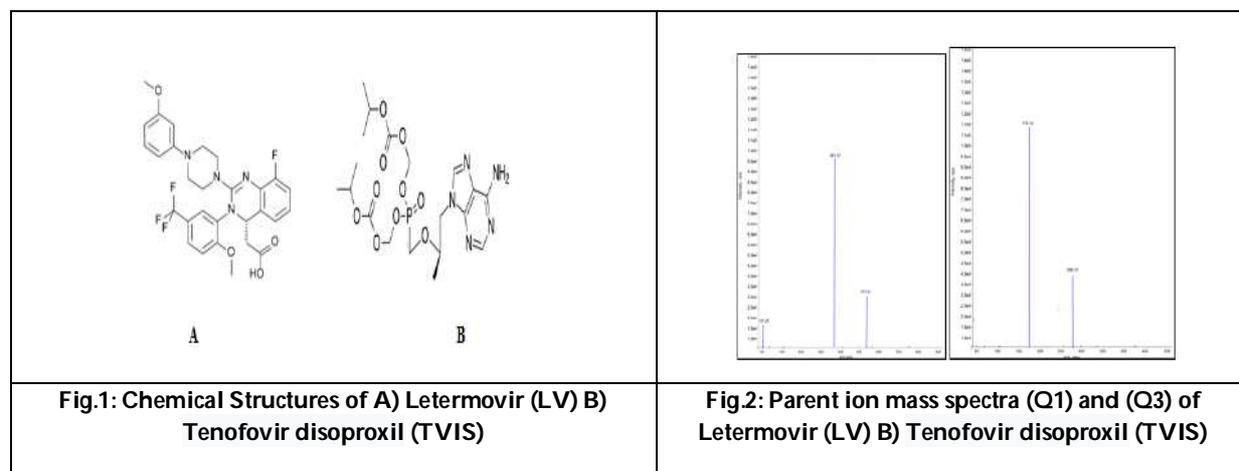
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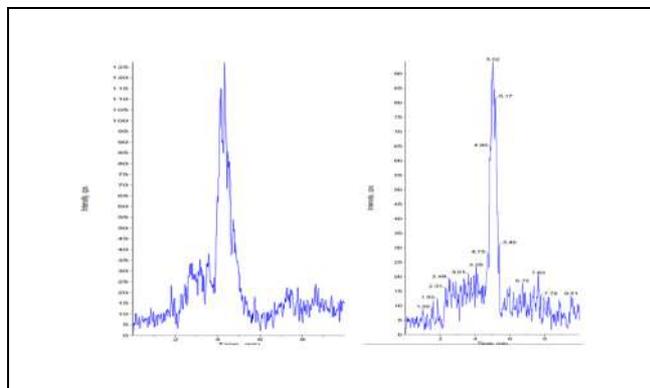
Fig.3: Blank chromatogram (Mobile Phase)
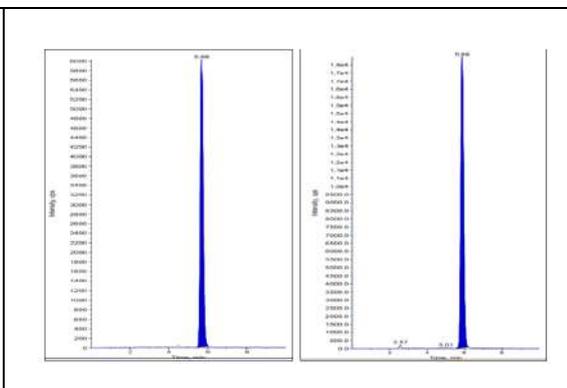
Fig.4: Standard chromatogram of LOQ sample (50% Linearity level) (LV and TVIS).
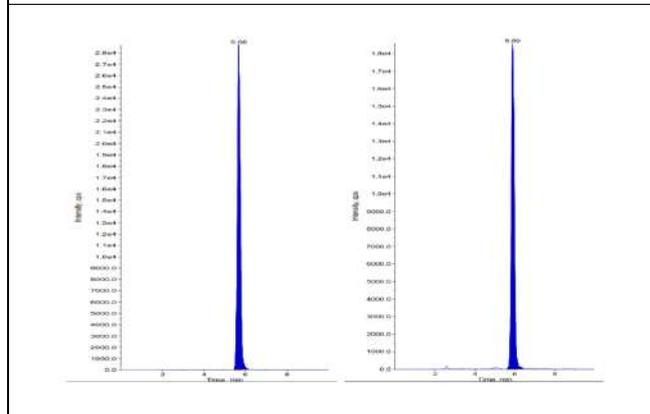
Fig.5: Standard chromatogram of ULOQ sample (150% Linearity level) (LV and TVIS).
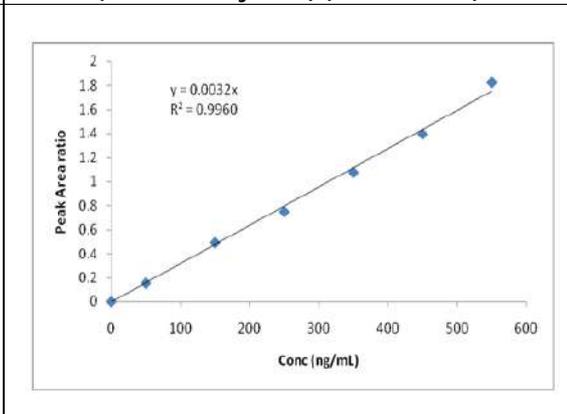
Figure-6: Calibration curve for Letermovir (LV)
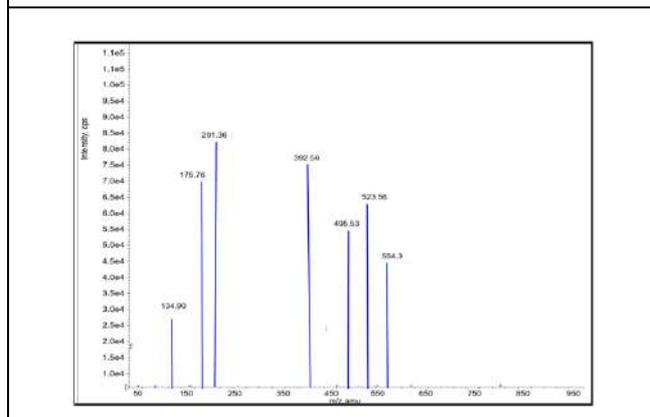
Figure:7 Fragmentation of Letermovir in oxidative degradation (Peroxide)
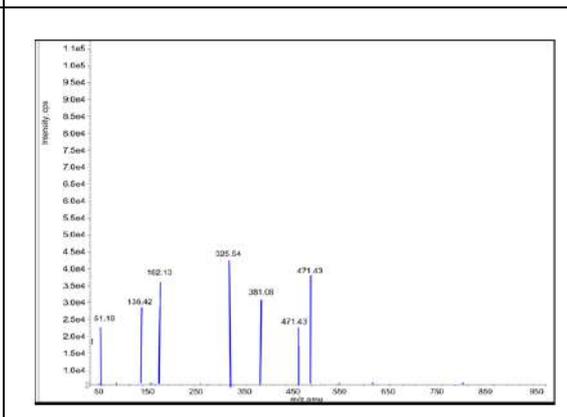
Figure:8.0. Fragmentation of Letermovir in photolytic degradation

RESEARCH ARTICLE

Dynamics of Cropping Pattern in North Western Agro-Climatic Zone of Tamil Nadu

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ABSTRACT

Economy of India is primarily depending on agriculture. It began to diversify in the early 1990s. Agriculture diversification has benefitted by replacing low value crops into high value crops. Modern intensive farming practices are identified as a possible way to raise agricultural income on the same piece of land. The present study is to analyse the growth rate and dynamics of various crop categories in study area. Multistage stratified random sampling is used to determine the sample for the intended research which is North western Agro-climatic zone of Tamil Nadu. The area under various crop categories in sample districts are considered for the study from the period of 2010-11 to 2019-2020. Trend analysis and Markov chain analysis were applied to quantify the dynamics and growth of various crop categories in the research region. The study results demonstrate that cereals and millets have a high likelihood of retention and a favourable growth rate in the North western Agro-climatic zone in Tamil Nadu.

Keywords: Cropping Pattern, North western Agro-climatic Zone, Tamil Nadu, Dharmapuri, Salem, Namakkal, Growth rate analysis, Markov Chain analysis

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INTRODUCTION

Introduction of economic reform in India during the 1990s offered more options for crop diversification [1]. Agricultural diversification takes an additional benefit from substitution of high value crops for low value crops [2]. The planting pattern may need to be altered for enhancing agricultural income [3]. Increasing pressure of populations are able to make changes in the land use and cropping pattern [4]. Crop loans and micro irrigation systems are more effective strategies of modern intensive farming [5]. Adoption of irrigation water management under micro irrigation system is likely to increasing the farm income [6]. Urbanisation, industrialization, growing populations and climate change are the crucial barriers for to attain sustainable food production and resource conservation activities in the study area. In recent years groundwater remains the major source of irrigation. Farmers are not using groundwater-friendly farming practices, irrigation and modern intensive farming technologies are needed for increasing the agricultural production. In general, farmers following the same cropping pattern is not enough to achieve a sustainable food production and agricultural income. In this concern, the present study was taken to know the growth and dynamics of various cropping pattern in the study area.

MATERIALS AND METHODS

Multistage stratified random sampling is used to select the sample for the intended research. Tamil Nadu is considered as a universe of the study. Different Agro-climatic zones were considered as stage two among agro climatic zones, North Western Agro-Climatic Zone is selected because its high dependence on groundwater is a source of irrigation for farming compared to other climatic zones [9]. In stage three Dharmapuri, Salem and Namakkal districts are selected because more than 90 per cent irrigated agricultural area was depended on groundwater for agriculture, compared to other districts in a North Western Agro-Climatic Zone [9]. Cereals and millets, pulses, sugar, spices and condiments, fruits, vegetables, fibre, oil seeds, and other crops were considered as various crop categories for intended research. The area under various crop categories in sample districts are considered for the study from the period of 2010-11 to 2019-2020 [8].

TOOLS OF ANALYSIS
Growth Rate Analysis
The modification of cropping pattern in the sample districts of North western agro climatic zone of Tamil Nadu (Dharmapuri, Salem, and Namakkal districts) were estimated by compound growth rate of area under various crop categories. Exponential function of the linear system was used to calculate the compound growth rate of various crops [7] using following equation.

$Y_t = Y_0 (1+r)^t$ -- (1)

Where,

Y_t = Area under the crop at time t (ha)

r = Compound growth rate of Y

Y_0 = Initial year area under the crop (ha)

By taking natural logarithm of (1),

$In\ Y_t = In\ Y_0 + t\ In\ (1+r)$ ------------------------------------- (2)

Now letting,

$\beta_1 = In\ Y_0$

$\beta_2 = In\ (1+r)$

Equation (2) can be written as

$In\ Y_t = \beta_1 + \beta_2 t$ --- (3)

Adding the disturbance term to (3), it can be written as

$In\ Y_t = \beta_1 + \beta_2 t + U_i$

Where,

Y_t = Area under crop at time 't' (ha)

t = time in years
β_1 = constant term
β_2 = regression co-efficient
This log linear function was fitted by using Ordinary Least Square (OLS) method. The compound growth rate (r) was obtained using the formula.
r = (Antilog of β_2 - 1) × 100

Markov Chain Analysis

The Markov chain method was used to investigate the direction of changes in the cropping pattern. The difficulties of mobility, both in terms of transitions from one state to another and in terms of shifting from one "state" to another, are explored by Markov chain model. It is employed to explain and assess the kinds of shifts brought by the movement of these variables, and in some situations, it may also be used to forecast changes in the future. Applying the first order Markov chain assumption, the direction of changes in the cropping pattern was calculated [3]. This is done in the way described below.

The transition probability matrix, that is given by equation, identifies a first order Markov chain (1):

$$P = \begin{vmatrix} P_{11} & P_{12} & \ldots & P_{1n} \\ P_{21} & P_{22} & \ldots & P_{2n} \\ P_{n1} & P_{n2} & \ldots & P_{nn} \end{vmatrix} \qquad \ldots\ldots\ldots (1)$$

Where, $P_{12} \ldots P_{ij}$ is the probability that an item under the classification T during the current year changes into the classification 'j' next year and 'n' is the number of crops. That is,

$$P_{ij} = Pr\{X(t+1) = jX_{(t)} = i\} \qquad \ldots\ldots\ldots (2)$$

Where,

$X_{(t)}$ = State of the system at the year 't'. it is clear that

$P_{ij} \geq 0, \quad i, j = 1, 2 \ldots n$

$\sum_{j=1}^{j=n} P_{ij} = 1 \quad i = 1, 2 \ldots n \qquad \ldots\ldots\ldots (3)$

The heart of this investigation was the determination of the transition probability matrix (P). The probability that an item would shift from the ith classification to the jth classification over time were indicated by the matrix element P_{ij}. The diagonal component P_{ij} indicated the probability of a particular category share would remain consistent during this period.

RESULTS AND DISCUSSION

Growth rate of area under major crop categories in Dharmapuri, Salem and Namakkal districts

Table 1, shows compound growth rate of Dharmapuri, Salem and Namakkal districts of North western agro climatic zone in Tamil Nadu. Compound growth rate of Dharmapuri district has showed positive growth rate for the area under pulses (4.72), fruits (3.71), other crops (3.17), cereals and millets (1.89), and spices and condiments (0.43), while the area under fibre (-0.31), vegetables (-1.12), oil seeds (-1.35) and sugar crops (-21.08) has showed negative growth rate. Pulses shows the highest positive compound growth rate (4.72 per cent), followed by fruits (3.71 per cent). Among the crop categories, cereals and millets (3.77), pulses (3.30), and fruits (1.31) express rising growth rates in the Salem district, but area under oil seeds (-1.54), vegetables (-1.90), fibre (-2.53), spices and condiments (-4.93) and sugar crops (-12.57) other crops (-15.10) exhibited falling growth rates. The highest positive growth rate was found in cereals and millets (3.77 per cent), followed by pulses (3.30 per cent). The area under cereals and millets (9.22), pulses (3.78), fibre (1.03), oil seeds (0.71), fruits (0.33), and vegetables (0.13) had positive compound growth rate in the Namakkal district. Negative growth rate was seen in spices and condiments (-5.21), sugar crops (-8.28) and other crops (-14.72). Cereals and millets had the highest growth rate, which was (9.10 per cent), and followed by pulses (7.37 per cent). The trend line of area under different crops over years (2010-2019) is shown in the following graphs (Fig.1 to Fig. 9).

Dynamic Changes of Major Crops in Dharmapuri, Salem and Namakkal district

By evaluating the transitional probability matrices, Markov chain analysis was used to investigate the direction of changing cropping pattern. Studying the diagonal and off diagonal elements of the transitional matrix are allowed the researcher to interpret the possibility of retaining a specific crop (gain or loss). The collected data on cropped area from 2010-11 to 2019-2020 is used to analyse the transitional probability matrix of dynamic changes of cropping pattern in Dharmapuri, Salem, and Namakkal districts of North western Agro-climatic zone in Tamil Nadu. Cereals and millets, pulses, sugar, spices and condiments, fruits, vegetables, fibre, oil seeds, and other crops are the major categories that were considered for the analysis. Findings are presented in a following table 2,3, and 4. Table 2, explains the Dharmapuri district retention probability of the various crop categories is represented by the diagonal elements. The cultivated area under cereals and millets had a retention probability of 38 per cent, sugar was at 31 per cent, vegetables (29 per cent), other crops (29 per cent), pulses (24 per cent), fibre (10 per cent), oil seeds (6 per cent), fruits (5 per cent), spices and condiments (4 per cent), respectively. Hence, among all of these categories, cereals and millets have the highest retention capacity. The steady state probabilities showed that if the trend continues like this, in future area under cultivation in cereals and millets 33 per cent, followed by pulses 21 per cent, vegetables 11 per cent and other crop categories are have less than 10 per cent only.

The possibility of retention capacity of crop categories in Salem district are represented in diagonal elements of the table 3. The expected capacity of retention probability in the area under cereals and millets at 48 per cent, followed by other crops at 44 per cent, oil seeds (31 per cent), pulses (30 per cent), vegetables (16 per cent), fibres (14 per cent), fruits (7 per cent), spices, and condiments (5 per cent) and sugar (1 per cent), respectively. As a result of Markov chain analysis indicates that, cereals and millets are still had the highest chance of retention. The steady state probabilities showed that if the trend continues like this, in future cultivation area under cereals and millets 41 per cent, followed by pulses 20 per cent, oil seeds 13 per cent and other crop categories have less than 10 per cent only.

The retention capacity of Namakkal district crop categories is shown in diagonal elements of table 4. Cereals and millets had a 53 per cent of retention probability followed by oil seeds (27 per cent), vegetables (11 per cent), sugar (8 per cent), fruits (4 per cent), pulses and other crops (2 per cent), fibre, spices and condiments (1 per cent), respectively. Cereals and millets are the most widespread crop categories, in accordance with the Markov retention probability matrix. The steady state probabilities showed that if the trend continues like this, in future cultivation area under cereals and millets 46 per cent, followed by vegetables 10 per cent and other crop categories have less than 10 per cent only. Cereals and millets crop category was covered majority of food crops that's why it has the solid retention capacity and dominant nature of among all crop categories in the study area. Other crop categories have retention probability is less than 30 per cent only, remaining share of area under other crop categories is majorly shifted towards cereals and millets in the study area. As a result, indicate that cereals and millets have a strong retention capacity in the study area.

CONCLUSION

To quantify the dynamics and growth of several crop categories in the research region, trend analysis and Markov chain analysis were applied. The compound growth rate analysis, shows both positive and negative growth rates of selected crop categories in the study area. Markov chain analysis reveals that cereals and millets have a strong retention capacity, shift probability is found high in cereals and millets, compared to other crops categories in the intended research. The results of the analysis, cereals and millets have a higher probability of being retained, and in the study region, they are also growing at a positive rate together including pulses and fruits. Crop water requirement of cereals and millers is quite high compared to other crops and also present status was high area under cereals and millets cultivation it clearly shows the high groundwater exploitation by cultivation of cereals and millets. The feasibility of micro irrigation is less in cereals and millets cultivation compared to other crops like vegetables, fruits etc. To overcome the present high groundwater exploitation, changing cropping pattern is need of the hour. The study concluded that, increasing the area under cultivation with low water required for high value crops and adaptation of modern farming technologies among the farming communities will increase the sustainable

income within optimum utilization of available resources effectively, which will affect the overall empowerment of farmer and sustainability of the available resources. It suggests that, farmers orientation programme towards cropping pattern and modern technologies are needed for present agriculture scenario.

ACKONWLEDGEMENT

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Table 1. The Growth Rate of area under major crops in Dharmapuri, Salem and Namakkal districts, 2010-11 to 2019-2020

S. No	Crop category	Dharmapuri	Salem	Namakkal
1.	Cereals and Millets	1.89	3.77	9.22
2.	Pulses	4.72	3.30**	3.78
3.	Sugar	-21.08 ***	-12.57***	-8.28***
4.	Spices and Condiments	0.43	-4.93	-5.21
5.	Fruits	3.71	1.31*	0.33
6.	Vegetables	-1.12	-1.90	0.13
7.	Fibre	-0.31	-2.53	1.03
8.	Oil seeds	-1.35	-1.54*	0.71
9.	Others	3.17	-15.10***	-14.72**

*, ** and *** denote significance at 10, 5 and 1 per cent levels, respectively.

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Table.2: Transitional Probability Matrix of Dynamic Changes in Major Crop categories of Dharmapuri district, 2010-11 to 2019-2020

Crops	Cer.Mil	Pul	Sug	Spi.Con	Fru	Veg	Fib	Oil S	Others
Cer.Mil	0.38	0.24	0.03	0.03	0.05	0.09	0.05	0.09	0.05
Pul	0.36	0.24	0.02	0.04	0.05	0.08	0.09	0.11	0.01
Sug	0.30	0.00	0.31	0.25	0.00	0.00	0.14	0.00	0.00
Spi.Con	0.40	0.21	0.02	0.04	0.05	0.07	0.08	0.10	0.01
Fru	0.41	0.08	0.04	0.00	0.05	0.12	0.00	0.11	0.19
Veg	0.08	0.19	0.06	0.06	0.17	0.29	0.05	0.10	0.01
Fibre	0.32	0.23	0.03	0.05	0.06	0.09	0.10	0.12	0.02
Oil S	0.41	0.33	0.00	0.00	0.04	0.11	0.00	0.06	0.05
Others	0.25	0.09	0.06	0.00	0.00	0.17	0.00	0.14	0.29
SSP	0.33	0.21	0.05	0.04	0.06	0.11	0.05	0.09	0.05

(Note: Cer.Mil: Cereals and Millets, Pul: Pulses, Sug: Sugar crops, Spi. Con: Spices and Condiments, Fru: Fruits, Veg: Vegetables, Fib: Fibre crops, Oil. S: Oil Seed crops and Others: Other crops)

Table.3:Transitional Probability Matrix of Dynamic Changes in Major Crop categories of Salem district, 2010-11 to 2019-2020

Crops	Cer. Mil	Pul	Sug	Spi.Con	Fru	Veg	Fib	Oil. S	Others
Crops	0.48	0.20	0.01	0.03	0.03	0.07	0.04	0.11	0.02
Cer. Mil	0.48	0.30	0.00	0.02	0.05	0.07	0.00	0.09	0.00
Pul	0.40	0.22	0.01	0.06	0.02	0.04	0.02	0.19	0.06
Sug	0.35	0.19	0.03	0.05	0.03	0.07	0.04	0.22	0.02
Spi.Con	0.39	0.27	0.00	0.03	0.07	0.10	0.00	0.14	0.00
Fru	0.37	0.02	0.03	0.01	0.03	0.16	0.20	0.04	0.14
Veg	0.53	0.16	0.00	0.00	0.01	0.13	0.14	0.02	0.00
Fib	0.20	0.23	0.04	0.07	0.04	0.05	0.00	0.31	0.05
Oil. S	0.09	0.08	0.11	0.05	0.01	0.09	0.05	0.08	0.44
Others	0.41	0.20	0.02	0.03	0.04	0.08	0.04	0.13	0.05

(Note: Cer.Mil: Cereals and Millets, Pul: Pulses, Sug: Sugar crops, Spi.Con: Spices and Condiments, Fru: Fruits, Veg: Vegetables, Fib: Fibre crops, Oil.S: Oil Seed crops and Others: Other crops)

Table.4: Transitional Probability Matrix of Dynamic Changes in Major Crop categories of Namakkal district, 2010-11 to 2019-2020

Crops	Cer.Mil	Pul	Sug	Spi.Con	Fru	Veg	Fib	Oil S	Others
Cer.Mil	0.53	0.08	0.04	0.02	0.02	0.09	0.01	0.18	0.04
Pul	0.13	0.02	0.2	0.05	0.06	0.15	0.03	0.2	0.17
Sug	0.3	0.09	0.08	0.04	0.03	0.09	0.01	0.23	0.13
Spi.Con	0.51	0.11	0.00	0.01	0.00	0.00	0.00	0.36	0.00
Fru	0.38	0.07	0.11	0.01	0.04	0.12	0.01	0.26	0.00
Veg	0.53	0.05	0.04	0.04	0.02	0.11	0.01	0.13	0.09
Fib	0.38	0.07	0.11	0.01	0.04	0.12	0.01	0.26	0.00
Oil S	0.39	0.07	0.08	0.01	0.04	0.13	0.01	0.27	0.00
Others	0.62	0.09	0.06	0.02	0.02	0.08	0.01	0.09	0.02
SSP	0.45	0.07	0.07	0.02	0.03	0.10	0.01	0.20	0.05

(Note: Cer.Mil: Cereals and Millets, Pul: Pulses, Sug: Sugar crops, Spi.Con: Spices and Condiments, Fru: Fruits, Veg: Vegetables, Fib: Fibre crops, Oil.S: Oil Seed crops and Others: Other crops)

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Fig. 1. Trend line of Cereals and Millets	**Fig. 2. Trend line of pulses**
Fig. 3. Trend line of Sugar crops	**Fig. 4. Trend line of Spices and Condiments**
Fig. 5. Trend line of Fruits	**Fig. 6. Trend line of Vegetables**
Fig. 7. Trend line of Fibre crops	**Fig. 8. Trend line of Oil Seeds**
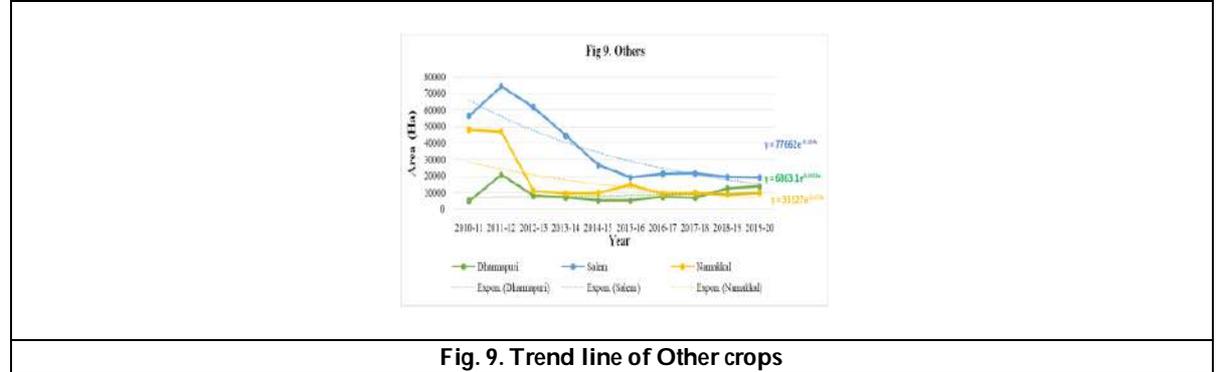
Fig. 9. Trend line of Other crops

RESEARCH ARTICLE

Rapid Stability Indicating HPLC Method for the Estimation of Organic Impurities for Ertapenem in Ertapenem Injection and Drug Substances

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ABSTRACT

A simple, accurate, precise method was developed for the estimation of the Ertapenem min Ertapenem Injection and Optimized separation was achieved on a Waters X Bridge C18, 4.6 mm x 50 mm, 3.5 µm using mobile phase composition of mobile phase A (pH 9.0 ammonium acetate buffer) and mobile phase B (mobile phase A and acetonitrile in the ration of 40:60 %v/v), at a flow rate of 2.0 mL/min in gradient elution mode with MP-A-100%-0 min, 80%-45 min, 0%-50 min & 68min and 100% -83 min. UV detection was carried out at a wavelength of 230 nm. Well-resolved peaks were observed with high numbers of theoretical plates, lower tailing factor, and reproducible relative retention time and response factor. The method was validated and all the validation parameters were found to be within the acceptance limits. The method was validated and all the validation parameters were found to be within the acceptance limits.

Keywords: Ertapenem sodium, Oxazinone, Ring Opened, Pro MABA, Dimer I+II, Dimer III, stress degradation, HPLC, RP-HPLC method development, Validation.

INTRODUCTION

Ertapenem is a carbapenem antibiotic drug that is marketed under the trade name is Invanz. It is structurally similar to meropenem and possesses a 1-beta-methyl group. The bactericidal activity of ertapenem results from the inhibition of cell wall synthesis and is mediated through ertapenem binding to penicillin binding proteins (PBPs). In Escherichia coli, it has strong affinity toward PBPs 1a, 1b, 2, 3, 4 and 5 with preference for PBPs 2 and 3.

Ertapenem is stable against hydrolysis by a variety of beta-lactamases, including penicillinases, and cephalosporinases and extended spectrum beta-lactamases. Ertapenem is hydrolyzed by metallo-beta-lactamases. A literature search confirms that there is no method reported for the simultaneous estimation of Ertapenem and its organic impurities Ring Opened, Pro MABA, Dimer I+II, Dimer III in pharmaceutical dosage forms of Injections and drug substance. Hence the present work aimed to develop a simple stability indicating RP-HPLC method for the separation and quantification of Ertapenem and its organic impurities Ring Opened, Pro MABA, Dimer I+II, Dimer III. The designed method was considered as an advisable to develop precise, accurate, simple RP-HPLC method.

MATERIALS AND MEHODS

Chemicals, reagents and instruments
Ertapenem sodium, Ammonium acetate, Ammonia solution, Acetonitrile and Milli-Q water.Xbrige C18 50 x 4.6mm, 3.5μm column, and HPLC instrument equipped with UV-VIS spectrophotometer & PDA detector.

Mobile phase and solutions preparation
Preparation of Mobile phase-A
Weigh about 0.77 g of Ammonium acetate and transfer into 1000 mL of water, dissolve and adjust the pH of the solution to 9.00 with dilute Ammonia solution and mix well.

Preparation of Mobile phase-B
Prepare a mixture of Mobile Phase A and Acetonitrile in the volume of 400:600 (v/v) and mix well.

Preparation of Diluent: Use water as diluent.

Standard Preparation
Weigh and transfer about 1.5 mg of Ertapenem sodium standard into 25 mL volumetric flask, sonicate to dissolvethe material in diluent and dilute the volume with diluent and mix well. Further pipette 2 mL of stock solution into 25 mL of volumetric flask and made up to volume with diluent.

Sample Preparation
Reconstitute vial with diluent, shake for few seconds and transfer entire the volume into a 250 mL volumetric flask. Rinse the vial with water and transfer into same volumetric flask. Dilute to volume with diluent and mix well.

Degradation studies
Oxidation
Reconstitute vial with diluent, shake for few seconds and transfer entire the volume into a 250 mL volumetric flask,rinse vial with water two more times and transfer into same volumetric flask, add the 1 mL of peroxide solution and transfer into same volumetric flask. Kept on bench top in few minutes and dilute to volume with diluent and mix well. For HPLC study, the resultant solution was diluted to obtain solution were injected into the system and the chromatograms were recorded to assess the stability of sample.

Acid Degradation Studies
Reconstitute vial with diluent, shake for few seconds and transfer entire the volume into a 250 mL volumetric flask,rinse vial with water two more times and transfer into same volumetric flask, add the 0.5 mL of 0.1N hydrochloric acid solution and transfer into same volumetric flask. Kept on bench top in few minutes and neutralized the solution with equivalent volume of 0.1N sodium hydroxide solution and dilute to volume with diluent and mix well. For HPLC study, the resultant solution was diluted to obtain solution were injected into the system and the chromatograms were recorded to assess the stability of sample.

Alkali Degradation Studies

Reconstitute vial with diluent, shake for few seconds and transfer entire the volume into a 250 mL volumetric flask,rinse vial with water two more times and transfer into same volumetric flask, add the 0.5 mL of 0.1N sodium hydroxide solution and transfer into same volumetric flask. Kept on bench top in few minutes and neutralized the solution with equivalent volume of 0.1N hydrochloric acid solution and dilute to volume with diluent and mix well. For HPLC study, the resultant solution was diluted to obtain solution were injected into the system and the chromatograms were recorded to assess the stability of sample.

Thermal Degradation Studies

Exposed vial reconstitute with diluent, shake for few seconds and transfer entire the volume into a 250 mL volumetric flask. Rinse the vial with water and transfer into same volumetric flask. Dilute to volume with diluent and mix well. For HPLC study, the resultant solution was diluted to obtain solution were injected into the system and the chromatograms were recorded to assess the stability of sample.

Photo Stability studies

Exposed vial reconstitute with diluent, shake for few seconds and transfer entire the volume into a 250 mL volumetric flask. Rinse the vial with water and transfer into same volumetric flask. Dilute to volume with diluent and mix well. For HPLC study, the resultant solution was diluted to obtain solutions were injected into the system and the chromatograms were recorded to assess the stability of sample.

Humidity Degradation Studies

Exposed vial reconstitute with diluent, shake for few seconds and transfer entire the volume into a 250 mL volumetric flask. Rinse the vial with water and transfer into same volumetric flask. Dilute to volume with diluent and mix well. For HPLC study, the resultant solution was diluted to obtain solution were injected into the system and the chromatograms were recorded to assess the stability of sample.

RESULTS AND DISCUSSION

With the progress of International Conference on Harmonization (ICH) guidelines, the determination of a stability-indicating related substance method has developed into more clearly and obligatory. The guidelines necessary for handling of forced degradation studies under different conditions, like acid, base, photo, oxidation, heat and humidity followed by separation of drugs from degradation products Hence for the necessity of separation of several components through the study of stability samples, HPLC has gained reputation in stability studies due to its specificity, sensitivity and high-resolution capacity. The work planned in this research was subjected towards the study of the chromatographic actions of the samples of stress degradation of Ertapenem and its impurities in the lipolyzedformulation. The stability indication study of present drug has not reported so far in the literature as per our knowledge and motivated us to develop an RP-HPLC- PDA stability indicating test where the degradation products were resolved from the integral drugs.

Method development

The standard drug solution containing 4 µg/mL concentrations of Ertapenem and it impurities were initially used for method development studies.

Method validation

The method was validated as per ICH guidelines. The different validation parameters which were performed are following: linearity, precision, accuracy, specificity, and limit of detection, limit of quantification, robustness, degradation studies and the stability indicating capability.

System suitability test
System suitability was evaluated with freshly prepared standard solutions. Six replicate standard solution injections were performed and calculated the % RSD for retention time and peak area. Other parameters theoretical plates and tailing factor were measured. System suitability results were tabulated in table 1 and table 2. % RSD values were within the limit 5%.

Linearity
Linearity parameter was evaluated with standard and its organic impurities solutions by preparing six different concentrations. Linearity levels are LOQ, 25%, 50%, 75%, 100%, 125%, 150% concentrations. All six linearity solutions were injected into the HPLC system and calculated the correlation coefficient values. Correlation coefficient was calculated for concentration versus peak area. Results were obtained in table 3. Results were satisfactory, correlation coefficient values were above 0.99.

Precision
Precision was performed for system precision for six replicate standard injections and method precision six replicate sample preparations by spiking of organic impurities. Six replicate solutions were carried out as per the test procedure mentioned in the materials and method section. Peak area, method precision % of RSD results were calculated and tabulated in table 4. Precision results were satisfactory and % RSD values were below 5 %.
Acceptance Criteria: The % RSD should not be more than 5%

Accuracy
Accuracy of the method was determined on three concentration levels by recovery experiments. The recovery studies were carried out by different concentration of organic impurities added to the sample LOQ, 50 %, 100 % and 150 % were evaluated. Accuracy recovery and % RSD were calculated and tabulated in table 5. % of recovery results were between 80 % to 120 % and % RSD values were below 10.0 %.

Robustness
Robustness of the method was performed with flow rate, mobile phase pH, temperature variations evaluated. System suitability was conducted to check the variation changes and results were found satisfactory.

Limit of detection and limit of quantification
Limit of detection (LOD) is the least concentration of analyte in a sample that can be identified but not quantified. Limit of quantification (LOQ) is defined as least concentration of analyte in a sample that can be estimated with tolerable precision, accuracy and reliability by a specified method under affirmed experimental conditions.

Degradation Studies
Degradation studies are acid, base, peroxide, thermal, humidity and Photolight conditions were evaluated. Further all stress results and force degradation results were tabulated in the table 5.

Chemical structures

Name	Ertapenem Sodium	Ring Opened
Structure		
Chemical name	Sodium 3-({[(2S,4S)-4-({(4R,5S,6S)-2 carboxy-6-[(1R)-1-hydroxyethyl]-4-methyl-7-oxo-1-azabicyclo [3.2.0]hept-2-en-3-yl}sulfanyl) pyrrolidin-2-yl] carbonyl} amino)benzoate	(2S,3R)-2-((1S,2R)-1-carboxy-2-hydroxypropyl)-4-(((3R,5S)-5-((3-carboxyphenyl)carbamoyl)pyrrolidin-3-yl)thio)-3-methyl-3,4-dihydro-2H-pyrrole-5-carboxylic acid

Pro MABA	Dimer I + II	Dimer III
(S)-3-(pyrrolidine-2-carboxamido) benzoic acid	(4R,5S,6S)-3-(((3R,5S)-1-((2S,3R)-2-((2S,3R)-5-carboxy-4-(((3R,5S)-5-((3carboxyphenyl)carbamoyl)pyrrolidin-3-yl)thio)-3-methyl-2,3-dihydro-1H-pyrrol-2-yl)-3 hydroxybutanoyl) -5-((3-carboxyphenyl) carbamoyl)pyrrolidin-3-yl)thio)-6-((R)-1 hydroxyethyl)-4-methyl-7-oxo-1-azabicyclo[3.2.0]	(4R,5S,6S)-3-(((3R,5S)-5-((3-((2S,3R)-5-carboxy-2-((1S,2R)-1-carboxy-2-hydroxypropyl)-4-(((3R,5S)-5-((3-carboxyphenyl)carbamoyl)pyrrolidin-3-yl)thio)-3-methyl-2,3-dihydro-1H-pyrrole-1-carbonyl)phenyl)carbamoyl)pyrrolidin-3-yl)thio)-6-((R)-1-hydroxyethyl)-4-methyl-7-oxo-1-azabicyclo[3.2.0]hept-2-ene-2-carboxylic acid

CONCLUSION

The current study describes new and simple, reliable, economic elution RP-HPLC-PDA method for the estimation of Ertapenem and its related impurities. The forced degradation studies were conducted for Ertapenem and its related impurities by using several degradation conditions like oxidation, acidic, alkali, thermal, and photolytic conditions and proposed method was effectively employed from the resolution of employed samples peaks. To our present knowledge, no such detailed and stability indicating method has been presented for the assay of this two drug mixture. The developed method finished use of PDA as a tool for peak integrity and purity confirmation. Therefore the proposed study method can be used for quantification of Ertapenem and its related impurities in bulk and

pharmaceutical dosage form. Finally, this method was carefully validated; as a result, it can be suggested for routine analysis and for testing quality through stability studies of the drugs.

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Table.1: System suitability results

Injection No.	Peak Area	% RSD	Tailing Factor	Theoretical Plates
1	49839			
2	50545			
3	50134	1.0	1.0	25554
4	49756			
5	49997			
6	49692			

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Table.2: Linearity concentration table

S. No	Ertapenem			Ring Opened	
	Level (%)	Concentration(µg/mL)	Peak area	Concentration (µg/mL)	Peak area
1	LOQ	0.2501	2871	0.7589	4836
2	50	2.5256	25325	25.0727	172590
3	75	3.5933	46551	36.5302	253645
4	100	4.9358	60128	48.5494	341075
5	125	6.0489	75001	60.4556	415585
6	150	7.3067	91995	72.2544	515875
Correlation Coefficient			0.9966	NA	0.9995

Table.3: Linearity concentration table for impurities

S. No	Pro-MBA			Dimer I + II		Dimer III	
	Level (%)	Concentration (µg/mL)	Peak area	Concentration (µg/mL)	Peak area	Concentration (µg/mL)	Peak area
1	LOQ	0.6458	11854	0.395	3658	0.3789	2352
2	50	2.4589	42258	16.4581	124567	1.6007	8900
3	75	3.6458	66786	24.5129	198954	2.5521	15920
4	100	4.5871	90535	32.4872	255784	3.2945	21948
5	125	6.0104	109111	40.3506	320158	3.8158	25803
6	150	7.2948	134120	48.5808	389584	4.9558	35858
Correlation Coefficient		0.9976	NA	0.9996	NA	0.9958	

Table.4: Method precision results

S. No	Sample Name	% of impurity			
		Ring Opened	Pro-MABA	Dimer I+II	Dimer III
1	Preparation-1	8.158	0.165	3.055	0.351
2	Preparation-2	8.458	0.168	3.458	0.353
3	Preparation-3	8.178	0.166	3.015	0.312
4	Preparation-4	8.798	0.147	3.458	0.325
5	Preparation-5	7.998	0.189	3.045	0.365
6	Preparation-6	8.014	0.187	3.158	0.347
Average		8.267	0.170	3.198	0.342
% RSD		1.2	2.2	3.2	4.2

Table.5: Accuracy results

S.No	Spiking Level	% Recovery			
		Pro-MABA	Ring Opened	Dimer I+II	Dimer III
1	LOQ -1	98.1	105.4	101.5	98.4
2	LOQ -2	97.5	106.4	100.1	97.9
3	LOQ -3	99.3	107.1	102.5	109.5
4	LOQ -4	99.0	106.0	102.5	103.4
5	LOQ -5	98.1	101.5	106.6	105.1
6	LOQ -6	98.5	102.4	108.1	99.6
7	50% -1	99.9	100.2	100.8	99.9
8	50% -2	99.4	99.4	99.3	100.8
9	50% -3	100.2	98.9	101.2	99.3
10	100% -1	101.5	98.6	96.2	98.7

11	100% -2	100.1	98.6	98.9	98.4
12	100% -3	99.2	99.2	99.7	97.9
13	100% -4	98.7	105.4	101.5	109.5
14	100% -5	99.6	106.4	100.1	103.4
15	100% -6	99.5	107.1	102.5	105.1
16	150% -1	101.1	107.2	100.1	99.6
17	150% -2	103.2	108.4	99.2	100.5
18	150% -3	102.4	99.7	99.7	100.9

Table.6: Degradation results

Stress condition	%Amount remaining	%Amount degraded	Peak Purity	
			Peak Purity	Factor
Normal	102.4	0.05	Pass	1.000
Acid	85.4	17.01	Pass	1.000
Base	102.5	0.12	Pass	1.000
oxidation	93.6	8.84	Pass	1.000
Thermal	100.1	2.33	Pass	1.000
Photolytic	101.1	1.34	Pass	1.000
Humidity	101.4	1.02	Pass	1.000
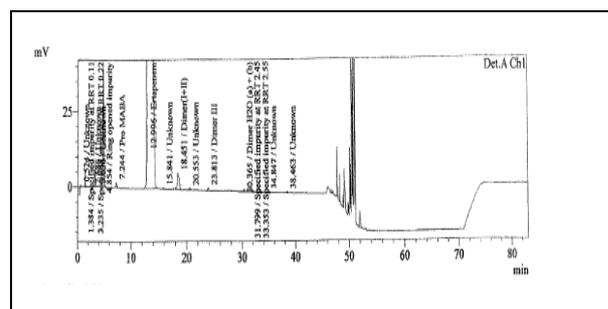
Figure.1: Typical chromatogram for UN degraded sample
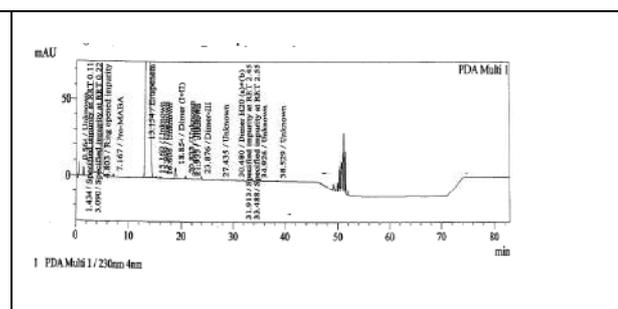
Figure.2: Typical chromatogram for Acid stresses sample
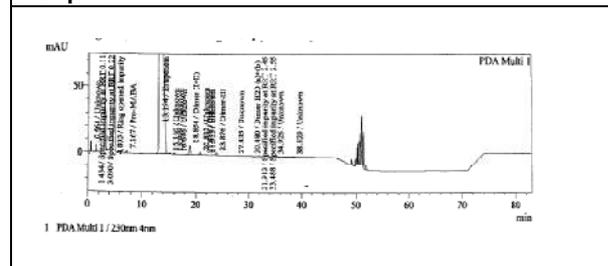
Figure.3: Typical chromatogram for Base stresses sample
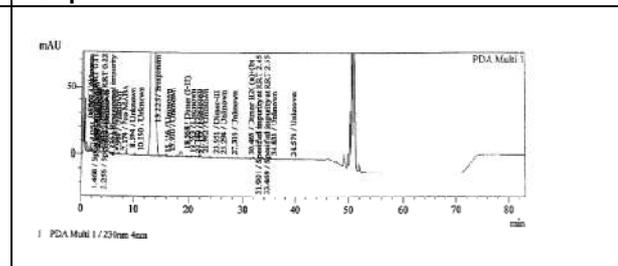
Figure.4: Typical chromatogram for Peroxide stresses sample

REVIEW ARTICLE

The Relationship between the Roots of Maxillary Posterior Teeth and Maxillary Sinus Floor using Cone Beam Computed Tomography: A Systematic Review

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ABSTRACT

The most recent focus of numerous researchers in the field of oral radiology has been on analysing the morphometric and anatomical variation of critical maxilla and mandibular structures using 3D CBCT scan. As one of the most significant structures in the maxillary region, the maxillary sinus proximity to the roots of the maxillary posterior teeth is critical for immediate implants, procedures for cyst/tumor, oroantral fistula, and other injuries to that area. Therefore, in this thorough systematic review, we are attempting to highlight the perspectives of many writers who planned and carried out CBCT investigations to assess the interaction between the roots of posterior maxillary teeth and the maxillary sinus floor. This research will eventually be used to develop artificial intelligence that can approximate important anatomical structures during various maxillofacial procedures.

Keywords: CBCT, Maxillary sinus floor, Premolar, Molar

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INTRODUCTION

Maxillary sinuses (MS) are significant anatomical elements that serve a variety of purposes, including acting as a resonance body for the voice, assisting with olfactory function, and regulating temperature and humidity[1]. They differ in morphology and anatomy, which includes size, form, and location on various sides of the same person as well as on distinct persons[1,2]. Depending on a person's age, size, degree of pneumatization of the MS, and dental health, the inferior wall's topography changes where the posterior maxillary tooth root apices are located [3]. Due to their proximity to the region where maxillofacial operations and dental practices are conducted, MS are of interest to dentists[2]. The Maxillary Sinus Floor (MSF) extends its boundaries to the alveolar process between the roots of neighbouring teeth, resulting in tiny cortical zones of elevation and depression known as "extensions." with narrow cortical areas. The normal link between the tooth and MSF is made up of either a direct connection with the maxillary sinus mucosa or a thin layer of compact bone that helps sustain the apical periodontal ligament fibres, to which it firmly attaches[4]. There are numerous clinical repercussions for posterior roots protruding into the maxillary sinus[3]. It is known that the tooth's apex has a larger impact on the antral tissue the closer it is to the MSF. Risks associated with this association can arise during endodontic or orthodontic treatments, as well as during some surgical procedures, such as tooth extraction and implant insertion[4]. Wehrbein and Diedrich showed a correlation between the amount of pneumatization that results during extraction and the length of root projection into the maxillary sinus as observed on panoramic radiography. The amount of bone height available for implant insertion may decrease as a result of sinus expansion that occurs after extraction.

Therefore, accurate assessment of the anatomic relationship between the maxillary sinus and the roots of the posterior teeth is crucial for both preoperative treatment planning and the diagnosis of maxillofacial diseases[3]. Apical protrusion of posterior root apices into the MSF is of critical clinical importance, as attempted root extraction or extensive periapical surgery may lead to oro-antral communication or cause root entry into the MSF. Dental surgeons encounter a large number of procedures in their daily dental practice, including these areas. These include extractions, extensive surgical implant procedures including maxillary sinus lift surgeries with immediate implantation, and maxillary sinus floor augmentation procedures with the hope that osteogenesis will accommodate and support the future implant. Attempts to extract the roots or significant periapical surgery can result in oro-antral communication or cause entry of the root into the MS, therefore apical protrusion of the posterior root apices into the MSF has critical clinical relevance. In their routine dental practice, dental surgeons encounter several operations in various areas. These include extractions, involved surgical implant procedures such as maxillary sinus lift surgeries during immediate implant surgery, and augmentation surgeries for the maxillary sinus floor in the hopes that osteogenesis will support and accommodate the future implant[5]. For the purpose of making the best decisions regarding treatment, surgery, and rehabilitation, it is crucial to have a thorough understanding of the anatomical relationships between the structures that make up the middle and lower thirds of the face, particularly the MS and its relationship to the posterior teeth[6].

Previous research revealed that the MS pneumatization volume is a metabolic process rather than a static state, rising at about the age of 12 and falling at around the age of 20 with the eruption of the maxillary third molars[7]. Their study came to the conclusion that whereas maxillary second molars are strongly associated to the MSF, maxillary first premolars are not. Some of these studies used their own classifications and some used classification from past studies[8]. The best imaging for the area which is required to determine the relationship between the posterior maxillary roots and the maxillary sinus floor are cone-beam computed tomography (CBCT), panoramic and periapical radiography, which are commonly used imaging modalities[9]. Because both bone and soft tissue may be scanned in several perspectives with thin sectioning, cone-beam computed tomography (CBCT) has recently been utilized to evaluate endodontic applications and has established itself as the gold standard for evaluating maxillary sinuses. The use of CBCT aids in diagnosis and gives doctors access to 3-dimensional data regarding the anatomical structures morphology and divergence. Axial, sagittal, and coronal slices are visible in the CBCT pictures, which minimize the superimposition of anatomical components. These benefits make it easier for the clinician to comprehend the tissue's whole anatomical structure[10].

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DISCUSSION

In order to determine the morphometric analysis of various normal anatomical structures such as the nasal cavity, maxillary sinus, mandibular canal, etc. pertaining to the orofacial region, various studies have been designed and formulated since the introduction of CBCT imaging in the year 1998, as it is the most recent in the field of orofacial radio diagnosis.[14]. A lot of researchers are interested in studying the proximity of the maxillary sinus, an important anatomical landmark in the maxillary region, in order to see how close the sinus is to the roots of the posterior maxillary teeth. The first study, conducted in 2014 by Shokri A *et al* [3]screened 110 CBCT scans to determine the relationship between the MSF and the posterior maxillary teeth. They discovered that MSF which is positioned away from the root tip, is most frequently observed in the first and second premolars. This outcome was consistent with earlier research by Ok E [10]. from 2014 and the most recent study by Razumova S *et al*[2] from 2019. However, Ok E *et al*[10] also noted that their research revealed a similar connection between MSF and the mesiobuccal and distobuccal roots of the first molar. According to Shokri A *et al*[3] in 2014 and Razumova S *et al* [2] in 2019, the most frequently involved roots in another type of relationship between MSF and roots, where the roots of maxillary posterior teeth intruded into the MSF, were the first and second molars. But according to Ok E *et al*[10] in 2014 and Kaushik M *et al*[12] in 2020, the palatal root of the maxillary first molar has this kind of a relationship with MSF. Later in 2018, Gu Y *et al* [8] reported a similar relationship between the palatal root of the first molar and the mesiobuccal root of the second molar with MSF in their investigation, which was consistent with the finding made by Zhan Xi *et al*[11] study in 2019. Although Yurdabakan ZZ *et al*[15] in year 2018 obtained inconsistent results, observed that the roots of 3rd molar showed such type of relation with the MSF, Goyal SN *et al* [13] in 2020 claimed that the entire the roots of 2nd molar showed such type of relation with the MSF. Another relationship between MSF and roots of maxillary posterior teeth, wherein the roots are contacting the MSF; this type of relationship was most frequently observed in the mesiobuccal roots of the second molar in the study done by Ok *et al* in 2014.[10]

The first molar roots, however, exhibited this kind of relationship with MSF in their investigation, according to Goyal SN *et al*[13] in the year 2020.The mesiobuccal root of the second molar has the shortest distance from the MSF, according to Estrela C *et al* [6] in 2016, Gu Y *et al* [7] in 2018, Zhang Xi *et al* [11] in 2019, Pei J *et al* [9] in 2020, and Razumova S e*t al* [2] in 2019. This conclusion was reached in relation to a parameter where previous authors evaluated the shortest distance between MSF and roots of maxillary posterior teeth. The palatal roots of the first molar also displayed the smallest distance in regard to MSF, according to Estrela C *et al*[6]. The mesiobuccal root of the second molar, followed by the distobuccal root of the second molar and the palatal roots of the first molar, had the lowest distances to the MSF, according to the findings of Gu Y *et al* [7] in 2018. However, Kaushik M *et al* [12] in 2020 and K Shaul H *et al* [5] in 2021 proposed opposing findings. K Shaul H *et al*[5] observed that the distobuccal root of the second molar has the shortest distance from MSF, while Kaushik M *et al*[12] in 2020 observed that the vertical distance of the root of the second premolar from the floor of the maxillary sinus was significantly less than that of the roots of the 1st premolar. The findings of Estrela C *et al*[6] in 2016 and Razumova S *et al*[2]in 2019 were in conflict regarding the widest distance of roots of posterior maxillary teeth from the MSF. The former stated that the widest distance from MSF was found in the buccal root of the first premolar while the latter observed that the distance of the palatal root of the first and second molar from MSF was found to be at maximum distance from MSF. Numerous earlier studies have followed the classification system developed by Kwak *et al*[16] (2004), and using this system, they discovered that type II (the inferior wall of the MS is located below the level connecting the buccal and palatal root apices without an apical protrusion over the MS) was the most frequently observed vertical relationship between roots of maxillary posterior teeth and MSF; this was confirmed by Estrela C *et al*[6]in 2016, Razumova S et al in 2019[2], K Shaul H *et al*[5] in 2021. However, Zhan Xi *et al*[11] in 2019, Yurdabakan ZZ *et al*[15] in 2018 observed type 1 vertical relationship (The inferior wall of the MS floor is located above the root apex of the buccal and palatal roots) in their study. To determine the horizontal relationship between posterior maxillary teeth roots and MSF, previous studies that used Kwak *et al*[16] classification had consistent results and had type 2H relationship (the alveolar recess of the floor of the maxillary sinus is situated between the buccal and palatal roots), which was also seen in the studies carried out by Estrela C *et al* [6] in 2016, K Shaul H *et al*[5] in 2021.

CONCLUSION

The aforementioned systematic review offers a clear understanding of the various studies that were carried out to investigate the connection between the roots of the maxillary posterior teeth and the maxillary sinus floor using 3D imaging i.e. CBCT. Through this, we can show that there are many differences between the findings of different researchers, which can be attributed to anatomical variations and varied geographic distribution. As a result, it is crucial to understand the thorough systematic examination of prior literature in order to develop a comprehensive and detailed future research on a related area of interest.

Conflict of interest
There are no conflicts of interest, according to the authors.

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Table.1: Another relationship between MSF and roots

o.	Author	Year of study	Results	
			Total CBCT Scans observed	**Observations**
1.	Shokri A *et al* [3]	2014	110 CBCT scans 1st PM – 214 2nd PM – 217 1st M – 220 2nd M - 220	The 1st and 2nd premolars frequently exhibit the most prevalent vertical relationship, in which the MSF is situated above the root tip. The apical projection above the maxillary sinus floor is the most prevalent horizontal relationship discovered, and it is frequently seen in the 1st and 2nd molars.
2.	Ok E *et al* [10]	2014	849 CBCT scans 1st PM – 1340 2nd PM – 1340 1st M – 1243 2nd M - 1243	The palatal roots of the 1st molar teeth most usually displayed type 1 (the roots pierced into the sinus floor). The mesiobuccal roots of the second molar teeth were the most frequently affected by type 2 (the roots met the sinus floor). The first and second premolar teeth, as well as the mesiobuccal and distobuccal roots of the first molar teeth, were the most commonly affected by type 3 (the roots extended below the sinus floor).
3.	Estrela C *et al* [6]	2016	202 CBCT scans 1st PM – 300 2nd PM – 300 1st M – 300 2nd M – 300	Type II was the most common vertical relationship identified, and type 2H was the most common horizontal relationship. (As stated by Kwak et al). The buccal root of the first premolar has the greatest distance from the floor of the maxillary

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				sinus, whereas the mesiobuccal roots of the second molar and the palatal roots of the first molar have the shortest distances. First premolar buccal root and second molar mesiobuccal root cortical thicknesses ranged from 1.28 to 0.42 and 0.65 to 0.41 mm, respectively.
4.	Gu Y *et al* [7]	2018	1011 CBCT scans 1st PM – 1745 2nd PM – 1663 1st M – 1331 2nd M - 1360	The palatal roots of the first molars and the mesiobuccal roots of the second molars showed the highest type IS relationship (in which the root apex extending inside the MSF), but the most prevalent relationship among all posterior roots was type OS relationship (in which the root tip extends outside the MSF). The shortest distance from the MSF is present with mesiobuccal roots of 2nd molar followed by the palatal root of the 1st molar and the distobuccal root of the 2nd molar are the teeth that are closest to the floor of the maxillary sinus.
5.	El Khateeb SM *et al* [8]	2018	39 CBCT scans 1st M – 58 2nd M - 70 3rd M - 32	The type 2 vertical relationship, where the root apex was in close contact with the Maxillary sinus floor (<1 mm), was the most frequently observed. The type B horizontal relationship was the most prevalent, with the lowest point of the maxillary sinus floor located in the middle and in respect to the roots.
6.	Zhang Xi *et al* [11]	2019	200 CBCT scans 1st M – 400 2nd M - 400	The smallest distance to the floor of maxillary sinus is present with mesiobuccal roots of the left and right second molars and the most frequent site of apical protrusion beyond the inferior wall of the sinus are found in the left mesiobuccal root of the second molar.

				The distobuccal roots of the right second molar have the thinnest mucosa of the maxillary sinus.
7.	Razumova S *et al*[2]	2019	325 CBCT scans 1st PM – 487 2nd PM – 502 1st M – 498 2nd M – 454 3rd M - 267	Type I vertical relationships between the first and second premolars were the most common (Inferior wall of the MSF is located above the root apex of the buccal and palatal roots). Type II was the most prevalent vertical relationship between the first and second molars (Inferior wall of the MSF is located below the level connecting the buccal and palatal root apices without an apical protrusion over the MS). The palatal root of the first molar is the furthest from the floor of the maxillary sinus, and the mesiobuccal roots of the second molar are closest.
8.	Pei J *et al* [9]	2020	212 CBCT scans 1st M – 326 2nd M – 326	Mesiobuccal root of the second molar was the one that was closest to the floor of the maxillary sinus. The absence of roots contacting the maxillary sinus floor and in cross-section, which occurs above the root apex, was the most frequent vertical connection.
9.	Kaushik M *et al* [12]	2020	452 maxillary posterior teeth 1st PM – 136 2nd PM – 118 1st M – 103 2nd M - 95	Compared to the 1st PM, the roots of the 2nd PM were closer to the floor of the maxillary sinus. The roots of posterior teeth most usually displayed a vertical connection of type OS (roots placed below the MSF). The palatal roots of the first molar were the most usually observed type IS (roots positioned inside the MSF) vertical relationship.
10.	Goyal SN *et al* [13]	2020	100 CBCT scans 1st M – 185	Frequently seen type II vertical relation was observed in 1st molar and second molar had type III

			2nd M - 180	vertical relation.(In accordance with Kwak *et al*). The second molar's distobuccal roots had the greatest separation from the cortical plate, measuring 1.20 mm.
11.	K Shaul H *et al*[5]	2021	200 CBCT scans 1st M – 400 2nd M - 400	Type II was the most common vertical relationship identified, and type 2H was the most common horizontal relationship. (As stated by Kwak *et al*). The right second molar's distomolar root was closest to the maxillary sinus (range: 0.68 to 0.39 mm).

RESEARCH ARTICLE

Adolescent Obesity and Socio-Economic Status in Educational Institutes of Guwahati Metro, Assam

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ABSTRACT

Adolescent's obesity is a serious public health problem in many developed and developing counties worldwide. It seems that in developed countries, children are more obese in low SES, whereas the opposite is observed in developing counties where children from the upper SES status are more likely to be obese than children from the lower SES status. In view of these contexts, the present study was undertaken to assess the association of socio-economic status with prevalence of adolescent's obesity in educational Institutions in Guwahati Metro. Assam. Cross-sectional survey design was used in this study. 580 samples were collected using multistage random sampling. Inclusion criteria were adolescent of age group 13-19 years studying in educational institutes in urban community in Guwahati metro. Exclusion criteria were adolescent who are sick or absent during data collection and whose exact birth date was not available. Data were collected using anthropometric measurements and structured tools related to demographic variables. Agarwal BMI growth chart used to assess prevalence of obesity and Kuppaswami classification to assess socio-economic status. The overall prevalence of Overweight and Obesity 7.41% and 4.48% according to Agarwal classification. Prevalence of obesity higher in female (5.46%) than male (4.48%). Highest prevalence was found among the age group 13 years of age (2.7%). Prevalence of obesity found to be higher in high SES status. Finding revealed the highly significant association of prevalence of obesity with socio-economic status ($P <.001**$). Adolescent obesity is a growing problem in northeast region of India. Multiple factors are risk of developing adolescent obesity. Socio-economic status one of the major influencing factor of adolescent obesity.

Keywords: Obesity, Overweight, Prevalence, Adolescents, Socio-economic status

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INTRODUCTION

Obesity in children and adolescents in gradually becoming a major public health problem in India[1]. Totally 5% of the Indian population has been affected by obesity[2]. India, which is already is the third most obese country in the world, is showing increasing incidence of over-weight children and adolescents in urban areas. Latest estimates show prevalence of obesity among adolescents (13-18 years) has grown from 16% to 29% over the last five years. Several other studies conducted in India also highlight the trend. More than 15 million children are estimated to be overweight in urban India. However, experts say the prevalence is still far lower in rural area[3]. Adolescence marks the developmental transition from childhood to adulthood, a time when many important social, economical, biological and demographic events set the stage for adult life. Adolescents aged 10-19 years constitute about one-fourth of Indian's population and young people aged 10-24 years about one-third of the population[4]. Overweight and obesity are important determinants of health leading to adverse metabolic changes and increase the risk of non communicable diseases[5]. Obesity is associated with an increased risk of morbidity and mortality as well as reduced life expectancy. The last two decades of the previous century have witnessed dramatic increase in health care costs due to obesity and related issues among children and adolescents[6].Environmental/socioeconomic and lifestyle risk factors often overlap, in that environmental factors can result in unhealthy diets and insufficient physical activity. Low-income families often live in neighbourhoods in which it is not safe to walk to school (in 2009, only 13% of children walked or biked to school) and that might not have safe areas nearby for regular outdoor exercise[7]. Additionally, schools in low-income neighbourhoods often do not offer full physical education programs or scheduled times and areas for physical activity, and budget constraints have led to cutbacks in physical education at schools across income levels. Families living in socioeconomically disadvantaged circumstances might not be in a position to prioritize weight control in the context of other problems; low-income neighbourhoods with minimal access to affordable, healthy foods (CDC-2011)[8]. Additionally, low-income neighbourhoods often contain an overabundance of fast-food restaurants and small convenience stores that do not typically stock high-quality, healthy food[9]. and many low-income parents have minimal time after work to prepare healthful meals.

MATERIALS AND METHODS

A cross sectional study was conducted on adolescents in 10 urban schools in Guwahati metro, from January to December' 2016. Ethical clearance from Institutional ethical committee was obtained. Stratified random sampling and simple random sampling technique were used to select the sample for the study. Data was collected for 580 adolescents from 16 numbers of schools. After obtaining verbal consent, had all performed standardized anthropometrical measurements of the adolescents in school uniform without shoes. Weight was measured in the upright position without shoes to the nearest 0.1 kg using calibrated electronic weighing machine. Height was measured without shoes to the nearest 0.1cm using calibrated stadiometer. Body mass index (BMI) was defined as the ratio of body weight to body height square, expressed as kg/m^2. Overweight and obesity was assessed by Agarwal BMI chart[10]. According to Agarwal BMI chart, children/adolescent with 95th percentile of BMI is taken as cut-off point. Adolescent with BMI more than this cut-off point with respect to age and sex is considered as obese and BMI > 85th percentile indicates an adolescent as overweight. The date of birth of each student was taken from the school records to verify the age. Socioeconomic status was assessed according to Kuppaswami classification[11].

RESULTS AND DISCUSSION

Socio-demographic variables of adolescents

Out of total 580 adolescents, 287 (49.4%) male and 293(50.5%) female adolescents, Majority 259 (44.6%) of adolescents belong to 13 years of age group, Majority 322(55.5%) of adolescents were 1st child in ordinal position of family. Majority 470 (81%) of adolescents were belongs to Hindu religion, 413 (71.2%) in general caste, 403(69.4%) belongs to Nuclear family, 234(40.3%) having 4 members, majority of mothers, 169(29%) education in high school

and majority of mothers 427(73.6%) were housewife. 142(24.4%) of fathers were in high school level and 139(23.9%) were in graduate or post graduate level. Majority of adolescents, 230(39.6%) family income were 13,875-18,497/-.

Prevalence of obesity among adolescents in educational institutes

The overall prevalence rate of overweight and obesity were 7.41% (95%CI 5.55-9.84 %, range13.17-23.30 mean 18.53, median 18.30, SD±2.58) and 4.48% (95%CI 3.08-6.49,range 25.00-26.20, mean 25.50, median 25.40 SD±0.29) respectively according to Agarwal classification. Similar study conducted in North India, reported the prevalence of overweight and obesity among aged group 10-19 years, 11% and 5.7% respectively. In a study, from Chennai,(Ramachandran A) the prevalence of overweight and obesity among adolescents was 22%[12]. In another study, from Kolkotta, (Mandal A) overall prevalence of Overweight and Obesity were 28.5% and 4.2% respectively[13]. A study in Delhi on affluent school children showed the prevalence of obesity to be 7.4%.(Kapil U, Singh P)[14]. Another study among affluent girls in Delhi(Mehta *et al.*) reported the prevalence of obesity and overweight to be 5.3 and 15.2%, respectively[15]. When the sex wise comparison of all the boys and girls were made (Table 1), it was noted that out of a total of 580 adolescents screened, 293 were girls, and 287 were boys. Among the total girls, 8.53% percent were overweight and 5.46 % percent were obese. Similarly among total boys 6.27 % percent were overweight and 3.48% percent were obese. It is clear that the prevalence of overweight and obesity was found to be higher in female 8.53% (95% CI 5.85%-12.29%), 5.46 % (95%CI 3.39%-8.69%) than in male 6.27% (95% CI 4.00%-9.70%), 3.48% (95%CI 1.90%-6.29%) respectively although this finding was not statistically significant (*P*: 0.278). A study was conducted by Cherian *et al* during 2010 among school going children (6 years to 15 years age group) in Kochi, Kerala. A total of 1634 school students were interviewed for study. The prevalence of obesity was 3% in boys and 5.3% in girls[16]. In the present study, reported that the prevalence of overweight and obesity was found to be higher 13,(2.2%) and 16,(2.7%) in age group 13years. 12,(2%) overweight and 8, (1.3%) obesity found in age of 14years, equal prevalence 6(1%) of overweight in age of 15 and 16 years; only 2(0.3%) of obesity found in age of 15 years; at the age of 17 and 18 years overweight was 1(0.1%) and 5(0.8%) respectively but not found any prevalence of obesity in this age group. In relation of association no statistically significant between the prevalence of obesity with age of the adolescents (p=0.056).

Similar study reported that 7.1% were overweight while 1.3% were obese at aged 14-19 by Remesh A[17]. The prevalence of obesity in different age groups were 41(1.7%) who were obese in 10–12 years, 37 (1.8%) in 13–15 years and 67 (4.4%) in 16–19 years age group by Manish Taneja[18]. And 7.1% at 13 years, 3.5% 1t 14years 9.5% at 15 years by HS Niranjan[19]. Socioeconomic status of parents was classified as high socio-economic group, middle socio-economic group and lower socio-economic group classified according to Kuppaswami based on the education of parents, occupations of parents and family income[11]. In the present study, prevalence of obesity among adolescent according to mother's educational qualification, it was found that highest prevalence of obesity among Graduate or post graduate (2.1%) and it was statistically significant (*P*<0.042). Highest prevalence of obesity (1.6%) was found among subjects of unemployed mothers. This finding was statistically significant (*P* <.001**) Similarly, prevalence of obesity was found to be higher among subjects of professional qualified fathers (1.9%) and in regards of occupation, highest prevalence was found among semi-professional fathers (1.9%) This finding was statistically highly significant (*P* <.001**). The prevalence of obesity was found to be higher (10% in higher income group (Rs. 18,498-36,996) when compared to lower income group (Rs. 1,866-5546) and it is statistically highly significant (*P* <.001**). The present study revealed that the prevalence of obesity was found to be higher among upper socio-economic class (1.4%) as compared to Upper -Middle class (2.1 %), Lower Class (0.7%) and Lower -Middle Class (0.3%). This finding was statistically highly significant (*P* <.001**). This finding is consistent a study conducted by Ayan Ghosh, reported significant association between the socioeconomic status and the occurrence of overweight/obesity (chi-square =33.81, df =3, *P* < 0.002)[20]. Marwaha *et al*[21], Goyal *et al*,[22] Aggarwal *et al*,[23] Kotian *et al*,[24] reported that the prevalence of overweight was high among adolescent children who belonged to higher socioeconomic class compared to those who belonged to the lower socioeconomic class. Literacy, occupation, and family income are an indirect measure of socioeconomic status. The study clearly revealed that better educational status of both parents and increasing household income lead to an increased prevalence of obesity. From above studies, it was found that the prevalence of obesity differs remarkably with different socioeconomic development levels. The present study

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also clearly shows that socio-economic status is a highly influencing factor of prevalence of obesity among adolescents. The remarkable variation in the prevalence across populations suggests that social, economic, and environmental factors are important influences on the epidemic, although it maybe also true that genetic differences across populations also play a role[25].

CONCLUSION

Adolescent's obesity is a serious public health problem in many developed and developing counties worldwide and problem continues to grow. In developed countries, children from the low SES are more obese than their affluent opposite counterparts, whereas the opposite is observed in developing counties where children from the upper SES status are more likely to be obese than children from the lower SES status. Therefore, SES can be considered as an associated factor of obesity; however, the association varies by gender, age and country. Education, occupation and family income are the indicators of SES. High socio-economic status has found high prevalence of obesity.

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Table-1: Association of the prevalence of obesity among adolescents with age

Variables	Categories	BMI Status				χ^2	df	p-value
		Normal	Overweight	Obese	total			
Age	13	230	13	16	259			
	14	121	12	8	141			
	15	58	6	2	66	17.93	10	0.056 [NS]
	16	28	6	0	34			
	17	38	1	0	39			
	18	36	5	0	41			

* Significant at P(<.05) ; ** Significant at P(<.01) ; NS Not Significant

Table-2: Association of the prevalence of obesity and socio-economic status

Socio-economic status	BMI status				χ^2	df	p-value
	Normal	Overweight	Obese	Total			
Upper Class	0	2	8	10			
Upper -Middle class	200	23	12	235			
Lower -Middle Class	227	7	4	238	181.0	6	0.001**
Lower Class	83	12	2	97			
Total	511	43	26	580			

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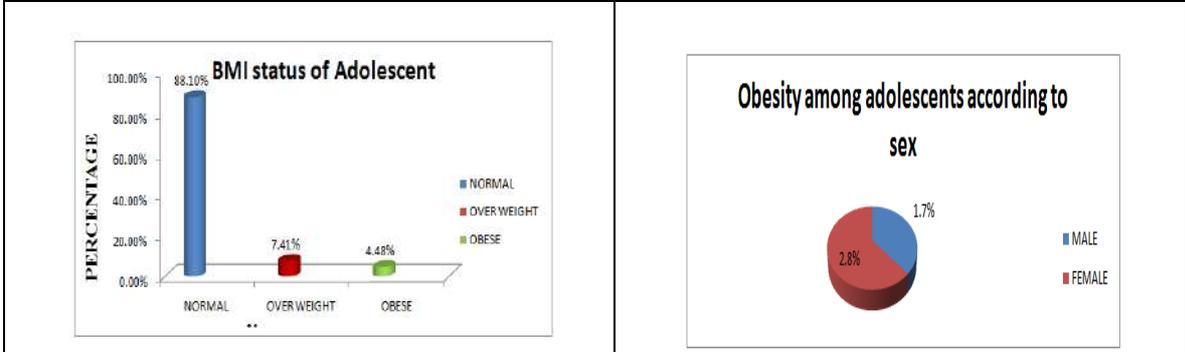
Fig. 1: Prevalence of obesity among adolescents in educational institutes

Fig. 2: Prevalence of obesity among adolescents according to sex
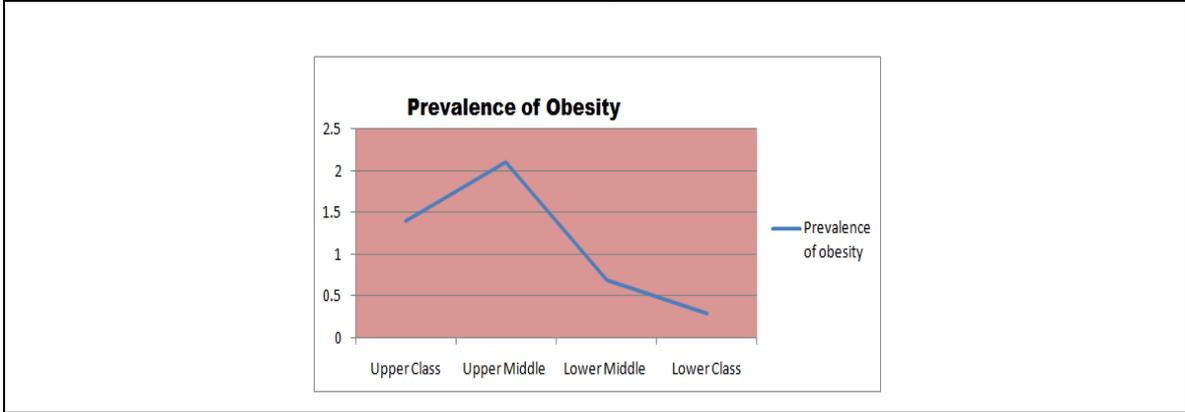
Fig. 3: Line diagram of prevalence of obesity according to socio-economic status

RESEARCH ARTICLE

Production of Amylase by Endophytic Fungi Isolated from Field-Grown Plants

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ABSTRACT

The present study reports optimization of amylase production by endophytic fungi isolated from agriculture field grown plants. Collected plant part fragments were plated on PDA medium plate and Percentage colonization rate was calculated. Based on macroscopic and microscopic characteristics, all endophytic fungal isolates were identified using standard taxonomical keys and monographs. All isolates were screened for presence of effective amylolytic fungi and most active fungal species were selected for optimization studies. Effect of various parameters like Carbon, Nitrogen, pH and temperature on both fungal amylase activity and fungal biomass growth were studied. A total of 24 endophytic fungi were isolated from 75 plant fragments with colonization rate of 32.0%. Ten endophytic fungi with significant characteristics considered for amylase screening were identified as *Aspergillus* sp. 1,*Penicillium* sp., *Aspergillus* sp. 2,*Pestalotiopsis* sp., *Trichoderma* sp., *Phomopsis* sp., *Fusarium* sp. 1,*Colletotrichum* sp., *Fusarium* sp. 2, and *Phoma* sp. Among all endophytic fungal isolates, eight isolates were amylase producers. Out of these, four isolates i.e.*Aspergillus* sp. 1, *Penicillium* sp., *Aspergillus* sp.2 and *Colletotrichum* sp. exhibited good amylase activity were selected for optimization of amylase production. Optimization studies showed that at 1.5% concentration, starch resulted in maximum amylase activity and biomass production by *Aspergillus* sp.1, *Aspergillus* sp.2, and *Colletotrichum* sp. whereas maltose was the good carbon source for amylase activity and biomass production by *Penicillium* sp. Sodium nitrate as nitrogen source at 0.3 % concentration was significantly influenced both amylase activity by all four fungi tested and the maximum growth by two fungi i.e. *Penicillium* sp. and *Colletotrichum* sp. However high biomass yield of *Aspergillus* sp.1 and *Aspergillus* sp.2 was observed in

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the presence of yeast extract as a nitrogen source. The optimum incubation temperature for maximum amylase activity by all fungi under assay was found to be at 30ºC and biomass yield also correlated with the results exception was *Colletotrichum* sp. At the initial fermentation medium pH of 6, both maximum amylase activity and fungal growth was shown by all fungi. The screening and identifying potential sources of fungal endophytes and their active enzymes are showing great success in the field of biotechnology.

Keywords: Endophytic fungi, amylase, optimization, growth parameters

INTRODUCTION

Within host plants, endophytic microorganisms survive which do not cause any visible symptoms of disease [1]. The hyphae of endophytic fungi lie in the intercellular spaces of the aerial plant, especially in leaf sheaths, sometimes even in the bark and root systems. But what are the factors responsible for colonization and the nutrient exchange between plants and fungi are little understood. Pathogen damage can be reduced by the endophytic fungi which are associated with plants. Endophytes can prevent pathogen infection and proliferation directly or indirectly inside the host by inducing innate resistance responses. The symbiotic association leads to the development of biomass and aerial parts in the form of flora. *In vitro* conditions, the endophytic fungi studied can synthesize the enzymes required to penetrate and colonize their plant hosts. Enzymes which have been reported are pectinase, xylanase, cellulase, lipases, proteinase and phenol oxidase [2]. The known sources of amylases are from plants, animals and microorganisms. However amylases from microbial sources, namely fungal and bacterial amylases are used for the industrial production because of cost effective production, consistency, less time and space. The enzymes from microbial sources generally meet industrial demands. Many bacteria and fungi known for hyper-production of amylases. Hence, there is a global interest in the screening and identifying potential sources of new microorganisms producing amylases suitable for industrial applications [3] Amylases have been reported to be produced by a number of fungi, including *Aspergillus*, *Mucor*, *Mycosphaerella*, *Penicillium* and *Rhizopus*, *Fusarium*, *Penicillium*, which are isolated from different plant parts contaminated with these fungi [4],[5]. This work reports the production of amylase enzyme from endophytic fungal isolates of field grown plants.

MATERIALS AND METHODS

Plant materials
Ten plant species namely *Mangifera indica L.* (Mango), *Triticum aestivum* L. subsp. *aestivum* (Common Wheat), *Brassica juncea* (Indian mustard), *Linum usitatissimum L.* (Linseed or flax), *Carthamus tinctorius L.* (Safflower), *Cicearientinum* L. (Chick Pea or Bengal gram), *Cajanus cajan* L.(Pigeon pea), *Citrus reticulate Blanco.* (Nagpur mandarin), *Dolichos lablab* L.(Hyacinth bean) and *Abelmoschus esculentus (L.) Moench* (Okra) were sampled from agriculture field of College of Agriculture, Nagpur and from nearby agriculture field of Taywade College, Koradi, Nagpur.

Collection of plant samples
The plant species growing in areas of distinctive ecological environmental conditions with the prospective for housing endophytes with prodigious multiplicity were selected. The healthy, mature and symptomless plant parts such as leaves, stem and root were collected and brought to the laboratory in a separate sterile polythene bags and stored in 4°C. The samples were processed within 24 h of collection [6].

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Isolation of endophytic fungi

For isolation of endophytic fungi, collected plant samples were washed several times in running tap water before sterilization. The samples were fragmented into small pieces and surface-sterilization done by dipping into 0.1% $HgCl_2$ for 1 min, again cleaned with sterilized distilled water and then placed into distilled water. Then, pieces of each plant were placed on a Potato Dextrose Agar (PDA) (Himedia) Petri dish supplemented with 0.5 g/L streptomycin sulphate. Plates were incubated at 28±1 °C for 7 days and checked for fungal growth. Individual hyphal tips grew out from plant pieces were then transferred to other PDA plates and incubated at 28±1 °C for 7 days. After fungal purity check it was transferred to another PDA medium plate and used as stock culture for further studies [1], [2]. Percentage colonization can be described as the total number of fragments colonized by fungi in relation to the total number of fragments x 100 [7].

Microscopic Observation

Morphological identification of each fungal isolates was done by slide culture technique [8]. Mount prepared in lactophenol-cotton blue was used to observe different fruiting bodies of taxonomic significance. In order to study, the different sporulating structures present in pure colonies of each endophytic fungi, semi-permanent slides were prepared and studied under OLYMPUS binocular research microscope. Photo-documentation was done using digi-cam fitted to OLYMPUS bright field research microscope.

Identification and Taxonomy of Endophytic Fungi

The endophytic fungal isolates were identified on the basis of macroscopic (colonial morphology, colour, texture, shape, diameter and appearance of colony) and microscopic characteristics (septation in mycelium, presence of specific reproductive structures, shape and structure of conidia and presence of sterile mycelium). In present study, all the endophytic isolates were identified using standard taxonomical keys and monographs [9]-[16]. In addition, other taxonomic papers relating to particular genera of endophytes were also referred.

Screening and isolation of effective amylolytic fungi

For the screening of effective amylolytic fungi, actively growing (3 days old) mycelium discs (along with agar medium) of 6 mm diameter were removed from the growing edge of the fungal isolates by using sterile cork borer. The discs were placed on the surface of sterile starch agar plates supplemented with antibacterial antibiotic Streptomycin sulphate (35μg/mL) aseptically and incubated at 28 ± 1 °C for 5-7 days. After the incubation plates were flooded with Iodine solution. The clear zones were formed around the fungal growth with dark blue background indicated the production of amylase enzyme [17]. Selection of most active fungal species for optimization studies was finalized based on the size of zone of clearance around the colony.

Optimization of growth parameters for maximum amylase enzyme production and optimum growth of endophytic fungi

Effect of different carbon and nitrogen sources on Amylase production

Different sources of carbon such as Maltose, Lactose, Starch and Glucose at 1.5 % (w/v) and Nitrogen sources, Sodium Nitrate, Ammonium Nitrate, Yeast extract and Peptone at 0.3% (w/v) were used to determine their effect on the production of amylase activity. Fermentation was carried out at 27°C for 7 days after adjusting the initial pH of the fermentation medium to 6.0.

Effect of initial pH of the fermentation medium and Temperature of incubation on amylase production

The optimum cultural conditions were determined from the following factors i) initial pH of the fermentation medium was adjusted to 3.0, 5.0, 6.0, 7.0, & 8.0, and Temperature of incubation was set at 25°C, 30°C, and 37°C to determine the most effective temperature for amylase production.

Growth medium and cultural conditions for Sub-merged fermentation (SmF)

The medium used for fermentative production of amylase consisted of (w/v), 10 g starch, 0.5 g potassium phosphate, 0.5 g potassium chloride, 0.5 g magnesium sulfate, 0.01 g ferrous sulphate, 2 g sodium nitrate, and 0.4 g yeast extract

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in 1000 ml of distilled water (pH 6). This Fermentation Medium was sterilized at 121°C for 15 minutes. Suspension of fungal spore was prepared by adding 5 ml of sterile saline water over the five days old fungal slant and dislodging the spores using sterile inoculating needle. 0.1 ml of spore suspension was inoculated to 250 ml Erlenmeyer flask containing 100 ml of the fermentation medium. The flasks were incubated at 27 °C in an Orbital shaking incubator at 120 rpm for 7 days. Mycelia and spores were then removed by centrifugation at 10000 rpm for 10 min (Cooling centrifuge Remi) at 4°C. The culture was filtered through a Whatman filter paper No. 4 and the enzyme filtrate was used as a source of crude enzyme.

Estimation of reducing sugars (Amylase assay)
The maltose concentration was determined by Dinitrosalicylic acid (DNS) method, as described by [18] using maltose as a standard of 1 mg/mL. The developed colour was read at 540 nm using, UV-VIS Spectrophotometer (Bioera,) and plotted the standard maltose calibration curve.

Determination of Amylase activity
The enzyme filtrate was used as crude amylase for activity assay. The activity assay was carried out by DNS method [18], [19]. The amylase activity was determined using 1% soluble starch as substrate, prepared in sodium citrate buffer (0.1 M, pH 5.6). The reaction mixture containing 0.5 mL of enzyme and 0.5 mL of substrate was incubated at 30 °C for 30 min. in a water bath. The reactions were stopped by the addition of 1 mL of DNS reagent followed by keeping in boiling water bath for 5 min. and cooled in ice cold water then added 10 mL of distilled water and its optical density (O.D.) was read at 540 nm against reagent blank using spectrophotometer. The O.D. of enzyme assay tubes was measured by deducting O.D. contributed by enzyme substrate control. The amylase activity of culture filtrate was expressed as unit per ml (U/mL), which is defined as the amount of enzyme which liberates 1 μmol of reducing sugar per mL per minute under assay conditions.

Determination of fungal biomass growth
The biomass of fungal culture was determined by measuring the dry weight of the mycelial mass. This was separated from the fermentation medium by centrifugation at 10,000 r.p.m. for 10 minutes, washed twice with distilled water & dried in hot air oven at 80°C to constant weight. Mycelial dry weight was expressed in mg/100ml.

RESULTS

Isolation of endophytic fungi
A total of 24 endophytic fungi were isolated from 75 healthy, symptomless leaves, Stem and root fragments from different plant species giving percentage cumulative colonization rate of 32.0% (TABLE 1). Leaf fragments of *Cajanus cajan* L. plant showed maximum colonization rate (80%) whereas no colonization was demonstrated in root and leaf fragments from *Carthamus tinctorius* L. and *Abelmoschus esculentus* (L.) Moench plants respectively (Fig.1). Out of 24 isolates, only 10 fungal isolates showing significant growth and distinct morphological structures were considered for study. Occurrence of selected 10 endophytic fungi (with codes F1 to F10) from the leaf, stem and root of 10 different plant species was summarized in TABLE 2. With the help of standard taxonomical keys and monographs, pure cultures of fungi isolates were identified as *Aspergillus* sp.1, *Penicillium* sp., *Aspergillus* sp. 2,*Pestalotiopsis* sp., *Trichoderma* sp., *Phomopsis* sp., *Fusarium* sp.1,*Colletotrichum* sp., *Fusarium* sp.2, and *Phoma* sp. Out of ten fungal endophytes, three isolates namely, *Pestalotiopsis* sp., *Phomopsis* sp. and *Colletotrichum* sp. were isolated from leaf and stem fragments of *Mangifera indica* L. and one from each plant species (TABLE 3). Ten endophytic isolates were categorised into 10 taxa, 4 coelomycetes genera *Colletotrichum* sp., *Pestalotiopsis* sp., *Phoma* sp., and *Phomopsis* sp. (40%), 6 hyphomycetes genera *Aspergillus* sp.1, *Aspergillus* sp.2, *Fusarium* sp.1, *Fusarium* sp.2, *Penicillium* sp. and *Trichoderma* sp. (60%). The recovery of endophytes was higher in leaf fragments compared to stem and root fragments.

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Demonstration (Screening) of amylase enzyme by plate assay

The ten endophytic fungi screened were able to produce amylase enzyme. The amylase activity was indicated by formation of clear zone around fungal colony against dark blue background. Among all endophytic fungal isolates, 80% of the isolates were able to produce amylase, whereas 20 % of isolates were with no amylase activity. The endophytes exhibited comparatively good amylase activity were *Aspergillus* sp.1, *Penicillium* sp., *Aspergillus* sp.2 and *Colletotrichum* sp. (Fig.1). Due to more amylolytic potential, these fungi were selected for optimization of amylase production.

Optimization of Amylase production and Growth of endophytic fungi

A total of four fungi were found to be efficient for amylase production, as determined by the clear zone (zone of hydrolysis) formed around the fungal colonies. The influence of carbon sources such as maltose, lactose, starch, glucose were tested at concentration (1.5%) and results are presented in TABLE 5. of the four carbon sources tested, starch resulted in maximum amylase activity and biomass production by *Aspergillus* sp.1, *Aspergillus* sp.2, and *Colletotrichum* sp. followed by maltose; lactose and glucose were the least effective carbon sources Fig.2(a), (b) & (d). However instead of starch, maltose was the good carbon source for amylase activity and biomass production by *Penicillium* sp. Like other fungi tested, similar order of influence of lactose and glucose on amylase activity was shown by *Penicillium* sp. Fig.2 (c). The effect of different nitrogen sources (Ammonium Nitrate, Sodium Nitrate, Yeast Extract and Peptone) on amylase production was studied at concentration of 0.3% and results are reported in Table 6. As can be seen in Fig.3 (a), (b), (c) & (d) maximum amylase activity by all fungi tested was observed when sodium nitrate was used as nitrogen source. There was no significant difference in amylase activity with yeast extract and peptone indicating that any of these sources can be alternatively used. Ammonium nitrate was comparatively least effective nitrogen source. Compared to undefined nitrogen source, the amylase activity was higher in defined nitrogen source. There were high biomass yield of *Aspergillus* sp.1 and *Aspergillus* sp.2 when yeast extract was used as nitrogen source. However, the maximum growth was observed by *Penicillium* sp. and *Colletotrichum* sp. in presence of sodium nitrate. The order of usability of substrate for maximum amylase activity by all fungi tested was Sodium Nitrate> Yeast Extract> Peptone> Ammonium Nitrate.

The impact of variable temperature (25, 30 and 37ºC) on amylase production was studied and results are shown in Table 7. As can be seen in Fig.4(a), (b), (c) & (d), the optimum incubation temperature for maximum amylase activity by all fungi under assay was found to be at 30ºC and biomass yield also correlated with the results. Negligible amount of amylase activity were obtained for fungi tested except *Penicillium* sp. at 25ºC. Maximum fungal growth were favoured at temperature 30ºC by all fungi exception was *Colletotrichum* sp. where 25ºC was the optimum temperature for maximum growth. The order of favourable temperature for maximum amylase activity by all fungi tested was 30ºC > 37ºC > 25ºC. The influence of temperature on amylase production is related to the growth of the organism. Effect of initial pH of the fermentation medium (3, 5, 6, 7 and 8) on amylase production was studied and results are shown in Table 8. The pH of the fermentation medium plays important role in enzyme production by any organism. Due to pH dependency, the effect of initial pH on enzyme production by all microorganisms is very important. It was observable from Fig.5.(a),(b), (c) and (d) that maximum amylase activity by fungi tested was obtained when the initial pH of the fermentation medium was adjusted to 6.Fungal growth also influenced by initial pH of the fermentation medium. In the present study, there was high biomass production by all fungi tested at pH 6.

DISCUSSION

In the present study, endophytic fungi isolated from 10 field grown plants. Ten plant species namely *Mangifera indica* L. (Mango), *Triticum aestivum* L. sub sp. *aestivum* (Common Wheat), *Brassica juncea* (Indian mustard), *Linum usitatissimum* L. (Linseed or flax), *Cartham ustinctorius* L. (Safflower), *Cicer arientinum* L.(Chick Pea or Bengal gram), *Cajanus cajan* L. (Pigeon pea), *Citrus reticulate* Blanco. (Nagpur mandarin), *Dolichos lablab* L. (Hyacinth bean) and *Abelmoschus esculentus* (L.)Moench (Okra) were used for the isolation of endophytic fungi. Several studies have reported the isolation of large numbers of endophytes from plants of medicinal and great economic importance. In

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the present investigation, endophytic fungi *Aspergillus* sp.1, *Penicillium* sp., *Aspergillus* sp.2, *Pestalotiopsis* sp., *Trichoderma* sp., *Phomopsis* sp., *Fusarium* sp.1, *Colletotrichum* sp., *Fusarium* sp.2, and *Phoma* sp. were isolated from leaf, stem and root parts. Several researchers isolated and identified endophytic fungi from different plants. Endophytes of the genera *Trichoderma, Phomopsis* and *Fusarium* were isolated previously in the study of [2] from *Ventilago madraspatana* plant. *Colletotrichum* sp was isolated from stem of *Artemisia annua* L. [20]. *Phoma* sp. NG-25 from *Saurauia ascaberrinae* plant [21] and *Aspergillus* sp strain HAB 10R12 from the host plant *Garcinia scortechinii* [22] were isolated. In present work, ten endophytic fungi tested were able to produce amylase enzyme. The occurrence of such hydrolytic enzyme producing fungi in various parts of plants agrees with earlier reports by [23], [25], [38] that plants are known to be a repository of hydrolytic enzyme producers. Amylolytic enzymes are known to be synthesized by a number of fungi. Many *Penicillium sp* are also reported to produce extracellular amylase [4], [26], [27]. In the present study, 80% of the endophytes were able to produce amylase and out of these, 40% of the endophytes exhibited comparatively good amylase activity. These fungi were *Aspergillus* sp.1, *Penicillium sp.*, *Aspergillus* sp.2 and *Colletotrichum sp.* Optimization studies were done for these fungi using advantageous submerged fermentation. It has been reported the advantages of economic feasibility of submerged fermentation processes for amylase production [28]. Filamentous fungi are considered to be one of the most efficient hyper producers of amylase that is used in industry. Moulds are known to be prolific producers of extracellular proteins; they are widely exploited for the production of different enzymes including α-amylase. Fungi belonging to the genus *Aspergillus* have been most commonly employed for the production of α-amylase [29].

In the present study, substrate starch as compared to glucose, lactose and maltose resulted in maximum amylase activity by *Aspergillus* sp.1, *Aspergillus* sp.2 at the concentration of 1.5%. This concentration was higher than that of previous report of [29] who found optimum concentration of 1% for amylase activity. Maximum amylase activity recorded at 0.5% starch concentration [30].These results are consistent with data obtained reported by [26] that addition of 1.5% starch as a carbon source gave maximum production of alpha amylase. This outcome is not in line with that of [27] who found that, sucrose supplemented with rice bran medium was the optimum as carbon source for maximum production of amylase. Similarly the results differ from the finding of [4] who found amylase production by *Penicillium chrysogenum* cultivated in media supplemented with maltose (2%) reached its maximum. It has been proved that starch was to be the best as carbon for the growth and sporulation of *Colletotrichum gloeosporioides* which is in line with the present study [31]. In the present study, fermentation medium containing 0.3% sodium nitrate showed maximum amylase production by all tested fungi. But one of the previous studies suggested ammonium nitrate (0.2%) as inorganic nitrogen source gave maximum amylase activity by *Penicillium* sp [26]. Yeast extract also exhibited as good nitrogen source for amylase production. It has been reported maximum amylase production with yeast extract as nitrogen source [27].

Researchers described 0.1% peptone as appropriate concentrations for amylase production from *A. oryzae* [28].[32] determined 3% peptone as optimum concentration of nitrogen source require for amylase production in the growth medium of fungi. According to [33], 0.5% peptone is sufficient to produce amylase from *Acremonium* sp. [34] reported 1% peptone concentration for amylase production. In the present study, the optimum incubation temperature for maximum amylase activity by all fungi under assay was found to be at 300C. Similar reports obtained by [28] reported that amylase activity was optimum at 300C in *Aspergillus oryzae, Botryodiplodia theobromae* and Rhizopusoryzae. The result matches with [35] reported 30°C as best temperature for growth and amylase production from *Aspergillus tamarii* and [36] recorded amylase production at 30°C by *Penicillium fellutanum*. [4] Reported optimum temperature range 30-400C. In the present study, best suited pH for maximum amylase activity and high biomass production by all fungi tested were at pH 6. According to [26] the maximum amylase production was at pH 7. *Penicillium chrysogenum* showed high amylase activity at a pH range from 5.0–6.0 [17]. The capacity of selected endophytic fungi *Aspergillus* sp.1, *Aspergillus* sp.2 *Penicillium* sp. and *Colletotrichum* sp. to produce and secrete large quantities of extracellular enzymes has placed them among the most important industrial enzyme producers. *Aspergillus nidulans* is the best extracellular amylase-producing organism and producing amylase in large quantity [37]. The amylolytic potential of these endophytes may help them to degrade starch which is available when

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the plant senescent [2]. Due to the great significance of the amylase in biotechnology, it finds its use in food, fermentation, textiles and paper industries. Recent advancement in field of biotechnology, the scope of amylase utilization has expanded to the great extent.

CONCLUSION

In this investigation, the aim was to assess, the potential of fungal endophytes for hydrolytic enzyme production, i.e. amyalse. This study has isolated and identified ten endophytic fungi from different parts of field grown plants. Such isolates were utilized for the production industrial important enzymes. Owing to the use of endophytic fungi in different fields, an increase of studies in these microorganisms and the discovery of new compounds with a wide range of application potential have been carried out. A variety of enzymes are also produced by endophytic fungi in addition to the large number of primary and secondary metabolites. The findings of this study suggest that such fungal endophytes which reside in interior of plant cell without causing any harm can be utilized to produce active enzymes which are showing great success in the field of biotechnology. The presence of such enzyme indicates a possibility of an interaction between plant and endophytic microorganisms.

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Conflict of interest
There is no any conflict of interest exist.

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Table.1: Number of isolates of endophytic fungi obtained from various plants leaf, stem and root fragments

Growth environment	Plant name	Plant parts	Number of fragments	Total number of isolates by plant parts	Colonization rate* (%)
Field-grown plants	*Brassica juncea*	Root	5	3	60.0
	Linum usitatissimum L.	Root	7	3	42.9
	Cicer arientinum L.	Root	14	1	7.1
	Cartham ustinctorius L.	Root	10	0	0.0
	Cajanus cajan L.	Leaf	5	4	80
		Stem	4	3	75
	Citrus reticulate Blanco.	Leaf	4	3	75
		Stem	4	2	50
	Mangifera indica L.	Leaf	6	2	33.3
		Stem	4	1	25
	Triticum aestivum L. sub sp. *aestivum*	Leaf	4	1	25
	Dolichos lablab L.	Leaf	4	1	25
	Abelmoschus esculentus (L.) Moench	Leaf	4	0	0
Total plants:	10				
Total fragments taken:			75		
Total isolates:				24	
Percentage colonization rate:					32.0

*Percentage colonization rate- the total number of pieces colonized by fungi in relation to the total number of pieces x 100.

Table.2: Selected 10 Endophytic Fungi From The Leaf, Stem And Root Of 10 Different Plant Species

Plant name	Organ	Code given to Unidentified Fungal isolates
Brassica juncea	Root	F1
Citrus reticulate Blanco.	Leaf	F2

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Linum usitatissimum L.	Root	F3(J1)
Mangifera indica L.	Leaf	F4(PP), F6 (MP)
Cajanus cajan L.	Leaf	F5(SPT)
Triticum aestivum L. subsp. *aestivum*	Leaf	F7(GF)
Mangifera indica L.	Stem	F8(GC)
Cicer arientinum L.	Root	F9(SF)
Dolichos lablab L.	Leaf	F10(SPP)

TABLE 3 Ten endophytic fungi isolated from the leaf, stem and root of different plant species

Plant name	Organ	Codes	Identified Fungal endophytes	Closely resembles to
Brassica juncea	Root	F1	*Aspergillus* sp.1	**Aspergillus terreus**
Citrus reticulata Blanco.	Leaf	F2	*Penicillium* sp.	**Penicillium chrysogenum**
Linum usitatissimum L.	Root	F3(J1)	*Aspergillus* sp.2	**Aspergillus niger**
Mangifera indica L.	Leaf	F4(PP),F6(MP)	*Pestalotiopsis* sp., *Phomopsis* sp.	**Pestalotiopsis palmarum** **Phomopsis mangiferae**
	Stem	F8(GC)	*Colletotrichum* sp.	**Colletotrichum gloeosporioides**
Cajanus cajan L.	Leaf	F5(SPT)	*Trichoderma* sp.	------
Triticum aestivum L. subsp. *aestivum*	Leaf	F7(GF)	*Fusarium* sp.1	**Fusarium graminearum**
Cicer arientinum L.	Root	F9(SF)	*Fusarium* sp.2	**Fusarium sporotrichioides**
Dolichos lablab L.	Leaf	F10(SPP)	*Phoma* sp.	------

Table.4: Screening of endophytic fungi for hydrolytic enzymes production

Endophytic isolates	Amylase activity
Aspergillus sp.1	++
Penicillium sp.	++
Aspergillus sp.2	++
Pestalotiopsis sp.	+
Trichoderma sp.	-
Phomopsis sp.	+
Fusarium sp.1	+
Colletotrichum sp.	++
Fusarium sp.2	-
Phoma sp.	+

Comparative enzyme activity: -, no activity; +, moderate activity; + +, good activity

Table 5 Effect of Different Carbon Sources on Amylase Production

Carbon Source (1.5 %)	*Aspergillus* sp.1		*Aspergillus* sp.2		*Penicillium* sp.		*Colletotrichum* sp.	
	Amylase Activity (U/mL)	Mycelial Dry weight (mg/100 mL)	Amylase Activity (U/mL)	Mycelial Dry weight (mg/100 mL)	Amylase Activity (U/mL)	Mycelial Dry weight (mg/100 mL)	Amylase Activity (U/mL)	Mycelial Dry weight (mg/100 mL)
Maltose	0.418±0.031	288.85	0.453±0.021	285.51	16.90±0.165	422.12	0.40±0.031	372.04
Lactose	0.144±0.021	188.15	0.151±0.012	191.49	11.24±0.305	214.67	0.23±0.021	364.67
Starch	0.439±0.052	345.56	0.494±0.021	327.23	13.786±0.237	398.76	0.49±0.048	412.10

| Glucose | 0.103±0.021 | 176.68 | 0.123±0.021 | 175.68 | 5.014±0.146 | 193.11 | 0.18±0.043 | 303.11 |

U/ml: Amount of maltose liberated in µmol per ml per minute. ±: standard deviation from the mean.

Table 6. Effect of different nitrogen sources on amylase production

Nitrogen Source (0.3 %)	*Aspergillus* sp.1		*Aspergillus* sp.2		*Penicillium* sp.		*Colletotrichum* sp.	
	Amylase Activity (U/mL)	Mycelial Dry weight (mg/100 mL)	Amylase Activity (U/mL)	Mycelial Dry weight (mg/100 mL)	Amylase Activity (U/mL)	Mycelial Dry weight (mg/100 mL)	Amylase Activity (U/mL)	Mycelial Dry weight (mg/100 mL)
Ammonium Nitrate	0.123±0.021	208.45	0.096±0.012	196.13	22.57±2.28	308.45	0.58±0.041	358.45
Sodium Nitrate	0.274±0.052	322.82	0.220±0.012	226.15	27.88±1.12	422.82	0.66±0.094	383.48
Yeast Extract	0.206±0.041	385.71	0.185±0.021	305.71	26.2±0.60	345.71	0.62±0.041	322.38
Peptone	0.172±0.031	308.99	0.123±0.021	288.65	24.93±0.10	412.32	0.5±0.052	342.99

U/ml: Amount of maltose liberated in µmol per ml per minute. ±: standard deviation from the mean.

Table.7. Effect of different temperature on amylase production

Temperature (°C)	*Aspergillus* sp.1		*Aspergillus* sp.2		*Penicillium* sp.		*Colletotrichum* sp.	
	Amylase Activity (U/mL)	Mycelial Dry weight (mg/100 mL)	Amylase Activity (U/mL)	Mycelial Dry weight (mg/100 mL)	Amylase Activity (U/mL)	Mycelial Dry weight (mg/100 mL)	Amylase Activity (U/mL)	Mycelial Dry weight (mg/100 mL)
25	0.082±0.021	315.11	0.06±0.021	218.45	6.43±0.36	215.11	0.11±0.048	353.11
30	0.357±0.052	357.82	0.28±0.021	257.95	9.06±0.25	257.82	0.45±0.054	314.49
37	0.213±0.043	196.04	0.23±0.021	226.08	8.13±0.24	222.71	0.27±0.021	261.38

U/ml: Amount of maltose liberated in µmol per ml per minute. ±: standard deviation from the mean.

Table 8. Effect of different pH on amylase production

Initial pH of Fermentation medium	*Aspergillus* sp.1		*Aspergillus* sp.2		*Penicillium* sp.		*Colletotrichum* sp.	
	Amylase Activity (U/mL)	Mycelial Dry weight (mg/100 mL)	Amylase Activity (U/mL)	Mycelial Dry weight (mg/100 mL)	Amylase Activity (U/mL)	Mycelial Dry weight (mg/100 mL)	Amylase Activity (U/mL)	Mycelial Dry weight (mg/100 mL)
3	0.117±0.031	305.28	0.089±0.012	285.28	0.137±0.012	295.61	6.09±0.237	257.94
5	0.158±0.031	436.25	0.117±0.012	334.25	0.165±0.021	318.25	7.6±0.247	266.25
6	0.185±0.041	486.98	0.165±0.021	354.65	0.206±0.021	334.98	8.7±0.281	286.25
7	0.159±0.031	356.66	0.144±0.021	292.67	0.19±0.021	258.33	4.95±0.591	252.67
8	0.123±0.031	320.56	0.124±0.021	290.70	0.16±0.021	246.00	4.3±0.58	241.30

U/ml: Amount of maltose liberated in µmol per ml per minute. ±: standard deviation from the mean.

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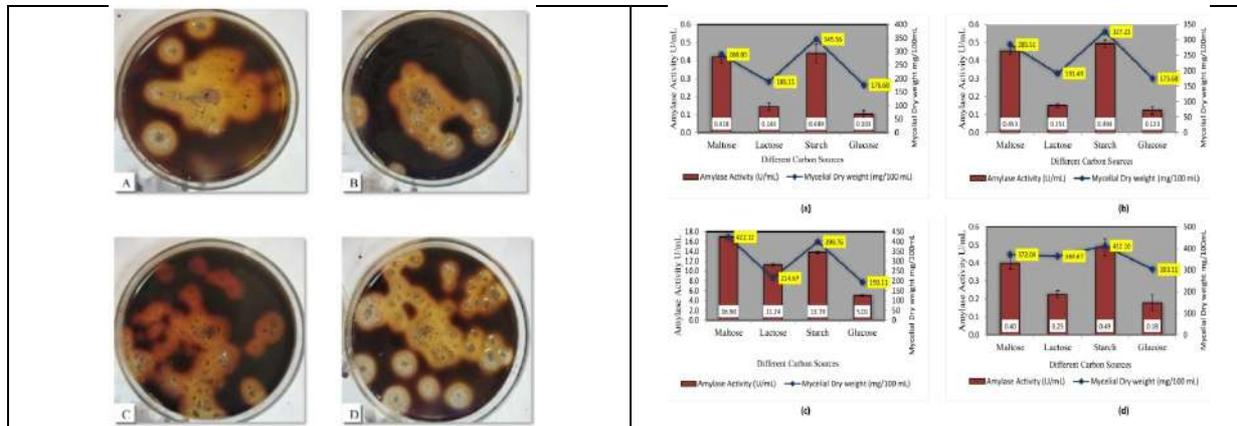
Fig.1.Clear zone around fungal colony representing amylolytic activity on starch medium of (A) *Aspergillus* **sp.1, (B)** *Penicillium* **sp., (C)** *Aspergillus* **sp.2, (D)** *Colletotrichum* **sp. after 7 days of incubation at 28 °C.**

Fig.2. Effect of different carbon sources on Amylase production in fungi (a) *Aspergillus* **sp.1, (b)** *Aspergillus* **sp.2, (c)** *Penicillium* **sp. (d)** *Colletotrichum* **sp.**
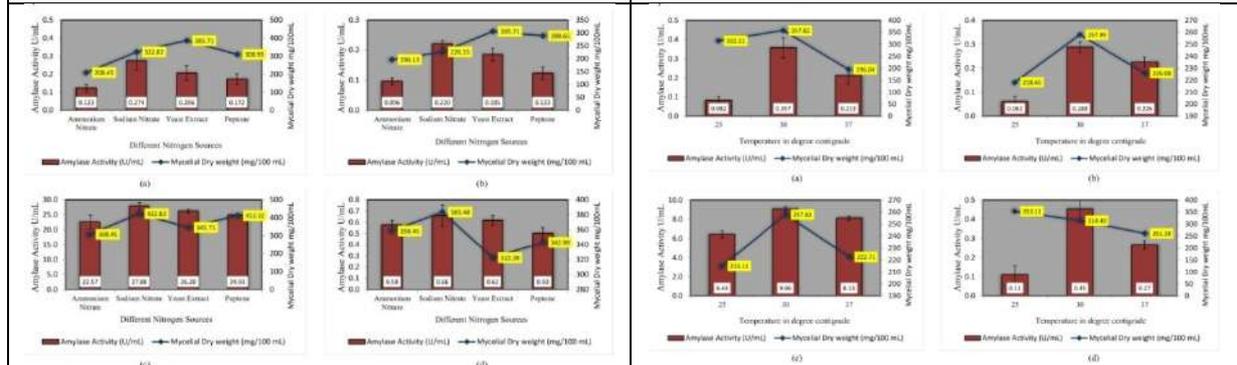
Fig.3. Effect of different nitrogen sources on Amylase production in fungi (a) *Aspergillus* **sp.1, (b)** *Aspergillus* **sp.2, (c)** *Penicillium* **sp. (d)** *Colletotrichum* **sp.**

Fig.4. Effect of different temperature on Amylase production in fungi (a) *Aspergillus* **sp.1, (b)** *Aspergillus* **sp.2, (c)** *Penicillium* **sp. (d)** *Colletotrichum* **sp.**
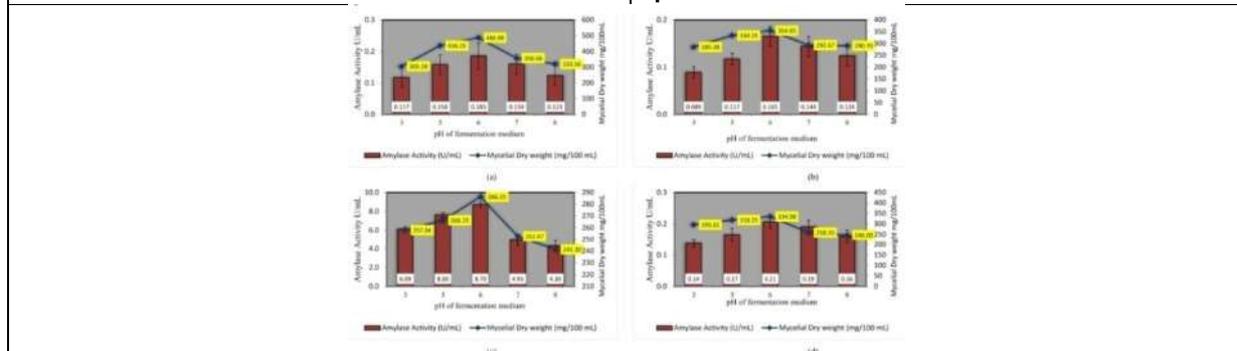
Fig.5. Effect of initial pH of fermentation medium on Amylase production in fungi (a) *Aspergillus* **sp.1, (b)** *Aspergillus* **sp.2, (c)** *Penicillium* **sp. (d)** *Colletotrichum* **sp.**

RESEARCH ARTICLE

Comparative Evaluation of Chemical Constituents in Alpan Banana (*Musa paradisiaca)* at Different Developmental Stages

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ABSTRACT

India leads the world, with a contribution of roughly 23% to global banana production. It is a good source of enzymes, calories, and a variety of other nutrients. The principal cause of 70–80% of all plant diseases are fungi. Fungi considerably lowers the agricultural productivity and result in financial loss. Mycologists and plant pathologists have primarily used two steps for the identification of fungal plant pathogens, morphological observation phylogeny, and molecular characterization for quick identification. This study compared the chemical composition and fungal incidence of banana sample (*Musa paradisiaca)* at various developmental phases (Mature and pre-mature).Chemical constituents were found to be relatively higher in mature than pre-mature banana sample. Three strains of fungi were isolated from banana and were preliminary identified on morphological basis. Results confirmed the species *Aspergillus fumigatus, Aspergillus flavus* and *Aspergillus niger* in mature banana sample and *Aspergillus Niger* in pre-mature banana sample. Due to the high chemical constituents and plenty of nutrients, matured banana sample were found to be more susceptible to microbial attack.

Keywords: Pre-mature Banana, mature banana, molecular characterization, Fungal isolation

INTRODUCTION

Banana (*Musa paradisiaca*), the second greatest fruit crop in tropical and subtropical regions of India and a member of the Musaceae family. It contains many calories, several more nutrients and enzymes. Fruit pulp includes amino acids, iron, calcium, vitamin C, vitamins B1, B2, and B3, phosphorous and proteins, both of which are abundant in the diet that people need on a regular basis [1]. Fruits can spoil due to a variety of physical, chemical, and enzymatic

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damage, although microbial activity is the main cause. When spoilage germs infiltrate, fruit deterioration caused by microbial activity begins. The microbial community expands and multiplies, causing un favourable alterations to the fruit's natural state. Microorganisms are no different from other organisms, in that they all require resources for metabolic processes. In order to grow, spoilage bacteria also require nutrients, which they often obtain from the host organism. Fruits are a practically perfect host for the survival and growth of many different types of germs because they are highly concentrated in the nutrients required for the growth of rotting microorganisms[2]. The formation and growth of microbes, however, can depend on a variety of other conditions, including temperature, water activity and oxygen. At the post-harvest level, the main cause of spoilage among fresh fruits is microbial pathogens [3]. Various fungal rots can affect bananas while they are being stored or transported. Such infectious rots reduce the market value and nutritional worth of the fruit, either as a result of its unpleasant look or due to changes in the fruits' stored components. Fruits change physically and biochemically as they ripen, and these changes vary depending on the type of fruit. Fruit flesh softening during the ripening process is primarily caused by the breakdown of starch and insoluble polysaccharides. During ripening, sugar content also rises from 2% to 20% [4]. The breakdown of chlorophylls causes banana peel colour shifts. Understanding the nature of such changes may aid with postharvest handling [5]. In this investigation, the chemical constituents and fungal prevalence of a banana sample (*Musa paradisiaca*) at various developmental stages (Mature and pre-mature) were compared. The estimation such as ascorbic acid, keto acid, total sugar content using various chemical method estimated the nutritional content variations at the two stages of the fruit. Enzymatic activity was analysed for pre mature and mature banana samples. Fungal isolates were identified based on morphological characteristic properties.

MATERIALS AND METHODS

Collection of sample or plants materials
Sample of pre-mature banana and mature banana was collected from the local market of Vaishali district, Bihar.

Chemicals used
Sodium Potassium tartrate, ascorbic acid, Copper sulphate, gallic acid, (2,4- Dinitrophenylhydrazine (DNPH)), Coomassie brilliant blue, bovine serum albumin etc., were obtained from Sigma Co. other chemicals were supplied by BDH Chemicals.

Isolation of Fruit Spoilage Fungi
Banana pulp for both the samples were cut into small pieces measuring approximately 6 mm; they were then surface sterilised with a 0.1 percent solution of mercuric chloride ($HgCl2$), and three times with sterile distilled water to remove any remaining mercuric chloride traces. After that, under aseptic conditions, surface sterilised tissues were transferred to sterile Petri plates with Sabouraud Dextrose Agar (SDA) (Himedia) medium. The plates were sealed with paraffin and incubated at 27°C for 48hrs and growth the fungus was monitored.

Identification and characterization of pathogens
The pure fungi isolates were identified using both cultural and morphological characteristics such as Surface texture [glabrous, suede-like, powdery, granular, fluffy, downy, cottony], Surface topography [flat, raised, heaped, folded, domed, radial grooved], Surface pigmentation [white, cream, yellow, brown, pink, grey, black etc.], Reverse pigmentation [none, yellow, brown, red, black, etc.] as well as comparing them with confirmed representatives of different species. [6]

Morphological characterization
Macroscopic and microscopic observations were obtained using 5-dayold pure fungal cultures maintained at 25°±2°C on SDA growth medium for morphology-based identification. Additionally, cultural samples and microphotographs were acquired for comparative analysis and future usage in the identification of fungi.[7] Microscopic characteristics include conidiophore length, wall, vesicle size and form, ornamentation of conidia, conidial size, shape, and colour,

among others. Macroscopic characteristics include colony colour, size, shape, texture, and margin zonation assessed with the naked eye. On the basis of macro and micro morphological characteristics, a detailed description of each isolate was written. By comparing it, species were identified [8]. Amylase activity was used as the criterion to determine the of ability to produce amylases. A single streak was made into centre of starch agar media for inoculation of fungus to be tested. After 5 days of incubation, iodine solution was added. Clear zone around the fungus in an otherwise blue medium indicated amylase activity. Protease activity was determined using casein hydrolysis media, make a single streak inoculation of fungus to be tested into centre of milk agar plate. After 5 days of incubation the at 27°C, examine the milk agar plate culture for the presence or absence of clear zone of proteolysis, surrounding the fungus growth.

Biochemical assessment of banana sample
Ascorbic acid
Ascorbic acid estimated by the method of [9]. 0.5 mg Ascorbic acid (vitamin C) was dissolved in 50mL of distilled water in a volumetric flask. 0.5g of the sample was weighed, macerated with 10ml of 0.4% oxalic acid in a test tube for 10 minutes. Centrifuged for 5 minutes and the solution was filtered. Filtrate was transferred into a dry test tube in duplicates. 9ml of 2,6- dichlorophenolindophenol was added and absorbance was taken at 15 seconds and 30 seconds interval at 520nm.

Keto acid
The Keto acid was determination by [10] method. 12.5 mg sodium pyruvate was dilute in 100 ml of distilled water. Dilute this stock solution in the ratio of 1:5. The concentration of working standard is 20 µg / ml.100mg diseased tissue were taken and it was homogenized with 10 ml of 80% ethanol. The extract was treated with equal volume of chilled 10% trichloroacetic acid. The mixed solution was kept overnight in a refrigerator. Next day solution was centrifuge and to 3 ml of supernatant, 1 ml of 0.1% solution of 2-4 dinitrophenylhydrazine in 2N HCL was added. The tube was incubated at 25Ċ for 30 min. 8 ml of ethyl acetate was added in each mixture and each mixture was agitated After this, 6ml of 10% sodium carbonate was added to each tube and separated with the help of separating funnel. 5 ml of aqueous carbonate layer was taken out and this 5 ml of 1.5N NaOH was added. The reading was taken into 435 nm against a blank prepared in water

Total sugar content
Sugar content was estimated by homogenizing 5 gm of the sample with 100 ml of warm water and neutralised with NaOH to determine the total sugar concentration. Incubation was done with lead acetate. The required quantity of sodium oxalate solution was added to the mixture after 10 minutes to eliminate the extra lead. A 250 mL volume was created by adding distilled water and filtering it. A 250 mL flask was filled with 50 mL of the cleared and diluted solution. The flask was filled with 10 mL of 1N HCl. After that, this solution was cooked for two minutes. Several drops of phenolphthalein were added after cooling, and the mixture's components were then neutralised with NaOH. After filtering, the volume was increased to 250mL.Consequently, the sample solution was made. A conical flask was filled with 10 mL of a combined Fehling's solution (5 mL of Fehling's solution-1 and 5 mL of Fehling's solution-2). The purified sample solution was poured into a burette, which was then passed through the full amount necessary to dilute the Fehling's solutions so that only 0.5–1.0 mL remained to finish the titration. The flask's contents were combined, then heated for two minutes to boiling. Methylene blue indicator was put in two to three drops. After that, the titration was continued until the blue tint totally vanished and changed to a brownish hue [11].

Phenol oxidase enzyme activity
Phenol oxidase activity was determined by homogenizing 10g of samples were in 10ml of water and sea sand and centrifuged tube, The collected supernatant was used as for enzyme activity. 1% triton X-100 and 5 mm ascorbic acid was added and homogenized. The reaction mixture containing 2.5 ml phosphate buffer, 0.3ml catechol solution and then add 0.2ml of enzyme substrate. The reaction was started by the addition of 4-methyl catechol to a final concentration of 2.5 Mm, then absorbance was taken at 495nm [12].

Ascorbic acid oxidase enzyme activity

Ascorbic acid oxidase activity was determined by diluting substrate in 0.5ml of ascorbic acid solution (1mg/ml in 01M acetate buffer) and 0.5ml of 01M acetate buffer (pH5.6) was added to each flask. The flasks were incubated at 30°C for 10minutes of slow shaking condition, The content was centrifuged for 20min at 3,000rpm after adding 2.5ml of 10% metaphosphoric acid. Then, 1ml of homogenized and extracted sample solution was taken and 1 ml potassium phosphate buffer solution and 0.5 ml ascorbate were added and take the absorbance at 265nm to different time interval [13].

RESULTS AND DISCUSSION

The development of banana and variations in chemical constituents from pre-mature to mature were examined in this study. The starch content steadily transforms into sucrose, glucose, and fructose as the fruit ripens, and the amount of water in the pulp also rises. Due to their high moisture content and plenty of nutrients, such ripe and mature fruits are susceptible to microbial attack [14]. Microbial analysis was performed to identify the fungal isolates.

Biochemical analysis of pre mature and mature banana sample

Table 1 shows overall biochemical analysis of pre mature and mature banana sample. The nutritional content (keto acid, sugar content, ascorbic acid) was found to be significantly higher in mature banana than the pre-mature banana sample.

Identification of fungus

Appeared fungal colonies were isolated, purified and maintained on SDA. A morphological analysis was used in this work to first identify the fungal isolates to the genus level based on the colours of the colonies that grew on the top, bottom, and both sides of the fungal cultures. Further identification was accomplished via a microscopic inspection of the spore-producing structure's form. To identify isolates up to the family or genus level, morphological inspection and identification of fungi is helpful [15].

Isolate 1

Macroscopic features

Isolate 1 showed black powdery colony texture due to heavy sporulation, and color of the colony was black from and yellowish on reverse appearance. (Table.1)Visual examination of mycelia suggested that hyphae were initially yellow which turned to black with the formation of conidia or upon maturity of the colony. Under stereoscope conidial heads were strictly radiate

Microscopic features

The size of conidiophore, that was measured to be 1000 µm Conidiophores were hyaline, thick and smooth walled, long and globose at tip. Vesicle size was 25 µm(Table 5). Conidia were globose, pale green in color, The spore wall was smooth. Based on morphological and microscopic features it was identified as *Aspergillus niger*.

Isolate 2

Macroscopic features

Isolate 2showed that colonies were growing rapidly and was heavily sporulated, powdery in texture, light green in color and yellowish on the reverse side. Growth zones were absent (Table 1). Under stereoscope conidial heads were prominent and radial.

Microscopic features

Conidiophores were hyaline, coarsely roughened and size was measured to be 1150 µm. Vesicles were hyaline, sub globose to globose with an average diameter of 30µm (Table 5) Based on morphological features, the species was identified as *Aspergillus flavus*.

Isolate 3

Macroscopic features

Isolate 3 showed Colony was bright green in color and pale green on the reverse side. Texture of the colony was powdery due to extensive sporulation (Table 1).

Microscopic features

Conidiophores were hyaline, thick and smooth walled having, size of200µm and vesicle size was 0.15 µm. Conidia were globose, pale green, 2.9 µm(Table 5).Based on the characteristics, the species was identified as *Aspergillus fumigatus*.

CONCLUSION

Pathogens cause deterioration of fruits mainly because they provide the best medium of growth. The results of various biochemical analysis of banana sample in two stages were obtained (pre-mature and mature).After purification of each fungal species, these were identified based on the colony morphology and microscopic characters. Colony identification was based on colony characteristics such as colour, texture of mycelia and type of pigmentation. The comparative figures of chemical constituents indicated the possibility of high infection chances in mature banana sample as it is rich in all the nutrients. Aspergillus was the genus most frequently isolated from the banana fruit sample. The main fungal contaminants were identified to be *Aspergillus niger, Aspergillus fumigatus* and *Aspergillus flavus.* Growth of all three fungus was observed in matured banana, while pre-mature banana showed only *Aspergillus niger.* This concludes that mature banana is more prone to the microbial activity and degradation. The results of this study suggest, additional research to be conducted in the future for pathogenicity analyses in banana sample.

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Table.1: Biochemical analysis of Banana sample (pre-mature and mature)

Sr. No	Test name	Pre- Mature	Mature
1	Ascorbic acid (mg/1000)	5.4	8.06
2	Keto acid (mg/g)	692	930
3	Total sugar (%)	44.5	54.5
4	Phenol oxidase (U/ml)	0.565	0.715
5	Ascorbic acid oxidase (U/ml)	0.128	0.158

Table.2. Colony Morphology (mature banana)

S. No	Isolate morphology		Color
1.		Isolate 1	Black, powdery, yellowish on reverse
2.		Isolate 2	Green powdery and yellowish on reverse
3.		Isolate 3	White changes to black

Table.3: Amylase and Protease for pre mature banana sample

S. No	Isolate	Amylase activity	Protease activity
1.	Isolate 1 Pre mature	Positive	Negative

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Table.4: Protease Activity on Casein Hydrolysis Media and Amylase Activity on Starch Agar plates for mature banana

S. No	Isolate	Amylase activity	Protease activity
1.	Isolate 1 Mature	Positive	Negative
2.	Isolate 2 Mature	Positive	Negative
3.	Isolate 3 Mature	Positive	Negative

Table 5:Microscopic characteristics of isolated fungus

Parameters	*A. niger*	*A. flavus*	*A. fumigatus*
Conidiophore length (µm)	1000	1150	200
Vesicle Size (µm)	25	30	0.15
Ornamentation of conidia	wrinkled	Spiny	wrinkled
Conidial size (µm)	1000	350	2.9
Shape	Cylindrical palisade	Flask shaped	Flask shaped
Color	Black	Yellowish green	White

(A)Mature Banana   (B) Pre-Mature Banana Sample
Figure 1.Banana Sample
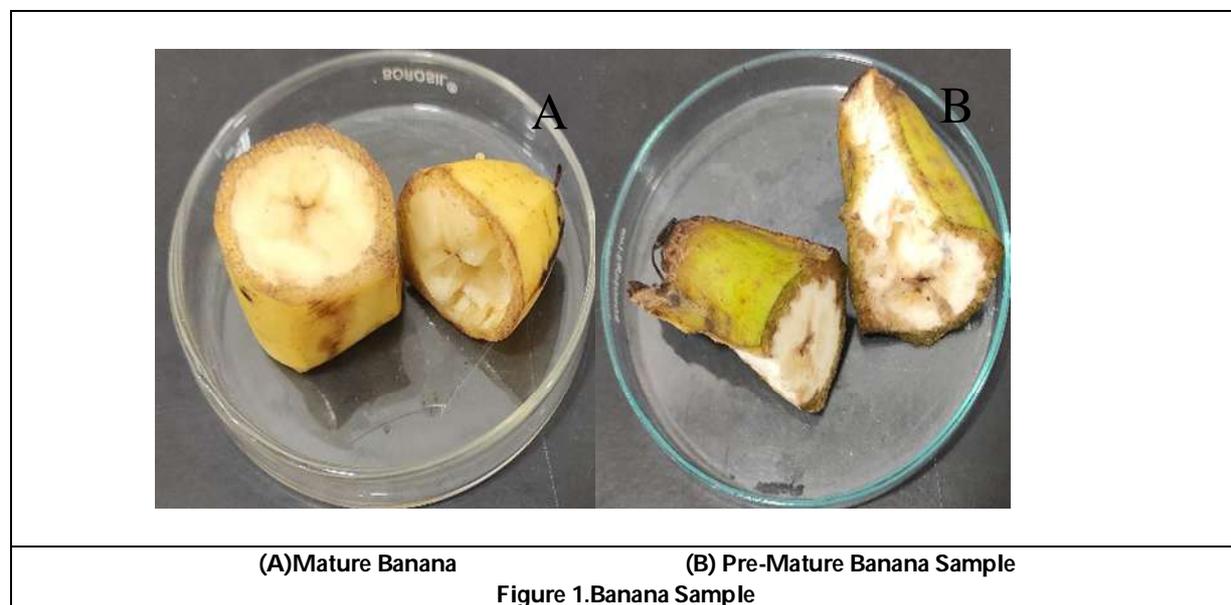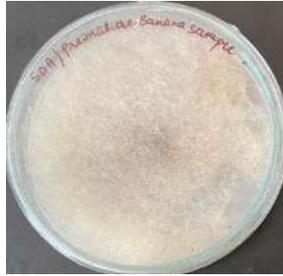
Figure 2. (Isolate 1 of pre-mature) initial growth is white later it turns black on SDA media
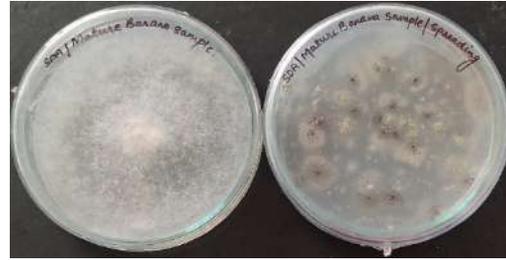
Figure 3. (Isolate 1) initial growth is white, becoming black later on giving "salt and pepper appearance (Isolate 2) and (Isolate 3) on SDA media in mature banana
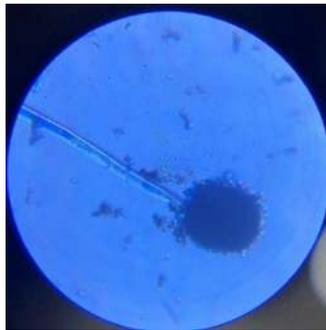
Figure 4. Isolate 1 found in pre-mature banana sample observed under microscope
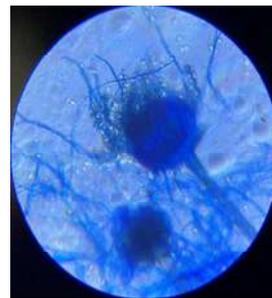
(A) Isolate 1   (B)Isolate 2   (C)Isolate 3
Figure 5. Fungal species found in mature banana sample observed under microscope

RESEARCH ARTICLE

Growth and Carbon Assimilation of Sal (*Shorea robusta*) Saplings under Influence of Ectomycorrhiza in Different Soil Combinations

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ABSTRACT

Shorea robusta is one of the prime timber yielding tree species of North East and Central India having positive mycorrhizal associations. Different mycorrhizal fungi present in the soil profile form symbiotic association with the fine roots of *Shorea robusta* under favorable conditions. Growth parameters like leaf number, midrib length, petiole length and width and physiological parameters like carbon assimilation, stomatal conductance, internal temperature, and internal carbon concentration of leaves in the seedlings colonized by mycorrhizal fungi showed stimulation variations as compared to non-mycorrhizal inoculated sapling samples. The observations pertaining to growth characteristics with respect to three different mycorrhizal composition treatments showed significant increase in seedling growth as compared to control, in the order T2M >; T3M >; T1M. More professed roots formation was observed under T_1M followed T_3M and T_2M in comparison to control set. Under T2M treatment maximum Carbon assimilation rate was 4.73µ mol CO 2 m^{-2}s^{-1}followed by T1M (4.52 µ mol CO 2 m^{-2}s^{-1}) and T3M treatment (3.5 µ mol CO 2 m^{-2}s^{-1}) respectively.

Keywords: Ectomycorrhizal inoculum, Nutrient uptake, Sal forest, Nursery trials

INTRODUCTION

Shorea robusta. Gaertn (Dipterocarpaceae), commonly popular as Sal, forms the major part of deciduous broad-leaved moist tropical forests having wide range of ecosystem distribution which spans over 10 million hectares including states like Assam, Jharkhand, West Bengal, Odisha, Chhattisgarh, Madhya Pradesh, Haryana, Himachal Pradesh and Uttrakhand (Singh and Singh, 1992). It is an important timber yielding species and one of the dominant species of rainforest of South and Southeast Asia with distribution ranging from India, Nepal, Bangladesh and Sri Lanka (Ashton, 1982). Significant reduction in Sal forest density has been reported from being 65.6% (1976) to 11.1% (1999) with overall estimated change to be 42.1% in total forest area (Chauhan *et al.,* 2003). Poor regeneration is one of the major factor identified pertaining to the decreasing density trend of Sal forest cover (Pyasi *et al.,* 2013). Recalcitrant seeds of Sal need immediate conditions of favorable moisture content, nutrition and mycorrhiza for positive establishment. Micorrhization is the process of infestation of root cortical tissues with mycorrhizal fungal hyphae (Harley, 1959). Mycorrhizae increase the sapling water and mineral absorption capabilities and in return the fungi are provided with a continuous and direct access to sucrose and glucose by the host plant. Basic pH soils contain mineralized phosphate ions which are inaccessible to the saplings, however mycorrhiza mycelium can access these and make them available for the plant (Bowen *et al.,* 1974), thus enhancing the initial stage growth rate of the plant. These fungi also bear a protective role against high metal concentration soils, acidic soils as well as coal mine restorations (Bowman *et al.,* 2013).

Most dipterocarps show ectomycorrhizal association, however dual association can also be observed in some tree genera like *Sal, Alnus, Eucalyptus, Casuarina, Cupressus, Juniprus, Tilia, Ulmus* and *Arbutus* (Harley and Smith 1983; Tupwal *et al.,* 2014). Majorly of Sal forests form association with basidiomyceteous and gasteromyceteous fungi. Important and common mycorrhizal fungi with respect to Central India as identified and reported by various researchers include *A. hygrometricus, B. edulis, B. fallex, G. triplex,* L. compactum, S. bovista, S. geaster, S. verrucosum, *R. adusta, R. cinerella, R. delicula, R. leelavathyi, R. michiganensis* (Bakshi, 1974; Pyasi *et al.,* 2011; 2012; Soni *et al.,* 2011). Symbiosis as defined in initial phase corresponded to leeches and parasites only however, in recent scenario the term is used to indicate beneficial associations only (Paracer and Ahmedjian, 2000). Mycorrhiza fungi form the most important ecological factors with respect to maintenance and governance of terrestrial ecosystem (Wang *et al.,* 2017). The mycorrhizal diversity is poorly documented till date, irrespective of having significant bio – geographic participation in tropical dipterocarp forest ecology (Alexander and Selosse, 2009; Kumar and Atri, 2019). Mycorrhiza due to their ability to act as fungal symbionts display properties like being the natural barriers against soil pathogens, facilitate the host with better nutrient absorption in addition to edible fruiting bodies of certain ectomycorrhiza species. Mycorrhizal fungi support in the process of plant adaptation during the course of transplantation to new habitats (Ksiezniak, 2007), along with providing increased survival and growth in micropropagation of mycorrhiza inoculated rootstocks of plants (Borkowska *et al.,* 2008).

The 95% of short roots of temperate forests form ectomycorrhiza (Smith and Read, 1997) which enhance plant growth in natural as well as agro forestry systems. Apart from absorption and transfer of nutrients, minerals and water from external environment, mycorrhizal fungi also help in degradation of recalcitrant organic sources and dissolving soil minerals (Landeweer *et al.,* 2001) for obtaining access to nutrients and minerals. Large number of studies indicates dominance of arbuscular and ectomycorrhiza with respect to tropical rainforest (Koide and Mosse, 2004; Bereau and Garbaye, 1994). Moyersoen *et al.,* (2001), reported up to 40% colonization of mycorrhiza among tree species of tropical forest and mixed dipterocarp forest of Brunei. Varying rates of colonization by species like *Acaulospora* and *Glomus* have been reported (Shi *et al.,* 2002) with the different species of dipterocarps. In context to North East India species like Glomus followed by Acaulospora were reported to be dominantly associated with dipterocarps. Putative association of Sal tree roots have been reported with large number of fungal genera including species like *Russula, Boletus, Agaricus, Amanita, Lactarius, Laccaria, Pisolithus, Suillus, and Cantharellus* (Natarajan *et al.,* 2005; Tupwal *et al.,* 2013; Kumar and Atri, 2016; 2019). Owing to the significance of *Shorea robusta* in North east and

Central India, the present study has been taken up to evaluate the role of mycorrhiza inoculation in growth of *Shorea robusta* seedlings outside its natural condition.

MATERIALS AND METHODS

Experimental location

The experiment was carried out at the departmental nursery of Department of Forestry, Guru Ghasi Das Vishwavidyalaya, Bilaspur, Chhatisgarh, India. The area experiences warm weather conditions during April to June with an average temperature range between 26^0C to 41^0C and 12^0C to 27^0C during November to February (winters). High annual rainfall (1386 mm), with prolonged monsoons from July to September is experienced in this region. AABR is one of the rich of biodiversity habitat in the world. This is located in central part of India at the elevation range 383-800m above sea level. The biosphere has an area of 552 sq. km. lies 20°24'S to 20 ° 35' N Latitude and 81 ° 34'W to 81°55'E Longitude in Bilaspur district of Chhattisgarh, India. The topography of AABR falls under bio-geographic zone- Deccan peninsula central high-lands of India.

Experimental Layout

Experimental design	:Complete Randomized Design(Factorial)
Number of repetition	: 4
Growing space	:open area near the glass house
Container size	:Plastic Bags(6'×8')

Mycorrhizal Treatment

Shorea robusta Seedlings having two to four leaves were taken from the natural forest of AABR and brought to the department nursery 80 km away from AABR. Four sets having ten seedlings each were maintained for each mycorrhizal treatment. Three treatments of mycorrhiza combinations T1M, T2M and T3M were used. In each treatment soil composition was different and in each poly bag 10mg mycorrhiza powder was given. Mycorrhiza powder used in experiment was obtained locally from the market having VAM (Vesicular Arbuscular Mycorrhiza) powder.

Soil composition in different mycorrhizal treatment was as following.

a) Mycorrhizal Treatment (T1M)
"Soil (2): Sand (1): FYM (1): Coco pit (1) + 10 mg Mycorrhiza"
b) Mycorrhizal Treatment 2 (T2M)
"FYM (2): Sand (1): Soil (1): Coco pit (1) + 10 mg mycorrhiza"
c) Mycorrhizal Treatments 3 (T3M)
"Coco pit (2): Sand (1): FYM(1): Soil (1) + 10 mg mycorrhiza"

Observations
Growth parameters

The growth of saplings, number of leaves formed, midrib length, petiole length, width of leaves ware measured at regular intervals.

Physiological parameters

After potting the seedlings in poly bags, the seedlings were kept under nursery conditions. The rates of carbon assimilation, stomatal conductance, evaporation, chamber temperature, internal CO2 concentration were determined in all the seedlings. From each seedling 3-5 mature leaves were selected for the analysis of physiological process throughout experimental duration.

Carbon assimilation and Stomatal conductance

The photosynthesis rate, transpiration rate and stomatal conductance of three to five randomly selected well developed leaves of *Shorea robusta* saplings were measured with the help of photosynthetic analyzer. The net exchange of CO2 between a leaf and the atmosphere was measured directly by enclosing leaf in the assimilation chamber and the rate was monitored at which the CO2 concentration changed over a definite time interval. The system automatically calculates the photosynthesis rate, transpiration rate and stomatal conductance on the basis of preloaded flow and leaf area as per the chamber used. Measurements were taken between 10.00 to 12.00 a.m. for photosynthesis. The parameters like carbon assimilation, stomatal conductance and transpiration rate were determined by the use of LC Pro+ (Delta-T, USA). The parameters included are as follows:

Net CO2 assimilation rate (A): $\mu mol\ CO_2\ m^{-2}\ s^{-1}$

Stomatal conductance (gs): $mol\ H_2O\ m^{-2}\ s^{-1}$

Evoparation rate (E): $\mu mol\ m^{-2}\ s^{-1}$

Internal temperature (Tic): ^0C

Intercellular CO_2 concentration: $\mu mol\ CO_2\ mol^{-1}$

Statistical analysis

Data derived on growth indices were subjected to one way analysis of variance ANOVA using SPSS statistics software and Duncan Multiple Range Test (Duncan, 1965) at ($P \leq 0.05$) level of significance.

RESULTS

Effect of mycorrhiza combination treatments on leaf number of *Shorea robusta* sapling has been depicted in figure 1. A gradual increase in leaf number can be clearly observed from July to June among all the three mycorrhizal treatments in the order of T2M > T3M >T1M. All the groups showed statistically significant results with p = 0.003 that is below the alpha level of significance p = 0.05 and thus, T2M is best suited combination with respect to formation of maximum leaf number. However, the influence of mycorrhizal combination treatment on the petiole was observed to be equivalent in T3M and T1M with minor variations and also was more pronounced than of T2M combination (figure 2). The significance level obtained was p = 0.01. Similarly the effect of mycorrhizal combination treatment on the midrib was observed and the results appeared to be in the order T3M > T2M > T1M (p = 0.009) (Fig 3). On the contrary the order of influence of mycorrhizal treatment on width of leaf was T2M > T3M > T1M (Fig 4) with statistical significance at p = 0.040 which showed high effect of mycorrhizal treatment on the saplings (Table 1).

Effect of mychorrhizal fungi on Physiological parameters

These include the evaluation of mycorrhiza combination effect on carbon assimilation in the *Shorea robusta* saplings. Figure 6 shows the degree of carbon assimilation from July to June among the three sets of experiments T1M, T2M and T3M. The results were statistically significant (p = 0.02), showing positive effect of mycorrhizal treatment on carbon assimilation of *Shorea robusta* saplings Through out the year in the order of T2M > T1M >T3M. Under T1M treatment maximum Carbon assimilation rate was $4.52 \mu mol\ Co_2\ m^{-2}s^{-1}$ during July followed by $4.17\ \mu mol\ Co_2\ m^{-2}s^{-1}$ during March. T2M treatment showed higher Co_2 assimilation rate than T1M and T3M treatment. Under T2m treatment maximum Co_2 assimilation rate was $4.73\ \mu mol\ Co_2\ m^{-2}s^{-1}$ and under T3M this value was $3.5\ \mu mol\ Co_2\ m^{-2}s^{-1}$. However, contradictory results were observed on the stomatal conductance with highest effect on T1M followed by T3M and T2M having variation range from 0.39 (within groups) to 0.27 (between groups) (Fig 7). Highest statistical significance was observed at alpha level of significance (p = 0.001). This shows the effect of mycorrhiza in soil composition pertaining to T1M to be best suited with respect to stomatal conductance. Effect on the rate of evaporation as depicted in Fig8 reveals highest effect in the T3M mycorrhizal composition followed by T1M($2.16\ \mu mol\ Co_2\ m^{-2}s^{-1}$)and T2M($1.85\ \mu mol\ Co_2\ m^{-2}s^{-1}$) . The results were significant at (p = 20.05). Effect on inner temperature followed the order of T1M > T3M > T2M as shown in Fig9, with high statistical significance at (p = 0.038). Similarly, when mycorrhizal treatment composition was evaluated for its effect on internal carbon concentration, it revealed the values in the order of T3M > T2M > T1M with p = 0.01 and thus, the results show high

statistical significance (Table 2). Carbon assimilation and stomatal conductance was better in T1M and T2M combination than T3M combination.

DISCUSSION

About 85% higher plants tend to form a beneficial association with mycorrhizal fungi in their natural habitats (Bakshi, 1974). Sometimes this relationship represents a mutual give and take deal among microbionts and phycobionts for sustainable survival while in some cases it is obligatory for both the species (Pyasi *et al.,* 2013). Significant contribution in plant nutrition, growth improvement, successful afforestation, reforestation, bio-control of pathogens and land reclamation programs using mycorrhizal fungi have been reported by different researchers (Rawat *et al.,* 2003; Tupwal *et al.,* 2015). This association can be helpful in establishment of new plantations in degenerating forest covers particularly at deteriorating sites. Three different types of mycorrhizal composition treatments were tested in the present study, as even though all the natural consortium of microbes are available in forest soil but are not much effective in proper growth and establishment of Sal saplings. Among the three different compositions of mycorrhiza treatment having varying soil, sand, FYM and coco pit ratios T2M showed higher growth rate among majority of the growth and physiological parameters followed by T3M and T1M.Considerable results have been reported results with artificial micorrhization in species like *Pinus* and *Eucalyptus* (Alexander, 1981; Marx and Ross, 1970; Lakhanpal, 1987; Lee and Alexander, 1994; Tawaraya *et al.,* 2003; Lee *et al.,* 2008; Tupwal *et al.,* 2015). Significant shoot growth was reported in inoculated sapling as compared to control sapling samples which showed congruence with the study of Tapwal *et al.* (2015). All the treatment groups were found to be having significant growth and augmented physiological parameters as compared to non- inoculated control samples. The higher growth rate of the seedlings inoculated with mycorrhizal composition treatments as compared to the control samples may be attributed to increase in nutrient mobilization towards the roots by the associated mycorrhiza fungi as they enhance the availability of minerals having low mobility like phosphorus and micronutrients (Smith and Read, 1997), as well as provide protection against plant pathogens; hence, improving the plant health (Morin *et al.,* 1999). *Shorea robusta* being an important timber species of North East and Central India has critical environmental requirements for proper seed establishment and mycorrhiza treatment proves to be having a direct effect on growth and establishment of saplings as seen from the results of the present study. Thus, in Central India, use of mycorrhizal inoculums in nursery conditions may facilitate seedling establishment outside its natural habitat and improved performance at the time of field transplantations.

CONCLUSION

As evident from the results of the present study all the three treatment compositions T1M, T2M, T3M were showing statistically significant effects in growth and physiology as evident in the seedlings of *Shorea robusta* in the order of T2M, T3M, T1M Control. Carbon assimilation, stomatal conductance and evaporation rates in young saplings were enhanced as compare to control set of experiment outside its natural habitat in *Shorea robusta*. Artificial introduction of ecto mycorrhizal fungi results in formation of mycorrhiza associated with feeder roots as well as enhance the initial growth and establishment of Sal seedling.

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Table.1: Growth pattern parameters depicting F and p – values of Shorea robusta saplings obtained from ANOVA.

	F	P-value
Height	3.833398	0.031844
Leaf Number	6.685163	0.003652
Petiole Length	5.15966	0.011226
Midrib Length	5.448146	0.009024
Leaf width	3.535069	0.040638

Table.2: Physiological parameters depicting F and p – values of Shorea robusta saplings obtained from ANOVA.

Physiological parameters	F	P-value
Carbon assimilation	4.328929	0.021403
Stomata conductance	11.65756	0.000148
Evaporation rate	1.428219	0.054169
Internal temperature	3.586208	0.038964
Internal CO_2 concentration	4.632402	0.016859

Fig 1. (A) Control-leaf number per sapling	Fig 1. (B) Leaf number per sapling Influence by different mycorrhizal treatment

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Fig 2. (A) Control-Height per sapling

Fig 2. (B) Height per sapling Influence by different mycorrhizal treatment

Fig 3. (A) Control-petiole length per sapling

Fig 3. (B) Petiole length of the leavesinfluenced by different mycorrhizal treatment

Fig 4. (A) Control-Midrib length per sapling

Fig 4. (B) Midrib length of the leaves influenced by different mycorrhizal treatment

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Fig 5. (A) Control-Midrib length per sapling
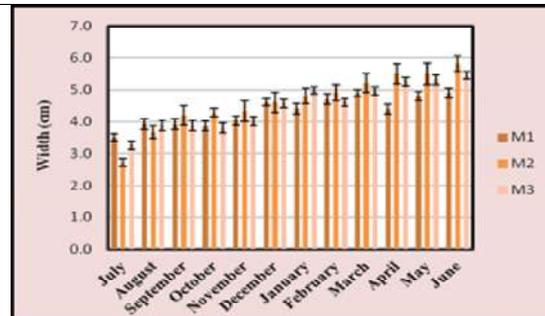
Fig 5. (B) Leaf width of the leaves as influenced by different mycorrhizal treatment
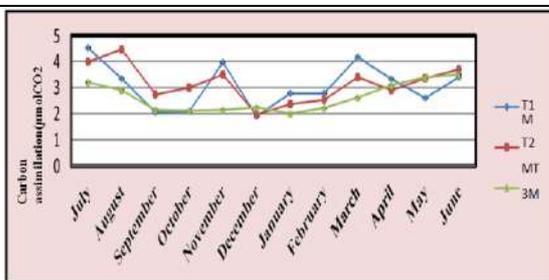
Fig6:-(A)Effect on Carbon assimilation of Different soil combination treatment with Mycorrhiza
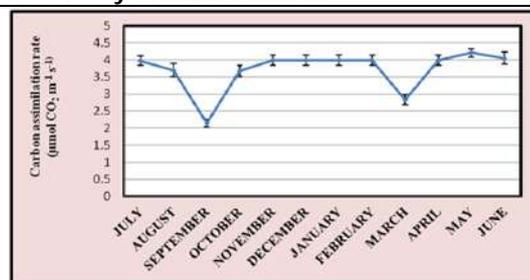
Fig6:-(B) Control treatment- Carbon assimilation rate in the sapling S.*robusta*.
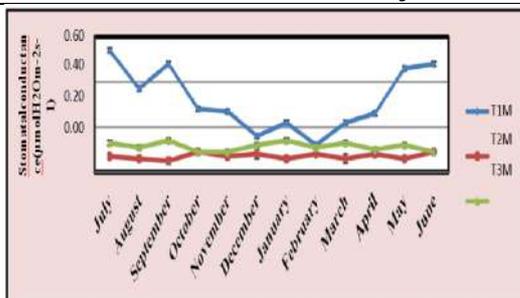
Fig7- (A)Effect on Stomatal conductance of different soil combination treatment with mycorrhiza
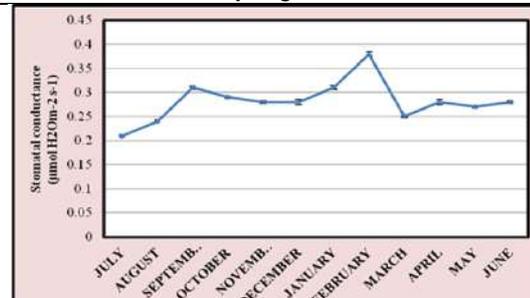
Fig7-(B)Control Treatment-Stomatal conductance in the sapling of *S.robusta*.
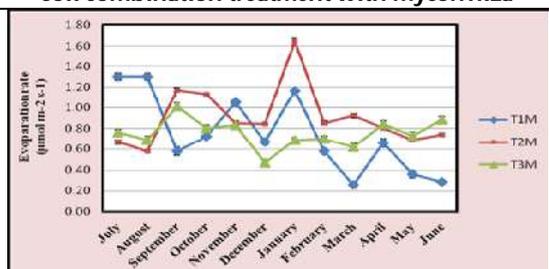
Fig8:-(A)Effect on Evaporation rate of different soil combination treatment with my corrhiza
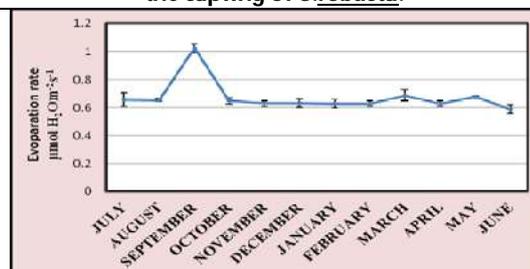
Fig8:-(B) Control- influence on Evaporation rate in the sapling of *S.robusta*.

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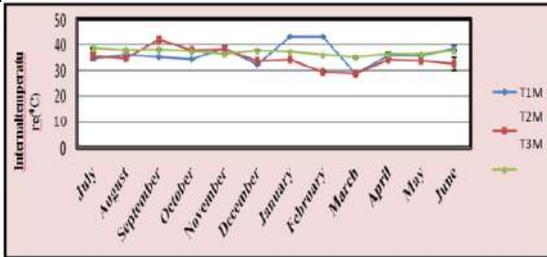
Fig 9:-(A)Effect on Internal temperature of different soil combination treatment with mycorrhiza
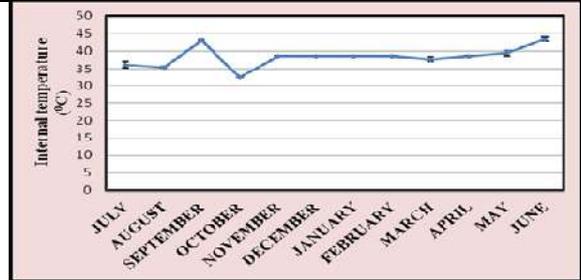
Fig 9:- (B) Control- influence on internal temperature in the sapling of *S.robusta*
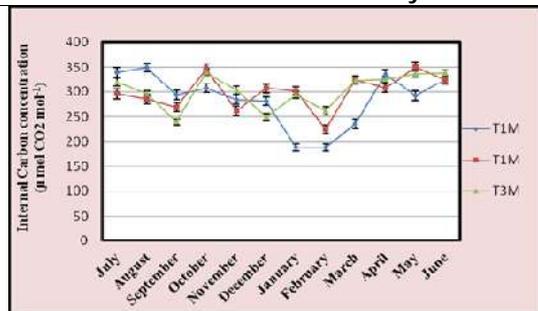
Fig.10:-(A)Effect on Internal Carbon concentration of different soil combination treatment with mycorrhiza
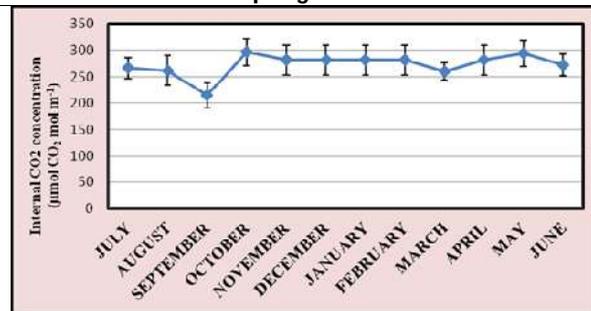
Fig.10:- (B) Control-influence on internal CO2 concentration in the sapling of *S.robusta*.

RESEARCH ARTICLE

Tissue Competition: Surprising Role of Cross-Adhesion

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ABSTRACT

Mechanical forces have been speculated to control the dynamics of tissue growth. In particular, the mechanical pressure determines the outcome of a tissue competition and the key factor is the homeostatic pressure which is the steady state pressure at which cell division rate and cell death rate are equal. It was observed previously that the tissue having larger homeostatic pressure always overwhelms the weaker tissues. Here the surprising importance of cross-adhesion has been presented. In particular, it is found that even the tissue having lower homeostatic pressure can coexist with the stronger tissues if the cross-adhesion strength is sufficiently small. The result can be understood from simple continuum modelling which can also predict the resulting cell number fraction.

Keywords: tissue growth, tissue competition, molecular dynamics simulations, particle-based simulations, homeostatic pressure, dissipative particle dynamics, modelling cell division

INTRODUCTION

Mechanics of tissue growth recently becomes vibrant field of study for physicists and biologists. In case of cancer, healthy host tissue and cancerous tissue are in a competition within a biological system for occupying space. It has been suggested that the homeostatic pressure[1] is an important factor which controls the tissue competition. The pressure, at which cell death rate (apoptosis) and cell division rate of a tissue are equal, is called homeostatic pressure. The cell division within a tissue is not uniform spatially. It has been reported that cells which are near the surface divide more than those in the bulk[2,3] which can easily be understood. A cell must have to change its surroundings to grow further and divide. When a cell is very close to the surface, then it is very easy to create

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deformation compared to its position in bulk and this suggests that the growth is more favoured when the cell is very close to the surface which is shown by performing computer simulation of growing tissue spheroid in ref.[3]. Tissue growth also depends on the environment and external forces. Tissue under tension enhances cell division rate whereas compressive stress on tissue increases cell death. Basan *et al.* [4] showed that when two tissues having non-zero homeostatic pressure difference are in a competition, the stronger tissue always wins the competition by taking over the compartment which is also suggested by ref.[5] for a competition on a substrate where the interface between the two tissues moves with a constant velocity, which increases linearly with the homeostatic pressure difference between the two tissues. In both cases, they have used the value of cross-adhesion strength identical to the self-adhesion strength. In this work, tissue competition (three-dimensional) has been studied using a computer simulation model[4, 6 – 9]. Again, it is found that the tissue having larger homeostatic pressure invades the other one. However, the result is surprising when tissues with non-identical adhesion strengths are in a competition. It is found that the tissue having lower homeostatic pressure can coexist with the tissue having larger homeostatic pressure, if the cross-adhesion strength between them is small enough compared to the self-adhesion strength.

MATERIALS AND METHODS

The same minimalistic mesoscale simulation model as implemented in ref. [4, 6 – 9] has been utilized here to study the tissue competition. In this model, a cell is constructed by two-point particles i and j which are repelling each other by a growth force $F_{ij}^g = \frac{G}{(r_{ij}+r_0)^2}\hat{r}_{ij}$ where G is the strength of the growth force, r_{ij} and $\hat{r}_{ij}$ are the displacement and unit displacement vector of ith and j^{th} particles belonging to the same cell and r_0 is some constant. When the separation between i^{th} and j^{th} particle of a cell reaches a predefined critical size r_c then the cell division starts. A single cell generates two new cells after divsion. To incorporate this fact, new particles are positioned randomly very close to i^{th} and j^{th} particles of the original cell which then act as two new-born cells. Apoptosis is implemented by complete removal of cells at constant rate k_a. Cell division and apoptosis are only the active processes in the simulation. The volume exclusion force $F_{ij}^v = f_0\left(\frac{R_{pp}^5}{r_{ij}^5} - 1\right)\hat{r}_{ij}$ is used to ensure impenetrability of cells, where f_0 denotes the cell-cell potential coefficient and R_{pp} is the cut-off distance of all interactions acting between i^{th} and j^{th} particles belonging to the different cells. The cell adhesion is modelled by taking a simple constant force $F_{ij}^a = -f_1\hat{r}_{ij}$ with the adhesion strength f_1. Dissipative particle dynamics (DPD) type thermostat [10, 11] is used to take care of random fluctuations and dissipation. It has two parts, (1) a random force $F_{ij}^r = \sigma\omega^R(r_{ij})\xi_{ij}\hat{r}_{ij}$ and (2) a dissipative force $F_{ij}^d = -\gamma^D\omega^D(r_{ij})(v_{ij}.\hat{r}_{ij})\hat{r}_{ij}$ where σ and γ^D are the strengths of the random and dissipative forces respectively, $\xi_{ij} = \xi_{ji}$ is a symmetric Gaussian random variable with unit variance and zero mean, $v_{ij} = v_j - v_i$ is the relative velocity between the particles i and j and $\omega^R(r_{ij})$ & $\omega^D(r_{ij})$ are the weight functions, which are coupled by $\omega^D(r_{ij}) = \left[\omega^R(r_{ij})\right]^2$.

RESULTS AND DISCUSSION

Coexistence

In this work, each Species is defined by the parameters G, f_1 & P_H. When two non-identical tissues (Species A: $G = 40, f_1^A = 6.0, P_H^A = 5.3$ & Species B: $G = 50, f_1^B = 6.0, P_H^B = 17.6$) having different homeostatic pressure are growing in a competition, it is found again that the tissue having larger homeostatic pressure (Species B) always invades the weaker one if the cross-adhesion strength f_1^c is identical with their self-adhesion strength which is reported in ref.[4] and shown in fig.1(a). However, if these tissues are competing with the cross-adhesion strength $f_1^c = 0$ then they are clearly in coexistence with different individual cell number fraction though they have different homeostatic pressure which is displayed in fig.1(b) and the steady state pressure of the mixture is larger than the individual homeostatic pressures which is presented in fig.1(c). These simulations are done in a cubic box with periodic boundary condition. The initial configuration is generated such that the initial number of cells present in Species A is 95% of the total number of cells in the simulation box. The division of space between the two Species is set along the z-direction and

that is why the interface, separating the two tissues, is parallel to $x - y$ plane which is shown in fig.1(d) and it is flat because of $f_1^c = 0$. The cells are dividing more near the interface and they are dying at the bulk. So, there is a flow of cells from the interface between the two tissues towards the bulk which sets the steady state. The steady state pressure of the mixture is greater than the homeostatic pressure of the individual component due to the enhanced growth at the interface.

Prediction of tissue competition between two identical Species with cross-adhesion strength f_1^c close to their self-adhesion strength f_1

For simplicity, two identical tissues are taken in a competition and they are interacting each other with different cross-adhesion strength f_1^c lower than their self-adhesion strength f_1. The two-rate model as introduced in ref.[3] is implemented here. The net bulk growth rate is $k_b = k_d - k_a$ with cell division rate k_d and apoptosis rate k_a. Since the growth rate close to the surface is higher than the bulk[8], the net surface growth rate is $k_s = k_b + \Delta k_s$ and the dependence of Δk_s on external stress is different than k_b. The net bulk growth rate k_b can be expanded around P_H, the homeostatic pressure, and can be written in terms of $P_H - P$, the pressure difference between the homeostatic pressure P_H of the tissue and an externally applied pressure P, as in ref.[6].

$$k_b = \gamma(P_H - P) \tag{1}$$

Considering the facts of the surface and bulk growth, the growth equation of a tissue can be written as

$$\frac{\partial N^A}{\partial t} = k_b N_b^A + k_s N_s^A \left[\because k_b = k_b^A = k_b^B \, \& \, k_s = k_s^A = k_s^B \right] \tag{2}$$

where N^A is the total number of cells of Species A present at any time in the simulation box, N_b^A and N_s^A are the instantaneous number of cells of Species A which construct the bulk and surface region of Species A respectively. Therefore, $N^A = N_b^A + N_s^A$. The total number of cells of both Species present within the simulation box is $N = N^A + N^B$ where N^B denotes the total number of cells of Species B. Dividing eqn.2 by $\left(N^A + N^B \right)$ and defining $\phi^A = \frac{N^A}{N^A + N^B}$ as cell number fraction of Species A, one can get

$$\frac{\partial \phi^A}{\partial t} = k_b \phi_b^A + k_s \phi_s^A \tag{3}$$

According to the definition, $\phi = \phi^A + \phi^B = 1$ and $\phi^A = \phi_b^A + \phi_s^A$ where ϕ^B is the cell number fraction of Species B and ϕ_b^A & ϕ_s^A are the cell number fractions corresponding to the bulk and surface region of Species A. Using these inputs, eqn.3 can be rewritten as

$$\frac{\partial \phi^A}{\partial t} = k_b \phi^A + \Delta k_s \phi_s^A \tag{4}$$

In this case, tissue competition with the cross-adhesion strength f_1^c close to the self-adhesion strength f_1 of the individual tissue has been studied. One can define a new parameter $\epsilon = \frac{f_1 - f_1^c}{f_1}$. For $|\epsilon| \ll 1$, Δk_s can be expanded around ϵ.

$$\Delta k_s = a_1 \epsilon + \mathcal{O}(\epsilon^2) \tag{5}$$

If the tissue competition has been started initially from a randomly mixed configuration of two Species with some initial fraction of cells of a tissue, then it can be assumed that $\phi_s \propto \phi^A \phi^B$ for $|\epsilon| \ll 1$ and one can write following equations using eqn.4.

$$\frac{\partial \phi^A}{\partial t} = k_b \phi^A + b_1 \epsilon \phi^A (1 - \phi^A) \tag{6}$$

$$-\frac{\partial \phi^A}{\partial t} = k_b (1 - \phi^A) + b_1 \epsilon \phi^A (1 - \phi^A) \tag{7}$$

where b_1 is a positive constant. Addition of eqn.6 and eqn.7 gives

$$-k_b = 2b_1 \epsilon \phi^A (1 - \phi^A) \tag{8}$$
and

$$P = P_H + \frac{2b_1 \epsilon}{\gamma} \phi^A (1 - \phi^A) \tag{9}$$

Eqn.9 shows that pressure is linear with ϵ which is reflecting in the fig.2(b) for the range of ϵ from 0 to 0.2 up to which this theory is valid. Subtraction of eqn.6 and eqn.7 generates

$$\frac{\partial \phi^A}{\partial t} = -2b_1 \epsilon \phi^A (1 - \phi^A) \left(\phi^A - \frac{1}{2}\right) [using\ eqn.(8)] \tag{10}$$

Eqn.10 suggests that at the steady state, ϕ^A has three solutions $\phi^A = 0$, $\frac{1}{2}$ & 1.
Lets, (say)

$$\mathcal{F}(\phi^A) = \frac{\partial \phi^A}{\partial t} = -2b_1 \epsilon \phi^A (1 - \phi^A) \left(\phi^A - \frac{1}{2}\right)$$

$$\mathcal{F}'(\phi^A) = \frac{\partial \mathcal{F}(\phi^A)}{\partial \phi^A} = -2b_1 \epsilon (1 - \phi^A) \left(\phi^A - \frac{1}{2}\right) + 2b_1 \epsilon \phi^A \left(\phi^A - \frac{1}{2}\right) - 2b_1 \epsilon \phi^A (1 - \phi^A) \tag{11}$$

So, for $\epsilon > 0$, $\phi^A = 0$ & 1 are unstable and $\phi^A = \frac{1}{2}$ is only the stable fix point but for $\epsilon < 0$, the stability of the solutions is reversed. This has been investigated by simulating competitions between two identical tissues which are represented by the parameters $G = 40, f_1 = 6.0$ & $P_H = 5.3$ and interacting via several values of cross-adhesion strengths f_1^c. Fig.2(a) shows the cell number fractions of a tissue (Species A) at steady state for the numerous values of ϵ for such simulations. It is found that the steady state solution of ϕ^A is $\frac{1}{2}$ for $\epsilon > 0$ and for $\epsilon < 0$, it is 1 as predicted by eqn.11 though the theory is valid for $|\epsilon| \ll 1$.
The exact solution of the eqn.10 is

$$\phi^A(t) = \frac{1}{2}\left[1 \pm \frac{1}{\sqrt{1 + 4\exp(b_1 \epsilon t + c)}}\right] \tag{12}$$

where $c = \ln\left[\frac{1}{(4\phi_0 - 2)^2} - \frac{1}{4}\right]$ with initial cell number fraction ϕ_0.

The dependence of k_b on pressure is calculated using constant pressure ensemble as stated in ref.[6]. Fig.3(a) displays how k_b changes as a function of $P_H - P$ for a given tissue and eqn.1, which is a straight line, is fitted (solid red line) there to evaluate the value of γ for that tissue. So, in eqn.12, the only parameter b_1 is unknown. To determine the value of b_1, tissue competitions between two identical Species with different $f_1^c (< f_1)$ for $|\epsilon| \ll 1$ have been simulated and plotted steady state values of the pressure with ϵ, shown in fig.3(b). After fitting eqn.9 to such plot, one can easily find the value of b_1 from the slope of the straight line, using the value of γ & ϵ. Now, $\phi^A(t)$ can be plotted with time as in eqn.12 for a competition and it can also be used to compare the theoretical result with the simulation data. The agreement is excellent which is shown in fig.3(c).

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CONCLUSION

In tissue competition between two tissues the interface between them plays a very crucial role. The tissue having larger homeostatic pressure can coexist with tissue having smaller homeostatic pressure due to the enhanced growth at the interface between them. Here, it is shown that the simple theory can predict the computer simulation results of cell number fraction quite well when $|\epsilon| \ll 1$. Another different theory has also been developed in ref.[8] to predict the cell number fraction.

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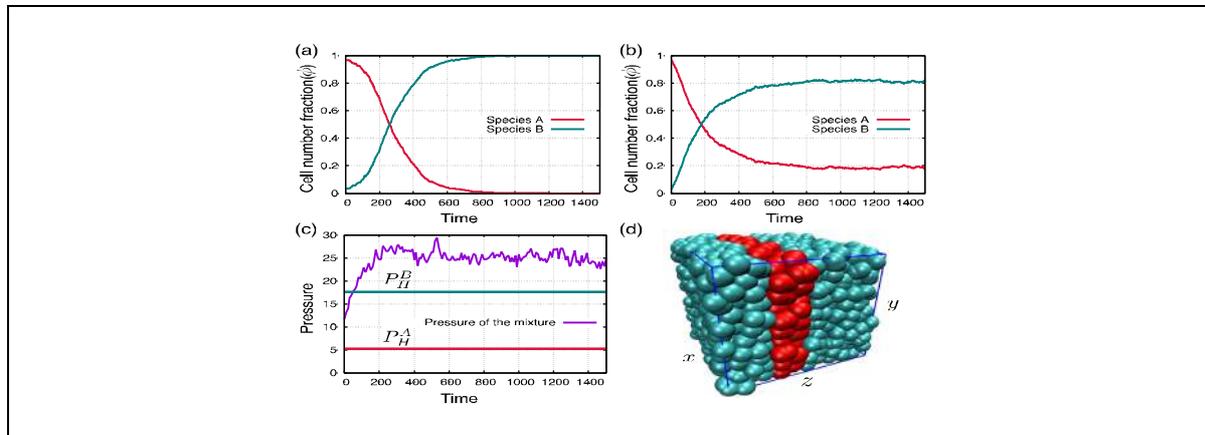
Figure 1: (a) Time evolution of the cell number fractions(ϕ) of Species **A** ($G = 40, f_1 = 6.0, P_H = 5.3$) and Species **B** $\left(G = 50, f_1^B = 6.0, P_H^B = 17.6 \right)$ when they are in competition with $f_1^c = f_1^{A/B}$. **(b)** Growth of these two tissues in terms of their cell number fractions(ϕ) with time when they are competing via $f_1^c = 0$. **(c)** Time evolution of pressure of the mixture for the competition as stated in **(b)**. **(d)** A snapshot of the tissue competition as described in **(b)**.
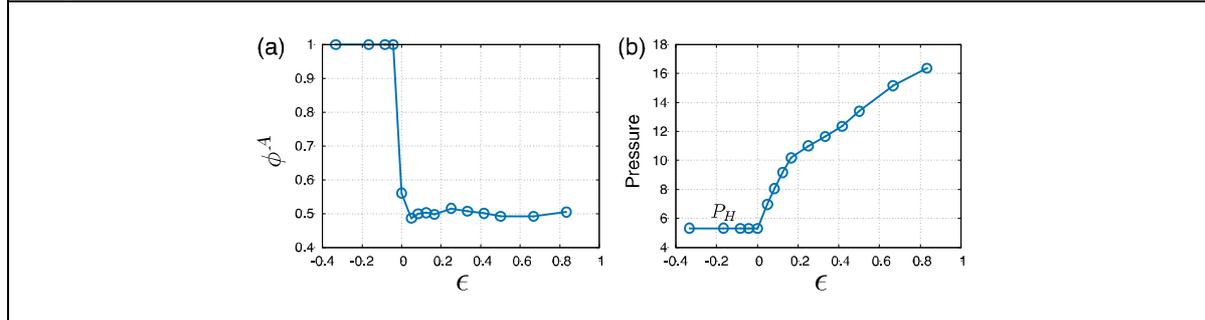
Figure 2: (a) Cell number fractions of Species A for different ϵ when two identical tissues (G = 40, f$_1$ = 6.0 & P$_H$ = 5.3) are competing with various values of f_1^c. **(b)** Variation of pressure for such competitions with ϵ. Pressure is linear with ϵ as in eqn.9 for the range of ϵ from 0 to 0.2 where the theory is valid.
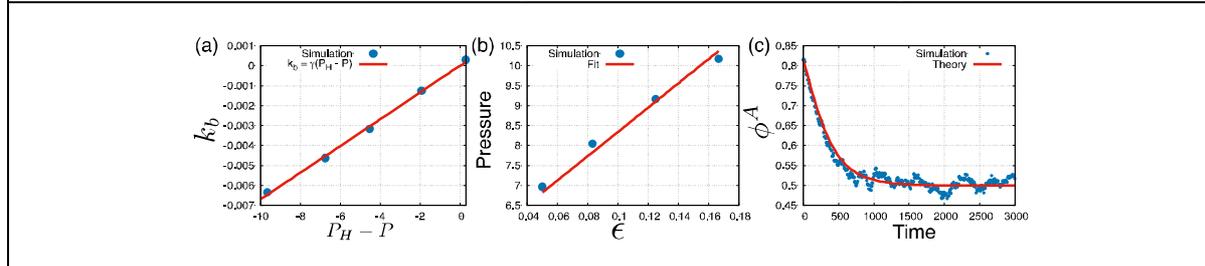
Figure 3: (a) Dependence of k_b on the pressure difference $P_H - P$ between an external pressure P and the homeostatic pressure P_H of the tissue ($G = 40, f_1 = 6.0, P_H = 5.3$). Solid red line is the fitting of eqn.1. **(b)** Pressures in tissue competitions between two identical Species as a function of ϵ for $|\epsilon| \ll 1$ (blue filled circles). The solid red line is the fitting of eqn.9. **(c)** Time evolution of $\phi^A(t)$(blue filled circles) during the competition between two identical Species ($G = 40, f_1 = 6.0, P_H = 5.3$) interacting via $f_1^c = 5.0$. Solid red line is the corresponding theoretical prediction which is the plot of eqn.12. The agreement between theory and simulation is magnificent.

RESEARCH ARTICLE

A Collective Setting of Cultural Tensions in Salman Rushdie's Midnight's Children

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ABSTRACT

The paper aims at producing the conflicts in *Midnight's Children* in the most original form. The Paper offers that Salman Rushdie's *Midnight's children* can be observed as a collection of conflicts, he has defied all the notions allotted to the words like Home, Ancestry, Migration, and Culture. Rushdie has successfully portrayed the impact of partition on the people of both countries and the journey India witnessed afterward. The paper based on secondary research and qualitative analysis in nature, provides a detailed perspective of conflicts presented by Rushdie along with justification of their presence from the view of different researchers. To understand the conflicts presented by Salman Rushdie. Exploring the depth of issues of conflict between Home, Ancestry, Migration, and Culture. Developing ideas about the subject from different perspectives.

Keywords: Migration, Culture, Home, Ancestry

INTRODUCTION

Published in 1981, the novel revolves around the life of Salem Sinai a boy born at the stroke of midnight with magical powers. Similar to all the other children born at that hour each with a different and special power. Infused with magic realism Rushdie has used most of his characters as metaphors especially Saleem who can be seen as a metaphor for Indian history (Durix, 1985).

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Though the story begins with Adam Aziz, the grandfather of Saleem, and his wife Naseem. The way they shift leaving their home Kashmir behind due to a single person and the hostility he makes Adam feel. They move to Agra, an important symbol in the story of Indian independence. One of their daughter (Mumtaz) after separation from Nadir khan marries Ahmad Sinai a young merchant and moves to Delhi and then to Bombay. The house they buy from an Englishman William Methwold is entertained by Willie Winky who sings along with his wife Vinita who is carrying the child of Methwold and is delivered at the same time as Amina's (Mumtaz). The Children are exchanged by a nurse Marry under the dilemma of socioeconomic status. The son of William Methwold is given to Amina and is known as Saleem Sinai while the son of Ahmad Sinai is given to Winky and is known as Shiva. Both the boys grew up to be arch-nemesis. The story prevails with the growth of Saleem and India after independence (Rushdie, 1995).

METHODOLOGY

The data collected for the paper is secondary and qualitative. A close reading of the text along with journals has been used as the primary source for data collection. All three parts of the novel are considered for the data collection and views of the writer based on his several media presence is considered as well. As the novel is reputed to be a semi-autobiographical novel the close connection of the author with the story is as well deduced for an enhanced understanding of his views and ideas behind conflicts. The collected data has been analysed using discourse analyses.

DISCUSSION

The novel has various conflicts including linage as the blood is not given the importance as was given in the earlier times, the writer has challenged all the conventional roles, symbols, and beliefs of Islam and Indian mythology infusing them with politics, history, magic realism, symbolism, and socio-economic status. The busting of conventions give rise to conflicts as witnessed in the novel. As per Kane and Rushdie (1996), the connection between Adam Aziz's nose and lord Ganesha's trunk while it represents the massacre of people is not something we can observe normally in literature the conflict of religion and its connection to destruction rather than perseverance is another example of conflicts presented and created by Rushdie. According to *Schurer (2004)*, Rushdie's knowledge of Indian mythology, history, and cultures is evident in the work but the way he has shaped the narrative shows his perception of knowledge which stands out from most population of the country, the novel can as well be observed as a conflict to the traditional history of India.

Conflict of Home

Upstone *(2007)*, has shed light on the existence of domestic space in the novel, the house has can be seen as a representation of many things including the site of power contestation, political struggle, or a safe domestic space. The representation can be deduced from the perspective of colonial and post-colonial literature giving different meanings to it. The conflict between home as a safe space a person has or seeks throughout his or her life can be observed in the novel the protagonist keeps running from one house to another which can as well be symbolic of the growth of the Country as it can't be settled. From the beginning of the novel no clear notion of home can be observed as Adam moves from Kashmir to Agra because he feels unsafe there, Ahmed moves to Delhi in search of a better life, and later to Bombay witnessing the destruction of his factory. Later Saleem moves to Pakistan and then strolls around India in search of the same safe space which is nowhere to be found. A similar conflict of the homeland can be observed as Pakistan is considered as the homeland of the Muslims but Saleem and Amina do not feel at home in the country. Saleem as well can be observed to struggle to find a home as he doesn't belong to any of the countries absence of that safe space in his life can be observed as a metaphor for not being a place left for Britishers in the country (Lipscomb, 1991).

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Conflict of Ancestory

Ancestry plays an essential role in the development of a person's character and at times in the development of their personality and shaping their future as well. Though the idea of ancestry is not exactly conventional in the novel. As Hogan (2001) explains the novel signifies the passing of nothing to the future generations in terms of connection of ancestry, on each stem the lead of the story is shown as different from its last generation. Rushdie has as well given more importance to the values of parenting than those of lineage. The characteristics of Saleem born from an extramarital affair, low class, and infused with greed from his father's side, shows none of the negative characteristics. Whereas Shiva having the blood of Doctor, Merchant, and several reputed members from earlier generations ends up being evil. The age-old saying of Indian mythology " like father like son" is yet again countered by Rushdie. The development of conflict of Ancestry can as well be observed as writers attempt to provide solace to people who lost their families and identities and started with new ones. Erasing the concept of the importance of ancestry contributes to powering the feeling of belongingness. Along with that, this promotion of hybridity and tolerance is an attempt to create a world that sees beyond lineage or ancestry (Brown, 2011).

Conflict of Migration

As mentioned by Doorgan *(*2011*)*, the views of migration held by Rushdie are inspired by his very own life experiences. He moved from Kashmir to Bombay, then to Pakistan, and at last to Britain. The development of thoughts he had through migration is similar to what he has introduced to his characters. Adam Aziz turns to politics and supports the unity of India and Pakistan because of what he witnessed in Amritsar and later in Agra. Amina has her own experiences which change her personality and make her stronger with time and in end, Saleem finds meaning in his life through constant migration. Migration is not presented as a medium of escape in the novel but rather as a journey towards growth and enlightenment. The cultural newness encountered due to the migration is presented in a positive light by Rushdie. The conflict further grows as the writer puts forth the problems of immigration a concept not popular in earlier post-colonial literature. People believed returning home is a symbol of peace, but the idea is countered by Rushdie throughout the novel. From Adam Aziz finding it difficult to survive in Kashmir to Saleem who fights to survive in the country, he grew up in.

Conflict of Culture

Rushdie (2006), sheds light on his perception regarding cultures mentioning the collective form of culture the writer has presented in Midnight's children including colonialism and native culture. Culture is considered not as a subjective entity keeping people together but rather as forces that people have to counter altered due to migration, hybridity, and colonization. In the novel culture is not observed to provide peace or comfort to the characters but rather makes their survival harder. As Germany returned doctor suffers hard to make peace with his cultural surroundings of Kashmir. In the case of Naseem, the control she has makes herself feel guilty due to the cultural barriers she has faced during the early years of her life. The characters witness a continuous struggle with the culture and only acceptance of multiculturalism provides them with solace.

CONCLUSION

The conflicts constructed in the novel present the mindset of the author, Rushdie's attempt on developing a story filled with unconventional turns, events, and characters presents the exact shape of India's journey post-independence and the message of acceptance and endurance is what further makes it more valuable. The discussion concludes the conflicts contribute greatly to the richness of fiction and make it stand out. Along with that, they make the work separate from most post-colonial literature. The conflicts can be directly connected to the issues faced by the people of India after the partition. These conflicts as well create a shift of focus from the issues people have fed more importance to than they deserved and bring to light a deeper common history and it's problems.

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REVIEW ARTICLE

A Systematic Review of Prescription Pattern of Antibiotics in Paediatrics

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ABSTRACT

To study the systematic review of Prescription pattern of antibiotics in Paediatric patients. A systematic search was performed Google Scholar, DELNET, and Pub Med for all articles on drug utilization in paediatric ward. The search was restricted to human studies and those that described drug utilization or drug patterns or trends. In this study, the major disorders for which antibiotics were prescribed include pneumonia (35%) and acute gastroenteritis (25 %). The male gender accounts for the majority of the subjects (65%), followed by the female gender (35 percent). The majority of the subjects were aged 1 month to 1 year (37.5%), followed by 6-12 years (25%), 0-28 days (22.5%), 12 months to 23 months (10%), and 2-5 years (5%). Cephalosporin (35%) are the most commonly prescribed antibiotics group. Aminoglycosides came in second (27.5%), followed by Penicillin (25%), Macrolides (11%), Fluoroquinolones (9%), and Sulphonamides (5%). It was found that ceftriaxone (15%) was the most commonly used antibiotic. Followed by Cefotaxime (8%), cefixime (5%), cefpodoxime (3%), and cephalexin (1%), Gentamicin (13%), Amikacin (12%), Ampicillin (7%), Amoxicillin (13%), Ciprofloxacin (5%), Levofloxacin (3%), Ofloxacin (1%) and Cotrimoxazole (3%). Ceftriaxone with amoxicillin was the most commonly prescribed antibiotic combination.

Keywords: Paediatrics, Antibiotics, Cephalosporin's, Penicillin, Prescription

INTRODUCTION

Many physiological changes occur during childhood that may have an impact on the pharmacokinetics and dynamics of a compound. Paediatric patients are now recognised as a special population for drug therapy. Absorption, distribution, metabolism, and excretion are all factors that influence tissue drug concentrations over time (ADME) [1]. These ADME processes differ in paediatric populations from adults and have an impact on a drug's

pharmacokinetic profile [2]. Due to differences in pharmacodynamics and pharmacokinetics, paediatric patients are among the most vulnerable groups to contact illnesses and adverse drug effects. Antibiotics are the key drugs for treatment of infections and are the mostly prescribed drugs in paediatric groups [3]. The antibiotic option will also be determined by its cost. Furthermore, accurate identification is important because it can reduce the cost and toxicity of antibiotic therapy as well as the potential for antibiotic resistance [4].

Antibiotics in Paediatrics

Antibiotics are the most commonly prescribed drugs in paediatric populations for the treatment of infections. Paediatric patients are among the most vulnerable group to contact illnesses and cause harmful effects of drugs due to differences in pharmacodynamics and pharmacokinetics [5]. The use of antimicrobial agents, particularly antibiotics has become a routine practice for the treatment of paediatric illnesses. Evaluation of prescribing pattern will help in minimizing adverse drug reactions, as paediatric groups are more liable to them and it shall also aid in providing cost effective medical care [6]. Effective treatment is based on accurate diagnosis & rational treatment of the medical condition. If the diagnosis is correct, antibiotics are more effective and play an important role in the management of infectious diseases. However, they can have serious consequences, such as super infection and the emergence of multidrug-resistant microorganisms, which are expected to cause more serious infections [7].

METHODOLOGY

A systematic search was performed Google Scholar, DELNET, and PubMed for all articles written in English reporting on drug utilization in neonatal wards. The search was limited to human studies and those that described drug use, patterns, or trends. The Preferred Reporting Items for Systematic Reviews in flowchart are used to illustrate the electronic search progression of this study. After duplicates were removed, the identified publications were manually screened based on titles and abstracts. Observational studies that were identified as potentially relevant were then reviewed as full-text articles. The reference lists of the selected publications were checked for other relevant publications that might meet the study eligibility criteria in order to improve the search. To reduce selection bias, all potentially relevant articles were critically reviewed and those that met the inclusion criteria were chosen. Abstracts were reviewed, and full articles were obtained if the study appeared to be relevant.

Study Criteria

Inclusion Criteria
 a. All the paediatric patients irrespective of gender between the ages of 0-12 years.
 b. Prescriptions containing antibiotics.
 Exclusion Criteria
a. All the paediatric patients irrespective of gender over 12 years.
b. Prescriptions which does not contain antibiotics.
c. Patients who are taking treatment on an emergency basis.

RESULT

Table: 1 Gender Wise Distribution of Antibiotics. Table: 2 Age Wise Distribution. Table: 3 Common Diagnosis Among Paediatric Patients. Table: 4 Percentage of Individual Antibiotics. Table: 5 Group Wise Distribution of Antibiotics. Table 6: Distribution of Antibiotic Combination In Paediatric Patients. Table: 7. Route of Administration of Drugs

DISCUSSION

Antibiotics were prescribed for the treatment of various disorders in the paediatric department of a tertiary care hospital in a total of 40 studies. The gender distribution of antibiotics is shown in Table 1. The male gender accounts

for the majority of the subjects (65%), followed by the female gender (35 percent). Table 2 shows the age distribution by gender. The majority of the subjects were aged 1 month to 1 year (37.5%), followed by 6-12 years (25%), 0-28 days (22.5%), 12 months to 23 months (10%), and 2-5 years (5%). Pneumonia affected 35% of the patients in the study. It was the most common disease diagnosed, with 25% of patients having acute gastroenteritis, 15% having urinary tract infections, 10% having URTIs, 10% having pharyngitis, 7.5 percent having meningitis, 5% having otitis media, and 2.5 percent having sepsis, as shown in Table 3. Antibiotics are among the most commonly prescribed drugs in hospitals and developed countries around 30% of hospitalized patients are treated with these drugs. Table 4 shows the frequencies of individual antibiotics prescribed. It was found that ceftriaxone (15%) was the most commonly used antibiotic. Followed by Cefotaxime (8%),cefixime (5%), cefpodoxime (3%), and cephalexin (1%), Gentamicin (13%), Amikacin (12%), Ampicillin (7%), Amoxicillin (13%), Ciprofloxacin (5%), Levofloxacin (3%), Ofloxacin (1%) and Cotrimoxazole (3%). Ceftriaxone has a highest cure rate when compared to cefotaxime. The response rate of ceftriaxone was 81 % and 80% for cefotaxime. Though prothrombin time, diarrhoea and superinfection did not differ between ceftriaxone and cefotaxime, ceftriaxone is more effective than cefotaxime. Table 5 shows the most commonly prescribed antibiotics groups for paediatrics. Cephalosporin (35%) are the most commonly prescribed antibiotics group. Aminoglycosides came in second (27.5%), followed by Penicillin (25%), Macrolides (11%), Fluoroquinolones (9%), and Sulphonamides (5%).

The effectiveness of cephalosporin against gram-positive cocci and some gram-negative bacilli, as well as their relative safety, make them potentially useful in treating paediatric infections, especially in cases of penicillin hypersensitivity. So this is why Cephalosporin Antibiotics are prescribed more frequently than Penicillin Antibiotics. Gram-negative bacteria cause the majority of bacterial infections in children, making aminoglycosides the second most commonly prescribed antibiotics in children, after the Cephalosporin group of antibiotics. Antibiotics in the Macrolides group are commonly prescribed as a penicillin alternative for patients who are allergic to penicillin. Sulphonamides are prescribed less frequently in this study due to their negative side effects, such as Photosensitivity. Ceftriaxone with amoxicillin was the most commonly prescribed antibiotic combination (50 %), followed by Ceftriaxone with gentamicin (17.5 %), Ampicillin with Gentamicin (12.5 %), ceftriaxone with Sulbactum (10 %), and ampicillin with Augmentin (7.5 %) (Table 6). The combination of antibiotics are mainly used to inhibit beta lactamase producing microorganisms, gram positive-gram negative infections and to treat resistant organisms.
The route of administration of antibiotics is shown in Table 7. The parenteral route had a 40% success rate. This is because the majority of the articles contained Ceftriaxone and Gentamicin, both of which are only available via parenteral administration. Suspension by the parenteral route is followed by the oral route, which accounts for 35 percent and 25 percent of the total.

Carbapenems class of antibiotics have been found to be as well tolerated and effective as antibiotics in the cephalosporin class. Antibiotics that contain carbapenems are effective against pseudomonas aeruginosa, listeria, and anaerobes while also being resistant to most beta lactamases enzymes. One of the most common side effects is seizure, which limits its use. As a result, it is primarily used in paediatrics for serious infections. Tetracycline antibiotics are antibiotics with a broad spectrum of action. It is not recommended for infants and children under the age of eight due to the risk of permanent tooth staining and growth retardation. Antibiotics containing chloramphenicol are not recommended for use in new-borns due to the high risk of Gray baby syndrome. Vomiting, irregular breathing, cyanosis, abdominal distension, hypothermia, and death are all symptoms. Pneumonia is the most common disease seen in children, followed by acute gastroenteritis and urinary tract infection, according to this study. The organisms in these top three diseases include both gram positive and gram negative bacteria. Because of its broad spectrum activity, ceftriaxone, a cephalosporin, has become one of the most widely used antibiotics. The antibiotics Gentamicin and Amikacin were the second and third most commonly used antibiotics, respectively. Because gram negative organisms caused the majority of the disease in this study, aminoglycosides were chosen as the second antibiotic. Due to their toxicity, such as cartilage abnormalities and photosensitivity, paediatricians used less fluoroquinolones and sulphonamide.

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CONCLUSION

The purpose of this study is to provide an overview of the pattern of antibiotic use in children. In general, our findings are consistent with those of previous similar studies. Pneumonia and gastroenteritis were the first and second most common reasons for antibiotic prescriptions, with Ceftriaxone and Amoxicillin being the most commonly prescribed combination. The majority of patients admitted to paediatric wards were between the ages of one month and one year, and they were mostly boys. Almost all of the antibiotics were administered intravenously

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Table: 1.Gender Wise Distribution of Antibiotics

Gender	Percentage (%)
Male	65%
Female	35%

Table: 2.Age Wise Distribution.

Age Group	Percentage (%)
0-28 days	22.5%
28 days to 12 months	37.5%
>12 months to 23 months	10%
2- 5 years	5%
6 – 12 years	25%

Table: 3.Common Diagnosis Among Paediatric Patients.

S.No	Diagnosis	Percentage (%)
1.	Pneumonia	35%
2.	Acute Gastroenteritis	25%
3.	Pharyngitis	10%
4.	Otitis Media	5%
5.	UTI	15%
6.	Sepsis	2.5%
7.	Meningitis	7.5%

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Table: 4.Percentage of Individual Antibiotics

Antibiotics	Percentage (%)
Ceftriaxone	15%
Cefotaxime	8%
Cefixime	5%
Cefpodoxime	3%
Cephalexin	1%
Gentamicin	13%
Amikacin	12%
Ampicillin	7%
Amoxicillin	13%
Azithromycin	11%
Ciprofloxacin	5%
Levofloxacin	3%
Ofloxacin	1%
Cotrimoxazole	3%

Table: 5.Group Wise Distribution of Antibiotics.

Antiibiotic Groups	Percentage (%)
Cephalosporin's	32%
Penicillin	20%
Amino glycosides	25%
Macrolides	11%
Fluoroquinolones	9%
Sulphonamides	3%

Table. 6: Distribution of Antibiotic Combination in Paediatric Patients.

Antibiotic Combinations	Percentage (%)
Ceftriaxone + Amoxicillin	50%
Ampicillin + Gentamicin	12.5%
Ceftriaxone + Sulbactam	10%
Ceftriaxone + Gentamicin	17.5%
Ceftriaxone + Augmentin	7.5%

Table: 7. Route of Administration of Drugs.

Route of Administration	Percentage (%)
Tablet	25%
Injection	40%
Suspension	35%

Analytical Study on Energy Efficient Secured Routing and Data Aggregation Techniques in Underwater Sensor Networks

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ABSTRACT

Underwater Sensor Network (UWSN) has number of independent underwater sensor nodes to perform monitoring tasks over given area. In underwater sensor network, the nodes not fixed due to the continuous water flow that affects the data transmission. Localization and security are the key problems to be considered in underwater sensor network. Data aggregation groups the data and transmits the aggregated data to the sink node. Due to power loss in UWSN, the sensor nodes stop the data transmission and reduce the time consumption. Many researchers carried out their research on data routing and data aggregation in UWSN. But, the delay was not minimized and bandwidth consumption was not reduced by using existing techniques. In order to address these problems, different routing and data aggregation methods are discussed.

Keywords: Underwater Sensor Network, localization, data aggregation, security, data routing, *bandwidth.*

INTRODUCTION

Underwater Wireless Sensor Networks (UWSNs) comprises the sensor nodes positioned underwater to sense properties like temperature, pressure and quality. The sensed data is used in different applications like military surveillance, disaster avoidance, offshore exploration and pollution level examining for the benefit of humans. UWSN face several problems like restricted bandwidth, greater propagation delay and random node mobility. UWSN reduced the propagation delay, bandwidth and packet loss. In UWSN, every node transmits the data packets with neighbor nodes. In UWSN applications, the secure transmission plays essential part in information sharing and

cooperation among sensor nodes. The sensor node mobility addressed various security attacks in UWSN. The node cooperation is very demanding one in UWSN due to node mobility. This paper is arranged as follows: Section 2 reviews the energy efficient secured routing and data aggregation in UWSN. Section 3 describes the existing energy efficient secured routing and data aggregation techniques. Section 4 explains the simulation settings with possible comparison between them. Section 5 discusses the limitation of existing energy efficient secured routing and data aggregation techniques. Section 6 concludes the paper.

LITERATURE REVIEW

A Q-learning-Based Opportunistic Routing (QBOR) protocol was introduced in [1] with onsite architecture for real-time data upload. But, delay was not minimized during routing process. A new routing scheme was designed in [2] to address the research constraints with higher energy efficiency and network unsteadiness in underwater communication. The reward function and adaptive fireflies was employed to determine optimal routing. Though the packet loss was minimized, the communication overhead was not minimized by new routing scheme. A compressive sensing scheme was designed in [3] for underwater environment expanded by recovery and transfer path. The compressive sensing was carried out at source and reconstructed using orthogonal matching pursuit at sink. But, energy consumption was not minimized by compressive sensing scheme. An improved energy-balanced routing (IEBR) algorithm was introduced in [4] to address the energy consumption issues for UWSN. The designed algorithm performed routing establishment and data transmission. However, the network lifetime was not improved by IEBR algorithm. A trust strategy-based dynamic Bayesian game (TSDBG) model was introduced in [5] to address the network congestion issues with lesser packet loss. The regular nodes were monitored to examine their neighbor nodes depending on the trust value. However, the computational complexity was not minimized. A distributed approach was designed in [6] to identify and avoid the routing attacks in networks. But, the energy consumption was not reduced by distributed approach.

A trusted cluster head and member nodes selection scheme was introduced in [7] using fuzzy logic. The trusted node was selected based on trust value with help of fuzzy logic rules. Though the energy consumption was reduced, delay was not minimized by designed scheme. A chaotic maps remote user authentication and key agreement scheme was designed in [8] for underwater acoustic networks depending on DLP and DHP. The authenticated users have rights to attain the useful information. However, the computational cost was not reduced by designed scheme. Secure Energy Efficient and Cooperative Routing (SEECR) protocol was designed in [9] for UWSNs. SEECR improved the security level through considering the resource constrained UWSNs environment. Though security level was improved, the data aggregation time was not reduced by SEECR protocol. A secure authentication and protected data aggregation method was introduced in [10] for cluster based UWSN. The data communicated in network was handled to ensure the network operations. Though the energy consumption and delay was reduced, the data aggregation accuracy was not improved by designed method. Q-learning based energy-efficient and balanced data gathering- adjacent node (QL-EEBDG-ADN) scheme was introduced in [11] to identify neighbor routes for packet transmission. However, the transmission delay was not minimized by QL-EEBDG-ADN scheme.

ENERGY EFFICIENT SECURED ROUTING AND DATA AGGREGATION IN UWSN

Underwater Wireless Sensor Networks (UWSNs) is an emerging technology for exploration of underwater resources. Security plays an important role in the UWSNs environment because the environment of UWSNs is prone to different security attacks. The key challenge of UWSN network are energy, cost, memory, communication range and limited lifetime of any individual sensor. UWSNs gained large interest because of rapid scientific development and advancements in defense needs. In underwater environment, efficient communication is a significant problem. Secure transmission prevents the packet loss and malicious activities.

Q-learning-Based Opportunistic Routing with an on-site architecture in UASNs

Q-learning-Based Opportunistic Routing (QBOR) protocol was introduced for real-time data upload. The on-site architecture was carried out for data center placement on surface. QBOR protocol transmitted the data to the seabed.

The reward function was described with packet delivery probability. The residual energy was considered in the routing to attain higher Packet Delivery Ratio (PDR) and energy efficiency. Q-value-based wait-competition mechanism was introduced from the opportunistic routing model. The mechanism determined the forwarding priority through holding time competition to minimize the packet redundancy and collision. In QBOR, data packets were transmitted from the source to the sink deployed in the subsea data center with neighbor participation. The sensor nodes attained the information and updated by monitoring channel conditions. QL technique was computed through optimal forwarder. A candidate set was constructed through PDR, residual energy and neighbor information. Q-value-based wait-competition mechanism was predefined for contention forwarding to avoid redundancy. With Q-value of node, the holding time was reduced and forwarding priority was increased.

DEQLFER — A Deep Extreme Q-Learning Firefly Energy Efficient and high performance routing protocol for underwater communication

With development of underwater sensor networks, communication has new research dimension. Underwater sensor networks are described by end-to-end delay, energy utility and network topology. Deep Extreme Q-Learning Firefly Energy Efficient and high performance routing (DEQLFER) protocol was introduced for underwater communication A new routing scheme depending on Q-learning framework and Deep Extreme Learning Machines with Adaptive Firefly Routing algorithm was introduced to address the energy efficiency limitations and network instability in underwater communication. The designed scheme combined the reward function and adaptive fireflies to identify optimal routing mechanism. Q-learning mechanism was replaced by Q-deep extreme learning mechanism with adaptive reward function for underwater environment to increase the packet-delivery ratio (PDR) and throughput. The firefly aided routing mechanism was used for energy efficient data transmission to avoid dilemma issues. The designed algorithm increased the network lifetime through finding the routes consistent with parameters such as energy distance and low latencies.

Underwater Wireless Information Transfer with Compressive Sensing for Energy Efficiency

The compressive sensing scheme was introduced by recovery and transfer path in underwater environment. Transmission loss in acoustic channel leads to the reduction of acoustic intensity. Compressive sensing scheme employed the compressive sensing at source node and reconstructed with orthogonal matching pursuit at sink termed Underwater Wireless Information Transfer with Compressive Sensing (UWITCS). The designed algorithm developed bandwidth estimation through cross traffic at intermediate forwarders for every source sensors to its associated sink. UWITCS employed compressive sensing with sparse signal representation and restoration. Sub-Nyquist criteria reduced the energy consumption with lesser number of transmission and reconstruction accuracy. The sensing period reduced energy consumption of sensor nodes without compromising the reconstruction accuracy. The compressive sensing minimized the sensing rate and number of transmission without successive reduction in reconstruction accuracy. The compressive sensing in underwater wireless environment aimed for transmission and reconstruction. The designed protocol determined the link efficiency prior to sensing and networked data communication. Identification eliminated the bottleneck links at intermediate forwarders to increase the network lifetime. Non convex optimization and recovery at sink provided high reconstruction with sensor node characteristics.

Secured transmission using trust strategy based dynamic Bayesian game in underwater acoustic sensor networks

The sensor node cooperation and unreliability of acoustic channels are important demands in Underwater Acoustic Sensor Networks (UASNs). In UASNs, unreliability resulted in the high packet loss because of high bit-error-rate and packets dropped because of network congestion. High packet loss reduced the transmission rate in network. An efficient secure transmission mechanism was important one among nodes in UASNs. A trust strategy based dynamic Bayesian game (TSDBG) model was introduced where secure suite was created among nodes in network. Trust and Payoff were determined for every node to compute the particular node in packet-dropping and misbehaving activities occurred during the transmission. Each node updated their trust value with help of Baye's rule. Regular nodes were observed to examine the neighbor nodes depending on trust value. The designed scheme minimized the packet-dropping attack, malicious node activities, and propagation delay for improved the secure transmission.

Securing Underwater Sensor Networks against Routing Attacks

UWSNs are more susceptible to different class of security attacks because of the challenges imposed by deployment environment. A distributed approach was introduced to identify and mitigate the routing attacks in UWSNs. An analytical model was employed to determine the interaction between different contributing parameters. The designed approach validated the correctness and efficiency. The underwater environment characteristics have unique challenges for terrestrial sensor networks. A sliding window was employed at every node of network to store the neighbor's ongoing traffic and to monitor their behavior. A theoretical model was employed for density of node deployment to identify the malicious activities. An upper bound was obtained for the malicious node isolation probability.

Trusted node selection in clusters for underwater wireless acoustic sensor networks using fuzzy logic

Cluster based routing is a popular method in Underwater Wireless Acoustic Sensor Networks (UWASNs) because of improved network lifetime, reduced energy consumption and scalability. The trusted cluster head and cluster member selection is a demanding task because of different features and constraints. A trusted cluster head and member nodes selection scheme was introduced by using fuzzy logic. In designed scheme, the security check of member nodes in cluster was performed through light weight XOR encryption algorithm to perform the node authentication. The trusted node was selected depending on the trust value with help of fuzzy logic rules. The trust value of node was determined depending on the fuzzy parameters like distance, energy and relative node mobility. The security check of all members in cluster was carried out through CH termed trust manager. A trust management scheme was monitored by CH to estimate trust of every node.

A Secure Remote Mutual Authentication Scheme based on Chaotic Map for Underwater Acoustic Networks

An Underwater Acoustic Network (UANs) has wireless sensor network structure in many applications. Sensor nodes were positioned in hostile area for collecting the information with minimal resource consumption. The underwater information was sensitive and authenticated users have the rights to obtain the original information. The existing secure resource-constrained authentication was suitable for underwater acoustic networks. A chaotic maps remote user authentication and key agreement scheme was employed for underwater acoustic networks depending on the DLP and DHP. The authenticated users have rights to attain the original information. The designed scheme uses the lightweight cryptographic functions like one-way hash function and chaotic maps to perform the mutual authentication and key agreement for underwater acoustic networks. The designed scheme was safe with security needs and goals.

SEECR: Secure Energy Efficient and Cooperative Routing Protocol for Underwater Wireless Sensor Networks

Secure Energy Efficient and Cooperative Routing (SEECR) protocol was introduced for UWSNs. SEECR has energy efficient and defense method for combating attacks in the underwater environment. SEECR performed cooperative routing for increasing the network performance. SEECR was appropriate for underwater environment through considering the resource constrained environment. The minimum computation was used for improving security results. SEECR identified and eliminated all active attacks that drop the packets. SEECR performance were determined through evaluation parameters like number of alive nodes, transmission loss, throughput, energy tax and end-to-end delay.

SAPDA: Secure Authentication with Protected Data Aggregation Scheme for Improving QoS in Scalable and Survivable UWSNs

Security was considered as the key objectives for underwater wireless sensor networks (UWSN). The sensors in UWSN were susceptible to malicious attack. It is easy for malicious attacks to manipulate the communication channel of UWSN. Authentication and data integrity was considered as the essential one to make the network scalable and survivable. A secure authentication and protected data aggregation (SAPDA) method was introduced for cluster based structure of UWSN. The cluster based arrangement created the concise and stable network. The cluster head in every cluster was authenticated by the gateway to guarantee that all clusters were handled by the valid nodes. The data communicated in network was handled to guarantee that it not get compromised during

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network operations. The security of all nodes was guaranteed to perform safe network communication. The designed method increased the data reliability in network through minimizing the energy consumption and delay.

Performance Analysis of Different Energy Efficient Secured Routing and Data Aggregation in UWSN

In order to compare different energy efficient secured routing and data aggregation techniques, number of data points and number of underwater sensor nodes is taken as an input to conducts the experiment. Experimental evaluation of nine methods namely QBOR protocol, DEQLFER protocol, compressive sensing scheme, TSDBG model, distributed approach, trusted cluster head and member nodes selection scheme, secure remote mutual authentication scheme, SEECR protocol and SAPDA method are implemented using NS2 simulator. Result analysis of existing energy efficient secured routing and data aggregation techniques are estimated with certain parameters are,

- Energy consumption,
- Data packet ratio,
- Data aggregation accuracy,
- Data aggregation time,
- Data confidentiality rate and
- Routing overhead

Impact of Energy consumption

Energy consumption is defined as the amount of energy consumed to perform efficient routing. It is the product of number of underwater sensor nodes and energy consumed by one underwater sensor node. It is formulated as,

$$Ener_{con} = \sum_{i=1}^{n} UWSN_i * Energy\ consumed\ by\ one\ UWSN \qquad (1)$$

From (1), '$Ener_{con}$' symbolizes the energy consumption. '$UWSN_i$' represents the number of underwater sensor node. It is measured in terms of Joules (J). Table 1 explains the energy consumption with respect to number of data packets varying from 50 to 500. When the number of data packets gets increased, the energy consumption ratio gets increased respectively. Let us consider, the number of data packets is 250, the energy consumption of QBOR protocol attained is 1400J. The energy consumption of DEQLFER protocol and compressive sensing scheme achieved is 1510J and 1590J. The graphical representation of energy consumption is illustrated in figure 1. Figure 1 explains the energy consumption measure versus number of underwater sensor nodes changing from 50-500. Therefore, the energy consumption of QBOR protocol is comparatively lesser than DEQLFER protocol and compressive sensing scheme. This is because of using Q-value-based wait-competition mechanism from opportunistic routing model. The mechanism performed the forwarding priority to minimize the packet redundancy and collision. Consequently, QBOR protocol reduces the energy consumption by 8% as compared to DEQLFER protocol and 14% when compared to compressive sensing scheme respectively.

Impact of Data packet delivery ratio

Data packet delivery ratio is defined as the ratio of number of data packets that are correctly delivered to the total number of data packets. It is formulated as,

$$D_{PDR} = \frac{Number\ of\ data\ packets\ that\ are\ corretly\ delivered}{Total\ number\ of\ data\ packets} \qquad (2)$$

From (2), 'D_{PDR}' symbolizes data packet delivery ratio. It is measured in terms of percentage (%). Table 2 explains the data packet delivery ratio with respect to number of data packets varying from 50 to 500. When the number of data packets gets increased, the data packet delivery ratio gets increased respectively. Let us consider, the number of data packets is 450, the data packet delivery ratio of QBOR protocol attained is 0.97. The data packet delivery ratio of DEQLFER protocol and compressive sensing scheme achieved is 0.88 and 0.83. The graphical representation of data packet delivery ratio is shown in figure 2. Figure 2 explains the data packet delivery ratio (PDR) measure versus number of underwater sensor nodes changing from 50-500. Therefore, the data packet delivery ratio of QBOR

protocol is comparatively lesser than DEQLFER protocol and compressive sensing scheme. This is due to the application of QL technique through optimal forwarder. A candidate set was built through PDR, residual energy and neighbor information. Q-value-based wait-competition mechanism was described for contention forwarding to eliminate the redundancy. Consequently, QBOR protocol reduces the energy consumption by 15% as compared to DEQLFER protocol and 22% when compared to compressive sensing scheme respectively.

Impact of Data aggregation accuracy

Data aggregation is defined as the ratio of number of data packets that are correctly aggregated to the total number of data packets. It is calculated as,

$$DA_{Acc} = \frac{Number\ of\ data\ packets\ that\ are\ corretly\ delivered}{Total\ number\ of\ data\ packets} * 100 \qquad (3)$$

From (3), 'DA_{Acc}' denotes the data aggregation accuracy. It is measured in terms of percentage (%).

Table 3 explains the data aggregation accuracy with respect to number of data packets varying from 50 to 500. When the number of data packets gets increased, the data aggregation accuracy gets increased correspondingly. Let us consider, the number of data packets is 250, the data aggregation time of secure remote mutual authentication scheme attained is 75%. The data aggregation time of SEECR protocol and SAPDA method achieved is 70% and 82%. The graphical representation of data aggregation accuracy is illustrated in figure 3. Figure 3 describes the data aggregation accuracy measure versus number of data packets changing from 50-500. Consequently, the data aggregation accuracy of SAPDA method is comparatively higher than SEECR protocol and secure remote mutual authentication scheme. This is because of applying cluster based arrangement in the concise and stable network. The cluster head in every cluster was validated through gateway to guarantee that all clusters were managed by the valid nodes. Consequently, SAPDA method increases the data aggregation accuracy by 10% as compared to secure remote mutual authentication scheme and 19% when compared to SEECR protocol respectively.

Impact of Data aggregation time

Data aggregation time is defined as the product of number of data packets and time consumed to perform an efficient data aggregation in UWSN. It is determined as,

$$DA_{Time} = \frac{Number\ of\ data\ packets\ that\ are\ corretly\ delivered}{Total\ number\ of\ data\ packets} * 100 \qquad (4)$$

From (4), 'DA_{Time}' symbolizes the data aggregation time. It is computed in terms of milliseconds (ms). Table 4 explains the data aggregation time with respect to number of data packets varying from 50 to 500. When the number of data packets gets increased, the data aggregation time gets increased respectively. Let us consider, the number of data packets is 350, the data aggregation time of secure remote mutual authentication scheme attained is 72ms. The data aggregation time of SEECR protocol and SAPDA method achieved is 62ms and 63ms. The graphical representation of data aggregation time is illustrated in figure 4. Figure 4 describes the data aggregation time measure versus number of data packets changing from 50-500. Consequently, the data aggregation time of SEECR protocol is comparatively lesser than SAPDA method and secure remote mutual authentication scheme. This is because of using energy efficient and defense method for combatting attacks in underwater environment. SEECR performed cooperative routing for enhancing the network performance. SEECR eliminated all active attacks. Consequently, SEECR protocol reduces the data aggregation time by 13% as compared to secure remote mutual authentication scheme and 3% when compared to SAPDA method respectively.

Impact of Data confidentiality level

Data confidentiality level is defined as the ratio of number of data points that are correctly accessed by authorized nodes to the total number of data points. It is computed as,

$$\llbracket Data \rrbracket\_CL = (Number\ of\ data\ points\ correctly\ accessed\ by\ authorized\ nodes)/Total\ number\ of\ data\ points) * 100 \qquad (5)$$

From (5), '$Data_{CL}$' symbolizes the data confidentiality level. It is measured in terms of percentage (%). Table 5 explains the data confidentiality level with respect to number of data packets varying from 50 to 500. When the number of data packets gets increased, the data confidentiality level gets increased correspondingly. Let us consider, the number of data packets is 300, the data confidentiality level of TSDBG model attained is 88%. The data confidentiality level of distributed approach and trusted cluster head and member nodes selection scheme achieved is 80% and 78%. The graphical representation of data confidentiality level is illustrated in figure 5. Figure 5 explains the data confidentiality rate measure versus number of data packets changing from 50-500. Consequently, the data confidentiality rate of TSDBG model is comparatively higher than distributed approach and trusted cluster head and member node selection scheme. This is because of determining the trust and payoff for every node to determine the particular node in packet-dropping and misbehaving activities occurred during transmission. Each node updated their trust value using Baye's rule. Therefore, TSDBG model increases the data confidentiality rate by 9% as compared to distributed approach and 14% when compared to trusted cluster head and member node selection scheme.

Impact on Routing Overhead

Routing overhead is described as the amount of time consumed to roué the data packets from the source underwater sensor node to the destination underwater sensor node. The routing overhead is expressed as,

$$Rou_{oh} = UWSN_i * time\ (routing\ one\ data\ packets) \qquad (6)$$

From equation (6), 'Rou_{oh}' symbolizes the routing overhead. '$UWSN_i$' symbolizes the number of underwater sensor nodes. It is measured in terms of milliseconds (ms). Table 6 explains the routing overhead with respect to number of data packets varying from 50 to 500. When number of data packets gets increased, the routing overhead gets increased respectively. Let us consider, the number of data packets is 200, the routing overhead of TSDBG model attained is 84ms. The routing overhead of distributed approach and trusted cluster head and member nodes selection scheme achieved is 75ms and 72ms. The graphical representation of routing overhead is illustrated in figure 6. Figure 6 explains the routing overhead measure versus number of data packets changing from 50-500. Consequently, the routing overhead of trusted cluster head and member node selection scheme is comparatively higher than distributed approach and TSDBG model. This is because of fuzzy logic where the security check of member nodes in cluster was performed through light weight XOR encryption algorithm for node authentication. The trusted node was chosen depending on trust value using fuzzy logic rules. Therefore, trusted cluster head and member node selection scheme reduces the routing overhead by 4% as compared to distributed approach and 12% when compared to TSDBG model.

Discussion of Limitations on Energy Efficient Secured Routing and Data Aggregation in UWSN
In QBOR protocol, reward function was determined with packet delivery probability and residual energy in routing to obtain higher Packet Delivery Ratio (PDR) and energy efficiency. QBOR reduced the packet redundancy and collisions. But, the delay was not reduced. DEQLFER increased the network lifetime and reduced the delay as well as energy consumption. DEQLFER algorithm integrated the online training policy when topology varied to make the best routing decisions with an adaptive topology. Though the packet loss was minimized, the communication overhead was not minimized by new routing scheme. Compressive sensing with acoustic propagation highlighted the available bandwidth and operational capability of intermediate forwarders. Compressive sensing framework meets underwater propagation phenomena needs and the sensor characteristics. TSDBG model minimized the packet-dropping attack, misbehaving activities of malicious nodes and propagation delay for secured transmission. Regular nodes were monitored to analyze their neighbor nodes depending on trust value. The computational complexity was not minimized by TSDBG model. A distributed approach was introduced to identify and mitigate

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the routing attacks in network. The energy consumption was not reduced by distributed approach. The trusted cluster head and member nodes selection scheme performed efficient malicious node detection with higher packet delivery ratio. The trusted node was selected depending on trust value with fuzzy logic rules. Though the energy consumption was reduced, delay was not minimized by designed scheme. SEECR performed cooperative routing for enhancing the network performance. SEECR efficiently utilized the energy of sensor nodes for increasing their lifetime. Though security level was improved, the data aggregation time was not reduced by SEECR protocol. In SPADA, cluster based arrangement created the concise and stable network. The security of all nodes was ensured to maintain the safe network communication. The designed technique increased the data reliability in network by minimizing the energy consumption and delay. Though the energy consumption and delay was reduced, the data aggregation accuracy was not improved by designed method.

CONCLUSION

A comparative study of different energy efficient secured routing and data aggregation techniques is carried out. From the study, the data aggregation accuracy was not improved. In addition, the data aggregation time was not reduced by SEECR protocol. The computational complexity was not minimized by TSDBG model. The wide experiment on conventional techniques estimates the result of different energy efficient secured routing and data aggregation techniques and discusses its issues. From the result analysis, the research work can be carried out using machine learning and ensemble learning techniques for efficient energy efficient secured routing and data aggregation with higher accuracy and lesser time consumption.

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Table 1. Tabulation of Energy Consumption

Number of underwater sensor nodes (Number)	Energy consumption (J)		
	QBOR protocol	DEQLFER protocol	Compressive sensing scheme
50	750	810	920
100	900	940	1010
150	1250	1320	1400
200	1350	1430	1510
250	1400	1510	1590
300	1450	1620	1680
350	1500	1670	1750
400	1550	1700	1810
450	1610	1840	1900
500	1700	1900	2010

Table 2. Tabulation of Data Packet Delivery Ratio

Number of Data packets (Number)	Data Packet Delivery Ratio (%)		
	QBOR protocol	DEQLFER protocol	Compressive sensing scheme
50	0.65	0.59	0.51
100	0.71	0.62	0.58
150	0.84	0.70	0.64
200	0.90	0.75	0.71
250	0.94	0.77	0.75
300	0.95	0.80	0.78
350	0.96	0.85	0.81
400	0.96	0.86	0.82
450	0.97	0.88	0.83
500	0.97	0.88	0.84

Table 3. Tabulation of Data aggregation accuracy

Number of Data packets (Number)	Data aggregation accuracy (%)		
	Secure Remote Mutual Authentication Scheme	SEECR protocol	SAPDA method
50	67	61	75
100	69	63	77
150	71	65	79
200	73	68	80
250	75	70	82
300	77	72	84
350	79	73	87
400	81	75	89
450	82	78	91
500	85	80	93

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Table 4. Tabulation of Data aggregation time

Number of Data packets (Number)	Data aggregation time (ms)		
	Secure Remote Mutual Authentication Scheme	SEECR protocol	SAPDA method
50	55	47	49
100	57	49	52
150	59	53	54
200	63	55	57
250	66	58	59
300	69	60	61
350	72	62	63
400	75	64	66
450	78	67	69
500	81	70	73

Table 5. Tabulation of Data confidentiality level

Number of Data packets (Number)	Data confidentiality level (%)		
	TSDBG model	Distributed Approach	Trusted Cluster Head And Member Nodes Selection Scheme
50	79	70	65
100	81	72	68
150	83	74	70
200	84	75	72
250	86	77	75
300	88	80	78
350	90	83	80
400	91	86	82
450	93	89	85
500	94	91	87

Table 6. Tabulation of Routing Overhead

Number of Data packets (Number)	Routing Overhead (ms)		
	TSDBG model	Distributed Approach	Trusted Cluster Head And Member Nodes Selection Scheme
50	79	70	65
100	81	72	68
150	83	74	70
200	84	75	72
250	86	77	75
300	88	80	78
350	90	83	80
400	91	86	82
450	93	89	85
500	94	91	87

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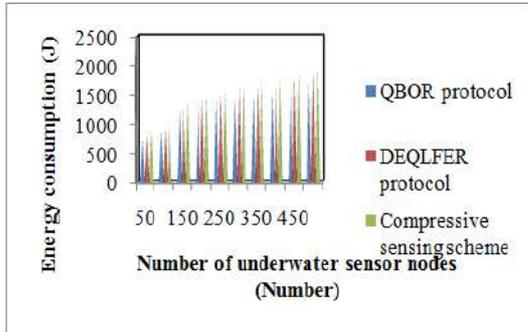
Figure 1. Measurement of Energy Consumption
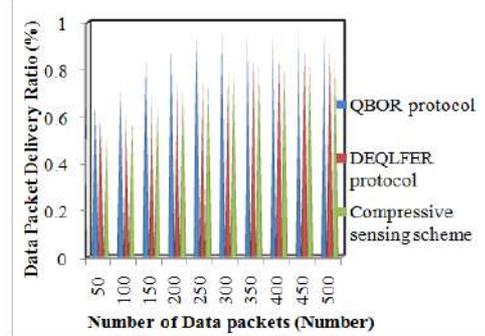
Figure 2. Measurement of Energy Consumption
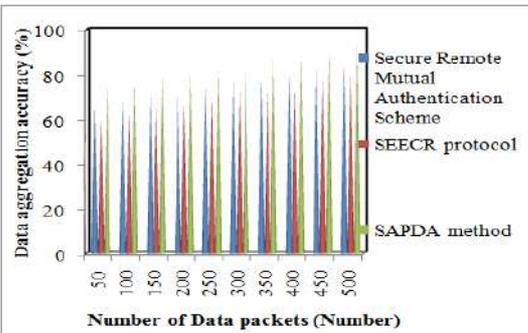
Figure 3. Measurement of Data Aggregation Accuracy
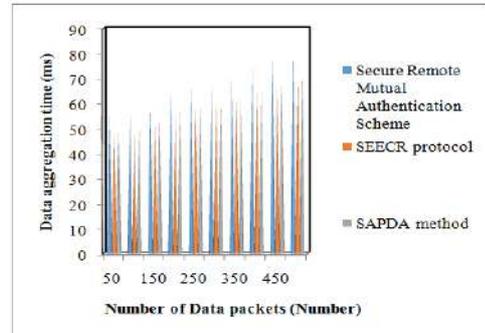
Figure 4. Measurement of Data Aggregation Time
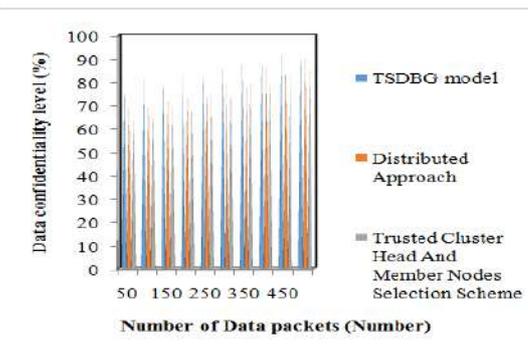
Figure 5. Measurement of Data Confidentiality Level
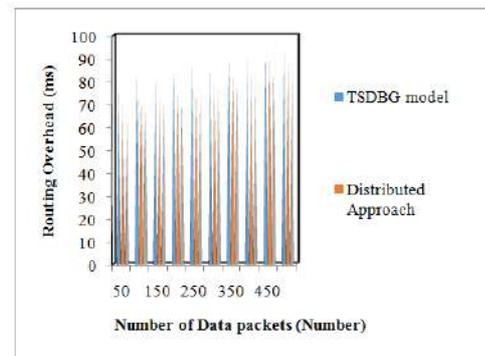
Figure 6. Measurement of Routing Overhead

RESEARCH ARTICLE

Design and Development of an Optimization Chatbot based on Random Forest Machine Learning Algorithm with Hyper parameter Tuning

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ABSTRACT

Recent popularity of chatbot for auto responses to users mimicking human behaviour are witnessed in most of applications with repetitive tasks. Resource characteristics and resource types are significant for levels of automation of chatbot. An Important resource characteristic of chatbot is performance, which can be enhanced to best by optimisation. The success of chatbot depends on its optimization which walks through parameters and gets back of them. Among these best parameters, some parameters acts as Key performance indicators. This paper focus to create chatbot with random forest, different evaluation factors of chatbot, evaluating created chatbot performance (accuracy), enhancing accuracy by optimisation chatbot with grid search hyper parameter tuning. This work also aims to find the key performance indicators of optimised chatbot. We created random forest chatbot and evaluated its performance without optimisation which has accuracy of 72% . Optimisation is performed on this chatbot and achieved accuracy of 76.95% with enhancements of 4.95%.

Keywords: Optimisation chatbot, Random forest, Hyperparameter tuning, Key performance indicator, Machine learning, Grid search

INTRODUCTION

Robotic process automation automates manual tasks using robots[1,2]. Different chatbot tasks are distributed to resources based on dependencies[3]. Chatbot automation capabilities are powered by artificial intelligence and learning algorithms with support to overcome restrictions to dependencies of automation capabilities[4].

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Importance of characterising robots[4,5] are :
- Helps to understand distinct characteristics of robots and human participants
- Identifies degree to which automation of process is feasible
- Adaption based resources and characteristics support various levels of automation

Different levels of automation are full automation, supervisory control, decision support and manual [4,5].Resource types are human agent and chatbot. Chatbot learns from data and human agent[6,7]. Resource characteristics are expertise, skills, preference, collaboration, workload, availability, suitability, authorisation, experience, performance(quality) and duration(time) along with usage of resource characteristics for allocation of tasks to resources[8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27]. Model parameters (learn their values during the training process, cannot be set manually) are different from model hyperparameters (set manually)

This study is motivated to get solution for research questions:

1.1 What are steps in design – development – optimisation of chatbot ?
1.2 Which of the factors essential that needs to be evaluated w.r.t chatbot ?
1.3 How to improve the performance of chatbot ?
1.4 What is the role of hyperparameter tuning in optimisation chatbot ?
1.5 Why key performance indicators are significant ?
1.6 How to obtain Key performance indicators of optimised chatbot with high performance ?

Research Gaps:

We have identified various research gaps from literature:
- Chatbot with random forest classifier has accuracy 72.6% & needs optimisation [28][29]
- Explore and compare different classifiers in developing chatbot and select best [28][29]
- KPI based evaluation of chatbot is necessary [28][29]

Objectives

Our study has following objectives :

1. Propose model for optimisation chatbot
2. Design and development of chatbot with random forest classifier
3. Evaluate the developed chatbot and find its performance
4. Improve the performance of developed random forest chatbot by optimisation hyperparameter tuning to get optimised chatbot
5. Explore and compare different evaluation factors of chatbot
6. Identify role of hyperparameter tuning and key performance indicators
7. Select the key performance indicators on which optimised chatbot performance depends

This paper is organised as: section 2: Methodology , section 3: Results , section 4: Discussion and section 5: Conclusion & Future enhancements

METHODOLOGY

In this section we consider the role of hyperparameter tuning and key performance indicators, proposed optimised chatbot model and design an algorithm for developing optimised chatbot using random forest and grid search hyper parameter tuning.

Proposed optimisation chatbot model

Optimised chatbot model proposed to be consisting of set of activities, set of constraints, set of resource characteristics , levels of automation, resource types, set of parameters(features), set of hyperparameters and key performance indicators, random forest classifier , hyperparameter tuning method, set of inputs and set of outputs. Activity set has one or more activity. Each activity has label, set of one or more resources permitted to perform activity , input & output. N & S represents int and string types respectively in input and output. Each resource has a

role , a resource type (human agent , chatbot)and set of resource characteristics. If performance of chatbot is low on task or incident then human agent will execute task without automation (manual) else if chatbot has high performance then chatbot tasks are automated. Task in a process are either manual (performed by human participants) or system supported automatically by chatbot (executed by software). Hyperparameters are set to get more relevant optimised model. Importance of hyperparameter tuning is to minimise errors, increase convergence of machine learning algorithm to larger extend. The scope of this work is in "design algorithm and develop chatbot using random forest , evaluate performance and enhance performance by grid search hyper parameter tuning optimisation with identification of key performance indicators responsible for optimisation chatbot highest performance". Now we develop optimised chatbot for detecting best team for providing required service using business process event log of banking dataset [28] having interaction management and incident management . This chatbot identifies team to handle tasks and assign the tasks to them automatically. Input to classifier are CI name, CI type and component of incident. Team of incident is output. Precession, recall and accuracy are measures and enhanced using grid search hyper parameter tuning optimisation. Random forest method is extension of bagging with feature randomness, obtains results by combining output of multiple decision trees, can handle classification and regression. This provides flexible, high speed training and prediction, more accuracy than non linear classifiers, robust(multiple decision trees used to get result), resolves over fitting and overcomes issues of missing values. These characteristics make random forest supervised method applicable to wide range of high dimensional problems and in creation of chatbot[30,31,32,33,34,35].

Random Forest
Working of random forest is outlined as in following algorithm.

Algorithm: Random Forest
Step 1: Random forest algorithm ={ Decision trees } with each tree = { Bootstrap sample } where Bootstrap sample ← train data
Step 2: Out-of-bag sample ← test data
Step 3: Randomness used for bagging to reduce correlation among decision trees
Step 4: Which type of problem?
If (problem == Regression task) then individual decision trees are averaged else if
(problem == Classification) then majority voting is used to get predicted class
Step 5: Perform cross validation using out-of-bag sample finalising that prediction

Proposed Algorithm
Now we focus on create , evaluate and enhance the chatbot resulting in optimised chatbot with high performance and corresponding algorithm proposed as follows:

Algorithm: **Design and development of random forest chatbot and optimisation of chatbot using grid search hyper parameter tuning:**

Step 1: Import packages
Step 2: Read the input file (data set)
Step 3: Extract relevant information (features)
Step 4: Prepare the data for machine learning classifier
Step 5: Pre-processing the data
Step 6: Data split into train and unseen data(test data)
Step 7: Evaluate the performance of random forest chatbot & store accuracy in variable acc1
Step 8: Perform hyperparameter tuning using grid search and cross validation 5 fold
Step 9:Evaluate performance of optimised chatbot with hyperparameter tuning and store accuracy in the variable acc2
Step 10: Optimised chatbot accuracy is acc2. Enhanced percentage of accuracy is acc = acc1 – acc2
Step 11: Identify the key performance indicators from best values of hyperparameter tuned Parameters

RESULTS

The implementation of proposed algorithm (section 2) using python library scikit tool resulted in accuracy of random forest chatbot with 72%(accuracy acc1) & accuracy of optimisation chatbot as 76.95% with grid search hyper parameter tuning. We observed that optimisation process by hyper parameter tuning has enhanced the accuracy by 4.95%. This scenario has two models of chatbot optimisation with random forest & grid search during hyper parameter tuning. First model with varying values of max_depth,   max_features,   min_samples_leaf, in_samples_split&n_estimators with fixed random state as 0. Second model with varying the values of max_depth, max_features,, random state & n_estimators. Initially we used model 1 with grid search hyperparameter tuning on random forest chatbot for the optimisation with parameters max_depth,   max_features,   min_samples_leaf, min_samples_split&n_estimators. The accuracy values computed for different values of above parameters & some values are as in table1. We observe from table 1 that increasing min_samples_leaf and min_samples_split has not much effect to increase accuracy. Further the experiment is conducted with model 2 to detect the KPI (key performance indicators) with only the parameters max_depth, max_features,, random state &n_estimators. This has resulted in extreme optimisation with boosting up the accuracy levels to 76.95%. Graph 1 to Graph 6 (Fig 2 to Fig 7) indicate the accuracy versus each of the above mentioned parameters respectively indicating the importance of random state, importance of max depth, max features , n estimators, importance of set of values in achieving various accuracies. The details of these graphs are as follows. Key performance indicator hyperparameter values of optimised chatbot accuracy 76.95% are as in graph of Fig 2. The graph of Fig 3., indicates hyperparameter values of random state, n estimators, max depth and max features for the accuracy of chatbot 71.79 % (least value) and 78.95% (best value) respectively. Graph of Fig 4 depicts Max depth, max features, n estimator and random state values for four different accuracies   of chatbot 73.04%, 76.53%, 75.45% and 74.87% respectively. This indicates that random state is one of kpi hyperparameter of optimised chatbot as its value controls accuracy. As the graph of Fig 5) display acccuracy (x axis) value for 35 different set (1 to 35 y axis) of hyperparameter values of table2. In this it is clear that the set 12 has highest value of accuracy of optimised chatbot and corresponding values of this highest accuracy versus hyperparameter values plotted in graph of Fig 6. Graph 5(Fig 6) indicates the highest accuracy versus max_depth,   max_features,, random state & n_estimators The share of kpi hyperparameters in best accuracy of optimised chatbot are as in Fig 7.The values of these hyperparameters play a vital role in enhancing the performance (accuracy) levels of the chatbot. Thus the key performance indicators of optimised random forest chatbot with grid search hyperparameter tuning optimisation are max_depth, max_features, random state & n_estimators

DISCUSSION

Similar type of work carried out by[28] obtained the accuracy of chatbot as 72.6%. But our work, for the same dataset has obtained accuracy of optimised chatbot as 76.95%. The optimised chatbot of this paper has increased accuracy by 4.35% with best selection of optimal hyper parameters i.e., hyper parameter tuning applied appropriately to enhance accuracy. The proposed algorithm has resulted in optimisation of chatbot by grid search hyper parameter tuning and also identification of KPI key performance indicators which has not done by any of the existing literature research work is.

CONCLUSION AND FUTURE ENHANCEMENTS

This work successful in creating , evaluating random forest chatbot and improving accuracy by resultant optimised chatbot along with all solutions to research questions (section 1.1 to 1.6). An efficient optimised chatbot model has been proposed (section 2.1) and an algorithm to design and develop optimised chatbot using random forest method with grid search hyper parameter tuning (section 2.3). Results presented (section 3) and accuracy boosted up. Further , the significant factors i.e., key performance indicators are identified which is responsible for obtaining higher accuracy of optimisation chatbot. The highest accuracy achieved by this optimisation chatbot is 76.95%. In comparison to the work [28]of hyperparameter tuning , we have improved the accuracy of optimised chatbot by

4.35% .This work can be extended with other hyper parameter optimisation methods. Another area for future work is to use a different classifier instead of random forest method.

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35. Overview of random forest methodology and practical guidance with emphasis on computational biology and bioinformatics

Table 1: Accuracy values for different values of parameters max-depth, max-features, min samples leaf, min samples split and N estimators for the fixed value of random state as 0

Sl no	Max depth	Max features	Min Samples leaf	Min samples split	N estimators	Accuracy
1	90	5	2	2	1	0.442595673876871
2	90	5	2	3	1	0.378535773710482
3	90	5	2	75	1	0.393510815307820
4	90	5	3	3	1	0.378535773710482
5	110	5	3	75	10	0.4334941763727121
6	90	5	2	2	1	0.4425956738768710
7	90	5	50	75	1	0.3785357737104825
8	90	100	2	75	1	0.7229617304492513
9	90	100	3	3	1	0.7204658901830283
10	90	100	3	75	1	0.7188019966722130

11	90	100	4	2	1	0.7279534109816972
12	90	100	4	75	1	0.7146422628951747
13	90	100	50	2	1	0.6622296173044925
14	90	100	50	3	1	0.5990016638931508
15	90	100	50	75	1	0.4559068219633943
16	90	100	2	2	10	0.7262895174708819
17	90	100	50	75	10	0.6805324459234608
18	90	100	2	2	100	0.7271214642262895
19	90	100	50	75	100	0.6821963394342762
20	100	5	50	75	1	0.3785535773710482
20	100	5	2	1	10	0.3785535773710482
21	100	5	2	3	10	0.3843594009983361
22	100	5	2	75	10	0.3785357737104825
23	100	291	3	75	1	0.7254575707154742
24	100	291	2	75	100	0.7262895170881900
25	100	291	3	2	100	0.7271214642262895
26	100	291	3	3	100	0.7271214642262895
27	100	291	3	75	100	0.7237936772046589
28	100	291	4	2	100	0.7262895174708819
29	100	291	4	3	100	0.7262895174708819
30	100	291	4	75	100	0.7254575707154742
31	100	291	50	2	100	0.6805324459234608
32	100	291	50	3	100	0.6805324459234608
33	100	291	50	75	100	0.6805324459234608
34	100	291	2	2	500	0.7271214642262895
35	100	291	50	2	500	0.6805324459234608
36	100	291	50	3	500	0.6805324459234608
37	100	291	50	75	500	0.6805324459234608
38	110	5	2	2	1	0.5324459234608985
39	110	5	2	3	1	0.5482529118136439
40	110	5	2	75	1	0.3785357737104825
41	110	5	3	2	1	0.4425956738368719
42	110	5	2	3	10	0.3785357737104825
43	110	5	2	75	10	0.4109816971713810
44	110	5	3	2	10	0.3785357737104825

Table 2: Accuracy values for different values of parameters max-depth, max-features, N estimators & random state

SI no	Max depth	Max features	N estimators	Random state	Accuracy
1	90	1000	1000	0	0.7304492512479202
2	90	1000	1000	18	0.7653910149750416
3	90	1000	1000	85	0.7545757071547421
4	90	1000	1000	110	0.7487520798668885
5	90	1000	1000	2	0.7470881863560732
6	90	1000	1000	3	0.7529118136439268
7	60	500	10	1	0.7396006655574043
8	60	500	300	1	0.7420965058236273

9	90	5	100	77	0.7678868552412645
10	90	5	300	77	0.7687188019966722
11	90	291	300	77	0.7662229617304492
12	100	5	1000	77	0.7695507487520798
13	100	291	100	77	0.7670549084858569
14	60	799	10	1	0.7429284525790350
15	60	799	300	1	0.7420965058236273
16	80	500	10	1	0.7437603993344426
17	80	799	300	1	0.7420965058236273
18	80	799	800	1	0.7462562396006656
19	292	500	10	1	0.7487520798668885
20	292	500	300	1	0.7462562396006656
21	60	500	10	2	0.7470881863560732
22	60	500	300	2	0.7479201331114809
23	80	500	10	2	0.7462562396006656
24	60	500	10	3	0.7495840266222962
25	60	500	300	3	0.7520798668885191
26	60	799	10	3	0.7470881863560732
27	80	500	10	3	0.7545757071547421
28	80	500	300	3	0.7529118136439268
29	80	500	800	3	0.7537437603993344
30	80	799	10	3	0.7470881863560732
31	60	500	300	4	0.7404326123128120
32	60	500	300	76	0.7254575707154742
33	10	200	10	17	0.7229617304492513
34	10	200	1200	17	0.7179700499168054
35	100	200	1000	17	0.7196339434276207

Fig 1: Proposed Optimised chatbot model	**Fig 2: Key performance indicator hyperparameter values of optimised chatbot accuracy 76.95**
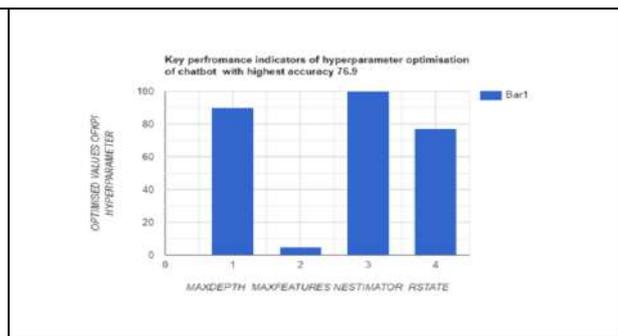
Bedre Nagaraj and Kiran B Malagi
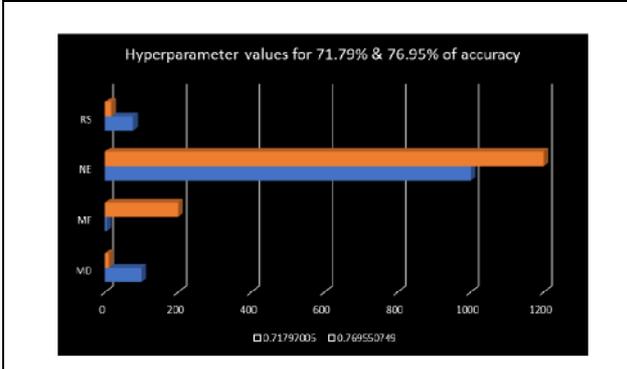
Fig 3: Hyperparameter values of random state, n estimators, max depth and max features for the accuracy of chatbot 71.79 % (least value) and 76.95% (best value) respectively.
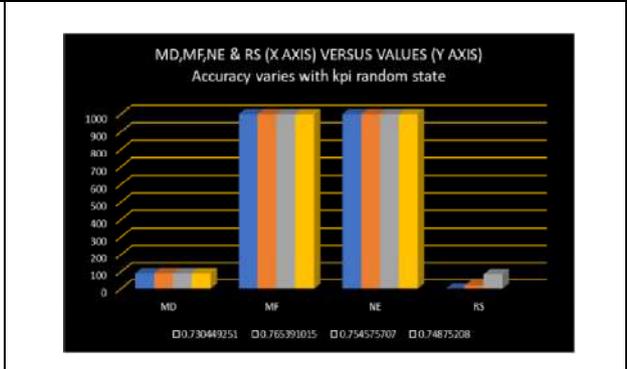
Fig 4: Max depth, max features , n estimator and random state values for four different accuracy of chatbot 73,04%, 76.53%, 75.45% and 74.87% respectively. This indicates that random state is one of kpi hyperparameter of optimised chatbot as its value controls accuracy
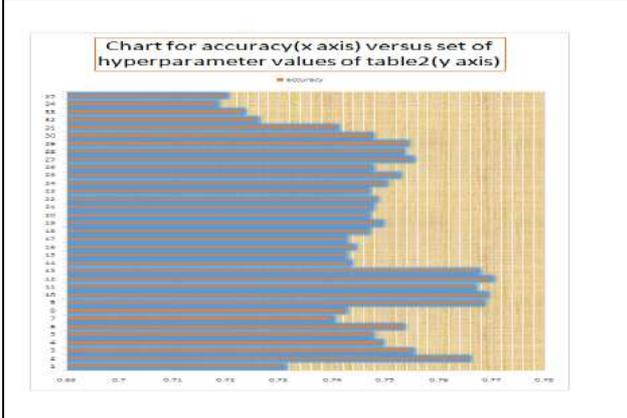
Fig 5: Acccuracy(x axis) values for 35 different set (1 to 35 y axis) of hyperparameter values of table 2
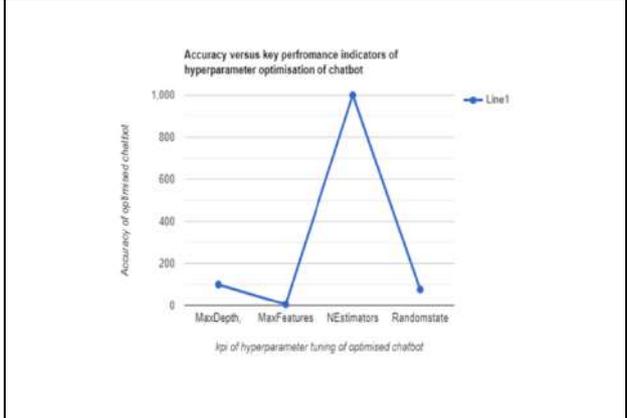
Fig 6: Accuracy versus hyperparameter values
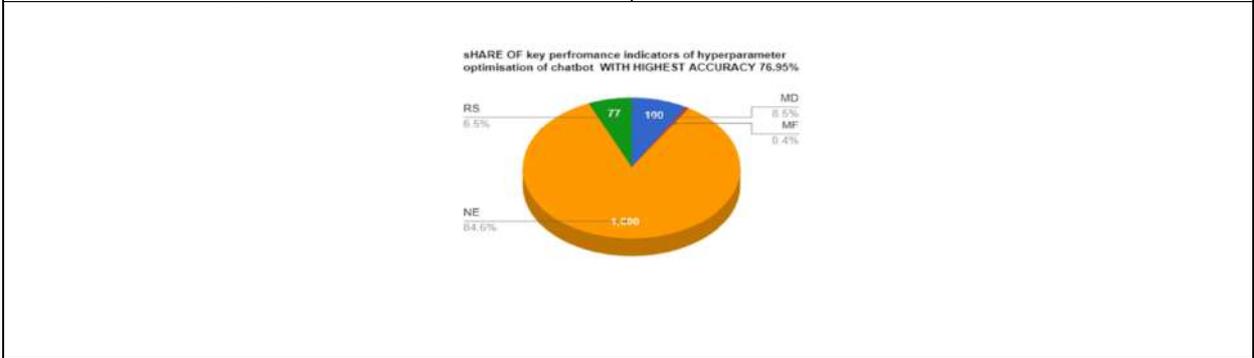
Fig 7: share of kpi hyperparameters in best accuracy of optimised chatbot

RESEARCH ARTICLE

Socio - Economic Profile Characteristics of MGNREGS Beneficiaries in Dharmapuri District of Tamil Nadu

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ABSTRACT

The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) guarantees 100 days of employment in a financial year to any rural household whose adult members are willing to do unskilled manual work. This act is an important step towards the realization of the right to work. This present study was conducted in Pennagaram block of Dharmapuri district in Tamil Nadu. Proportionate random sampling procedure was used to select one hundred and twenty respondents from the selected panchayats in this study. Based on judges opinion, sixteen socio- economic characteristics were selected for studying the profile characteristic of the MGNREGS beneficiaries. The profile characteristics of MGNREGS beneficiaries revealed that majority of the beneficiaries in this study were female, old aged, illiterate and belonged to SC/ST category. Mostly they are married and live in nuclear family. They have MGNREGA as their main source of income, posses marginal size of landholdings with low level of annual income and have less social participation. They live in hut type of houses, employing low level of farm power.

Keywords: Socio- Economic Profile characteristics, MGNREGS beneficiaries

INTRODUCTION

India is a land of villages and even today about 70.00 per cent of it's population is employed in farming of which 28.30 per cent live below poverty line. Our Government of India (GOI) is giving considerable importance to rural reconstruction and has formulated a number of action plans towards rural development. To overcome many rural

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social problems, Government of India took a historic step by enacting the National Rural Employment Guarantee Act (NREGA) in 2005 by merging Swarnajayanthi Gram Swarojgar Yojana (SGSY) and National Food for Work Programme (NFFWP) for providing livelihood security to our rural population. The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) is a job guarantee scheme, enacted through legislations on February 2nd 2006, amidst great hype and hope. The MGNREGA came into force in 200 of India's backward districts. This scheme aims to provide a legal guarantee for one hundred days of employment in every financial year to all adult members of any rural household willing to do public work related to unskilled manual work at the statutory minimum wage. In Tamil Nadu, the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGA) was launched on 02.02.2006 and it was initially implemented in six districts. From 01.04.2007 onwards it was launched in four more districts and finally from 01.04.2008 onwards, the scheme was extended to the remaining all twenty one districts of Tamil Nadu.

METHODOLOGY

This study was undertaken to assess the socio-economic profile characteristics of MGNREGS in Dharmapuri District, one of the most backward district in Tamil Nadu as identified by the state planning commission. The study was taken up in ten villages of Pennagaram block of Dharmapuri district namely Ajianahalli, Anchahalli, Koothapadi, Manjinaikanahalli, Nagamarai, Donnakuttahalli, Mangarai, Manjarahalli, Pikkili, Sunchalnatham which were selected based on the maximum number of beneficiaries working under MGNREGA. A sample of 120 beneficiaries was selected by using proportionate random sampling technique. Data were collected with the help of a well structured and pre-tested interview schedule. The data collected was documented, tabulated and analyzed using the appropriate statistical tools.

RESULTS AND DISCUSSION

Table 1- The findings of this research study revealed the following

Age
Majority of the MGNREGS beneficiaries (60.00 per cent) was found to belong to old age category followed by 23.33 and 16.67 per cent in the middle and young age categories.

Gender
Majority of the MGNREGS beneficiaries (64.17 per cent) were females and 35.83 per cent of the beneficiaries were males in this study.

Marital status
Majority of the MGNREGS beneficiaries were (81.67 per cent) were married followed by 12.50 per cent of the beneficiaries belonging to widow/divorced category and only a meager proportion of 5.83 per cent of the beneficiaries belonged to unmarried category.

Educational status
Majority of the MGNREGS beneficiaries were illiterates (60.00 per cent) followed by middle education (11.66 per cent) and about 9.17 per cent of the beneficiaries studying upto primary education. Only 6.67 per cent of the beneficiaries were functionally literate and very meager amount of the beneficiaries (2.50 per cent) had upto secondary and collegiate education.

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Occupational status
About 40.00 per cent of the beneficiaries engaged in MGNREGA had this as their main occupation, followed by 30.00 per cent of the beneficiaries engaging in MGNREGA +wage earners as their occupation and only (17.50 per cent) and (12.50 per cent) of the beneficiaries had MGNREGA + farming, MGNREGA+Farming + Wage earners as their occupational status.

Farm size
About 46.67 per cent of the MGNREGS beneficiaries were found to be marginal farmers in this study, followed by (35.00 per cent) of the beneficiaries belonging to landless labour category. Only 18.33 per cent of the beneficiaries were found to have owned small sized farms.

Annual income
Majority of the MGNREGS beneficiaries (64.17 per cent) were having low level income followed by 25.00 per cent of the beneficiaries having medium level of income and a very small proportion (10.83 per cent) of the beneficiaries have high level of income.

Social participation
Majority (62.50 per cent) of the MGNREGS beneficiaries were reported to have low level of social participation followed by 26.67 and 10.83 per cent of the beneficiaries coming under medium and high level of social participation in this study.

Socio economic status
Type of House
Majority (60.83 per cent) of the MGNREGS beneficiaries were reported to live in hut houses followed by 28.33 and 10.84 per cent of the beneficiaries living under kutcha and pucca house respectively.

Caste
Majority of the MGNREGS beneficiaries (47.50 per cent) belonged to SC/ST category followed by 28.33 per cent belonging to Backward caste and 24.17 per cent of the beneficiaries hail from socially most backward castes.

Farm power
About 55.00 per cent of the MGNREGS beneficiaries were reported to have low level of farm power followed by 31.67 and 13.33 per cent of the beneficiaries having medium and high level of farm power respectively in this study.

Material possession
Majority (61.67 per cent) of the MGNREGS beneficiaries in this study have medium level of material possession followed by 21.67 and 16.66 per cent of the beneficiaries coming under low and high level of material possession respectively.

Family type
Majority of the MGNREGS beneficiaries (60.00 per cent) belong to nuclear family category and only 40.00 per cent of the beneficiaries were reported to be under joint family system.

Family size
Majority (73.33 per cent) of the MGNREGS beneficiaries had upto five members in their family whereas only 26.67 per cent had more than five members in their family.

Economic motivation
Majority (57.50 per cent) of the MGNREGS beneficiaries were reported to have medium level of economic motivation followed by 35.00 and 7.50 per cent of the beneficiaries coming under high and low level of economic motivation.

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CONCLUSION

It could be concluded from this study that, Majority of the MGNREGS beneficiaries in Dharmapuri district of Tamil Nadu were female, old aged, illiterate belonging to SC/ST category. Mostly they are married and live in nuclear families with five members. They have MGNREGA as their main source of income. They have marginal landholdings with low level of annual income and have less social participation. They live in hut type houses, employing low level of farm power. Our policy planners at the national, state and district level, Extension and development professionals at all levels need to integrate and work together in strengthening this welfare scheme by involving Panchayat Raj Institutions (PRIs), effectively use social audits, use advanced information and communication technologies to improve the effectiveness of this welfare scheme in reaching its intended goals and objectives and also meeting the development needs of its beneficiaries in the near future.

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Table1-Socio- Economic Profile characteristics of MGNREGS beneficiaries in Dharmapuri District

Profile characteristics		Frequency	Percentage
Age	Young (Up to 35 years)	20	16.67
	Middle (About 35 up to 45 years)	28	23.33
	Old (More than 45 years)	72	60.00
Gender	Male	43	35.83
	Female	77	64.17
Marital status	Married	98	81.67
	Unmarried	7	5.83
	Widow/Divorced	15	12.50
Educational status	Illiterate	72	60.00
	Functionally literate	8	6.67
	Primary education	11	9.17
	Middle education	14	11.66
	Secondary education	12	10.00
	Collegiate education	3	2.50
Occupational status	MGNREGA only	48	40.00
	MGNREGA+ Wage earners	36	30.00
	MGNREGA+ Farming alone	21	17.50
	MGNREGA+ Farming + Wage earners	15	12.50
Farm size	Landless labourers	42	35.00
	Marginal farmers	56	46.67

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	Small farmers	22	18.33
Annual Income	Low (up to 26,000)	77	64.17
	Medium (26,000 to 45,000)	30	25.00
	High (45,000 to 60,000)	13	10.83
Social Participation	Low	75	62.50
	Medium	32	26.67
	High	13	10.83
Socio Economic Status Parameters			
i) Type of House	Hut	73	60.83
	Kutcha	34	28.33
	Pucca	13	10.84
ii) Caste	SC/ST	57	47.50
	Backward	34	28.33
	Most backward	29	24.17
iii) Farm Power	Low	66	55.00
	Medium	38	31.67
	High	16	13.33
iv) Material Possession	Low	26	21.67
	Medium	74	61.67
	High	20	16.66
v) Family Type	Nuclear	72	60.00
	Joint	48	40.00
vi) Family Size	Upto 5 members	88	73.33
	More than 5 members	32	26.67
Economic Motivation	Low	9	7.50
	Medium	69	57.50
	High	42	35.00

RESEARCH ARTICLE

Internet of Things Assisted Air Pollution Monitoring System in Industrial area using Mayfly Optimization with Deep Learning Model

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ABSTRACT

Air pollution can have a variety of effects on our health and environment. Over the past few years, urban and industrial areas have suffered from deteriorating air quality due to heavy environmental loads. The task of improving and controlling air quality has drawn considerable national attention. Ambient air quality data mining is a tool concerned with finding hidden patterns inside largely available data, so that the information retrieved can be transformed into usable knowledge. This work aid data mining to uncover the hidden knowledge of air pollution distribution in the voluminous data retrieved from monitoring stations. The data has been collected from TNPCB (Tamil Nadu Pollution Control Board) online data, CPCB (Central Pollution Control Board) online data, and Industrial data from an organization monitoring system and real time data. The distribution of suspended particles like Temperature, humidity, Carbon dioxide (CO_2), Nitrogen dioxide (NO_2), and sulphur dioxide (SO_2) in polluted environment air is identified. The data are analyzed using data mining techniques for the past eight years (2015-2022). This helps in the prediction of air quality in urban and industrial areas. The distribution of suspended particles like DHT22, CO_2 (MG811), NO_2 (MICS-4514), and SO_2 (SGS-SO_2) in polluted environment air is identified. The data are analyzed using the Deep Learning Model technique. This helps in the prediction of air quality in industrial areas and this could serve as an important reference for government agencies in evaluating present and devising future air pollution policies. To enhance a better pollution prediction system, the Deep Learning Model with the new Mayfly Optimization (MFO) with Hybrid Convolutional Neural Network-Long Short-Term Memory (HCNN-LSTM) model for air pollution monitoring has been applied. In contrast to existing methods, the advantage of the proposed method can effectively handle multi-objective optimization. In addition, to

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perform preventative analysis on air quality in industrial areas the proposed hybrid HCNN-LSTM model makes use of a published dataset of past sensor data and machine conditions. The proposed method is a cutting-edge optimization technique, that is quite competitive with the existing methods.

Keywords: Internet of Things (IoT), Industrial Pollution, Air Quality Index, Hybrid Convolutional Neural Network, Long Short-Term Memory, Mayfly Optimization.

INTRODUCTION

This paper briefly introduces air pollution and its hazardous effects, the role of the Internet of Things in implementing a system for air quality monitoring, and the employability of deep learning in predicting air quality parameters. The earth is the only planet that has Sunlight, Air and Water. Air is very essential for all living creatures [1]. Without air and water, the earth would be unable to sustain life. Air pollution is defined as the contamination of the nearby atmosphere by several gaseous, fluid, and concrete wastes generating hazardous effects on health of humans, the well-being of plants and wildlife worldwide [2]. These air pollutants can potentially produce numerous health risks in multiple illnesses like sinus infection, asthma, allergy syndrome, toxic dust syndrome, nervous system related threats, and several more. Air pollution caused discomfort to the health of humans and animals and caused damage to plants and earth. In the current period of a new industrial revolution broadly recognized as Industry 4.0, the internet of things (IoT), big data, and artificial intelligence have enabled a range of industrial sectors and started concentrating majorly on areas such as Smart Agriculture, Smart Transportation, Smart Environmental Monitoring, Smart Manufacturing and many more [3]. Such industrial sectors have revamped the practices of traditional industries by facilitating 24 * 7 interconnectivity, automation, real-time data analytics, and IoT-based predictive maintenance. In this context, IoT enables industries to be more efficient, interactive, and aware. There is an internet of things (IoT) that consists of interconnecting everyday objects. A deep learning approach based on a Convolutional Neural Network (CNN), a Long Short-Term Memory (LSTM), and a Gated Recurrence Unit (GRU) is presented in this paper for forecasting future air quality values [4]. As a result, in this paper, an IoT analysis model is proposed using deep learning techniques. The Air Quality Index (AQI) measures local air quality and tells us how clean or unhealthy the air is.

The Deep Learning (DL) concept is developed by analysing and forecasting a huge amount of data. An analysis of neural network models in selected regions. Another health problem that affects people is the concentration of air pollutants in industries [5]. In other words, an air quality monitoring and alarm system could reduce the degree of air pollution if precautionary measures were taken. Using a hybrid model, higher prediction performance is obtained with neural networks. The AQI is also predicted using hybrid approaches, such as fuzzy models [6]. Another researcher applied an LSTM-based technique to forecast pollutant gas to alert residents such as neural networks enabled by deep learning are producible [7]. An artificial neural network (ANN) to predict daily PM10 concentrations in regional and urban locations was suggested [8]. There are several research in the literature that provide solutions to the DL prediction problem. The state-of-the-art recurrent neural network (RNN) for regulated temporal sequence learning is LSTM, which is a subtype of DL. To make better use of its input, LSTM features a structure of loops that recall prior events. LSTM is used to solve a variety of problems, including speech recognition, machine translation, traffic flow prediction translation, video text recognition, and acoustic modelling. It performs effectively in the broad area of modelling sequential data by mapping input sequence to goal sequence. Neural network with long short-term memory LSTM is a one-of- a-kind recurrent neural network (RNN) approach with RNN characteristics that utilises a sequence of memory cells to deal with any input data and improve time series learning. It also captures the long-term reliance of the input information in order to prevent the gradient disappearance of data transmission, hence improving its capacity to catch the dynamic variations of the time series [9].

The long short-term memory (LSTM) architecture was established by Hochreiter and Schmidhuber (1997) and enhanced by [10]. In terms of prediction quality, the LSTM architecture outperformed all other models, with lower MAE values of 0.09, 0.056, 0.096, and 0.114 for NO, NO_2, CO, and O_3, respectively. Due to the general CNN algorithm's computational efficiency, it can replace deep-feed backward networks like RNN, LSTM, and GRU models to forecast pollutants quickly and correctly. Several deep learning approaches, including Convolutional Neural Network (CNN), Recurrent Neural Network (RNN), Long Short-Term Memory (LSTM), and Gated Recurrent Unit (GRU), were employed in the study to estimate hourly pollutant concentrations based on geographical and meteorological data. The study also provided an evaluation of feature selection using different feature combinations for the model's performance and showed an increase in accuracy. Because environmental pollutants have a significant influence on global warming and climate change, forecasting their growth rate for the future will help in the management of these pollutants.

METHODOLOGY

Internet of Things (IoT) is emerging as an essential technology in developing smart cities across the globe. The government is also using the Internet of Things to provide various public sector services to the citizens. "Internet of Things" (IoT) is a system that extends communication to "things" or physical objects. Interrelated machines or everyday devices embedded with sensors or other hardware/electronic devices and software can communicate and provide identity to other devices over the internet without active human interaction. In this present work, the major intention of the proposed model is to predict the air pollution index level. The proposed model initially applies data pre-processing in two stages namely data normalization and class labeling. For the classification of air pollutants and determining air quality, the HCNN model is used as a classifier, which predicts the air quality accurately. In addition, the MFO algorithm is applied as a parameter tuning technique to optimally determine the hyper parameter values of the HCNN-LSTM model. In order to examine the air quality monitoring performance of the proposed model, an extensive set of simulation analyses is performed on the Air Quality dataset from the Kaggle repository. The experimental outcome highlights the optimal performance of the proposed model over the recent techniques.

Detection Sensors
In the suggested system, four sensors—the weather sensor (DHT22), the CO_2 (MG811) sensor, the NO_2 (MICS-4514) sensor, and the SO_2 sensor—are employed to detect the industrial environmental pollutant parameters (11-508). Digital outputs of the DHT22 weather sensor are used to measure temperature and humidity. The CO_2 Sensor (MG811) measures carbon dioxide via digital output. The 12-bit analogue NO_2 (MICS-4514) sensor needs to be converted into digital via an ADC. The digital input of the Arduino UNO controller is where the DGS-SO_2 sensor is connected [11]. The ATMEGA-328P family-based Arduino UNO is a low-cost, powerful microcontroller board with a strong ADC that is simple to connect to the Raspberry Pi. Because the Raspberry Pi 3 model gets pollution data from the Arduino controller and transmits computation to the IoT platform (IBM Bluemix). The MQTT (Message Queuing Telemetry transport) protocol is employed to allow connection between an IoT cloud server and a raspberry pi. By using the device id, the client can view the data that is being shown on the dashboard, but the client is unable to edit the data that has been sent.

Computation Unit
The quad-core 64-bit ARM Cortex-A53 SoC processor that powers the Raspberry Pi 3 can operate at 1.2 GHz. This can be used for browsing the web and workplace apps. The addition of a Wi-Fi chip and Bluetooth Low Energy is without a doubt the primary benefit of the Raspberry Pi 3. It also makes more USB ports available for connecting the Arduino controller to collect data on environmental pollution parameters [12]. The Raspberry Pi 3 board is roughly the same size as the Raspberry Pi 2, and the connector and component arrangement are virtually identical.The Raspberry Pi 3 can also run Windows 10 IoT Core, an operating system that has been installed for producing and creating dashboards for monitoring pollutants in industrial areas.Because of this, the Internet of Things (IoT) and home computing have begun to use the new Raspberry Pi model.

Transfer of data using an IoT cloud service

For IoT-based environmental pollution monitoring in this suggested system, the open-source programming tool Node-RED has been utilised. It is a well-liked visual programming tool that helps with the Raspberry Pi 3 and Arduino integration. Thanks to its tens of thousands of flows and nodes, the Node Red programming tool enables the user to connect all pollution parameter sensors. Flows can be run at the network's edge on a Raspberry Pi 3. The IoT hardware developers deploy their flows using Node-Red to a minimal runtime industrial environment region [13].When transferring pollution monitoring data between a Raspberry Pi and an IBM Bluemix cloud server, the MQTT protocol is employed. It is the communication protocol that is most suited for IoT Cloud services since it minimises the need for extra interface devices, a low bandwidth, and an unstable network. The compiler in the Arduino section can support any programming language whose source code has been translated to binary code [14]. The proposed system uses the Arduino IDE Platform to receive and interpret data from pollution sensors, including temperature, humidity, CO_2, NO_2, and SO_2, among others. IDE may run on Windows, Linux-based operating systems, as well as Mac OS because it is platform independent. A message box, a toolbar for basic actions, and a text console are a few of the main characteristics of IDE. The sketch is the name of an Arduino program that runs on the IDE platform. The Arduino IDE supports programming in languages including C and C++.

Proposed Prediction Model

The implementation of an industrial environmental pollution monitoring system can be splitted into four models namely, measuring and sampling location, hardware setup model, software setup model and ensemble prediction model. The workflow diagram of the proposed model is shown in fig 2. In the present study, deep learning techniques are used to get more precise prediction results. The proposed system uses a Long-Short-Term Memory Network (LSTM), bidirectional LSTM (Bi-LSTM) and Gated Rectified Unit neural network (GRU) N has a stronger capability to obtain more accurate prediction results.

LSTM

A unique variety of memory-based Recurrent Neural Network (RNN) is the LSTM. The fading away gradients issue of the RNN was resolved by the introduction of another neural network architecture, which preserved long-term information and overcame short-term input. For handling long-term temporal dependencies in the data, these memory cells are a crucial component. This cell state can have information added to it or removed by LSTM. Specialized LSTM structures known as gates do this operation [15].Input gates (i_g), forget gates (f_g), and output gates (o_g) are the three types of gates designed in LSTM which is shown in equations 1 to 6.

$$h_g = \sigma\left(W_i \cdot [h_g - 1, x_g] + b_i\right) \tag{1}$$
$$h_g = \sigma\left(W_f \cdot [h_g - 1, x_g] + b_f\right) \tag{2}$$
$$o_g = \sigma(W_o \cdot [h_g - 1, x_g] + b_o) \tag{3}$$
$$\check{C}_g = \tanh(W_c \cdot [h_g - 1, x_g] + b_c) \tag{4}$$
$$C_g = f_g * C_{g-1} + i_g * \check{C}_g \tag{5}$$
$$h_g = o_g * tanh(C_g) \tag{6}$$

Where Based on the present input and the past hidden state, the hidden state "candidate" $\widetilde{C_g}$ is calculated. The device's internal memory is denoted by C_g. It consists of the recently computed hidden state multiplied by the input gate and the previously stored memory multiplied by the forget gate. In order to calculate the output hidden state, multiply the memory by the output gate.

Gated Recurrent Units (GRU) network

GRU is another improved version of RNN. The cell architecture is simpler than that of LSTM. Also, GRU has a gating mechanism for controlling information flow. However, it has fewer parameters and does not have an output gate. It consists of two gates, rg, which is a reset gate, and zg, which is an update gate. There is an equivalent forget gate in the LSTM called the reset gate. The reset gate regulates the flow of new input to the previous memory decides how

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much of the past information to forget and computed with the same formula as the update gate. It decides how much of the previous memory to keep for retaining future information based on the current input. [16]. This network topology has a candidate-hidden state called "d," which selects what data to discard from earlier time steps by multiplying the current input by the sum of the prior hidden state and the reset gate. This is shown in the following equation

$$z_g = \sigma(W_{xz}x_g + W_{hz}h_g - 1 + b_z) \tag{7}$$

$$r_g = \sigma(W_{xr}x_g + W_{hr}h_g - 1 + b_r) \tag{8}$$

$$\widetilde{h_g} = \tanh(W_{xh}x_g + W_{hh}(r_g \odot h_g - 1) + b_h) \tag{9}$$

$$\breve{h}_g = z_g \odot h_{g-1} + (1 - z_g) \odot \widetilde{h_g} \tag{10}$$

Bidirectional LSTM

Each current input in a typical RNN architecture is solely dependent upon the prior input because information can only be transferred forward. When developing predictions about the current state in some applications, such as text auto-complete and machine translation, it is necessary to use data from both earlier time steps and later steps because every moment in these applications has context information [17]. In order to process all inputs equally, a bidirectional recurrent neural network architecture was developed.It is composed of forward and backward covert states $\overrightarrow{C_t}$ and $\overleftarrow{C}_t$ as shown in the fig 3. Such a network might combine two or three separate LSTM, Bi-LSTM, and GRU models, where each input from the sequence data is supplied into one network made up of sequential units in one time order and into another network in the other time order [18]. The final covert layer, "C_{t-1}," which is utilised to build the output layer, "o_t," is created by concatenating the outputs of the two opposing directional networks, forward (f) and backward (b), at each time step.

$$\overrightarrow{C_t} = g\left(W_{xc}(f)x_t + W_{hc}(f)\overrightarrow{C_{t-1}} + b_c(f)\right) \tag{11}$$

$$\overleftarrow{C_t} = g\left(W_{xc}(b)x_t + W_{hc}(b)\overleftarrow{C_{t-1}} + b_c(b)\right) \tag{12}$$

$$o_t = \tanh(W_q^c C_t + b_q) \tag{13}$$

In order to forecast the future environment value based on the data had already been collected, LSTM, GRU, and Bi-LSTM were employed. The concept was to aggregate the results of various sequential models. Every model differs in its strengths and weaknesses, making predictions that are superior to all others under particular circumstances. The models must be effective in various ways, specifically by producing distinct prediction errors. Our ensemble can produce better forecasts than any single best model, in addition to lowering the variance in the prediction.

RESULTS AND DISCUSSION

In the proposed work, 1850 predicted values were taken into consideration and the anticipated hybrid model was used to find the dependability of the predicted values. This was found by using confusion matrix as shown below.
It can assess how well the proposed model's scores, match the real values using confusion matrix. The above confusion matrix is based on actual class versus predicted class matrix. From the confusion matrix the reliability of the proposed system is examined. This is done by considering six different level of classes based on the different accuracy levels. Those six levels are very poor, poor, moderate, good and satisfactory. From 1850 sensor data, the classification accuracy of the proposed model under trained data has 77 severe classification, 297 very poor classification, 416 poor classification, 1745 moderate classification, 312 good classification, and 1456 satisfactory classification. Similarly, after training, using the acquired data from each sensor, testing is done to check the vulnerability of the proposed system. This can be examined using the trained confusion matrix From the above trained confusion matrix, it is evident that the accuracy of the proposed Mayfly Optimization (MFO) with Hybrid Convolutional Neural Network-Long Short Term Memory (HCNN-LSTM) model for air pollution monitoring has higher prediction accuracy than the test model. From the matrix it was evident that for 1850 sensor data, the

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classification accuracy of the proposed model has 39 severe classification, 106 very poor classification, 211 poor classification, 760 moderate classification, 137 good classification, and 596 satisfactory classifications. This proves that the proposed model has more accurate prediction as it has lesser false detection probability.

Precision recall Curve

Precision formula: $\frac{TP}{TP+FP}$.

Recall is measured using the formula: $\frac{TP}{TP+NP}$

And F-score is measured using the formula: $(2*Precision*Recall)/(Precision*Recall)$

It is the ratio between true positive values to the sum of true positive and false positive value. From the above graph Precision is additionally known as positive predictive value. The proportion of accurately anticipated positive outcomes to all positively expected outcomes and Recall is also called as Sensitivity, probability of detection, and true positive rate. In the existing methods, the Harsh [19] has measured the air quality level using MQ135 and MQ6 gas sensor but have not predicted the future air quality level for awarding future mishaps. In the case of Ahmed [20] has 97.48% prediction accuracy is achived in the case of CNN-LSTM. Where as in the case of the proposed new Mayfly Optimization (MFO) with Hybrid Convolutional Neural Network-Long Short-Term Memory (HCNN-LSTM) model the proposed system has 98% higher prediction accuracy than the existing methods. From the above graph, the precision-recall is calculated at 0.1 and is shown in the table 1. It is evident from the table: 1 that the proposed model after training has better prediction when compared to testing data accuracy.

Receiver operating characteristics curve

Fig.7 is the ROC curve which represents True positive rate vs. False positive rate in prediction probability. For different threshold levels, the true positive rate (sensitivity) is presented as a function of the false positive rate (specificity). For different threshold levels, the true positive rate (sensitivity) is presented as a function of the false positive rate (specificity). With an area under the curve (AUC) of 0.99, the promises of good accuracy and trustworthy prediction are validated. Despite the tiny quantity of the data set, the classifier's accuracy is higher since the curve is closer to the upper left corner. Despite the short size of the data set, the curve is closer to the upper left corner, suggesting remarkably good accuracy of the classifier.

Result

The proposed method combines the robustness of a CNN network and the time series forecasting and the classification of the LSTM with modified Model using Mayfly Optimization was proposed. To evaluate hybrid Mayfly Optimization with CNN-LSTM model, a published real-world industrial machine data is used. The results show that the proposed model hybrid Mayfly Optimization (MFO) with Hybrid Convolutional Neural Network-Long Short-Term Memory (HCNN-LSTM) model the following prediction accuracy The proposed model has achieved an average of 98.1% Precision, 98.6% Recall, 98.37% F-Score, 98.82% accuracy, 99.76% specificity, ROC score of 99.98%, false positive rate of 0.02% and Mathew's coefficient of 98.12%on the testing dataset. The hybrid CNN-LSTM with MFO model shows improvement in prediction accuracy than the existing models.

CONCLUSION AND FUTURE WORK

In order to increase the accuracy of short-term load forecasting, we introduce the Mayfly Optimization with LSTM-CNN hybrid model method us introduced in this study. In addition to utilising the useful information and possible features present in the vast input data from the CNN, our method makes use of a deep network to learn the temporal information through LSTM network. The Mayfly algorithm was used to optimize those results to attain higher prediction accuracy in terms of air quality monitoring.

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Table .1: Precision / Recall table using hybrid MFO and HCNN-LSTM

Precision/Recall	Test data using hybrid MFO and HCNN-LSTM	Training data using hybrid MFO and HCNN-LSTM
severe	1.0	0.9997
very poor	0.998	0.9971
poor	0.9986	0.09986
moderate	0.9997	0.9998
good	0.9982	0.9982
satisfactory	0.9994	0.9995

Accuracy	Precision	Recall	Specificity	F1-Score	ROC-AUC Score	False Positive Rate	Mathews Correlation Coefficient
0.9882	0.981	0.9866	0.9976	0.9837	0.9998	0.0024	0.9812
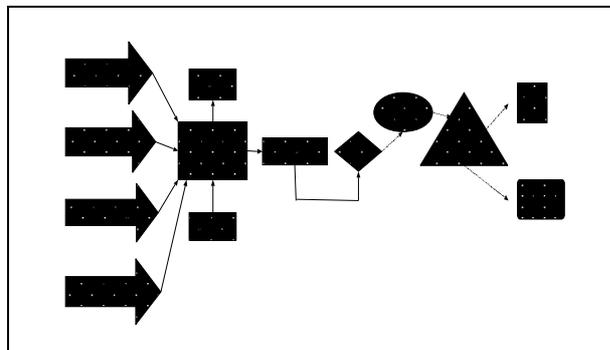
Fig. 1:Hardware System Architecture of Mayfly Optimization with Deep Learning Model
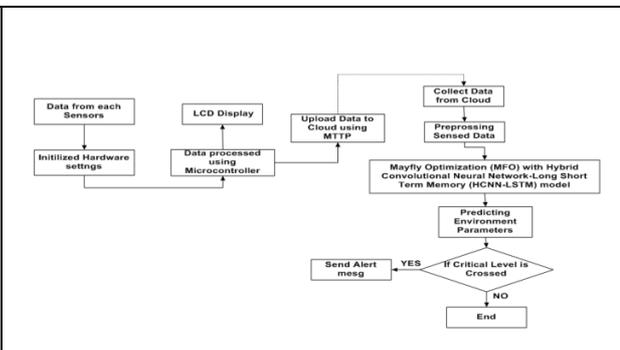
Fig .2: Workflow of Proposed Ensemble based prediction Model using Mayfly Optimization with Deep Learning Model
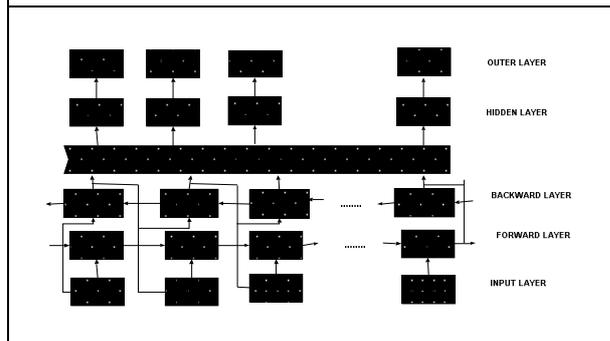
Fig. 3: Bidirectional recurrent neural networks structure.
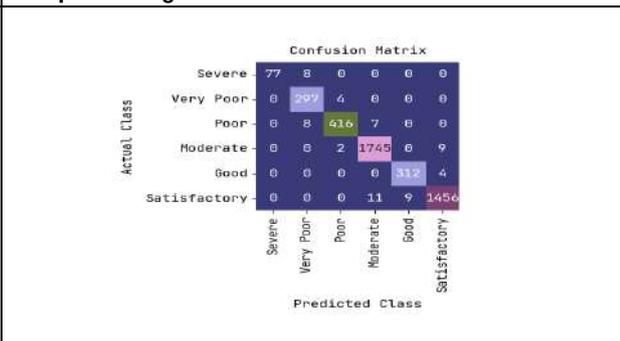
Fig. 4: Confusion matrix for the train data set

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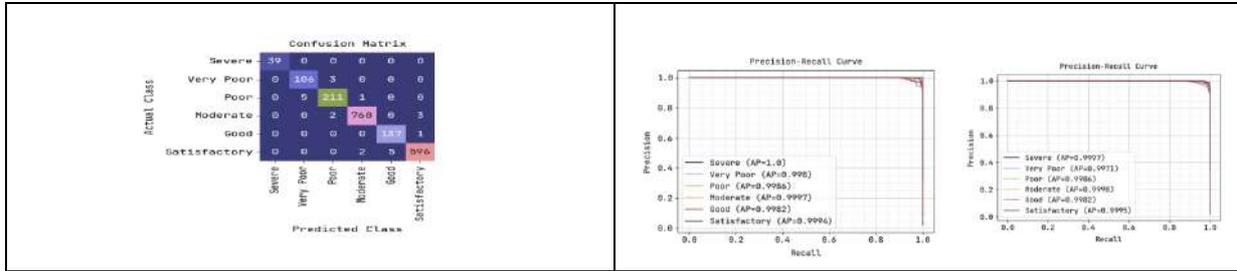
Fig. 5: Confusion matrix of testing data set

Fig. 6: Precision recall graph for test and trained data
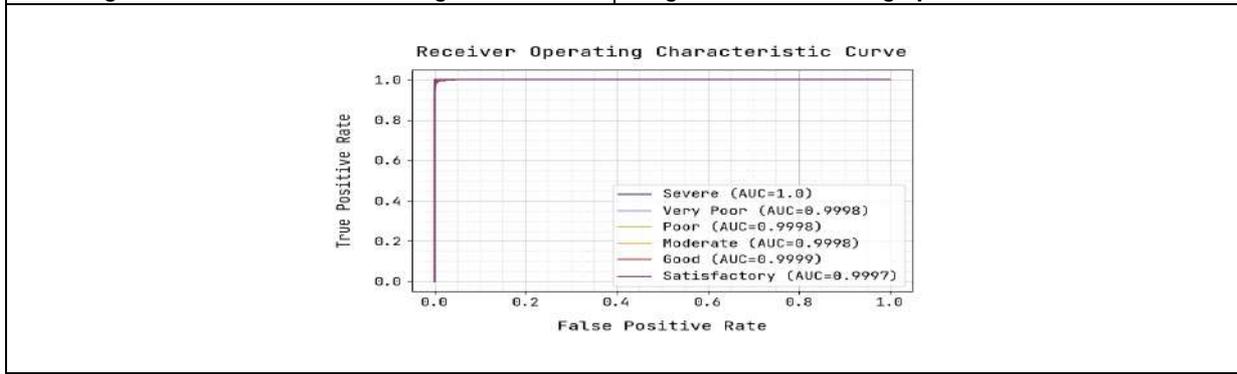
Fig.7. Receiver Operating Characteristics Curve

RESEARCH ARTICLE

A Study on School and College Attitude toward Online Classes during the Covid-19 Pandemic Situation

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ABSTRACT

The learning's goal mouth was to determine how high school and college students felt about taking online programs. All 86 students who met the inclusion and exclusion criteria were randomly selected to participate in an online cross-sectional research project. An ATOC (attitude towards online classes) and a socio-demographic questionnaire were included in the researcher's semi-structured online questionnaire created with Google Form. All of the selected respondents received a link to the questionnaire via WhatsApp messaging and emails. The data was analysed using IBM SPSS version 20 software. Using Cronbach's alpha test, we were interested in determining the questionnaire's reliability. Chi-square tests were used to investigate the connection between categorical variables. More than half of those polled said they liked online education. There was a link between attitudes toward online education and socio demographic factors like age.

Keywords: Google Form, Online Education, Demographic, WhatsApp, Emails.

INTRODUCTION

As can be observed, the entire world has seen significant advancements in both development and acceptance of digital technologies in daily human existence. Every discipline uses technology to some extent, and education is no exception. COVID-19, a newly discovered corona virus disease, has forced the closure of educational institutions across many countries. Schools agreed to halt operations to protect their students from viral infections, which are common in a student population that is highly social. Teachers and students are compounded with a slew of new challenges as schools and institutions close for the foreseeable future.

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As can be seen, the digital technologies that people use on a regular basis have been subjected to enormous change all over the world, both in terms of the progression of their development and the amount of people who have adopted them. Technology is making a difference in a variety of fields, including education. Education is just one of these fields. As a result of the novel corona virus disease COVID-19, which has been spreading throughout the world, a number of nations have issued orders for the closure of all educational institutions. The operations of educational institutions were halted so that students could be shielded from potential viral exposures. This had to be done because there was such a high number of students engaging in social activities. When schools and colleges are closed for an indefinite period of time, both students and teachers are presented with a number of difficult challenges. At this time online education appeared as an alternative method to impart education with minimum social contact. The word 'online learning' refers to a wide range of pedagogical resources and methods that are constantly evolving to meet the needs of students and teachers. Web content has enriched day by day and becomes more interactive for users as global connectivity and internet access speeds have increased.1 Students can effectively communicate with others using online learning systems because they offer an alternative, more versatile mode of communication.

In order to remain competitive in a growing student market, online learning systems aim to provide students with easier access to quality education, improve the quality of instruction, and allow universities to do so. 3 The institution's online learning experience would provide a strategic chance to explore a new sector of education in the long run. This method also allowed\students to access a range of materials at any time and\from any place. This gives students more control over their education by allowing them to gather the resources they require and do research when they have free time. Furthermore, network-based online learning platforms support special acquaintance creation and group knowledge sharing, which can raise individual and group learning efficiency, facilitate knowledge innovation, and improve learning efficiency. As a result, online learning platforms appear to be efforts to take a step forward in the direction of a more effective and high-quality education system. The success of online classes is determined by the skill of the students, their interest in technology, and the availability of certain necessary resources. In addition to the student's attitude, the facilitator's attitude is critical in making online learning more attractive. Web-based learning has undeniably taken over the world of education and made learning more convenient, but it is not yet a standard part of the curriculum in developing countries like India.

As a result of factors such as the availability, affordability, and accessibility of technological devices such as smart phones, laptops and personal computers, internet connectivity and a lack of technological skills among the students in India, attitudes toward online classes can be affected. As a result, this research was carried out to determine how students feel about taking classes online.

Objective of the study
➤ A study on socio-demographic profile
➤ An examining the attitudes of high school and college students toward online classes during the COVID-19 pandemic lockdown period.

Hypothesis of the study
➤ There is no relationship Between Socio-demographic and Attitude towards online classes

METHODS

An online cross-sectional design was used in the current research. July to August 2021 was the time frame for this study in the Coimbatore district of Tamil Nadu. Purposive sampling was used to select 86 high school and college students who met the inclusion and exclusion criteria for the study, and the Ethical Committee approved the study.

Analysis and Interpretation

The above table 1 shows the percentage analysis of following socio geographic such as age, gender, father occupation, family income, residence, family type and educations.

Chi square

The calculated value of chi-square is more than the table value at 5% level of significance. So the null hypothesis is rejected. Hence there is a relationship between Socio-demographic and Attitude towards online classes.

CONCLUSION

Despite this, India has seen fast technical advancements, particularly in the communication industry. With the advancement of technology in the communication sector, a new teaching method known as online class rooms has emerged. During the COVID-19 contagion's lockdown, internet education aided students and teachers in their academic endeavours. Due to their poor income, the majority of individuals lack technological skills and cannot afford smartphones, laptops, computers, or internet access. These issues may have an impact on students' and teachers' perceptions of online courses. According to the survey results, the majority of young people had an optimistic perspective on digital training. Age, academic level, and family income were found to have a strong relationship with attitudes toward online education. Students who took online classes, had technological skills, and were supported by their parents had a more positive attitude toward online classes, according to the study. According to the findings, pupils who have experienced physical or mental psychological trauma have a negative attitude toward online education.

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Table 1. Percentages analysis

Variables	Categories	Frequency	Percentage
AGE	Below 20	36	42
	20 And Above	50	**58**
GENDER	Male	41	48

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	Female	45	**52**
EDUCATIONS	High School	36	42
	Intermediates	12	14
	Undergraduate	23	27
	Postgraduate	15	17
Father's Occupation	Farmer	12	14
	Labour	20	23
	Shop Owner/Business	6	7
	Private Job	32	**37**
	Government Job	22	26
Residence	Rural	35	41
	Urban	51	**59**
Family type	Nuclear	62	**72**
	Joint	24	28
Family income (Rupees)	Below 10000	5	6
	10001-20000	12	14
	20001-30000	39	**45**
	above 30000	30	35

Table 2. Chi square

		Attitude towards online classes				CHI SQUARE VALUE	DF	P VALUE
		Low	Medium	High	total			
AGE	BELOW 20	10	14	12	36	12.45	2	0. 001979
	20 AND ABOVE	10	20	20	50			
		20	34	32	86			
		Low	Medium	High	total			
GENDER	MALE	20	11	10	41	10.75	2	
	FEMALE	15	14	16	45			0. 004631
		35	25	26	86			
		Low	Medium	High	total			
EDUCATIONS	high school	12	12	12	36			
	intermediates	2	5	5	12			
	undergraduate	7	5	11	23			0. 001344
	postgraduate	5	6	4	15	21.75	6	
		26	28	32	86			
		Low	Medium	High	total			
Father's Occupation	Farmer	3	4	5	12			
	Labor	5	6	9	20	22.70		
	Shop owner/business	2	1	3	6		8	0. 003772

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	Private job	7	12	13	32			
	Government job	6	4	6	16			
		23	27	36	86			
		Low	Medium	High	total			
Residence	RURAL	8	16	11	35			
	URBAN	21	9	21	51	6.19	2	0.045275
		29	25	32	86			
		Low	Medium	High	total			
Family type	Nuclear	33	15	14	62			
	Joint	7	3	14	24	8.45	2	0.014625
		40	18	28	86			
		Low	Medium	High	total			
Family income (Rupees)	below 10000	1	2	2	5			
	10001-20000	2	5	5	12			
	20001-30000	9	13	17	39		6	0. 069749
	above 30000	12	10	8	30	11.67		
		24	30	32	86			

RESEARCH ARTICLE

An M/G/1 Retrial Queue with Working Vacation, Reneging and A Waiting Server

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ABSTRACT

An M/G/1 retrial queue with working vacation, reneging and a waiting server is taken into consideration in this study. Both retrial times and service times are assumed to follow general distribution and the waiting server follows an exponential distribution. During the working vacation period customers are served at a lesser rate of service. Before switching over to a vacation the server waits for some arbitrary amount of time and so is called a waiting server. We obtain the PGF for the number of customers and the mean number of customers in the invisible waiting area which is acquired by utilizing the supplementary variable technique. We also computethe mean waiting time. Out of interest a few special cases are conferred. Numerical outcomes are exhibited.

Keywords: Retrial queue, Working vacation, Supplementary variable technique, Reneging, Waiting server.

INTRODUCTION

Retrial queues are expressed by the fact that if a customer observed that the server is occupied then they are entering into the invisible waiting area called an orbit. In recent years numerous researchers have examined the retrial queue. For a more in-depth analysis of the retrial queues, one can refer[1, 2, 3]. In Queueing theory queueing models with server vacation has a most impactful application. In addition to the vacation strategy Servi and Finn [4] developed a

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newest vacation strategy, called as Working Vacation (WV). In the WV period the server provides a lesser rate of service to the customers than during the regular service period. Wu and Takagi[5] examined M/G/1/MWV. Kalyanaraman and Pazhani Bala Murugan [6] have developed the retrial queue with vacation, Pazhani Bala Muruganand Santhi[7] studied the M/G/1 retrial queue with MWV. For a comprehensive study on WV, one can refer [8]. Whenever the system becomes empty the server leaves from the regular service period (RS) and goes on a WV, but in a *waiting server model the server wait for a arbitrary amount of time before going to WV. For a detailed study on waiting server model , can refer [9, 10, 11]. Customers in the retrial queues repeatedly request services from the orbit and they are uncertain about when they will be served. As a result, customers become impatient and leave the orbit before receiving service and they never will arrive back. This is considered as reneging.For a detailed study on reneging model, refer [17, 18, 19].* In this article, we consider an M/G/1 retrial queue with multiple WV, reneging and a waiting server. This article has the following structure. We explain the model in segment 2. In segment 3 performance measures are established. Segment 4 discusses some special cases. In segment 5 numerical outcomes are exhibited . The conclusion is given in segment 6.

2. MODEL DESCRIPTION

We examine an M/G/1 retrial queue with WV, reneging and a waiting server where the primary customers arrival follows a Poisson process with arrival rate λ. If an approaching customer discovers that the server is occupied then they exit the service area because, we assume that there is no waiting area and they joins the orbit. At a service completion instant, if the number of customer is at the extreme front end of the orbit, is permitted to approach the server with a distribution function G(x) and the retrial time follows a general distribution. For the normal service period, let g(x) and $G^*(\theta)$ signify the pdf and LST respectively, and for WV period, let$L(x)$,l(x), $L^*(\theta)$ signifies the distribution function, pdf and LST respectively. On the service completion epoch of each customer, if there is a contest between primary customer and an orbit customer, then it will be determined with $R_s(x)$, $r_s(x)$, $R_s^*(\theta)$ as its distribution function, pdf, LST with general distribution.The service delivered among the WV period follows general distribution with $W_v(x)$, $w_v(x)$,$W_v^*(\theta)$ as its distribution function, pdf andLST. Retrying customers renege from the orbit, which is expected to follow an (exp.) distribution with the rate ξ. The server waits for a arbitrary period of time once the orbit turns empty which follows an (exp.) distribution with rateα. After completion of waiting time the server goes for WV which follows an (exp.) distribution with rate β and inter-arrival times, retrial periods, RS periods, and WV periods are all presumed to be independent of one another.

Let's use the subsequent random variables

O(t)- Size of the orbit at "t" .

$R_s^0(t)$, $G^0(t)$- the RST and RRT in RS period.

$W_v^0(t)$, $L^0(t)$- the RST and RRT in WV period are the random variables

At time "t" the four distinct states of the server are

$$E(t) = \begin{cases} 0 & \text{if the server is not occupied in WV} \\ 1 & \text{if the server is not occupied in RS period} \\ 2 & \text{if the server is occupied in WV} \\ 3 & \text{if the server is occupied in RSperiod} \end{cases}$$

Further variables are introduced,to generate bivariate Markov Processs, $\{(E(t), B(t)); t \geq 0\}$, where

$B(t) = L^0(t)$, if $E(t) = 0$; $G^0(t)$,   if $E(t) = 1$; $W_v^0(t)$, if $E(t) = 2$; $R_s^0(t)$, if $E(t) = 3$

$W_{0,0} = \lim_{t\to\infty} P[O(t) = 0, E(t) = 0]$

$R_{0,0} = \lim_{t\to\infty} P[O(t) = 0, E(t) = 1]$

$W_{0,h} = \lim_{t\to\infty} P[O(t) = h, E(t) = 0, x < L^0(t) \leq x + dx]$; $h \geq 1$

$R_{0,h} = \lim_{t\to\infty} P[O(t) = h, E(t) = 1, x < G^0(t) \leq x + dx]$; $h \geq 1$

$W_{1,h} = \lim_{t\to\infty} P[O(t) = h, E(t) = 2, x < W_v^0(t) \leq x + dx]$; $h \geq 0$

$R_{1,h} = \lim_{t\to\infty} P[O(t) = h, E(t) = 3, x < R_s^0(t) \leq x + dx]$; $h \geq 0$

Following are the limiting probabilities.

$$R_s^*(\theta) = \int_0^\infty e^{-\theta x} r_s(x) dx \qquad W_v^*(\theta) = \int_0^\infty e^{-\theta x} w_v(x) dx$$

$$L^*(\theta) = \int_0^\infty e^{-\theta x} l(x) dx \qquad G^*(\theta) = \int_0^\infty e^{-\theta x} g(x) dx$$

$$W_{0,h}^*(\theta) = \int_0^\infty e^{-\theta x} W_{0,h}(x) dx \qquad W_{0,h}^*(0) = \int_0^\infty e^{-\theta x} W_{0,h}(x) dx$$

$$W_{1,h}^*(\theta) = \int_0^\infty e^{-\theta x} W_{1,h}(x) dx \qquad W_{1,h}^*(0) = \int_0^\infty e^{-\theta x} W_{1,h}(x) dx$$

$$R_{0,h}^*(\theta) = \int_0^\infty e^{-\theta x} R_{0,h}(x) dx \qquad R_{0,h}^*(0) = \int_0^\infty e^{-\theta x} R_{0,h}(x) dx$$

$$W_0^*(z,\theta) = \sum_{h=1}^\infty W_{0,h}^*(\theta) z^h \quad W_0^*(z,0) = \sum_{h=1}^\infty W_{0,h}^*(0) z^h$$

$$W_0(z,0) = \sum_{h=1}^\infty W_{0,h}(0) z^h \qquad W_1^*(z,\theta) = \sum_{h=0}^\infty W_{1,h}^*(\theta) z^h$$

$$W_1^*(z,0) = \sum_{h=0}^\infty W_{1,h}^*(0) z^h \qquad W_1(z,0) = \sum_{h=0}^\infty W_{1,h}(0) z^h$$

$$R_0^*(z,\theta) = \sum_{h=1}^\infty R_{0,h}^*(\theta) z^h \qquad R_0^*(z,0) = \sum_{h=1}^\infty R_{0,h}^*(0) z^h$$

$$R_0(z,0) = \sum_{h=1}^\infty R_{0,h}(0) z^h \quad R_1^*(z,\theta) = \sum_{h=0}^\infty R_{1,h}^*(\theta) z^h$$

$$R_1^*(z,0) = \sum_{h=0}^\infty R_{1,h}^*(0) z^h \quad R_1(z,0) = \sum_{h=0}^\infty R_{1,h}(0) z^h$$

The above mentioned are the LST and PGF which we have defined.In steady state the system was illustrated by the subsequent differential difference equations:

$$\lambda W_{0,0} = W_{1,0}(0) + \alpha R_{0,0} \tag{1}$$

$$-\frac{d}{dx} W_{0,h}(x) = -(\beta + \lambda) W_{0,h}(x) + W_{1,h}(0) l(x); \ h \geq 1 \tag{2}$$

$$-\frac{d}{dx} W_{1,0}(x) = -(\beta + \lambda) W_{1,0}(x) + W_{0,1}(0) w_v(x) + \lambda W_{0,0} w_v(x) + \xi W_{1,1}(x) \tag{3}$$

$$-\frac{d}{dx} W_{1,h}(x) = -(\beta + \lambda + \xi) W_{1,h}(x) + \lambda W_{1,h-1}(x) + W_{0,h+1}(0) w_v(x)$$
$$+ \lambda \int_0^\infty W_{0,h}(x) dx \, w_v(x) + \xi W_{1,h+1}(x); h \geq 1 \tag{4}$$

$$(\lambda + \alpha) R_{0,0} = R_{1,0}(0) \tag{5}$$

$$-\frac{d}{dx} R_{0,h}(x) = -\lambda R_{0,h}(x) + R_{1,h}(0) g(x) + \beta \int_0^\infty W_{0,h}(x) dx \, g(x); \ h \geq 1 \tag{6}$$

$$-\frac{d}{dx} R_{1,0}(x) = -\lambda R_{1,0}(x) + R_{0,1}(0) r_s(x) + \beta r_s(x) \int_0^\infty W_{1,0}(x) dx + \xi R_{1,1}(x) \tag{7}$$

$$-\frac{d}{dx} R_{1,h}(x) = -(\lambda + \xi) R_{1,h}(x) + \lambda R_{1,h-1}(x) + R_{0,h+1}(0) r_s(x) + \xi R_{1,h+1}(x)$$
$$+ \beta r_s(x) \int_0^\infty W_{1,h}(x) dx + \lambda r_s(x) \int_0^\infty R_{0,h}(x) dx; \ h \geq 1 \tag{8}$$

Taking the LST from (2) to (8) on both sides, results

$$\theta W_{0,h}^*(\theta) - W_{0,h}(0) = (\lambda + \beta) W_{0,h}^*(\theta) - W_{1,h}(0) L^*(\theta); \ h \geq 1 \tag{9}$$

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$$\theta W_{1,0}^*(\theta) - W_{1,0}(0) = (\lambda + \beta)W_{1,0}^*(\theta) - W_{0,1}(0)W_v^*(\theta) - \lambda W_{0,0}W_v^*(\theta) - \xi W_{1,1}^*(\theta) \tag{10}$$

$$\theta W_{1,h}^*(\theta) - W_{1,h}(0) = (\lambda + \beta + \xi)W_{1,h}^*(\theta) - \lambda W_{1,h-1}^*(\theta) - W_{0,h+1}(0)W_v^*(\theta)$$
$$\quad\quad -\lambda W_{0,h}^*(0)W_v^*(\theta) - \xi W_{1,h+1}^*(\theta); \quad h \geq 1 \tag{11}$$

$$\theta R_{0,h}^*(\theta) - R_{0,h}(0) = \lambda R_{0,h}^*(\theta) - R_{1,h}(0)G^*(\theta) - \beta G^*(\theta)W_{0,h}^*(0); \quad h \geq 1 \tag{12}$$

$$\theta R_{1,0}^*(\theta) - R_{1,0}(0) = \lambda R_{1,0}^*(\theta) - R_{0,1}(0)R_s^*(\theta) - \beta R_s^*(\theta)W_{1,0}^*(0)$$
$$-\lambda R_{0,0}R_s^*(\theta) - \xi R_{1,1}^*(\theta) \tag{13}$$

$$\theta R_{1,h}^*(\theta) - R_{1,h}(0) = (\lambda + \xi)R_{1,h}^*(\theta) - \lambda R_{1,h-1}^*(\theta) - R_s^*(\theta)R_{0,h+1}(0)$$
$$\quad\quad -\beta R_s^*(\theta)W_{1,h}^*(0) - \lambda R_s^*(\theta)R_{0,h}^*(0) - \xi R_{1,h+1}^*(\theta); \quad h \geq 1 \tag{14}$$

Summing over h from 1 to infinity $\times$ (9) with z^h, results,

$$W_0^*(z,\theta)[\theta - (\beta + \lambda)] = W_0(z,0) - L^*(\theta)W_1(z,0) + L^*(\theta)W_{1,0}(0) \tag{15}$$

Summing over h from 1 to infinity $\times$ (11) with z^h and comprise with (10), results

$$W_1^*(z,\theta)[\theta - (\beta - \lambda z + \lambda + \xi - \tfrac{\xi}{z})] = W_1(z,0) - \tfrac{W_v^*(\theta)}{z}W_0(z,0) - \lambda W_{0,0}W_v^*(\theta) - \lambda W_v^*(\theta)W_0^*(z,0) \tag{16}$$

Placing $\theta = (\beta + \lambda)$ in (15), results

$$W_0(z,0) = L^*(\beta + \lambda)[W_1(z,0) - W_{1,0}(0)] \tag{17}$$

Placing $\theta = 0$ and (Sub.) (17) in (15), results

$$W_0^*(z,0) = \frac{(1 - L^*(\lambda + \beta))(W_1(z,0) - W_{1,0}(0))}{\lambda + \beta} \tag{18}$$

Placing $\theta = [\beta - \lambda z + \lambda + \xi - \tfrac{\xi}{z}]$and (Sub.) (17) and (18) in (16), results

$$W_1(z,0) = \frac{W_v^*(\lambda - \lambda z + \beta + \xi - \tfrac{\xi}{z})[\lambda z(\lambda + \beta)W_{0,0} - (L^*(\lambda + \beta)(\lambda - \lambda z + \beta) + \lambda z)W_{1,0}(0)]}{z(\lambda + \beta) - W_v^*(\lambda - \lambda z + \beta + \xi - \tfrac{\xi}{z})(L^*(\lambda + \beta)(\lambda - \lambda z + \beta) + \lambda z)} \tag{19}$$

(Sub.)(19) in (17), results

$$W_0(z,0) = \frac{zL^*(\lambda + \beta)(\lambda + \beta)[\lambda W_v^*(\lambda - \lambda z + \beta + \xi - \tfrac{\xi}{z})W_{0,0} - W_{1,0}(0)]}{z(\lambda + \beta) - W_v^*(\lambda - \lambda z + \beta + \xi - \tfrac{\xi}{z})(L^*(\lambda + \beta)(\lambda - \lambda z + \beta) + \lambda z)} \tag{20}$$

Let$f(z) = (\beta + \lambda)z - W_v^*(\beta + \lambda - \lambda z + \xi - \tfrac{\xi}{z})(L^*(\lambda + \beta)(\beta + \lambda - \lambda z) + \lambda z)$, for
f(z) = 0 we obtain f(0) < 0 and f(1) > 0 which $\Rightarrow$ that $\exists$ a real root $z_1 \in (0,1)$.
At z = z_1 (20) is converted in to

$$W_{1,0}(0) = \lambda W_v^*(\lambda - \lambda z_1 + \beta + \xi - \tfrac{\xi}{z_1})W_{0,0} \tag{21}$$

(Sub.) (21) in (19), results

$$W_1(z,0) = \frac{\lambda W_v^*(\lambda - \lambda z + \beta + \xi - \tfrac{\xi}{z})U(z)}{z(\lambda + \beta) - W_v^*(\lambda - \lambda z + \beta + \xi - \tfrac{\xi}{z})(L^*(\lambda + \beta)(\lambda - \lambda z + \beta) + \lambda z)}W_{0,0} \tag{22}$$

where, $U(z) = z(\lambda + \beta) - W_v^*(\lambda - \lambda z_1 + \beta + \xi - \tfrac{\xi}{z_1})[\lambda z + L^*(\beta + \lambda)(\beta - \lambda z + \lambda)]$

(Sub.) (21) in (20), results

$$W_0(z,0) = \frac{\left[L^*(\beta + \lambda)\lambda z(\beta + \lambda)\left[W_v^*(\lambda - \lambda z + \beta + \xi - \tfrac{\xi}{z}) - W_v^*(\lambda - \lambda z_1 + \beta + \xi - \tfrac{\xi}{z_1})\right]\right]}{z(\lambda + \beta) - W_v^*(\lambda - \lambda z + \beta + \xi - \tfrac{\xi}{z})(L^*(\lambda + \beta)(\lambda - \lambda z + \beta) + \lambda z)}W_{0,0} \tag{23}$$

(Sub.) (21) and (22) in (18), results

$$W_0^*(z,0) = \frac{[(1 - L^*(\lambda + \beta))\lambda z[W_v^*(\lambda - \lambda z + \beta + \xi - \tfrac{\xi}{z}) - W_v^*(\lambda - \lambda z_1 + \beta + \xi - \tfrac{\xi}{z})]}{z(\lambda + \beta) - W_v^*(\lambda - \lambda z + \beta + \xi - \tfrac{\xi}{z})(L^*(\lambda + \beta)(\lambda - \lambda z + \beta) + \lambda z)}W_{0,0} \tag{24}$$

Placing $\theta = 0$ and (Sub.) (22), (23) and (24) in (16), results

$$W_1^*(z,0) = \frac{\lambda\left(1 - W_v^*(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})\right)U(z)}{(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})[(\beta + \lambda)z - W_v^*(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z}) \times (L^*(\beta + \lambda)(\lambda + \beta - \lambda z) + \lambda z)]}W_{0,0} \tag{25}$$

Summing over h from 1 to infinity $\times$ (12) with z^h and, results

$$R_0^*(z,\theta)(\theta - \lambda) = R_0(z,0) - G^*(\theta)[R_1(z,0) - R_{1,0}(0)] - W_0^*(z,0)\beta G^*(\theta) \qquad (26)$$

(Sub.) $W_{1,0}(0) = \lambda W_v^*(\lambda - \lambda z_1 + \beta + \xi - \frac{\xi}{z_1})W_{0,0}$ in (1),we get,

$$\alpha R_{0,0} = \lambda(1 - W_v^*(\lambda - \lambda z_1 + \beta + \xi - \frac{\xi}{z_1}))W_{0,0}.$$

Placing $\theta = \lambda$ and (Sub.) $R_{1,0}(0) = \lambda(1 - W_v^*(\lambda - \lambda z_1 + \beta + \xi - \frac{\xi}{z_1}))W_{0,0} - \lambda R_{0,0}$ in (26),   results

$$R_0(z,0) = G^*(\lambda)\left[R_1(z,0) - \lambda\left(1 - W_v^*\left(\lambda - \lambda z_1 + \beta + \xi - \frac{\xi}{z_1}\right)\right)W_{0,0} - \lambda R_{0,0} + \beta W_0^*(z,0)\right] \qquad (27)$$

Summing over h from 1 to infinity $\times$ (14) with z^h and comprise with (13), results

$$R_1^*(z,\theta)[\theta - \lambda + \lambda z + \xi - \frac{\xi}{z}] = R_1(z,0) - \left[\frac{R_0(z,0)}{z} + \beta W_1^*(z,0) + \lambda R_0^*(z,0) + \lambda R_{0,0}\right]R_s^*(\theta) \qquad (28)$$

Placing $\theta = 0$ and (Sub.) (27) and

$R_{1,0}(0) = (1 - W_v^*(\lambda - \lambda z_1 + \beta + \xi - \frac{\xi}{z_1}))\lambda W_{0,0} - \lambda R_{0,0}$ in (26), results

$$R_0^*(z,0) = \frac{(1-G^*(\lambda))}{\lambda}[R_1(z,0) - (1 - W_v^*(\lambda - \lambda z_1 + \beta + \xi - \frac{\xi}{z_1}))\lambda W_{0,0} - \lambda R_{0,0} + \beta W_0^*(z,0)] \qquad (29)$$

Placing $\theta = \lambda - \lambda z + \xi - \frac{\xi}{z}$ and (Sub.) (27) and (29) in (28), results

$$R_0(z,0) = \frac{\begin{bmatrix}R_s^*(\lambda-\lambda z+\xi-\frac{\xi}{z})[\beta z W_1^*(z,0)+\lambda z R_{0,0}+\beta[(1-z)G^*(\lambda)+z]W_0^*(z,0)\\ -[(1-z)G^*(\lambda)+z][(1-W_v^*(\lambda-\lambda z_1+\beta+\xi-\frac{\xi}{z_1}))\lambda W_{0,0}-\lambda R_{0,0}]]\end{bmatrix}}{z-R_s^*(\lambda-\lambda z)(z+G^*(\lambda)(1-z))} \qquad (30)$$

(Sub.) (30) in (27), results

$$R_0(z,0) = \frac{\begin{bmatrix}z G^*(\lambda)\ [\beta R_s^*(\lambda-\lambda z+\xi-\frac{\xi}{z})W_1^*(z,0)+\beta W_0^*(z,0)\\ -\lambda(1-W_v^*(\lambda-\lambda z_1+\beta+\xi-\frac{\xi}{z_1}))W_{0,0}-\lambda(1-R_s^*(\lambda-\lambda z+\xi-\frac{\xi}{z}))R_{0,0}]\end{bmatrix}}{z-R_s^*(\lambda-\lambda z+\xi-\frac{\xi}{z})[(1-z)G^*(\lambda)+z]} \qquad (31)$$

(Sub.) (30) in (29), results

$$R_0^*(z,0) = \frac{\begin{bmatrix}(1-G^*(\lambda))z\ [\beta W_1^*(z,0)R_s^*(\lambda-\lambda z+\xi-\frac{\xi}{z})+\beta W_0^*(z,0)\\ -\lambda(1-W_v^*(\lambda-\lambda z_1+\beta+\xi-\frac{\xi}{z_1}))W_{0,0}-\lambda(1-R_s^*(\lambda-\lambda z+\xi-\frac{\xi}{z}))R_{0,0}]\end{bmatrix}}{\lambda\{z-R_s^*(\lambda-\lambda z+\xi-\frac{\xi}{z})[(1-z)G^*(\lambda)+z]\}} \qquad (32)$$

Placing $\theta = 0$ and (Sub.) (30), (31) and (32) in (28), results

$$R_0^*(z,0) = \frac{\begin{bmatrix}(1-R_s^*(\lambda-\lambda z+\xi-\frac{\xi}{z}))\{\beta W_1^*(z,0)z+W_0^*(z,0)[(1-z)G^*(\lambda)+z]\beta\\ -[G^*(\lambda)(1-z)+z][\lambda(1-W_v^*(\lambda-\lambda z_1+\beta+\xi-\frac{\xi}{z_1}))W_{0,0}+\lambda R_{0,0}]+\lambda z R_{0,0}\}\end{bmatrix}}{(\lambda-\lambda z+\xi-\frac{\xi}{z})\ [\ z-R_s^*(\lambda-\lambda z+\xi-\frac{\xi}{z})[z+G^*(\lambda)(1-z)]]} \qquad (33)$$

(Sub.) (24) and (25) in (32), results

$$R_0^*(z,0) = \frac{z(1-G^*(\lambda))W_{0,0}}{(\lambda+\beta-\lambda z+\xi-\frac{\xi}{z})Dr_1(z)Dr_2(z)}\left[\beta R_s^*\left(\lambda-\lambda z+\xi-\frac{\xi}{z}\right)\left(1-W_v^*\left(\lambda+\beta-\lambda z+\xi-\frac{\xi}{z}\right)\right)\right.$$

$$\times \{(\beta+\lambda)z - W_v^*(\lambda+\beta-\lambda z_1+\xi-\frac{\xi}{z_1})\ [\lambda z+(\lambda+\beta-\lambda z)G^*(\lambda+\beta)]\}$$

$$+ \beta z(\lambda+\beta-\lambda z+\xi-\frac{\xi}{z})(1-L^*(\lambda+\beta))\ \times [(W_v^*(\lambda+\beta-\lambda z+\xi-\frac{\xi}{z})$$

$$-W_v^*(\lambda+\beta-\lambda z_1+\xi-\frac{\xi}{z_1})] - (\lambda+\beta-\lambda z+\xi-\frac{\xi}{z})\ \times \{(\lambda+\beta)z$$

$$-W_v^*(\lambda+\beta-\lambda z+\xi-\frac{\xi}{z})\ [\lambda z+(\lambda+\beta-\lambda z)L^*(\beta+\lambda)]\}$$

$$\times (1-W_v^*(\lambda+\beta-\lambda z_1+\xi-\frac{\xi}{z_1}))\ -\frac{\lambda}{\alpha}(\lambda+\beta-\lambda z+\xi-\frac{\xi}{z})$$

$$\times (1-W_v^*(\lambda+\beta-\lambda z_1+\xi-\frac{\xi}{z_1}))\ (1-R_s^*(\lambda-\lambda z+\xi-\frac{\xi}{z}))$$

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$$\times \{(\lambda + \beta)z - W_v^*(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})\,[\lambda z + (\lambda + \beta - \lambda z)L^*(\beta + \lambda)]\} \qquad (34)$$

where

$$Dr_1(z) = z(\lambda + \beta) - W_v^*(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})(\lambda z + L^*(\lambda + \beta)(\lambda + \beta - \lambda z)) \qquad (35)$$

$$R_1^*(z,0) = \frac{\lambda z(1 - R_s^*(\lambda - \lambda z + \xi - \tfrac{\xi}{z}))W_{0,0}}{(\lambda z - \xi)Dr_2(z)(\lambda + \beta - \lambda z(\lambda z - \xi) - \tfrac{\xi}{z})Dr_1(z)}\, \Big\{ \beta z[[(1-z)(\lambda z - \xi) + \beta]G^*(\lambda) + z(\lambda z - \xi)]$$

(Sub.) (24), (25) in (33), results

$$R_1^*(z,0) = \frac{\lambda z(1 - R_s^*(\lambda - \lambda z + \xi - \tfrac{\xi}{z}))W_{0,0}}{(\lambda z - \xi)Dr_2(z)(\lambda + \beta - \lambda z(\lambda z - \xi) - \tfrac{\xi}{z})Dr_1(z)}\, \beta z[[(1-z)(\lambda z - \xi) + \beta]G^*(\lambda) + z(\lambda z - \xi)]$$

$$\times [1 - L^*(\beta + \lambda)][W_v^*(\beta + \lambda - \lambda z + \xi - \tfrac{\xi}{z}) - W_v^*(\beta + \lambda - \lambda z_1 + \xi - \tfrac{\xi}{z_1})]$$

$$-(1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1}))\,[[(1-z)(\lambda z - \xi) + \beta]G^*(\lambda) + z(\lambda z - \xi)]$$

$$\times \{(\lambda + \beta)z - W_v^*(\beta + \lambda - \lambda z + \xi - \tfrac{\xi}{z})\,[\lambda z + (\lambda + \beta - \lambda z)L^*(\lambda + \beta)]\}$$

$$+\beta z(\lambda + \beta) \times \left(W_v^*\left(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z}\right) - W_v^*\left(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1}\right) \right)$$

$$\times L^*(\beta + \lambda) - \tfrac{\lambda}{\alpha}(1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1}))\,(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})$$

$$\times G^*(\lambda)\{(\beta + \lambda)z - W_v^*(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})[\lambda z + (\lambda + \beta - \lambda z)L^*(\beta + \lambda)]\} \qquad (37)$$

We define $W_v(z) = W_0^*(z,0) + W_1^*(z,0) + W_{0,0}$

$$W_v(z) = \frac{W_{0,0}}{\left(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z}\right)D_1(z)}\, \Big[(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})\lambda z(1 - L^*(\lambda + \beta))[(W_v^*(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})$$

$$-W_v^*(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1})] + \lambda(1 - W_v^*(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z}))\,[z(\lambda + \beta)$$

$$-(\lambda z + L^*(\lambda + \beta)\,(\lambda + \beta - \lambda z))]W_v^*(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1}) + (\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})$$

$$\times \left[z(\beta + \lambda) - \left(\lambda z + L^*(\beta + \lambda)(\lambda + \beta - \lambda z)\right)W_v^*\left(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z}\right) \right] \Big] \qquad (38)$$

when the server is on WV period, as the PGF for the no of customers in orbit and
$R_S(z) = R_0^*(z,0) + R_1^*(z,0) + R_{0,0}$

$$R_S(z) = \frac{W_{0,0}}{(\lambda z - \xi)\left(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z}\right)(Dr_1(z)\,Dr_2(z))}\, \Big[z(1 - G^*(\lambda))(\lambda z - \xi)\{\beta R_s^*(\lambda - \lambda z + \xi - \tfrac{\xi}{z})$$

$$\times (1 - W_v^*(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z}))\{(\beta + \lambda)z - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1})$$

$$\times [\lambda z + (\lambda + \beta - \lambda z)G^*(\lambda + \beta)]\} + \beta z(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})(1 - L^*(\lambda + \beta))$$

$$\times [(W_v^*(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z}) - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1})] - (\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})$$

$$\times (\lambda + \beta)z - W_v^*\left(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z}\right)[\lambda z + (\lambda + \beta - \lambda z)L^*(\beta + \lambda)]$$

$$\times (1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1}))\} + \lambda(1 - R_s^*(\lambda - \lambda z + \xi - \tfrac{\xi}{z}))$$

$$\times \{\beta z[[(1-z)(\lambda z - \xi) + \beta]G^*(\lambda) + z(\lambda z - \xi)] \times [1 - L^*(\beta + \lambda)]$$

$$\times [W_v^*(\beta + \lambda - \lambda z + \xi - \tfrac{\xi}{z}) - W_v^*(\beta + \lambda - \lambda z_1 + \xi - \tfrac{\xi}{z_1})]$$

$$-(1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1})) \times [[(1-z)(\lambda z - \xi) + \beta]G^*(\lambda) + z(\lambda z - \xi)]$$

$$\times (\lambda + \beta)z - W_v^*\left(\beta + \lambda - \lambda z + \xi - \tfrac{\xi}{z}\right)[\lambda z + (\lambda + \beta - \lambda z)L^*(\lambda + \beta)]$$

$$+\beta z(\lambda + \beta)(W_v^*(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z}) - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1}))L^*(\beta + \lambda)\}$$

$$-\tfrac{\lambda}{\alpha}(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z}) \times (1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1})) \, [(\lambda + \beta)z$$

$$-W_v^*(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})[\lambda z + L^*(\lambda + \beta)(\lambda + \beta - \lambda z)][\lambda G^*(\lambda)$$

$$\times (1 - R_s^*(\lambda - \lambda z + \xi - \tfrac{\xi}{z})) - (\lambda z - \xi)G^*(\lambda)(z - R_s^*(\lambda - \lambda z + \xi - \tfrac{\xi}{z}))] \qquad (39)$$

when the server is on RS period, as the PGF for the no of customers in the orbit. Again, we define $R(z) = R_S(z) + W_v(z)$

$$R(z) = \frac{W_{0,0}}{(\lambda z - \xi)(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})(Dr_1(z)Dr_2(z))} \Bigg\{ z(1 - G^*(\lambda))(\lambda z - \xi)\{\beta R_s^*(\lambda - \lambda z + \xi - \tfrac{\xi}{z})$$

$$\times (1 - W_v^*(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z}))\{(\beta + \lambda)z - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1})$$

$$\times [\lambda z + (\lambda + \beta - \lambda z)G^*(\lambda + \beta)]\} + \beta z(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})(1 - L^*(\lambda + \beta))$$

$$\times [(W_v^*(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z}) - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1})] - (\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})$$

$$\times (\lambda + \beta)z - W_v^*\left(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z}\right)[\lambda z + (\lambda + \beta - \lambda z)L^*(\beta + \lambda)]$$

$$\times (1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1}))\} + \lambda(1 - R_s^*(\lambda - \lambda z + \xi - \tfrac{\xi}{z}))$$

$$\times \{\beta z[[(1-z)(\lambda z - \xi) + \beta]G^*(\lambda) + z(\lambda z - \xi)] \times [1 - L^*(\beta + \lambda)]$$

$$\times [W_v^*(\beta + \lambda - \lambda z + \xi - \tfrac{\xi}{z}) - W_v^*(\beta + \lambda - \lambda z_1 + \xi - \tfrac{\xi}{z_1})]$$

$$-(1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1})) \times [[(1-z)(\lambda z - \xi) + \beta]G^*(\lambda) + z(\lambda z - \xi)]$$

$$\times (\lambda + \beta)z - W_v^*\left(\beta + \lambda - \lambda z + \xi - \tfrac{\xi}{z}\right)[\lambda z + (\lambda + \beta - \lambda z)L^*(\lambda + \beta)]$$

$$+\beta z(\lambda + \beta)(W_v^*(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z}) - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1}))L^*(\beta + \lambda)\}$$

$$-\tfrac{\lambda}{\alpha}(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z}) \times (1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1})) \, [(\lambda + \beta)z$$

$$-W_v^*(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})[\lambda z + L^*(\lambda + \beta)(\lambda + \beta - \lambda z)][\lambda G^*(\lambda)$$

$$\times (1 - R_s^*(\lambda - \lambda z + \xi - \tfrac{\xi}{z})) - (\lambda z - \xi)G^*(\lambda)(z - R_s^*(\lambda - \lambda z + \xi - \tfrac{\xi}{z}))]$$

$$+(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})\lambda z(1 - L^*(\lambda + \beta))[(W_v^*(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})$$

$$-W_v^*(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1})] + \lambda(1 - W_v^*(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})) \, [z(\lambda + \beta)$$

$$-(\lambda z + L^*(\lambda + \beta)(\lambda + \beta - \lambda z))]W_v^*(\lambda + \beta - \lambda z_1 + \xi - \tfrac{\xi}{z_1}) + (\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})$$

$$\times [z(\beta + \lambda) - (\lambda z + L^*(\beta + \lambda)(\lambda + \beta - \lambda z))W_v^*(\lambda + \beta - \lambda z + \xi - \tfrac{\xi}{z})] \, (\lambda z - \xi)$$

$$\times \{z - R_s^*(\lambda - \lambda z + \xi - \tfrac{\xi}{z})[G^*(\lambda)(1 - z) + z]\} \Big] \qquad (40)$$

where $Dr_1(z)$ and $Dr_2(z)$ are given in (35) and (36) as the PGF for the no of customersin the orbit.Make use of the normalizing condition $R(1) = 1$ to findout that $W_{0,0}$ araise in (40). Using and L'Hospitals rule and (Sub.) $z = 1$ in (40) results,

$$W_{0,0} = \frac{1 - \varrho_s}{\left[\begin{array}{l} \left\{ \frac{(\lambda - \lambda W_v^*(\lambda - \lambda z_1 + \beta + \xi - \frac{\xi}{z_1}) + \beta)[\lambda + \beta G^*(\lambda) - W_v^*(\beta)(\lambda + \beta L^*(\lambda + \beta))]}{\beta G^*(\lambda)[\lambda + \beta - W_v^*(\beta)(\lambda + \beta L^*(\beta + \lambda))]} \right\} \\ - \left\{ \frac{\lambda E(R_s) W_v^*(\beta)[\lambda + \beta - W_v^*(\lambda - \lambda z_1 + \beta + \xi - \frac{\xi}{z_1})(\lambda + \beta L^*(\beta + \lambda))]}{G^*(\lambda)[\lambda + \beta - W_v^*(\beta)(\lambda + \beta L^*(\lambda + \beta))]} \right\} \\ + \left\{ \frac{\beta W_v^*(\lambda - \lambda z_1 + \beta + \xi - \frac{\xi}{z_1}) L^*(\beta + \lambda)(1 - G^*(\lambda))}{G^*(\lambda)[\lambda + \beta - W_v^*(\beta)(\lambda + \beta L^*(\beta + \lambda))]} \right\} \\ + \left\{ \frac{\lambda}{\alpha}(1 - W_v^*(\lambda - \lambda z_1 + \beta + \xi - \frac{\xi}{z_1}))[\xi E(R_s) + 1] + \xi R(n) \right\} \end{array} \right]} \qquad (41)$$

$$\varrho_s < 1 \qquad (42)$$

$$R_{0,0} = \frac{\lambda}{\alpha}(1 - W_v^*(\lambda - \lambda z_1 + \beta + \xi - \tfrac{\xi}{z_1})) W_{0,0} \qquad (43)$$

where $\varrho_s = \frac{(\lambda - \xi) E(R_s)}{G^*(\lambda)}$,

$R(n)$

$$= \frac{\left[\begin{array}{l} \lambda E(R_s)(2\lambda + \beta G^*(\lambda))(1 - W_v^*(\lambda - \lambda z_1 + \beta + \xi - \frac{\xi}{z_1})) + \beta[L^*(\lambda + \beta) W_v^*(\lambda - \lambda z_1 + \beta + \xi - \frac{\xi}{z_1}) + \beta E(R_s)[G^*(\lambda) \\ - L^*(\lambda + \beta) W_v^*(\beta)]] - \lambda W_v^*(\beta) - \lambda \beta L^*(\lambda + \beta) E(R_s)[W_v^*(\beta) - W_v^*(\lambda - \lambda z_1 + \beta + \xi - \frac{\xi}{z_1})] + \beta[1 - G^*(\lambda)] \\ [\beta E(R_s)[W_v^*(\beta) + L^*(\lambda + \beta) W_v^*(\lambda - \lambda z_1 + \beta + \xi - \frac{\xi}{z_1})] + W_v^*(\beta) + \lambda E(R_s) W_v^*(\beta)(1 - W_v^*(\lambda - \lambda z_1 + \beta + \xi - \frac{\xi}{z_1}))] \end{array} \right]}{\beta G^*(\lambda)[\lambda + \beta - W_v^*(\beta)(\lambda + \beta L^*(\beta + \lambda))]},$$

$E(R_s)$ is the mean service time and the system's stability condition is obtained from (41).

3. THE MODEL'S PERFORMANCE MEASURES
Mean System Length
We assume that
W_v, R_s - mean orbit size in WV and RS
W_v, W_s - mean waiting time of the customer in the orbit during WV period and RS period
Then

$$L_v = \frac{d}{dz} W_v(z)\big|_{z=1}$$

$$= \frac{d}{dz}[W_1^*(z,0) + W_0^*(z,0)]\big|_{z=1}$$

$$= \frac{d}{dz}\Big[\frac{S(z)}{(\beta - \lambda z + \lambda + \xi - \frac{\xi}{z}) Dr_1(z)} + \frac{K(z)}{Dr_1(z)} \Big] W_{0,0}\big|_{z=1}$$

$$= \left[\begin{array}{l} \frac{Dr_1(z)(\lambda - \lambda z + \beta + \xi - \frac{\xi}{z}) S'(z) - S(z)[Dr'_1(z)(\beta - \lambda z + \lambda + \xi - \frac{\xi}{z}) + Dr_1(z)(-\lambda + \frac{\xi}{z^2})]}{(Dr_1(z))^2(\beta - \lambda z + \lambda + \xi - \frac{\xi}{z})^2} \\ + \Big[\frac{K'(z) Dr_1(z) - Dr'_1(z) K(z)}{(Dr_1(z))^2} \Big] \end{array} \right] W_{0,0}\big|_{z=1} \qquad (44)$$

where

$$S(z) = \lambda(1 - W_v^*(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z}))[z(\lambda + \beta) - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1})$$
$$\times (L^*(\lambda + \beta)(\lambda + \beta - \lambda z) + \lambda z)]$$

$$K(z) = \lambda z(1 - L^*(\lambda + \beta))(W_v^*(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z}) - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1}))$$

$$Dr_1(z) = z(\lambda + \beta) - W_v^*(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z})(L^*(\lambda + \beta)(\lambda + \beta - \lambda z) + \lambda z)$$

Differentiating $S(z)$, $K(z)$ and $Dr_1(z)$ with respect to z, we get

$$S'(z) = \lambda(\lambda - \frac{\xi}{z^2})W_v^{*'}(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z})[z(\lambda + \beta) - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1})$$
$$\times ((\beta - \lambda z + \lambda)L^*(\lambda + \beta) + \lambda z] + (1 - W_v^*(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z}))\lambda[\lambda + \beta$$
$$- (\lambda - \lambda L^*(\lambda + \beta))W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1})]$$

$$K'(z) = \left(1 - L^*(\beta + \lambda)\right)\lambda\left(W_v^*\left(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z}\right) - W_v^*\left(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1}\right)\right)$$
$$- \lambda z(1 - L^*(\beta + \lambda))(\lambda - \frac{\xi}{z^2})W_v^{*'}(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z})$$

$$Dr_1'(z) = (\beta + \lambda) + (\lambda - \frac{\xi}{z^2})W_v^{*'}(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z})(\lambda z + L^*(\beta + \lambda)(\lambda + \beta - \lambda z)$$
$$- W_v^*(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z})(\lambda - \lambda L^*(\lambda + \beta))$$

At $z = 1$, L_v turns as

$$L_v = \left[\frac{\beta Dr_1(1)S'(1) - S(1)[\beta Dr'_1(1) - \lambda Dr_1(1)]}{(\beta Dr_1(1))^2} + \frac{Dr_1(1)K'(1) - K(1)Dr'_1(1)}{(Dr_1(1))^2}\right]W_{0,0}$$

But $L_v = \frac{W_v}{\lambda}$

where

$$S(1) = \lambda(1 - W_v^*(\beta))[\beta + \lambda - W_v^*(\lambda - \lambda z_1 + \beta + \xi - \frac{\xi}{z_1})(\lambda + \beta L^*(\beta + \lambda))]$$

$$S'(1) = \lambda(\lambda - \xi)W_v^{*'}(\beta)[\lambda + \beta - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1})(\lambda + \beta L^*(\lambda + \beta))]$$
$$+ \lambda(1 - W_v^*(\beta))[\lambda + \beta - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1})(\lambda - \lambda L^*(\lambda + \beta))]$$

$$K(1) = \lambda(1 - L^*(\beta + \lambda))(W_v^*(\beta) - W_v^*(\beta - \lambda z_1 + \lambda + \xi - \frac{\xi}{z_1}))$$

$$K'(1) = \lambda(1 - L^*(\beta + \lambda))[W_v^*(\beta) - W_v^*(\beta + \lambda - \lambda z_1 + \xi - \frac{\xi}{z_1}) - (\lambda - \xi)\lambda W_v^{*'}(\beta)]$$

$$Dr_1(1) = \beta - (\lambda + \beta L^*(\beta + \lambda))W_v^*(\beta) + \lambda$$

$$Dr'_1(1) = \beta + (\lambda - \xi)W_v^{*'}(\beta)(\lambda + L^*(\lambda + \beta)\beta) + \lambda - (\lambda - \lambda L^*(\lambda + \beta))W_v^*(\beta)$$

$$L_s = \frac{d}{dz}R_S(z)|_{z=1}$$
$$= \frac{d}{dz}[R_1^*(z, 0) + R_0^*(z, 0)]|_{z=1}$$
$$= \frac{d}{dz}\left[\frac{Nr_1(z)(1 - G^*(\lambda)) + Nr_2(z)Nr_3(z)}{Dr_1(z)(\lambda - \lambda z + \beta)Dr_2(z)}\right]W_{0,0}|_{z=1}$$

$$L_s = \frac{\begin{bmatrix}[Dr'_2(z)2Nr'_1(z)(\lambda Dr_1(z)-(\lambda+\beta-\lambda z)Dr'_1(z))+(\lambda-\lambda z+\beta)Dr_1(z)Nr''_1(z)(Dr'_2(z)\\-Dr''_2(z)Nr'_1(z))](1-G^*(\lambda))+2(\beta-\lambda z+\lambda)Nr'_2(z)Dr'_2(z)(Nr'_3(z)Dr_1(z)-Nr_3(z)Dr'_1(z))\\+Nr_3(z)[2\lambda Nr'_2(z)Dr'_2(z)+(\lambda+\beta-\lambda z)Dr'_2(z)Nr''_2(z)-(\lambda+\beta-\lambda z)Dr''_2(z)Nr'_2(z)]Dr_1(z)\end{bmatrix}}{2(Dr_1(z)(\lambda+\beta-\lambda z)Dr'_2(z))^2}$$

Where

$$Nr_1(z) = \beta z R_s^*(\lambda - \lambda z + \xi - \frac{\xi}{z})(1 - W_v^*(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z})\{(\beta + \lambda)z$$
$$-W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1})[\lambda z + (\lambda + \beta - \lambda z)G^*(\lambda + \beta)]\}$$

$$+\beta z^2(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z})(1 - L^*(\lambda + \beta)) [(W_v^*(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z})$$
$$-W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1})] - z(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z}) \times \{(\lambda + \beta)z$$
$$-W_v^*(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z})[\lambda z + (\lambda + \beta - \lambda z)L^*(\beta + \lambda)]\}$$
$$\times \left(1 - W_v^*\left(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1}\right)\right) - \frac{\lambda z}{\alpha}\left(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z}\right)$$
$$\times (1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1})) (1 - R_s^*(\lambda - \lambda z + \xi - \frac{\xi}{z}))$$
$$\times \{(\lambda + \beta)z - W_v^*(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z})[\lambda z + (\lambda + \beta - \lambda z)L^*(\beta + \lambda)]\}$$

$$Nr_2(z) = (1 - R_s^*(\lambda - \lambda z + \xi - \frac{\xi}{z}))$$

$$Dr_1(z) = (\lambda + \beta)z - W_v^*(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z})[L^*(\lambda + \beta)(\lambda + \beta - \lambda z) + \lambda z]$$

$$Dr_2(z) = z - R_s^*(\lambda - \lambda z + \xi - \frac{\xi}{z})[(1 - z)G^*(\lambda) + z]$$

$$Nr_3(z) = \beta z[[(1 - z)(\lambda z - \xi) + \beta]G^*(\lambda) + z(\lambda z - \xi)][1 - L^*(\beta + \lambda)]$$

$$\times \left[W_v^*\left(\beta + \lambda - \lambda z + \xi - \frac{\xi}{z}\right) - W_v^*\left(\beta + \lambda - \lambda z_1 + \xi - \frac{\xi}{z_1}\right)\right]$$
$$-\left(1 - W_v^*\left(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1}\right)\right)[[(1 - z)(\lambda z - \xi) + \beta]G^*(\lambda)$$
$$+z(\lambda z - \xi)]\{(\lambda + \beta)z - W_v^*(\beta + \lambda - \lambda z + \xi - \frac{\xi}{z})[\lambda z + (\lambda + \beta - \lambda z)$$
$$\times L^*(\lambda + \beta)]\} + \beta z(\lambda + \beta) (W_v^*(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z})$$
$$-W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1}))L^*(\beta + \lambda) - \frac{\lambda}{\alpha}(1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1}))$$
$$\times (\lambda + \beta - \lambda z + \xi - \frac{\xi}{z})G^*(\lambda)\{(\beta + \lambda)z - W_v^*(\lambda + \beta - \lambda z + \xi - \frac{\xi}{z})$$
$$\times [\lambda z + (\lambda + \beta - \lambda z)L^*(\beta + \lambda)\}$$

At $z = 1 L_s$ turns

$$L_s = \frac{\begin{bmatrix}(1 - G^*(\lambda))2Nr'_1(1)Dr'_2(1)(\lambda Dr_1(1) - \beta Dr'_1(1)) + \beta Dr_1(1)(Dr'_2(1)Nr''_1(1)\\-Nr'_1(1)Dr''_2(1))] + 2\beta Nr'_2(1)Dr'_2(1)(Dr_1(1)Nr'_3(1) - Nr_3(1)Dr'_1(1))\\+Nr_3(1)Dr_1(1)[2\lambda Nr'_2(1)Dr'_2(1) + \beta Dr'_2(1)Nr''_2(1) - \beta Nr'_2(1)Dr''_2(1)]\end{bmatrix}}{2(\beta Dr_1(1)Dr'_2(1))^2}$$

w.k.t $W_s = \frac{L_s}{\lambda}$,

where

$$Nr'_1(1) = -\beta(\lambda - \xi)W_v^*(\beta) + \beta(\lambda - \xi)E(R_s)(1 - W_v^*(\beta))[\lambda + \beta$$

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$$-W_v^*\left(\lambda - \lambda z_1 + \beta + \xi - \frac{\xi}{z}\right)[\lambda + \beta L^*(\beta + \lambda)] - \beta^2 L^*(\beta + \lambda)W_v^*(\beta)$$

$$+\beta^2 W_v^*\left(\lambda - \lambda z_1 + \beta + \xi - \frac{\xi}{z_1}\right)L^*(\beta + \lambda) + (\lambda - \xi)\,[\beta + \lambda$$

$$-\beta W_v^*(\beta)L^*(\lambda + \beta) - \lambda W_v^*(\beta)] - (\lambda - \xi)W_v^*\left(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z}\right)$$

$$\times [\lambda - [\beta L^*(\lambda + \beta) + \lambda]W_v^*(\beta) - \beta\xi L^*(\lambda + \beta)[W_v^*(\beta)$$

$$-W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1})]\ +\frac{\lambda}{\alpha}\beta E(R_s)\{(\lambda + \beta)$$

$$-W_v^*(\beta)[\lambda + \beta L^*(\lambda + \beta)]\,(1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1}))$$

$$Nr'_2(1) = -(\lambda - \xi)E(R_s)$$
$$Nr''_2(1) = -(\lambda - \xi)^2 E(R_s^2)$$

$$Nr''_1(1) = \lambda + \beta - W_v^*\left(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1}\right)[\beta L^*(\lambda + \beta) + \lambda]\,[(1 - W_v^*(\beta))$$

$$\times [2\beta E(R_s) + \lambda\beta E(R_s) + \beta E(R_s^2)(\lambda - \xi)^2 + 2\lambda\beta W_v^{*'}(\beta) + 2\beta E(R_s)$$

$$\times\ W_v^{'}(\beta)(\lambda - \xi)^2 - \beta W_v^{*2}(\beta)(\lambda - \xi)^2]] + \{\lambda + \beta - W_v^*(\beta)$$

$$\times [\beta L^*(\lambda + \beta) + \lambda]\}\,[2\lambda(1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1}))]\ + \{\lambda + \beta$$

$$-W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1})[\lambda - \lambda L^*(\lambda + \beta)]\}\,[2\beta(1 - W_v^*(\beta))$$

$$\times [1 + E(R_s)(\lambda - \xi)] + \beta W_v^{*'}(\beta)(\lambda - \xi)]\ + [W_v^*(\beta)$$

$$-W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1})](1 - L^*(\lambda + \beta))[2\beta(\beta + \xi - 2\lambda)]$$

$$+W_v^{*'}(\beta)(1 - L^*(\lambda + \beta))[2\beta[(\lambda - \xi)^2 + \xi\beta - 2\lambda\xi]]$$

$$+\beta^2(1 - L^*(\lambda + \beta))W_v^{*2}(\beta)(\lambda - \xi)^2 + \{\lambda + \beta - W_v^*(\beta)[\lambda - \lambda L^*(\lambda + \beta)]$$

$$+(\lambda - \xi)[\beta L^*(\lambda + \beta) + \lambda]W_v^{*'}(\beta)\}\,[2(1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1}))$$

$$\times (\lambda - \xi) - \beta]\ - \beta(1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1}))\{2W_v^{*'}(\beta)(\lambda - \xi)$$

$$\times [\lambda - \lambda L^*(\lambda + \beta)] + 2\xi W_v^{*'}(\beta)[\lambda + \beta L^*(\lambda + \beta)] - (\lambda - \xi)^2 W_v^{*2}(\beta)\}$$

$$-\frac{\lambda}{\alpha}\{[\lambda + \beta - W_v^*(\beta)[\lambda + \beta L^*(\lambda + \beta)][1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1})]$$

$$\times [2E(R_s)[(\lambda - \xi)^2 - \lambda\beta] - \beta E(R_s^2))(\lambda - \xi)^2]\ - \beta[1$$

$$-W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1})]\,E(R_s)(\lambda - \xi)\{\lambda + \beta - W_v^*(\beta)$$

$$\times [\lambda - \lambda L^*(\lambda + \beta)]\ + [\beta L^*(\lambda + \beta) + \lambda]W_v^{*'}(\beta)(\lambda - \xi)\}\}$$

$$Nr_3(1) = (1 - W_v^*(\beta))[\lambda\beta W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1})G^*(\lambda)\ - \beta\xi L^*(\beta + \lambda)$$

$$\times\ W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1})\ - \lambda\beta G^*(\lambda) + \beta^2 L^*(\beta + \lambda)G^*(\lambda)$$

$$\times W_v^*\left(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1}\right) - \beta^2 G^*(\lambda) - \beta(\lambda - \xi)]$$

$$+[\lambda\beta L^*(\beta + \lambda)W_v^*(\beta)\ + \lambda(\lambda - \xi)W_v^*(\beta) - \lambda(\lambda - \xi)]$$

$$\times (1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1}))\ + \beta^2 L^*(\beta + \lambda)[W_v^*(\beta)$$

$$-W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1})] - \frac{\lambda\beta}{\alpha}(1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1}))$$

$$\times G^*(\lambda)\{\lambda + \beta - W_v^*(\beta)[\beta L^*(\beta + \lambda) + \lambda]\}$$

$$Dr_1(1) = \beta + \lambda - (\lambda + \beta L^*(\beta + \lambda))W_v^*(\beta)$$
$$Dr'_1(1) = \beta + \lambda + (\lambda - \xi)(\lambda + \beta L^*(\lambda + \beta))W_v^{*'}(\beta) - \lambda(1 - L^*(\lambda + \beta))W_v^*(\beta)$$

$Dr'_2(1) = G^*(\lambda) - E(R_s)(\lambda - \xi)$

$Dr''_2(1) = -2(\lambda - \xi)(1 - G^*(\lambda))E(R_s) - E(R_s^2)(\lambda - \xi)^2$

$Nr'_3(1) = 2\beta\left(1 - L^*(\lambda + \beta)\right)\left[W_v^*(\beta) - W_v^*\left(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1}\right)\right]$

$\times \ [\beta G^*(\lambda) + (\lambda - \xi) + \beta[\lambda + (\lambda - \xi)(1 - G^*(\lambda))]] - \{\lambda + \beta$

$-[\lambda + \beta L^*(\beta + \lambda)]W_v^*(\beta)(1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1}))\}$

$\times \ [[\lambda + 2(\lambda - \xi) - (\lambda - \xi - \beta)G^*(\lambda)] - \frac{\lambda}{\alpha}(\lambda - \xi - \beta)G^*(\lambda)]$

$-\{\lambda + \beta - [\lambda + \beta - [\lambda - \lambda L^*(\beta + \lambda)]W_v^*(\beta) + [\lambda + \beta L^*(\beta + \lambda)]$

$\times \ W_v^{*'}(\beta)(\lambda - \xi)\}(1 - W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1}))[(\lambda - \xi)$

$+\beta G^*(\lambda) + \frac{\lambda\beta}{\alpha}G^*(\lambda)] + 2\beta(\lambda + \beta)[W_v^*(\beta)$

$-W_v^*(\lambda + \beta - \lambda z_1 + \xi - \frac{\xi}{z_1})]L^*(\beta + \lambda) - W_v^{*'}(\beta)(\lambda - \xi)[\beta[\beta G^*(\lambda)$

$-(\lambda - \xi)](1 - L^*(\beta + \lambda)) + \beta(\lambda + \beta)L^*(\beta + \lambda)]$

4. SPECIAL CASES

(a) If the service time distribution follows an (exp.) distribution and no retrial, no service among the vacation period and $\xi = 0$ then the present model will be remodeled as analysis of M/M/1 queue with server vacations and a waiting server.

(b) If the server does not wait after the completion of the RS period and $\xi = 0$ then the present model will be remodeled as "An M/G/1 retrial queue with multiple working vacation".

5. NUMERICAL RESULTS

The curved graph constructed in Figure 1 and the values tabulated in the Table 1 are obtained by setting the fixed values $\mu_v = 0.8$, $\mu_s = 8.4$, $\mu_{vr} = 0.4$, $\mu_{sr} = 2.2$, $\alpha = 0.3$, $\xi = 0.7$ and varying the values of λ from 1 to 2 incremented with 0.2 and extending the values of β from 0.3 to 0.5 in steps of 0.1,we observed that as λ rises L_s also rises which shows the stability of the model.The curved graph constructed in Figure 2 and the values tabulated in the Table 2 are obtained by setting the fixed values $\mu_v = 0.8$, $\mu_s = 9.8$, $\mu_{vr} = 0.9$, $\mu_{sr} = 3.2$, $\alpha = 0.4$, $\xi = 0.7$ and altering the value of λ from 1 to 2 incremented with 0.2 and extending the values of β from 0.5 to 0.7 in steps of 0.1. From the graph, we studied that as λ rises W_s also rises which shows the stability of the model. The curved graph constructed in Figure 3 and the values tabulated in the Table 3 are obtained by setting the fixed values $\mu_v = 1.2$, $\mu_s = 8.8$, $\mu_{vr} = 0.8$, $\mu_{sr} = 2.8$, $\alpha = 0.4$, $\xi = 0.8$ and varying the value of λ from 1 to 2 incremented with 0.3 and extending the values of β from 1 to 1.6 in steps of 0.5, we observed that as λ rises L_v also rises and hence the stability of the model is verified. The curved graph constructed in Figure 4 and the values tabulated in the Table 4 are obtained by setting the fixed values $\mu_v = 1.4$, $\mu_s = 7.9$, $\mu_{vr} = 0.5$, $\mu_{sr} = 2.8$, $\alpha = 0.9$, $\xi = 0.8$ and varying the value of λ from 1 to 2 incremented with 0.2 and extending the values of β from 1.5 to 1.9 in steps of 0.3,we observed that as λ rises W_v also rises which is expected.

CONCLUSION

In this paper, an M/G/1 retrial queue with working vacation, reneging and a waiting server is evaluated. We obtain the PGF for the number of customers and the mean number of customers in the orbit. We worked out the mean waiting time. We also derive the performance measures. We perform some particular cases. We illustrate some numerical results.

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Table.1: L_s with turn over of λ

λ	$\beta = 0.3$	$\beta = 0.4$	$\beta = 0.5$
1.0	2.8123	0.9411	0.5069
1.2	4.0101	1.5621	0.8756
1.4	5.4632	2.3901	1.3977
1.6	7.1863	3.4598	2.1102
1.8	9.1798	4.8108	3.0599
2.0	11.4203	6.4852	4.3062

Table.2: W_s with turn over of λ

λ	$\beta = 0.5$	$\beta = 0.6$	$\beta = 0.7$
1.0	0.4166	0.2456	0.1611
1.2	0.5845	0.3528	0.2336
1.4	0.7867	0.4906	0.3328
1.6	1.0249	0.6609	0.4613

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1.8	1.3038	0.8691	0.6248
2.0	1.6305	1.1231	0.8318

Table.3: L_v **with turn over of** λ

λ	$\beta = 1$	$\beta = 1.3$	$\beta = 1.6$
1.0	0.1394	0.0834	0.0558
1.2	0.1991	0.1184	0.0787
1.4	0.2587	0.1539	0.1021
1.6	0.3177	0.1892	0.1253
1.8	0.3752	0.2238	0.1481
2.0	0.4305	0.2573	0.1701

Table 4: W_v **with turn over of** λ

λ	$\beta = 1.5$	$\beta = 1.7$	$\beta = 1.9$
1.0	0.1611	0.1283	0.1046
1.2	0.1916	0.1526	0.1244
1.4	0.2199	0.1754	0.1431
1.6	0.2483	0.1985	0.1621
1.8	0.2792	0.2239	0.1831
2.0	0.3166	0.2549	0.2086
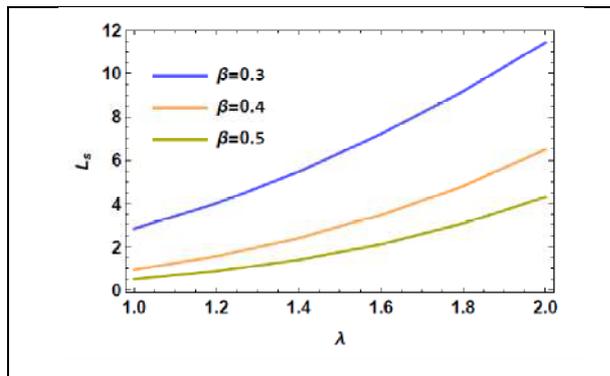
Figure 1: L_s **with turn over of** λ
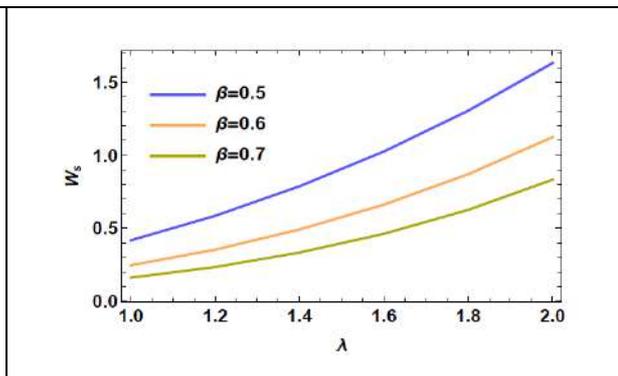
Figure 2: W_s **with turn over of** λ
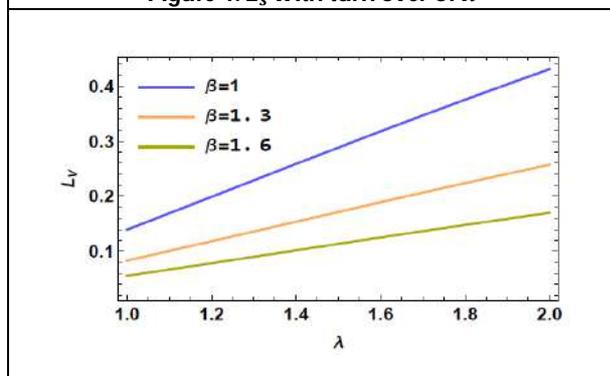
Figure 3: L_v **with turn over of** λ
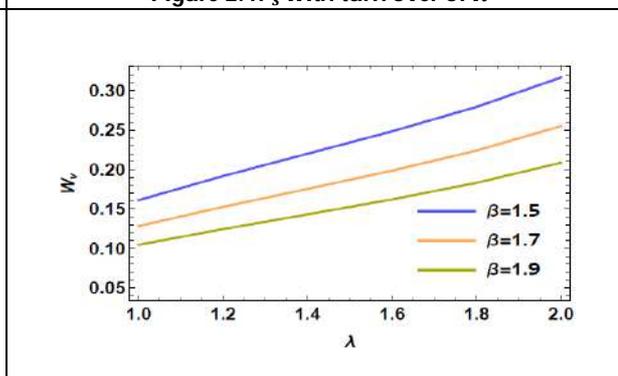
Figure 4: W_v **with turn over of** λ

RESEARCH ARTICLE

An Image Analysis-Based Deep Learning Framework for Dermatology Disorder Classification and Detection

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ABSTRACT

Dermatology and subsurface disorders are often the sixth most common source of treatable disease problems in the general population, affecting 20–60% of people and affecting people of all ages. The goal of this paper is to offer an autonomous method for classifying skin lesions that has a higher classification rate using the transfer learning theory and a deep neural network that has already been trained. The deep learning model of the Visual Geometry Group Net-16 (VGGNet-16) Architecture and the convolutional neural network architecture, which alters its performance with few changes when the investigated, were used in this study to evaluate a leading technology for categorizing skin diseases. The proposed model utilized in this study accomplished with more than 93.01% accuracy and was based on the HAM10000 dataset, which contains 10,015 photos from the ISIC repository. The system used deep learning to create a pre-trained VGGNet-16 convolutional neural network to classify diseases using different input skin image conditions. In order to boost the classification of skin diseases in process, an automatic approach has been applied for this performance of classification task applying a deep learning model.

Keywords: Skin lesion, Classification, transfer learning, Convolutional neural network, VGG Net.

INTRODUCTION

In comparison to other illnesses, skin conditions are the most prevalent health issue worldwide. The variation in these skin layers are observable because of many environmental, geographical feature variants. Skin lesions may be initiated by allergy, bacteria, fungal infection or viruses, etc. The illnesses that are occurring in people of all ages are to harm. A skin condition can alter the surface or color of the skin and frequently causes damage since it penetrates into various parts of the body. Skin conditions are frequently contagious and occasionally emphasize to progress to skin malignancy. In order to stop skin disorders from spreading and growing on the surface of the body, it is crucial to diagnose them early on[1]. Skin lesions require a lengthy diagnosis process and expensive medical care to treat, relieving the patient of their misery. Skin lesions are diagnosed using a variety of diagnostic test facilities so that signs can be found months later and can affect the disease's improvement and progression. The advancement of medical knowledge in photonics and lasers has made it feasible to identify skin lesions more precisely and efficiently. Furthermore, a detection of a skin infection like this is expensive yet somehow constrained. We therefore present a concept for a skin infection system of image processing for the diagnosis of various abnormalities[2].This proposed approach employs image analysis to identify the kind of skin disease and includes the dermatoscopic image of the effect of a dermatitis on an area of skin. The HAM10000 dataset was used to study more than 10,000 dermatoscopic skin imaging of seven distinct forms of skin illnesses, including epidermis malignancy, harmless event or condition lesions, age spots skin discoloration, offer a wide range, melanomas nevi, and intra-epithelial carcinoma. These dermatoscopic data from the HAM10000 Dataset were separated into optimum parts for training and least splits for evaluation for creating the model [3]. The section summarizes core is arranged as follows: In Section II, the earlier study's classification of skin infections is expanded. Section III describes the Modernized VGG(16)-CNN model's methodology, while Section IV presents the study's conclusions. Section V completes this effort and also predicts the extent of the future.

Literature survey

Researchers remain focused on applying several algorithms that can be handled to identify different types of skin diseases. In the method of [4], presented a model that can met performance analysis and also made some of observations based on outcomes. Dermatoscopic images of different skin diseases were made with the help of an image-processing technique that removed morphological characteristics and other aspects. Dermatoscopic images were sent into the system as input to view the results. The system was capable of identify almost accurately and detect arsenic in the images. In this technique [02852.v26], the studied model worked based on the MobileNet V2 and LSTM (Long Short-term Memory) methodology showed better efficient for skin lesions classification and detect with minimum measurable effort. The results are favorable, with an accuracy of 85.24% over the real data downloaded from Kaggle when checked and compared with a few other approaches. The biographer of [**5**] applied the system for an initial training showed the result accuracy of 70% nearly. This can be certainly enlarged by increasing the training dataset in the deep learning model architecture. Five skin conditions were initially confirmed; There can be additional requirements later on. Images can be identified with higher than 90% accuracy using a huge dataset. Due to development of [6], a skin image-processing tool, automatic computerized screening techniques for the majority of skin diseases are now feasible. Two approaches, including the pattern recognition technique and the supervised learning technique, were classified using dermatoscopic images.

Although segmentation is a vital step in determining the area infected by skin condition, it is feasible to go beyond this. The categorization plays a bigger part in the extraction of skin image features. Numerous research fields have recently made contributions to the study of computer vision and image processing techniques for various skin disorders. The challenge of doing research in these areas for identifying acne issues aggressively [7]. According to Theyazn H. H. Aldhyani *et al.* in [13], skin tumor incidence is speedily growing in addition is turning into a severe well-being issue. A key necessity of the remedial part is an exact and completely programmed organization arrangement because it helps lessen this risk to life. To date, a number of deep learning- and computer vision-based approaches have been put forth to achieve this. Consequently, a CNN-based model that successfully proposed. The

proposed approach can also be used to classify diseases with precision of 97.85% on the test dataset using a dataset. Skin illnesses can be brought on by fungi that develop on the skin, microscopic germs, hypersensitivity, pathogens and tone of skin-surface [14]. The specific number of layers typically relies on the needed memory cost and network capacity for a particular categorization activity. The study method presents identifying images of bare skin and images that are safe for work using a proposed CNN model and an existing CNN architectural model (VGG19), and evaluating the effectiveness of both architectures. With an accuracy of 87.29% for 15 epochs, the suggested Convolution Neural Network architecture outperforms VGG-19 on our dataset. This new model presented Classifier model, which is depicted in figure 2 (16 convolution layers + 7 fc layers), and employed 5600 training data and 1000 testing images for VGG-19 (16 convolution layers + 3 fc layers). Both use the Sigmoid activation mechanism and SGD Optimization method by [15].

Proposed Methodology
In this section, Modernized VGG(16)-CNN model is briefly elucidated. The structural design of skin lesion classification using Modernized VGG(16)-CNN model is shown in Figure1.

Research Data
The ISIC repository [8] includes a huge number of openly available skin datasets, and this is where the histopathological data collection HAM10000 was found. You can access this HAM10000 dataset in online available repository. It comprises 1,00,15 dermoscopic images in seven groups. The dermoscopic images are composed over a time of twenty years ago by Australia. This HAM10000 dataset involves505 dermoscopic images demonstrated by pathology. The details of HAM10000 Data set are listed in Table 1.

Data Preparation
Dermoscopic images were composed in the HAM10000 dataset with related labels and features. This HAM10000 dataset has categorized into seven classes along with its names age, sex, localization, image id, dx, dx type, and lesion id. The dataset has some non-identical dermoscopic images. The process is used to remove it and skin disease images remain to be more treated. This HAM10000datasetisthen divided in to three portions the training, testing, and validation data for process.

Pretrained Network Model
Pretrained network models are a perfect source to inculcate a technique and an attainable structure. In this phase, Pretrained network models prepared in this training are the Visual Geometry Group Network(VGG Net(16)).The VGG Net(16) structure has totals of 16 layers. Next, the addition of another two more layers in this structure, namely, the Dropout layer and Dense layer [9].To eliminate over-fitting difficulties in network structure, it is advised to use the drop - out rates layer. A longer High-density layer is present, further to way the Fully Connected (FC) layer in network deployment. The transfer learning has been adapted to the Pre-trained Network VGGNet-16 in different ways, containing adjust the weights of this proposed architecture, changing the number of classification layer with a soft-max function that performed predictions with seven kinds of skin lesions, and augmenting dataset by distributed random rotation angles. The objective model of VGGNet(16)was framed with alayer count of 18layers in the network.

Modernized VGG(16)- CNN Skin Disease Detection Adaptation Model
Detection and Classification
Convolutional Neural Network (CNN)-based dermoscopic disease classification performance on an image of skin disease has been taken into consideration for the new architecture model. This Modernized VGG(16)-CNN network is trained for classification using an ADAM optimizer. In order to classify the assessment input images into the seven categories of dissimilar classifications—beneficial keratosis, actinic keratosis, melanoma, basal cell carcinoma, derma to-fibroma, melanocytic nevus, and vascular lesion—the trained Modernized VGG(16)-CNN model is used.

Algorithm for Modernized VGG(16)-CNN Model: HAM10000 photo dataset and VGG Net as source (16) Skin disease classification as an outcome Begin Data Preprocessing; Acquire the augmented images; *for* (*eachsampleimage*) construct the VGGNet(16)-CNN model in the end-to-end procedure; Give the VGG Net(16)-CNN classifier the segmented frames; classify the description of skin conditions; *endfor* End

Experimental Results

This section examines the Modernized VGG(16)-CNN Model's performance using Python 3.7.8 with the HAM10,000 dataset and VGG Net (16). In the entire categorization, instruction uses 80% of certain HAM skin images. Throughout the complete class, the remaining 20% of the HAM10000 skin images are used for evaluation. Additionally, to better understand how well it classify skin illnesses, the Alex Net[10], ResNet50[11], and ResNet152[12] are compared to it in order to improve accuracy, recalls, f-measure, and exactness. Figure 2 displays instances of dermoscopic images for each of the four domains of skin disorders. The Modernized VGG(16)-CNN implemented on theHAM10000 data set in terms of precision, recall, f-measure, and accuracy are given in Table 2and illustrated inFigure2.

CONCLUSION

In this research, a Modernized VGG(16)-CNN model is proposed to classify the various skin conditions. The suggested examination of the VGGNet-16 model with CNN, which can run on multipart computational hardware, will have an impact on high level accuracy. In order to accurately categorize the various skin conditions, images from the dropout layer are additionally segmented before being passed to the updated VGG(16)-CNN layout method. The results of the analysis revealed that, about the HAM dataset, the Modernized VGG(16)-CNN seemed to have an average correctness of 93.01%, whereas AlexNet, ResNet50, and ResNet152 had mean accuracy values of 84.43%, 86.46%, and 86.68%, respectively.

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Table1.DetailsofHAM10000Dataset

Name of the skin disease	Number of Dermoscopic samples	Total percentage	Train Sample	Test Sample	Validation Sample
Melanocytic-nevus	6705	66.95	5364	1341	1341
Melanoma	1113	11.11	890	223	223
Benign-keratosis	1099	10.97	879	220	220
Basalcell-carcinoma	514	5.13	411	103	103
Actinickeratosis	327	3.27	262	65	65
Vascular-lesion	142	1.42	114	28	28
Dermato-fibroma	115	1.15	92	23	23

Table2. Consequences from the HAM10000 dataset using the Skin Disease Classifier Models

Presentation Metrics in %	AlexNet	ResNet50	ResNet152	Modernized VGG(16)-CNN Model
Precision	83.28	85.92	87.3	91.12
Recall	83.35	86.12	88.21	91.21
F-measure	84.369	86.28	88.46	92.13
Accuracy	84.43	86.46	88.68	93.01

Figure1.Identification of Skin Diseases Using a Modernized VGG(16)-CNN Model	Figure2. Evaluation of efficiency presentation on HAM10,000 data

BIOGRAPHY

	Mrs. A. Kalaivani, Assistant Professor, Department of Computer Technology, Nallamuthu Gounder Mahalingam College, Pollachi. She has 9 years of teaching experience. She has been recognized guide under Bharathiar University to guide MPhil scholars in the area of Data Mining. She received her M.Phil Degree in the field of Data Mining from Sree Sareswathi Thyagaraja College of Arts and Science Pollachi and as Ph.D research scholar in the area of Data Mining in PSGR Krishnammal College for Women, located in Coimbatore. She got circulated 07 study documents in National, International Journals and 4 National Conferences in the broad filed of computer science.
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RESEARCH ARTICLE

Understanding the Fundamentals of Uncertainty in Neural Networks, Causes and Types

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ABSTRACT

Neural Networks is a subclass of machine learning and is an essential part of deep learning algorithms. The concept of Neural Network (NN) and its functionality is influenced by the human brain and how the neurons in it communicate with each other to process a given input. The NN consists of multiple node layers, where each node represents an artificial neuron. The first layer is the input layer, followed by one or more layers of nodes and finally the output layer. Each node is associated with a particular weight and threshold value which determines the predicted output. Unfortunately, it is difficult to make predictions accurately, that is, the outputs are unstable and this is known as uncertainty. Uncertainty is the state of being unsure of something, which is an inevitable component of the real world. Uncertainty exists because of various reasons like missing information, unreliable data, noise and so on. To narrow down, there are two types of uncertainties: Epistemic and Aleatory. Epistemic uncertainty is one which arises due to limited data and knowledge. Epistemic uncertainty can be rectified by collecting more data samples for training the model. Aleatoric uncertainty on the other hand, arises due to naturally occurring vagueness in data, which cannot be reduced even when the amount of sample data increases. Aleatoric uncertainty can be measured as homoscedastic uncertainty, which does not vary from sample to sample. In contrast to homoscedastic uncertainty, heteroscedastic uncertainty is the uncertainty that varies from sample to sample. It is impractical to build a model which is unquestionably certain, but we can identify the source of uncertainty, quantify it and reduce it. As much as uncertainty is unfavorable for predicting accurate results, it helps us to identify overlooked scenarios which may turnout to be beneficial.

Keywords: Neural network, Uncertainty, Bayes' theorem, Epistemic uncertainty, Aleatoric uncertainty.

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INTRODUCTION

In the past decade, neural networks have become the core of artificial learning, classification and predictions. The applications of NNs have extended to each and every paradigm of science and technology. Neural networks simulate the thinking process and provide almost accurate predictions. The result of any neural network model has some percentage of uncertainty. Uncertainty refers to the lack of confidence in the output provided by the model. Uncertainty can be defined by unknown values, irrelevant data or uncertain data. Uncertainty provides scope to accommodate exceptions that occur in nature, and hence uncertainty finds its application in the real world. It can be used in medical analysis where the approximation of predictive uncertainty is critical for medical imaging[7] as false positives can be predicted. Another application is in the field of robotics[7] where mission-critical predictions must be made for systems like self-driving cars, surgical robotics, space robotics. The usefulness of uncertainty in such applications prevents biased results which may be fatal. Uncertainty gives the band of possible values rather than a particular value, this region consists of probable values the outcome can take. Although this reduces the precision of the model, it improves the inclusiveness of data. Reduction of accuracy of a model makes its implementation in certain areas difficult. Thus, efforts must be made to reduce uncertainty, however it is impossible to completely remove it.

2.Literature Survey

Artificial neural networks (NNs) have achieved breakthrough success in the millennium, bringing out a new era in artificial intelligence (AI).There has been an enhancement in the performance of the tasks performed by systems by considering NNs as building blocks. These systems, however, lack crucial qualities that are critical for widespread application in the real world. applications. The concept of uncertainty [8] is extremely important in machine learning and is a vital component of the technique. Uncertainty has long been associated with conventional probability and probabilistic predictions, in keeping with statistical tradition. However, because of its growing importance, newer problems and obstacles have lately been revealed. Safety regulation issues may necessitate new methodological developments, according to experts. This covers the significance of distinguishing between at least two separate things with aleatoric and epistemic uncertainty are two sorts of uncertainty. Neural networks have penetrated practically every discipline of study in the previous decade and have become a critical component of a variety of real-world applications. Because of the widening gap, the confidence in neural network predictions grew with more significant basic neural networks, which, on the other hand, do not provide. Overconfidence or under confidence in certainty estimates are not properly calibrated. Many researchers working to overcome this have been attempting to comprehend and measure ambiguity in the predictions made.

In the machine learning literature[9], various learning strategies have been presented. The learner queries the label of those occurrences, successively for which its current prediction is most uncertain in uncertainty sampling, which is one of the most significant methodologies. Most of the predictions and measurements that are used to quantify the degree of uncertainty, such as entropy, are based on probability theory. In this study, we find that there are two types of uncertainty: epistemic and aleatoric uncertainty. These two types make up the reducible and irreducible parts of the total uncertainty in a prediction. The origin and characteristics of uncertainty for risk and reliability studies are examined[5]. While there are numerous types of doubt, they are often classified as epistemic or aleatory. When the modeler finds a way to reduce uncertainty by increasing the datasets or improving the model, then the uncertainty is called epistemic. If the modeler cannot reduce the uncertainty, even by finding new data, it is termed as aleatoric uncertainty. Categorizing the uncertainty in a model is beneficial since it becomes easy to identify which uncertainties can be reduced. The two forms of uncertainties have different effects on reliability, performance dependent engineering models, and critical decision making.

Introduction to Neural Networks

Artificial neural networks (ANNs) were created with the intention of simulating the biological brain. The first step was to present a model for the "units" that make up the brain, the neurons. The figure.1 below represents the structure of a neuron. The neuron consists of:

● Synapse: Neurons are the fundamental units of the brain. Each neuron transmits and receives electrochemical signals. Synapse is the junction of two neurons where the transmission takes place.
● Dentrite: Dendrites transmit input signal to the cell nucleus.
● Axon: Axon is the output structure of the neuron
● Cell Nucleus: Nucleus contains the genetic material

McMulloch and Pitts [1] proposed a basic mathematical model of the neuron back in 1943. This was designed to take binary inputs and output a single binary output. This system was also shown to be capable of performing certain fundamental logic operations. Rosenblatt [2] presented an evolution to this concept in 1958, which is known as the "perceptron". Instead of explicitly implementing the function that translates inputs to outputs (e.g. logic operations in the prior model), the aim was to let the neuron learn it. A schematic representation of an "artificial neuron" and how it differs from its organic counterpart is shown below. In the figure.1, a neuron gets sample input information x from associated neurons via their axons, with xi denoting the i-th member of the vector x. The use of the superscript x (j) to refer to the j-th sample. The weight *wi* to be applied to the inputs that are stored in the synapses. The contributions from various inputs are then transmitted to the cell body through dendrites, where the weighted sum of the inputs is done (typically a bias value b is added). The element wise activation function like sigmoid, Tanh, ReLU for the transformation in the output. The main aim of neural network model is to make the model understand and learn from the training datasets and to apply this knowledge to make predictions on new input data. The Bayes' Theorem is used to predict the probability of the occurrence of a new event based on information that may or may not be related to that event. The figure.3 gives the Bayes' Theorem. This theorem is named after Reverend Thomas Bayes (1701-1761), and is also referred to as Bayes' law or Bayes' rule[3]. Bayes' theorem gives conditional probability, or 'posterior probability', of an event A when event B is given to be true[reference]. It depends on the conditional probability or likelihood of event B when event A is known to be true. Prior knowledge that the probability of event A is true with the evidence or marginalization that probability of event B is true.

3.1 Uncertainty In Neural Networks

A typical neural network model consists of nodes which represent the neuron, which are arranged in multiple layers to form a network. The first layer takes the input from a source, the middle layers also called as hidden layers perform most of the processing and finally the last layer gives the output of the model. Each node is associated with a particular weight and threshold value which determines the predicted output. In reality, it is impossible to make completely accurate predictions, it always is accompanied by a percentage of uncertainty. Uncertainty is the state of being unsure. Uncertainty refers to data or predictions which may not be completely true. It may be due to the result of lack of knowledge, unreliable data, conflicting information and so on. Uncertainty is an inevitable part of any model. Uncertainty can be described as incompleteness, unreliability and untimeliness of source data[4] . Uncertainty can be quantified statistically by confidence interval, prediction interval and tolerance interval. The heart of any neural network is the data, through which the network learns. Due to the presence of uncertainty data, uncertainty plays a key role in neural networks. The lack of certainty in the training data results in lack of surety in the predictions made by the model.

Types of Uncertainty

Uncertainty that affects the prediction of a neural network can be classified majorly into two types, Epistemic Uncertainty and Aleatoric Uncertainty [5]

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Epistemic Uncertainty

Epistemic uncertainty refers to the uncertainty that occurs due to insufficient data availability. This means that there exists a shortage of datasets that are used to train the Neural Network model. Insufficient data also accounts for the relevance of the data used and its quality. As any model learns from the dataset used to train it, the lack of knowledge gives rise to uncertainty in the predictions made by that model. Epistemic uncertainty also accounts for the bias induced in a model. Limited amount of training data enables the model to learn only from a few instances which may lead to one-sided knowledge or bias in the predictions or end results. Epistemic uncertainty can be reduced by increasing the data availability. Additional data can be provided to the model during the time of training so that more instances are learnt by the model which will enable it to make more efficient predictions. Increasing the quantity of data should not mean the reduction of the quality of data, it is equallyimportant to maintain the quality and relevance of the dataset. Epistemic uncertainty of a model increases if the input test dataset is distant from the training dataset and reduces if the input dataset is close to the training dataset. Sufficient and appropriate dataset can be used to reduce Epistemic uncertainty of a model. In reality, it is impossible to gather infinite datasets which are accurate, thus Epistemic uncertainty of a model can never be zero, although efforts can be made to minimize it.

Aleatoric Uncertainty

Aleatoric uncertainty refers to the uncertainty that is inherently present in the data itself. It includes the characteristic of the data which in itself is an uncertainty. It includes noise and randomness [6] that is an unavoidable part of the dataset. Aleatoric uncertainty accounts for the vagueness and variability that exists naturally in the world. Aleatoric uncertainty can be measured as homoscedastic uncertainty, which does not vary from sample to sample. In contrast to homoscedastic uncertainty, heteroscedastic uncertainty is the uncertainty that varies from sample to sample. Aleatoric Uncertainty adds to the reduction of accuracy of the result of the model, but it cannot be reduced. Increasing the dataset will simply mean that the noise associated with the data also increases, thus it cannot be used to reduce or control aleatoric uncertainty. Even if the quality of the dataset is improved, there would still be noise present in it as it is a part of the data itself. This form of uncertainty can never be corrected and thus must be accepted as an error margin that may be useful to include exceptions that may occur. Prediction uncertainty is the final uncertainty that is exhibited by the model, which is the summation of Epistemic uncertainty and Aleatoric uncertainty.

Causes of Uncertainty

Uncertainty is an essential part of a neural network as it plays a part in the learning phase of the model which inturn affects the prediction result of the model. It is important to understand the causes of uncertainty in order to quantify it or reduce it. The following are factors that cause uncertainty in neural network [7] :

- Variability that occurs in the real world,
- Errors that are inherently present in measurement systems,
- Errors present the neural network's architecture,
- Errors that are caused by unknown or noisy data.

Variability that Occurs in the Real World

The real world environment is highly variable and subject to changes. This induces noise and vagueness in the datasets that are captured from the real world. The variability in the real world has a direct impact on the parameters of the data. Discrepancy that occurs in the dataset is due to the rapid and unpredictable changes that occur in nature. This causes uncertainty in the prediction made by the model.

Errors that are Inherently Present in Measurement System

Many methodologies are used to collect data from various sources. The measurement systems that collect data inherently have a certain amount of errors. This includes errors in the devices, false labeling, image resolution issues,

and so on. These errors accumulate with the increase in data that is collected in the same way and thus adds to uncertainty.

Errors Present in the Neural Network's Architecture

The way the neural network is structured has a direct impact on its performance. The arrangement of nodes, number of hidden layers, parameters of the data which may cause the under-fitting or over-fitting on the training data. Thus, architecture of the neural network model is one of the causes of uncertainty.

Errors that are Caused by Unknown or Noisy Data

There exists a large amount of missing or unknown data. This includes lack of knowledge entirely or partially missing data. Models trained on such datasets produce more uncertainty. Noise present in the data which may include background noise or random noise also adds to uncertainty. Unreliable data sources have more unknown andnoisy data. Invalid data can be presented to a model as an input which may lie outside the domain of the training dataset, this also leads to uncertainty in prediction.

CONCLUSION

A neural network is used to simulate the working of the human brain. This involves the construction of nodes which form the fundamental part of the neural network. The main aim of the neural network model is to learn from the given training dataset to make predictions for a new test dataset. The prediction made by any model is never fully accurate, it is uncertain. Uncertainty is an inevitable part of a neural network model, hence it is not possible to createa model that is completely certain. It is only possible to identify, quantify and reduce uncertainty that may be presentto improve the performance of the model.

Benefits of Uncertainty

Uncertainty can be useful as it helps to include the exceptions that may occur in real world scenarios. It enables us to not overrule any special cases that exist in nature. By taking this into consideration it is possible to prevent certain actions that may be based on predictions that are assumed to be accurate that may lead to fatalities. Uncertainty induces a sense of doubt which prevents the implementation of tasks that have damaging consequences that can be taken based on predictions made by the model. It reminds us about the possibility of false positives and gives us a reason to explore more before coming to any conclusion.

Disadvantages of Uncertainty

Uncertainty can play a key role in mission-critical applications where the prediction of the neural network model is an essential component of the task. In such situations, the uncertainty in the prediction made by the model must be reduced to a great extent. There are many methods to reduce uncertainty, but it depends on the type of uncertainty and the application of the model. Reduction of uncertainty in a model increases the accuracy of the prediction made by a model. Uncertainty is a part of all applications of neural network models. The uncertainty in a model should be reduced to improve its performance, but the benefits it provides must be explored.

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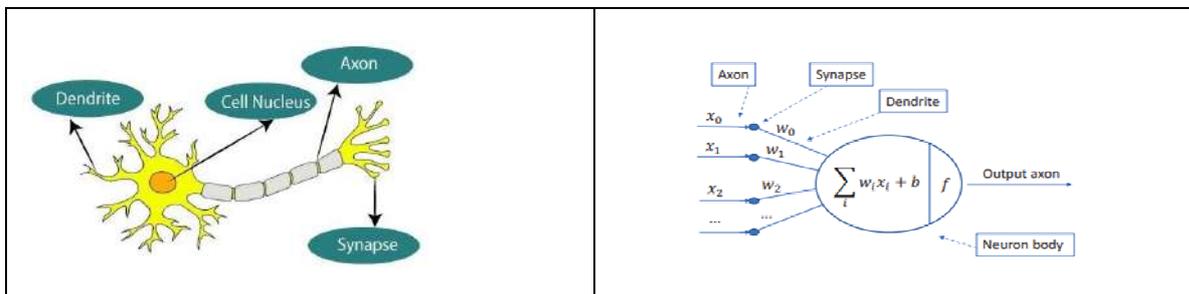
Figure.1: Structure of Neuron	**Figure.2: Schematic representation of perceptron, that conceptualized the model of a neuron.**
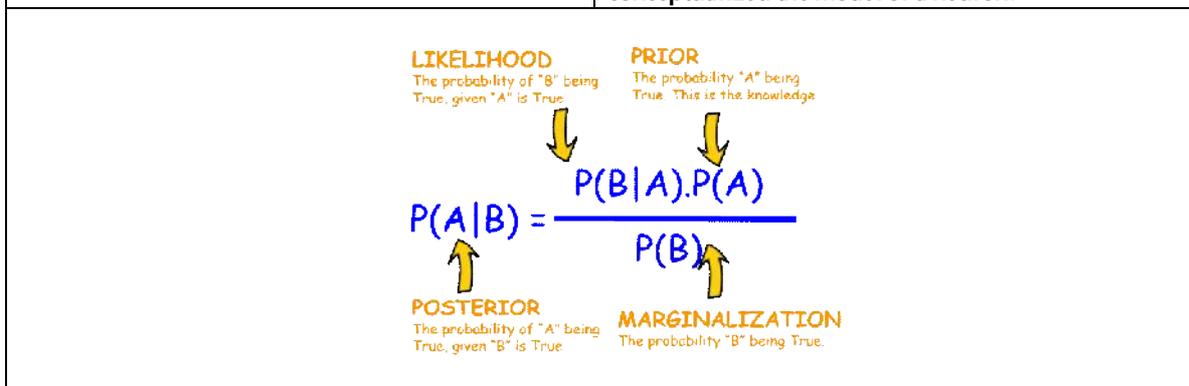
Figure.3: Bayes' Theorem

RESEARCH ARTICLE

Web-Page Summarization and generation of Paraphrases using a Neural Network based Transformer Model

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ABSTRACT

Paraphrasing and Text Summarization of contents in a URL is a Natural Language Processing task that has success with the Neural Network based Transformer model. The soaring accumulation of unstructured online text data, text summarization, and paraphrasing has found many applications in various domains. In this paper, we wish to provide a Transformer model to build a tool for Research students and Procrastinating examinees of colleges to understand their online work material link completely just by reading the generated summary and paraphrases so that the reader can save time and can decide whether to go through the entire document or not. Research interest growth in developing better summarization models, more humanlike summarizations, and more processed and refined datasets have offered to test and evaluate the models to improve existing NLP model performances. This article provides a simpler way of Paraphrasing and Summarizing the online articles and materials using the T5 Transformer model and analyses its performance on some datasets. To assess the model's efficacy, the suggested model has compared the output with respect to ROUGE scores.

Keywords: NLP, Paraphrasing, Text summarizing, Transformer model.

INTRODUCTION

With the massive expansion in digitized data, data mining has become a Critical technique for assisting and interpreting the data. Clustering, classification, categorization, paraphrasing, and summary are all examples of this. Summaries are frequently required to allow for fast relevance judgments, information extraction, and analysis of

information from the source material. Text summarization is a time-saving approach that may be used in conjunction with Information Retrieval and Filtering systems. Automatic summarization is a significant natural language processing (NLP) jobs, but it is also one of the least solved ones, according to recent research. Because it offers the potential for natural language applications, automatic summarizing and paraphrasing have become quite popular in NLP [1]. Summarization is the process of converting a lengthy text into a compressed concise version that highlights its most crucial points. The two basic summarizing techniques are extractive and abstractive[4]. Abstractive procedures, like a human-written summary, can produce new terms and phrases that aren't included in the original text. Extractive techniques produce summaries primarily from passages retrieved directly from the source document. The attention-based encoder-decoder[8] paradigm in abstractive summarization has lately been extensively investigated, particularly due to the effectiveness of neural networks in machine translation experiments. The model revisits the input and pays attention to key information by dynamically accessing the pertinent pieces depending on hidden states of decoders during the production of output sequences. The skills necessary for producing high-quality summaries, including paraphrasing, generalizing, or assimilating practical knowledge, can only be learned within an abstractive framework. Paraphrasing is done to change the structure or arrangement of words while preserving the meaning of the actual sentence. Cosine similarity [16] and Levenshtein distance [17] are checked for variation in the generated text. The T5 model is pre-trained over a natural language corpus and trained to reach state-of-the-art performance. In our paper, we scrap data from websites which will be summarized and paraphrased using the T5 model [15]. The paper is structured as follows: Section II provides relevant and existing works. Section III shows the Experimental Setup. In Section IV we evaluate our work. Section V presents the results of our work. Section V concludes our paper and provides prospective plans for future work.

Literature Review
Transformers
The Transformer uses self-attention methods to randomly assign weights to each component of the input data. It is widely employed in algorithms for NLP. Before transformers, RNNs (Recurrent neural networks), were made to handle sequence models. Transformers are utilized for tasks like text summarization, paraphrase generators, and translation. The Contextualization for points in input streams is provided by Attention. The Transformer won't have to think back to past points to process the last. Instead, it indicates the context in which each statement's words are comprehended. Transformers, developed in 2017 by a Google Brain team, are quickly getting replaced by RNN models like LSTM (Long Short-termed Memory) as the preferred model for NLP issues. The encoders and decoders are attached to a "multi-headed attention layer" [8] which is then attached to "feed-forward network" level in transformer paradigm. Sine and cosine functions, which result in positional encoding, are used in the model to recall the location and order of words. A technique that relies on self-attention is used by the "multi-headed attention" at encoding, decoding layers. Three interconnected layers receive the input to construct the queries (Q0), keys (K0), and value (V0) vectors [8].

Transformer Model Architecture
The model includes an encoder-decoder structured architecture. An input series of symbols are translated into element sequences by the encoder. A symbol-output-sequence is given by the decoder, from our input value. This is regressive at every level, and the recently produced symbols are used as extra input to create the next step. Transformers use "self-attention" layers [8], complete connection layers for the encoders and decoders in accordance with its overall architecture presented in fig 1.

Encoder-Decoder
Six identical layers make up an encoder. A positional connection of a "feed-forward network" and a "multi-headed self-attention" are present in each layer. Following layer normalization, a residual connection is used for connecting sub-layer structures. Thus, the function carried out by each sub-layer itself is the output of our sub-layer. The result of the sub-layer is given by "LayerNorms(y + Sublayer(y))". The decoder is made of 6 identical layers in a stack. The first sub-layers are added with the decoder, which adds to the encoder stack's output, giving it multi-head attention. [8].

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BART approach

The "Bidirectional and, Auto-Regressive Transformer", was developed by Lewis et al. [10] and combines an auto-regressive decoder, similar to a GPT, and a "bidirectional encoder (similar to a BERT)" into a single Seq2Seq model which can be used for text summarization and paraphrase generation [11]. This means it returns to the Transformer's architecture originally proposed [8] shown in fig 2, albeit with some modifications.

T5 approach

The transformer model architecture, on which the "T5 (Text-To-Text Transfer Transformer)" is built, enables it to have a variable size of input rather than RNN, and CNN models. In T5 a sequence of embedding will be mapped to the input sequence and supplied to the encoder as input. The T5 model employs positional embedding elements; and the elements are scalars added to the logistic used to compute the attention. Maximize efficiency is achieved by distributing this information throughout layers [5].

Attention Masks

The "mask" utilized by various attention processes is a key identifying characteristic of various architectures. In a Transformer, the self-attentions produce a new contextual sequence with a length the same as the input [5]. Calculating the weighted averages of inputs, each item of the output sequence is created as shown in fig 3. Specifically, y_i is the ith text-element of the result; x_j is the jth text-element of the input. We used a matrix Q to hold a collection of questions and compute the attention function on them all at once. Additionally, V and K include both the values and the keys.

We computed the matrix of outputs as below

$$y_i = \sum_j w_{i,j} x_j$$

Here $w_{i, j}$ is a scalar weight.

Note: Some weights are zeroed out using the attention mask.

The encoder and the decoder are both layers of stacks that make up the transformer. A "fully visible" attention mask is employed by the encoder. A self-attention mechanism focuses on every input sequence of its resultant output because of its "fully visible" mask. When a "prefix," or context that is given to the model and will subsequently be utilized to make predictions, is the focus of attention, this type of masking is appropriate. A "causal" masking pattern is used in the attention procedures of the decoder. A "causal" masking helps the decoder prevent the model from attending jth entries during handling ith input for i<j. The purpose of this is to prevent the model from being able to "look into the future" while producing its output during training.

Experimental Setup

Raw data from Datasets (Dataset Selection)

The News Summary dataset from Kaggle was used for the experiment on Summarization. The dataset consists of 4515 examples from the Hindu, Indian times, and Guardian websites. The examples are from February to August 2017. Column names: "Authors_name_1", "Headline_1", "Url", "Short_text_1", "full_Article_1". PAWS [14] was used for the experiment on Paraphrase Generation. This dataset contains human-validated paraphrases and examples which are semantically different but grammatically similar. We use the former one for Paraphrase Generator. We used HuggingFace's [13] datasets to collect the data.

Column names: Source, Target, Label To execute our model, we used the Google Collab environment, and fig 4 below shows our proposed model.

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Data Preprocessing

The following operations were taken during the preprocessing of the documents: stop word removal, Lemmatization, lower-case transformation, punctuation mark, determiner, and preposition removal. The words on the list of English stop words were eliminated during the stop word removal phase. The proposed T5-based model was developed in Python. The Scikit-learn, Pandas, Numpy, and PyTorch [18] libraries were utilized. We extracted the paraphrase examples labeled as "1" for paraphrase generator training as they are human-validated. Cosine similarity and Levenshtein [17] distance are checked for the quality of the dataset. These Datasets are split to get training and testing sets with "*train_test_split()*" method in the "sklearn" Library.

Training

The competitive efficient performance, scalability to higher model size, and simplicity in use for problems like straightforward "text-to-text" mapping problems, and "text-to-text" transfer transformers (T5) are becoming more and more prominent. The author proposed to consider any text process task as a "text-to-text" task using the model T5 [5], which has been pre-trained in a variety of NLP tasks. The model is trained over "Colossal-Clean-Crawled-Corpus (C4)" dataset. This model is trained for sentiment analysis, question-answer translation, and text summarization shown in fig5. After experimenting with several models (mostly from the hugging face library), simpleT5 (small) appeared to deliver the greatest results with the least amount of training. We used a pre-trained T5-small model from Hugging Face and then we train it on our dataset using Pytorch Lightning [18]. In this work, we chose to employ the most straightforward T5small model in consideration of the available computational resources. We anticipate that the results of our study would serve as a lower bound for the effectiveness of a T5-based model. The complexity of these versions varies; the T5small has 60M parameters as opposed to the largest one's 11B. (T511B).

Hyper Parameter Settings for T5 Model

The available resources and computing power were taken into consideration when choosing the following parameters. As a result, we used the manual configuration technique to choose the Hyper parameters. With the help of a sample function from the pandas framework, the dataset is split into training(70%) and testing(30%) portions. We used the simpleT5 library to train our summarization model.

Model training parameters:

```
train_df: pd.DataFrame,
eval_df: pd.DataFrame,
source_max_token_len: int = 512,
target_max_token_len: int = 512,
batch_size: int = 8,
max_epochs: int = 5,
use_gpu: bool = True,
outputdir: str = "outputs",
early_stopping_patience_epochs: int = 0,  # 0 to disable early stopping feature
precision=32,
logger="default", "paraphrase"
dataloader_num_workers: int = 2,
save_only_last_epoch: bool = False,
val_check_interval=0.5(for paraphraser),
learning_rate = 1e −4 (default: 0.01) for summarizer, 4e-4 for paraphraser
seed = 42 (default: 42)
```

These parameters train the T5 model on the News summary dataset.

Argument description:

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- "source_max_token_len" (integer, defaultValue): Default value= 512.
- "target_max_token_len" (integer, defaultValue): Default value= 512.
- "batch_size" (integer, defaultValue): Default value= 8.
- "max_epochs" (integer, defaultValue): Default value= 5.
- "use_gpu" (boolean, defaultValue): if set to true, the model can use GPU to train. Default value= True.
- "outputdir" (string, defaultValue): output directory for saving model checkpoint files.
  Default value= "outputs".
- "early_stopping_patience_epochs" (integer, defaultValue): checks val_loss on epoch end and stops to train, if val_loss does not improve over the specified epoch number. Default value= 0 (disabled)
- "precision" (integer, defaultValue): sets precision training - Double precision (64), full precision (32), or half-precision (16). Default value= 32.
- "logger" (pytorch_lightning.loggers): any logger supported by PyTorch Lightning. Default value= "default". If "default", PyTorch lightning default logger is used.
- "dataloader_num_workers " (integer, defaultValue): number of workers in train/test/Val data loader
- "save_only_last_epoch"(boolean, defaultValue): If True, saves only the last epoch else models are saved at every epoch

Model prediction parameters:

- source_text: str,
- max_length: int = 512,
- min_length=50, #optional
- num_return_sequences: int = 1,
- num_beams: int = 2,
- top_k: int = 50,
- top_p: float = 0.95,
- do_sample: bool = True,
- repetition_penalty: float = 2.5, 1(for paraphraser)
- length_penalty: float = 1.0,
- early_stopping: bool = True,
- skip_special_tokens: bool = True,
- clean_up_tokenization_spaces: bool = True,

Argument description:

- "max_length" (integer, defaultValue): maximum token length for prediction text. Default value =512.
- "num_return_sequences" (integer, defaultValue): number of predicted texts . Default value= 1.
- "num_beams " (integer, defaultValue): Default value= 2.
- "top_k" (integer, defaultValue): Default value= 50.
- "top_p" (float, defaultValue): Default value= 0.95.
- "do_sample" (boolean, defaultValue): Default value= True.
- "repetition_penalty" (float, defaultValue): The penalty given for repetition Default value= 2.5 for summarizer, 1 for paraphraser
- "length_penalty" (float, defaultValue): Exponential penalty. Default value= 1.0.

Returns:
str: text

Initiating Fine-Tuning

Summarizer

Epoch: 0, train-loss: 2.0027, val-loss: 1.5980

Epoch: 1, train-loss: 1.6708, val-loss: 1.5229

Epoch: 2, train-loss: 1.5456, val-loss: 1.4898

Paraphraser

Epoch: 0, train-loss: 2.8078, val-loss: 2.2068

Epoch: 1, train-loss: 1.5906, val-loss: 1.5872

Epoch: 2, train-loss: 1.3406, val-loss: 1.2018

Web scraping for real data

We automatically scraped the web and preserve the most pertinent material, free of any adverts or other links, using the requests, bs4, and newspaper packages. To "GET" the desired URL page, the requests package is used, and it returns an objectof that website. The request object that was received is converted and parsed into HTML using the Beautiful Soup [12] class. The needed data, in this example the links to the most pertinent article, can then be scraped

using it. After that, the variable "href" is used to store the article's link. The article is downloaded, parsed, and saved into the variable 'info' so that it can be summarized with the help of the Article class.

Evaluation
ROUGE measures [9] were employed during the evaluation procedure. This is an automatic summary evaluator that compares the predicted summary to the reference-text for the quality of text produced (ideal or human-written).

Rouge-N
It indicates the degree to which the computer-generated summary and ideal reference summary overlaps in terms of n-gramcounts.

Rouge-L
Longest Common Subsequence match between the reference text and the text produced by the system is shown in table 1and 2.

RESULTS

The results of the Summarizer and Paraphraser built with the T5 method are shown below in Table. The extracted text from a URL is summarized and paraphrased. According to the ROUGE scores achieved, the models produced a text that is for the most part abstractive. Similar sentences will receive a score of 1, whereas sentences with no words in common will receive a score of 0. The min_length (minimum length of the generated text) parameter for 1st example was set higher and therefore we see the length of the summary a bit higher than in the example 2nd where the min_length parameter was set a bit lower. The repetition_penalty (the penalty given to the model for repetition) for the latter was set lower compared to the former to test thegenerated texts.

CONCLUSION AND FUTURE ENHANCEMENTS

We talked about the state-of-the-art Transformer Model which is Neural-Network based architecture for text generation. The pre-trained transformers from the Hugging Face library were implemented and trained the model using Pytorch Lightning. We generated summaries and paraphrases of the text which are extracted from online websites using a T5 model [5]. Experiments with custom datasets and Hyper parameters were done to increase the proficiency of the model. Proficiency was checked with ROUGE scores secured by the model. Experimental results on News Summary and PAWS datasets [14] suggest that the model is predominantly abstractive. In the future, we wish to develop the model by training it with T5-base and T5-large architecture and build an app for ease of interfacing.

Web Scrapped Text	Summarized Text	Paraphrased Text	URL
1. The Indira Gandhi Institute of Medical Sciences (IGIMS) in Patna on Thursday made corrections in its Marital Declaration Form by changing 'Virgin' option to 'Unmarried'. Earlier, Bihar Health Minister defined virgin as being an unmarried woman and did not consider the term objectionable. The institute, however, faced strong backlash for asking new recruits to declare their virginity in the form.	The Indira Gandhi Institute of Medical Sciences (IGIMS) has made corrections in its Marital Declaration Form. Earlier, Bihar Health Minister defined virgin as being an unmarried woman. The institute, faced strong backlash for asking new recruits to declare their virginity in the form.	Indira Gandhi Institute of Medical Sciences (IGIMS) updated the Marital Declaration Form in Patna on Thursday by changing the "Virgin" option to "Unmarried." Previously, the health minister for Bihar described a virgin as an unmarried lady and did not find the term offensive. However, the institute received a lot of criticism for requiring virginity declaration on the form for new members.	http://www.hindustantimes.com/patna/bihar-igims-form-loses-virginity-after-row-opts-for-unmarried-instead/story-8XmHIg39etGBeZAYEBQxMK.html?utm_source=inshorts&utm_medium=referral&utm_campaign=fullarticle

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Table 1: Rouge scores for Paraphraser and summarizer

	ROUGE scores for Paraphrases			ROUGE scores for Summarizer		
	ROUGE-1	ROUGE-2	ROUGE-L	ROUGE-1	ROUGE-2	ROUGE-L
Precision	0.2978	0.2488	0.2853	0.3687	0.2409	0.3298
Recall	0.3385	0.1665	0.3368	0.4007	0.2708	0.3411
F1	0.2189	0.1796	0.3566	0.3994	0.2877	0.3669

Fig 1. The Transformer-ModelArchitecture [8]

Fig 2. The Bidirectional and Auto-Regressive Transformer (BART) [10],

Fig 3. Multi-HeadAttention[8]

Fig 4: Proposed Model

Fig 5: "Text-to-text" representation [5]

RESEARCH ARTICLE
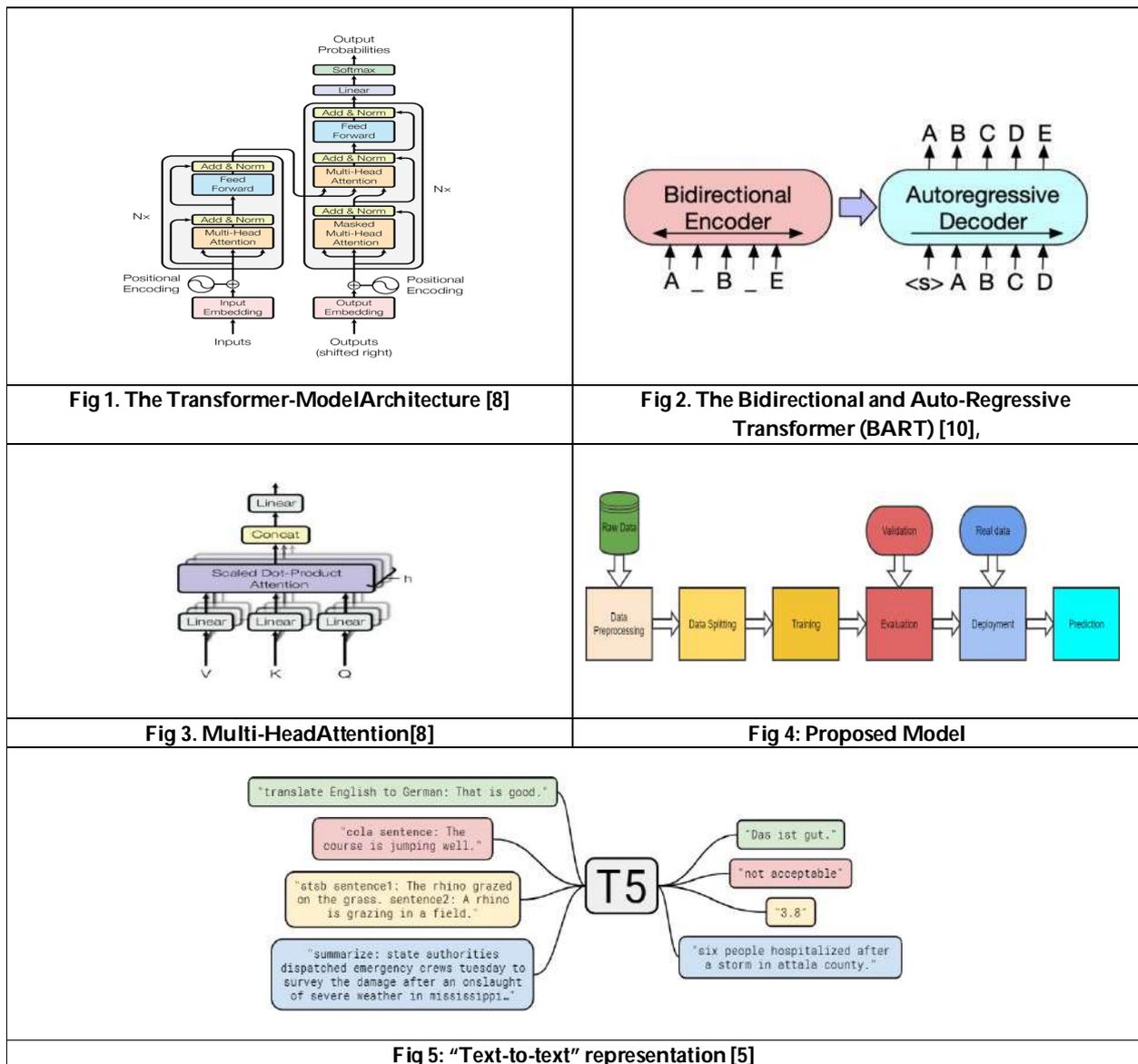
A Survey On illustration generation using Deep Dream Algorithm

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ABSTRACT

A new area of artificial intelligence called "creative AI" enables machines to produce original artwork, gripping narratives, and music. A computer vision system created by Google called the deep dream algorithm is used to produce artwork. The connection between text and image is made using the clip guidance technique. They discover that people prefer the letter because they evaluate it for photorealism and caption accuracy and construct realistic images. Higher-level aspects of sensory input are gradually extracted using artificial neural networks. This ANN can extract text and visual content and then transform it into artwork. Artificial neural networks occasionally overemphasize pictures, making the image appear different from the one that had to be generated. The CNN with various image processing steps and the CNN with various optimizers aids in the extraction of high-definition unique features from the image. In this study, we deploy a deep dream algorithm that is built on cognitive-based computational art rendering systems and convolutional neural networks. Using this technique, it is demonstrated how the idea of a seed incident can be used to inspire the creation of new artwork. The deep dream algorithm is built on generative convolutional networks, where a seed incident is given into the algorithm and comparable images are generated based on the seed incident. Additionally, the GAN's Creative Adversarial Networks subcategory is employed to generate the images. There is a proposed innovative text-to-image method that addresses these deficiencies because recent text-to-image creation systems have several crucial flaws. As well as having the capacity to produce high-resolution images that enhance the visual quality, it also offers many other features like scene editing, text editing, and anchor scenes

Keywords: generative convolutional, CNN with various, crucial flaws

INTRODUCTION

Despite the fact that language can frequently be used to describe images like illustrations, paintings, and pictures, creating them can be labor-intensive and require specialised expertise. Therefore, the ability to make natural

language can allow realistic visuals people to give high and varied optical content with previously unheard-of simplicity. Natural language editing of photographs also enablesfine-grained control and iterative refinement, both of which are essential for physical world applications. Intelligent behaviour involves original thought. Most people would agree that this is true, but it would be far more difficult to come to an understanding of what is meant by "creative behaviour," especially if the meaning had to be couched at the level of programmed specifications. Nevertheless, attempts to develop imaginative systems have been made throughout AI history, albeit infrequently. But it shouldn't be surprising that these programmes frequently differ significantly in terms of both what they want to accomplish and how they go about doing it. In this survey, we will go through different research on creative AI and what are outcomes of it. The project focuses on an artificial intelligence technique which uses to illustrate how the concept of a seed incident may be used computationally and to exhibit their influence on the ensuing generative art, we use cognitive-based art rendering tools. which is being rendered using a deep dream algorithm which is based on convolutional neural networks. The images which is being generated is based on the seed incident which is generated based on different scenarios.

Literature Survey

Recent research has demonstrated that diffusion models may produce excellent synthetic pictures, particularly when combined with a guidance method that compromises diversity for fidelity. The issue of text-conditional image synthesis is investigated using diffusion models, and two distinct guiding methods—CLIP guidance and classifier-free guidance—are contrasted. According to our research, the latter frequently yields photorealistic examples and is favoured by rating scales for both photorealism and caption similarity. Human judges prefer samples from a compared to those from DALL-E, a text-conditional dissipation model with 4 billion parameters uses classifier-free guidance., even when the latter makes use of pricey CLIP reran king. Furthermore, they discover that their models may be adjusted to conduct picture painting, providing robust text-driven image manipulation. It has been demonstrated that the contrastive model CLIP can learn reliable representations of pictures that capture both style and meaning. They suggested a two-stage approach to take use of these picture representations: a prior that, given a text caption, constructs a CLIP image embedding, a decoder that produces image conditional on the embedding. They demonstrate how directly constructing picture representations increases image variety while suffering little loss in photorealism and narrative similarity. Their decoders may also create versions of particular image that keep its meaning and aesthetic intact while changing the non-essential aspects that are missing from the image representation since they have been trained on picture representations. The joint embedding space of CLIP allows for zero-shot language-guided picture transformations.

They test diffusion and autoregressive models for the prior and auto-regressive models for decoder, finding that the latter is computationally more efficient and produces samples of higher quality. Current methods for creating text-to-images have several serious flaws. They provide an innovative text-to-image method that closes these gaps. Their approach opens the door to the creation of high resolution photographs that improve visual quality and achieve cutting-edge FID and human evolution results. The development of story illustrations, scene editing, text editing with anchor scenes, and overcoming out-of-distribution text prompts were among the functions they offered. In the same vein as low temperature sampling or truncation in other types of generative models, a current method for balancing sample quality and mode coverage in conditional diffusion models post-training is classifier guidance. Since this method combines the gradient of an image classifier with the score estimate of a diffusion model, an image classifier must be trained independently of the diffusion model. We demonstrate that guidance can be achieved by a pure generative model without the need for a classifier by jointly training a conditional and an unconditional diffusion model. We find that by combining the conditional and unconditional scores, we can achieve a sample quality and diversity trade-off that is comparable to that attained by classifier guidance. A family of generative models known as denoising diffusion probabilistic models (DDPM) has recently been demonstrated to yield outstanding samples. It demonstrates that DDPMs can also obtain competitive log-likelihoods while preserving high-quality examples with a few straightforward adjustments. They also find that learning reverse diffusion process variances permits sampling with a factor of orders of magnitude fewer forward passes and scarcely perceptible sample quality variations, which is critical for the practical implementation of these models. Additionally, they

contrast the accuracy and recall of DDPMs and GANs in terms of how well they cover the target distribution. Finally, we demonstrate that these models are easily scalable due to the smooth scaling of their sample quality and likelihood with model capacity and training computation. A predefined set of predetermined item categories are predicted by computer vision systems during training. Their generality and applicability are constrained by this limited type of supervision since there are more labelled data. Any other graphic concept must be described. A potential approach that draws on a considerably larger supply of supervision is learning about pictures straight from raw text They demonstrate that the simple pre-training task of guessing which caption matches with which picture is a successful and scalable way to learn SOTA image representations from scratch on a dataset of 500 million (image, text) pairs collected from the internet. Natural language is employed to refer to previously taught visual ideas (or describe brand-new ones) after pre-training, enabling the zero-shot transfer of the model to subsequent tasks.

By evaluating our method against more than 30 current computer vision datasets, we can examine how well it performs tasks like OCR, action identification in films, geo-localization, and many sorts of fine-grained object categorization. The model generalises non-trivially to most tasks and is typically competitive with a fully supervised baseline without the need for any training on a specific dataset. From[1], we get to know how inverse image problems can be solved using the convolutional neural network(CNNs). As they also studied previous papers to gain more knowledge about it as well as they give main focus on three points: firstly, from where training data come from, secondly, on what architecture CNN work and third point how the problem can be formulated to make it easier to understand as well as can be solved. Here they designed CNN for the inverse image problem and also provided training data set a model for better understanding. As it is a review paper they also provide a reason why CNN is good because of its universal approximation, unrolling and invariance. The generative adversarial networks (GANs) framework is used in conjunction with a range of innovative architectural elements and training techniques that they provide. They primarily concentrate on two GAN applications: semi-supervised learning and the creation of aesthetically realistic graphics. Contrary to most generative model research, their main objective is not to train a model that gives test data a high probability score, nor do they demand that the model can be trained effectively without utilising any labels. With the cutting-edge techniques they have created, you may obtain cutting-edge results in semi-supervised classification on the MNIST, CIFAR-10, and SVHN datasets. A visual Turing test demonstrated the exceptional quality of the generated images: their model produces MNIST samples that are indistinguishable from genuine data by humans and CIFAR-10 samples with a human mistake rate of 21.3%. Additionally, they demonstrate how their techniques allow the model to acquire recognised aspects of Image Net classes by presenting Image Net examples with previously unheard-of resolution.

Deep Fusion Generative Adversarial Networks(DF-GAN)[2], is a direct text-to-image pillar that directly synthesises high-standard images without making difficulty between various generators as well as it also provides consistency as it will not introduce extra networks and it also has a fusion block This completely integrates text and visual aspects. They proposed DF-GAN which achieves high performance on widely used datasets. As from the above example, we can see in(a) text-to-image models stack various generators to generate high-resolution images as well as there are various generators as shown(P^1, P^2, P^3). As from P^1 to P^3 by passing through various generators images get produced. In figure(b) they showed an image generated by DF-GAN which is a high-quality image and due to the fusion block, there are no multiple generators as there is only (P). Their model also has some limitations: To begin with, their approach only incorporates text information at the sentence level, which has an impact on the fine-grained visual feature synthesis. Second, expanding pre-trained extensive language models to accommodate additional data may further improve performance. We'll try to solve these limitations in our next endeavour. Attentional Generative Adversarial Networks (AttnGAN)[3] because it enables attention-driven and, on top of that, multi-stage refinement for finely grained text-to-image production. Because it can synthesise fine-grained features at various picture subregions by giving the appropriate word in the natural language description greater weight. As with earlier techniques, high-resolution photographs are created, but they are missing the crucial fine-grained image. In addition to AttnGAN, another component that is capable of comparing the similarity between the generated image and the sentences is DAMSAM (Deep Attentional Multimodal Similarity Model), which uses both global sentence-level information and fine-grained world information to encode each word in sentences into a word vector.

As in[4], they mainly focus on improving the image quality of StyleGAN and also analyzing it. As they basically work on the quality of the image. Here, they suggest an alternate architecture that will assist in attaining the aim since training starts with a concentration on low-resolution photos and progresses to higher resolutions while maintaining the network structure. As they have used StyleGAN2 so due to which PPL value is less so there is better consistency of image as well as performance gets better. Why Combining CLIP with the generative capability of StyleGAN, since the CLIP model is pretrained on 400 million image-text pairings of data from the web and since natural language is able to represent a deep and larger variety of visual concepts. As in [5], they research three methods in combination with StyleGAN: First, text-guided latent optimization, which takes a short while to optimise and uses the CLIP model as a loss network. Secondly, they trained a latent residual mapper for a particular text prompt. Thirdly, they offered a technique that allowed for control over the degree of disentanglement as well as the strength of the manipulation. They used photos of human faces, animals, automobiles, and cathedrals to show a range of semantic changes in their article. All of them were acquired by combining a pretrained StyleGAN and CLIP model, since many of them had never been proven by any earlier StyleGAN manipulation efforts.

A group of scientists carried out an experiment[13] to classify, which artwork is better?, the one made by humans or the ones which were created by the computer by making use of the algorithms written into it. After conducting many trials and comparing various artworks which were being created by humans and algorithms, surprisingly they found out that the artwork generated by the computer using various creative algorithms were better when compared to those made by humans and they took less time to be created. This study surprised the scientists conducting the experiments as creating a good artwork by an artist takes a long amount of time as it requires brainstorming ideas and then implementing it and giving a perfect colour combinations which makes the artwork meaningful. While the algorithm generated images did not require any brainstorming and since it creates various random images, out of so many images generated there would be some images which has better colour combinations and is actually better than the image created by an artist which required a long time to be created. The authors compare the creativity of humans and computers based on various parameters such as the charm of the human intelligence based on creativity[14]. Also using the characteristics of technical languages, the power of artificial intelligence is known. To start, a robot that can physically create paintings[15] using a variety of creative mediums, such acrylic paint applied to canvas. A machine-learning algorithm and an articulated painting arm make up the device, which aims to determine the exact sequence of brushstrokes needed to transfer digital pictures onto canvas. The system's creator will have control over the finished piece of art through the selection of numerous factors, including the palette, brush types, and brushstroke parameters. Alternately, a creator can also affect the result by altering the computational inputs and outputs of the learning process.

The robotic system enables a computer to create a real painting using artistic interpretation from a raw image. The computer-artist system can comprehend an input image when given environmental factors like brush sizes. The robot then uses paint to execute the image onto a canvas. The robotic system is made up of three primary parts: an industrial robotic arm, a genetic algorithm, and a digital paint simulation. The paint simulation makes it possible to foresee how a paint stroke might appear on a canvas. This paint simulation is used as feedback by the genetic algorithm to attempt to choose a set of brush strokes that will match the input image. Finally, using brushes and acrylic paint, the robotic arm will autonomously apply these strokes to an actual canvas. The paint simulation programme can mimic the blending of up to eight different wavelengths of paint. The canvas and brush in the simulation are represented by two digital pictures. The channels of the picture maintain track of the scattering and absorption coefficients, and each pixel serves as a representation of a single cell. Mechanisms are used by genetic algorithms to solve issues. The process begins with the answer to the issue being encoded into a series of bits that the computer can manipulate. Next, an algorithm generates a population of solutions at random. The population is then altered using the operators for mutation and recombination, and a new set of paintings is produced. AARON[16], is an artificial intelligence algorithm which can draw freehand drawings. It was developed by Harold Cohen, who is an English abstract expressionist painter. In the 1970s, AARON's images were limited to abstract geometric designs. But by the mid-1980s, his cognitive program expanded to include the recognition of human and plant morphology, thus making it possible to produce freehand drawings of people with plants and garden. It has several levels where the

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top level is Artwork, which controls the overall organization, including problems of the spatial distribution. Mapping is the next level in which, the finding and allocation of space for making of the individual elements is done. Planning is the next level which is responsible for the development of these individual elements. Curves determine the movement of the pen and finally Movement control is responsible for producing the actual drawing.

A study[17] highlights about the AI creativity deep learning system that has been developed by the authors to understand and build artworks which are aesthetic and directly impacts the human brain by the aesthetic artworks being created by the system which increases the conversion rates and interactivity of any system. The technology has the ability to produce visually pleasing photos and films. This study illustrates how higher cognitive judgements, such as aesthetic perceptions, that depend on these divergent information streams may be utilised to analyse the nature of the dual-pathway neuro-architecture of the human visual system. By using machine learning to create sculptures, this study[18] investigates the meeting point between human and technological creativity. They explain two 3D point cloud generation techniques before talking about how to make sculptures out of them and how to incorporate them into a larger art piece. In particular, the Amalgamated Deep Dream (ADD) algorithm produces imaginative and printable point clouds while resolving the sparsity issue brought on by the simplistic Deep Dream-inspired technique. The Partitioned Deep Dream (PDD) technique, which combines ADD and point cloud clustering algorithms, enables us to investigate the construction of more varied 3D objects. In this, the Deep dream algorithm and Convolutional Neural Network (CNN) are used to generate a new picture or pattern by blending different visual quality images. The model uses a depth learning framework which creates a whole new scope for the textile and art industries. Its key traits come through in the ability to transform part of the raw information that shouldn't be visible into a graphic or image that is shown to humans. The model converts the shapes of a graphical image into a new and unique design that a human brain can never imagine. This help in creating an inexhaustible source of creation which takes the art platform to another level. In this, the Deep dream algorithm and Convolutional Neural Network (CNN) are used to generate a new image or pattern by blending different visual quality images. The model uses a depth learning framework which creates a new opportunity for the textile and art industries.

Its characteristics are manifested in a way that it can convert the original information that should be visible to a graphic or image displayed to us. The model converts the shapes of a graphical image into a new and unique design that a human brain can never imagine. This help in creating an inexhaustible source of creation which takes the art platform to another level. The model achieves a high recognition rate and outperforms conventional methods in terms of performance and has a wide range of informational applications. This personal identification system is based on a combination of biometric inputs, such as finger veins and iris. In the image generating stage, they use Convolutional Neural Networks (CNN) with several optimizers, which aid in obtaining high-definition unique features and combine the input photos, they employed CNN and the Deep Dream algorithm. This system is connected to an alarm system to warn of a security breach, which makes the entire system accurate, stable, and effective. The efficiency of the algorithm "Deep dream" and the benefits of artificial intelligence and machine learning is made possible by these models, which link the dots. All of them come from the brain, which connects the dots by examining how the neural networks in our brains work together to create our experiences and beliefs. According to their concept, machine learning may be able to shed light on how the brain typically perceives sensory data. Artificial neural networks (ANN) use a priori knowledge to determine the nature of an object and gradually higher-level properties from sensory input. Iteratively enhancing such outputs in ANNs that employ methods like Google's "deep-dreaming" allows the network to over-emphasize some objects it "thinks" it recognises in particular regions, creating representations that are too dissimilar from "reality". These models can produce psychotic predictions that can be put to the test. As from the above example, we can see in(a) text-to-image models stack various generators to generate high-resolution images as well as there are various generators as shown(P_1, P_2, P_3). As from P_1 to P_3 by passing through various generators images get produced. In figure(b) they showed an image generated by DF-GAN which is a high-quality image and due to the fusion block, there are no multiple generators as there is only (P). Their model also has some limitations: To begin with, their approach only incorporates text information at the sentence level, which has an impact on the fine-grained visual feature synthesis. Second, expanding pre-trained extensive language models to accommodate additional data may further improve

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The authors compare the creativity of humans and computers based on various parameters such as the charm of the human intelligence based on creativity[14]. Also using the characteristics of technical languages, the power of artificial intelligence is known. To start, a robot that can physically create paintings[15] using a variety of creative mediums, such acrylic paint applied to canvas. A machine-learning algorithm and an articulated painting arm make up the device, which aims to determine the exact sequence of brushstrokes needed to transfer digital pictures onto canvas. The system's creator will have control over the finished piece of art through the selection of numerous factors, including the palette, brush types, and brushstroke parameters. Alternately, a creator can also affect the result by altering the computational inputs and outputs of the learning process. The robotic system enables a computer to create a real painting using artistic interpretation from a raw image. The computer-artist system can comprehend an input image when given environmental factors like brush sizes. The robot then uses paint to execute the image onto a canvas. The robotic system is made up of three primary parts: an industrial robotic arm, a genetic algorithm, and a digital paint simulation. The paint simulation makes it possible to foresee how a paint stroke might appear on a canvas. This paint simulation is used as feedback by the genetic algorithm to attempt to choose a set of brush strokes that will match the input image. Finally, using brushes and acrylic paint, the robotic arm will autonomously apply these strokes to an actual canvas. The paint simulation programme can mimic the blending of up to eight different wavelengths of paint. The canvas and brush in the simulation are represented by two digital pictures. The channels of the picture maintain track of the scattering and absorption coefficients, and each pixel

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serves as a representation of a single cell. Mechanisms are used by genetic algorithms to solve issues. The process begins with the answer to the issue being encoded into a series of bits that the computer can manipulate. Next, an algorithm generates a population of solutions at random. The population is then altered using the operators for mutation and recombination, and a new set of paintings is produced. AARON[16], is an artificial intelligence algorithm which can draw freehand drawings. It was developed by Harold Cohen, who is an English abstract expressionist painter. In the 1970s, AARON's images were limited to abstract geometric designs. But by the mid-1980s, his cognitive program expanded to include the recognition of human and plant morphology, thus making it possible to produce freehand drawings of people with plants and garden. It has several levels where the top level is Artwork, which controls the overall organization, including problems of the spatial distribution. Mapping is the next level in which, the finding and allocation of space for making of the individual elements is done. Planning is the next level which is responsible for the development of these individual elements. Curves determine the movement of the pen and finally Movement control is responsible for producing the actual drawing.

A study[17] highlights about the AI creativity deep learning system that has been developed by the authors to understand and build artworks which are aesthetic and directly impacts the human brain by the aesthetic artworks being created by the system which increases the conversion rates and interactivity of any system. The technology has the ability to produce visually pleasing photos and films. This study illustrates how higher cognitive judgements, such as aesthetic perceptions, that depend on these divergent information streams may be utilised to analyse the nature of the dual-pathway neuro-architecture of the human visual system. By using machine learning to create sculptures, this study[18] investigates the meeting point between human and technological creativity. They explain two 3D point cloud generation techniques before talking about how to make sculptures out of them and how to incorporate them into a larger art piece. In particular, the Amalgamated Deep Dream (ADD) algorithm produces imaginative and printable point clouds while resolving the sparsity issue brought on by the simplistic Deep Dream-inspired technique. The Partitioned Deep Dream (PDD) technique, which combines ADD and point cloud clustering algorithms, enables us to investigate the construction of more varied 3D objects. In this, the Deep dream algorithm and Convolutional Neural Network (CNN) are used to generate a new picture or pattern by blending different visual quality images. The model uses a depth learning framework which creates a whole new scope for the textile and art industries. Its key traits come through in the ability to transform part of the raw information that shouldn't be visible into a graphic or image that is shown to humans. The model converts the shapes of a graphical image into a new and unique design that a human brain can never imagine. This help in creating an inexhaustible source of creation which takes the art platform to another level. In this, the Deep dream algorithm and Convolutional Neural Network (CNN) are used to generate a new image or pattern by blending different visual quality images. The model uses a depth learning framework which creates a new opportunity for the textile and art industries.

Its characteristics are manifested in a way that it can convert the original information that should be visible to a graphic or image displayed to us. The model converts the shapes of a graphical image into a new and unique design that a human brain can never imagine. This help in creating an inexhaustible source of creation which takes the art platform to another level. The model achieves a high recognition rate and outperforms conventional methods in terms of performance and has a wide range of informational applications. This personal identification system is based on a combination of biometric inputs, such as finger veins and iris. In the image generating stage, they use Convolutional Neural Networks (CNN) with several optimizers, which aid in obtaining high-definition unique features and combine the input photos, they employed CNN and the Deep Dream algorithm. This system is connected to an alarm system to warn of a security breach, which makes the entire system accurate, stable, and effective. The efficiency of the algorithm "Deep dream" and the benefits of artificial intelligence and machine learning is made possible by these models, which link the dots. All of them come from the brain, which connects the dots by examining how the neural networks in our brains work together to create our experiences and beliefs. According to their concept, machine learning may be able to shed light on how the brain typically perceives sensory data. Artificial neural networks (ANN) use a priori knowledge to determine the nature of an object and gradually higher-level properties from sensory input. Iteratively enhancing such outputs in ANNs that employ methods like Google's "deep-dreaming" allows the network to over-emphasize some objects it "thinks" it recognises in particular regions,

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creating representations that are too dissimilar from "reality". These models can produce psychotic predictions that can be put to the test.

CONCLUSION

An important yet mysterious phenomenon known as creativity appears to be closely related to the idea of intelligence. As we have surveyed a wide range of papers, which have shown us how different models help in improving image quality and producing a high-resolution image as GAN help in prediction as well as from time to time different models are presented which is related to GAN to produce a high-resolution image. Experiments were carried out to study the creativity of the algorithms when compared to humans where they found that the artwork generated by computer algorithms was better than those created by humans. Various algorithms are being studied in the research papers and also many advanced real-time techniques executed are being studied and analyzed thoroughly. The research which has been conducted, explains that the model used has high accuracy in attaining the desired output. The Deep dream algorithm and Convolutional Neural Network (CNN) help in finding the most accurate image pattern. The sample input is loaded first and then several different scenarios with similar concepts of the image are generated. The efficiency of the Deep dream algorithm helps in finding the desired output and connects the dots to produce the image. CNN and ANN are used to enhance the quality of the image representing the image in its best form. The image produced is of a high-defined unique feature that has the best and most realistic image.

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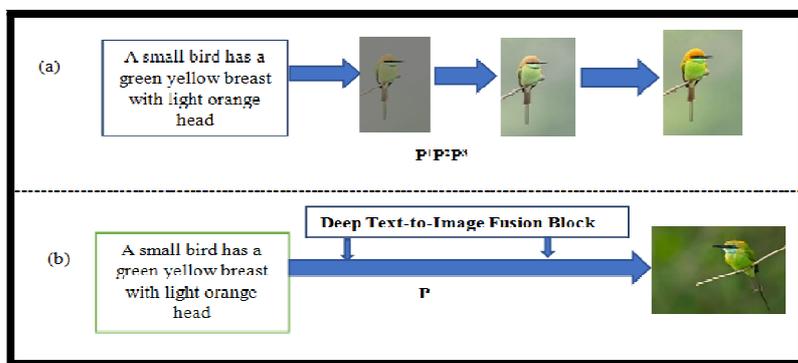
Fig 1: There are various generators as shown(P^1, P^2, P^3).

RESEARCH ARTICLE

ATM Cash Demand Prediction using Revolutionized Grandiant Boosting Regression

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ABSTRACT

Automated Teller Machine (ATM) plays a main role in cash management process of the bank which has a physical interaction points between financial institutions and real customers. ATMs approaches have empowered self-service, simple in use and time-independent mechanism that influence financial institution by supporting more number of services to its users. Cash flow prediction is important which assist in increasing profits as well as improving the capital allocation better, mature firms and preventing of fast-growing firms, or firms with distress, from the ATM with no cash. Bank popularity will get lessening, when an ATM become run out of cash frequently which may lead to increased costs for the bank as well as the customer usage of the respective bank ATMs get minimized. Since, one of the main transactional load for these ATMs network system depends on cash withdrawal prediction from the bank ATMs. Classification associated with Lazy model has overcomes this issue by concentrating on given test instance features. This assist in increase of chance for generating more rules which have been beneficial in classifying test instances. An adequate way of withdrawn pattern perspective is done by profitable insights from the possible historical data for predicting demand for future cash flow. Thus, the paper influences Machine Learning (ML) using lazy predict with hyper parameter algorithm by Bayesian Optimization (BO) for improving the prediction of ATM replenishment accuracy. Data driven technique is used in the estimation of exact amount to each ATM or certain groups of ATMs.

Keywords: Automated Teller Machine (ATM), Machine Learning (ML), Lazy predict, Hyper parameter, Bayesian optimization.

INTRODUCTION

ATM act as a computerized telecommunication devices are used for performing financial transaction through electronic cards without human assistance in a bank. In the year end of 2015, about 3.5 million of ATMs had setup in worldwide as per the ATM Industry Association (ATMIA) report [1]. The major benefit of ATMs is operation around-the-clock and even support a variety of financial services without any human assistance is highly suitable to the customers. As a result, ATMs count from the past years have been increased up to 3 million ATMs [2].There are several ATMs in financial institutions namely banks, credit unions, and stock brokerages that may effects millions of transactions in each year. The ATMs and debit cards amount in Iran is roughly 60 thousand as well as 23 million correspondingly as an instance [3].In order to maximize transaction revenue and meet client demand in cash, some banks may consequently keep up to 40% more currencies in ATMs than actual requirement. However, loading of more cash into ATMs than the roughly needed has resulted in higher operational and potential expenses [4-6]. ATM cash demand prediction has obtained with high concentration in the context of taking into account various aspects namely historical trends, seasonal considerations, geographic location, and predictive models. Moreover, selection of an efficient model for suitable prediction over ATM's cash demand is the highly significant operations. Hence, the comprehensive study in predicting time series consists of no unique model which has been considered as the best due to each model advantage and its individual limitations [7].Initially the challenges has been addressed using two ML methods namely Random Forests (RF) and stochastic gradient boosting which have been currently accomplishing remarkable success in the applications of real world [8, 9]. In these methods, building of ensemble learning algorithm that combine a huge estimator set from decision trees. Contrasting regressions, a critical feature of these approaches has the capability in estimating models, when the predictor amount is higher than the observation amount.

The ML algorithms also have definitely designed in performing complex combination and cast an extensive net in its requirement search. Thus, the algorithms have been specified in predicting tasks as they deal with high accuracy in predictive performance by regularization to choose model as well as over fitting mitigation. It is still difficult to fairly compare all of the methodologies suggested in the literature for certain reason. There are several datasets that have either unavailable with publicly or only relevant for particular economic situations like private businesses in several countries [10, 11].Optimizing the process of hyper parameters is a common challenge in AI and a variety of fields namely materials science, and is not specific to ML. This is feasible in some instances, such as when gradients are accessible or additional information about the optimization process is used. There are lot of situations in which the process is represent as black box, whose intricacies may be examined but its understanding is insufficient to help with optimization. A technique named Bayesian Optimization(BO) makes that possible which is a sample-efficient optimization technique. It doesn't need a lot of samples in producing better results and is therefore especially appropriate and helps in evaluating for many fields of Artificial Intelligence (AI). The proposed lazy predict model has assisted the cash flow management for analyzing the exact demand of cash flow in the respective bank ATMs. However, this helps the consumer to use the same ATMs frequently for the best services provided from the bank by maintaining the cash as per customer expected. Therefore, this paper focuses on hyperparameter tuning to obtain the improved accuracy in predicting the cash demand in ATMs exactly based on the several labels acquired from collected datasets. The traditional lazy predict model is trained with hyper parameter tunability using Bayesian Optimization (BO) with Gaussian process accomplishing improved accuracy in predicting the cash demand in the bank ATMs effectively. The tuned lazy predict model is then compared with untuned lazy predict ML model usinge valuating metrics like Error Rate (ERR) metrics namely Mean Absolute Error (MAE), Root Mean Squared Error(RMSE), R- Squared value and adjusted R- Squared value.

Literature Review

This literate review helps to find out the predicting methods of cash withdrawal in ATMs which plays the major role in determining the factors influenced to correlate with cash demand in ATMs. Credit scoring learning algorithms are rarely parameter-free. To improve the algorithms' prediction power, certain hyper parameters must be tuned. Grid

Search (GS) and Manual Search (MS) are two well-liked methods for credit score hyper parameter improvement. Bergstra and Bengio has suggested that Random Search(RS) has the capable of generating random trial and error process which is highly efficient than GS. The comparison main goal is to estimate the efficient of Tree structured Parzen Estimator (TPE) method with hyper parameter optimization [12].The amount of iterations for the iterative RS and TPE optimizers is fixed to 100 in order to establish a reasonable balance among precision and complexities. Y. Xia et al., has discussed TPE is a BO hyper parameter method that accomplishes a high accuracy than the other techniques. TPE has consequently outperforms equivalent approaches with a large margin and TPE is highly performs than GS and MS[13].In designing model for predicting the cash needs of ATMs within a network for a single financial institution, LSTM is a Recurrent Neural Networks (RNN) which shown to perform better for this challenge when compared to other technique. The dataset utilized for this research was made up of the transactions made at seven ATMs in Karachi, Pakistan, between June 2013 and December 2015. Using the Symmetric Mean Absolute Percentage Error (SMAPE), the results of the trials may be reported [14]. Time Series Model for ATM is based on the ARIMA approach and uses time series data (TASM4ATM). Data replenishment from 2040 ATM has been utilized for training the software. The model is compared to RNN and Amazon's Deep AR model. Predicting ATMs may be done in two ways namely single ATM and a cluster of ATMs[15]. The performance of model is evaluated through RMSE in which LSTM model consists of 132.53, which is positive. The expectation of cluster ATMs based on transaction patterns and cash demand similarities in order to predict a cash supply, be used as basic model to service a large number of ATMs in this manner [16].

Due to seasonality effects, ATM withdrawals can take in many different forms. The Support Vector Regressor (SVR) and Artificial Neural Network (ANN) are the two modelling techniques that produce the best results have been subjected to the study on methodologies connected to forecasting cash flows by researchers. This research identified that ANN is more difficult to comprehend and complex than SVR, which is more practical in real-world settings and can predict withdrawal behavior with a 97.72% accuracy and in ANN, it provides additional space available for future research that could improve cash management [17].Some nonlinear characteristics, such as location and season, have an impact on prediction of cash flow. For each ATM, bank has employed a three-layered feed forward neural network that has been trained using an optimization technique of Levenberg Marquardt and the RMSE among the predicted as well as three real values. The strategy outlined in section II-C, consists of Linear Regression (LR) rather than LSTM to achieve superior results that is applied in addition to the neural network approach [18]. In this scenario, LR produced the expected results than LSTM technique. Falkner et al., has combined BO with bandit based approaches, while Bischl *et al.*, proposed a broad and adaptable system for hyper parameter tuning by BO [19, 20]. The discipline of automated ML (AutoML) is heavily relies on BO and related techniques that have been created in response to the necessity for hyper parameter tuning in ML. More information and researching approaches have been stated in a recent book by Hutter *et al.* [21]. Instead of analyzing various the design space to the materials, Kikuchi et al., and Bondevik *et al.*, has employed BO in optimizing the structure of grain boundary for polycrystalline materials [22, 23]. Hence, it is possible to provide results that are comparable in quality to those of extensive evaluation at a price which is much cheaper and with enhancement in efficiency until consideration of two orders of magnitude. The grain boundary energy has also been adjusted by Ueno et al. over thousands of precomputed hyper parameter configurations that allowing them to assess the effectiveness of various strategies [24]. By assessing its performance on a set of a few hundred precomputed results, Talapatra *et al.* used BO for better efficiency. They improve a material's elastic characteristics and show that BO can swiftly find the ideal hyper parameters in their limited representation of the real search space [25].

RESEARCH METHODOLOGY

This work has focus on predicting ATM cash demand effectively. The goal of this study is to put forth a thorough analysis that can reliably forecast ATM cash demand. IDE. Jupiter or google colab is a web application used as an open source for sharing and creating documents that consists of equations, live code, text and visualization narrated. This tool involved for data cleansing, data preprocessing like data transformation, value simulations modeling by

statistics ML tools and data visualizations. The proposed lazy predict model has assisted the cash flow management for analyzing the exact demand of cash flow in the respective bank ATMs. This work focuses on hyper parameter tuning, ie revolutionized, to obtain the improved accuracy in predicting the cash demand in ATMs exactly based on the several labels acquired from collected datasets. The lazy predict model is trained to identify the best model and with hyper parameter tunability using Bayesian Optimization (BO) with Gaussian process over the best model, accomplishing improved accuracy in predicting the cash demand in the bank ATMs effectively. The tuned lazy predict outcome, LGBM, is then compared with untuned lazy predict ML model usinge valuating metrics like Error Rate (ERR) metrics namely Mean Absolute Error (MAE), Root Mean Squared Error(RMSE), R- Squared value and adjusted R- Squared value, on the improvement acquired. The predicting the cash demand of the ATMs is progressed as per proposed hyper parameter optimization architecture shown in figure 1.steps involved in the approach is as under

Data Collection

The data acquisition is the daily total cash withdrawal from certain ATMs for seven years[26], transactions involve 11589 records under 12 attributes, as database, considered for research analysis. The total amount withdrawal from the bank ATMs is considered in a daily basis, has various other features like the sequence of working day or holidays, festival or non-festival region and also from the holiday sequence. Each attribute column provides an essential detail in predicting data as well as data handling. The data set as such with attribute ATM name and Transaction Date is used in identifying the insights in data.

Data quality and Missing values

Data completeness is ensured by finding No null values in all attributes. There is no missing at random but on the missing completely at random has been addressed by mean imputation relevance to the day and month patterns.
Data preprocessing is effectively applied. Major independent features are converted to integer type using Label Encoder. EDA (Exploratory Data Analysis) process is done to have good insight of the input datasets. With EDA the withdrawal pattern, is shown in Fig.2, as Sunday showed highest of 23%, over Saturday's 14%. And the week day sequence factor, reflects the day's flow, Fig.3 shows WHH is lowest of 14% when WWW is 31%. Generated the Correlation Matrix to explore the correlation coefficients among different variables and is an essential tool to reflect the relationship of data patterns, which showed   the high correlation in total amount withdrawn to No of withdrawals as 0.92, followed by working Day to holiday sequence as 0.74.

Base Model

After the data get preprocessed by standard scaler for scaling, all variable unit as unique is handled. The data is split into 80% of training dataset and 20% of testing dataset considered. The regression models are made to be trained using lazy predict. supervised library. Lazy predict help in building several and different basic ML models with certain code and assist in understanding which models may execute better accuracy without any parameter tuning. In this research lazy regress or is used for solving regression-based dataset in predicting the cash demand in the ATMs for the respective bank. Lazy predict identifies the top ML model as Light Gradient Boaster Machine model, which is considered with untunned ML model. Figure 5 shows the comparison, in 2 decimals rounded. So LGBMRegressor is the taken for further reinforcement.

Revolutionized Gradian Booster Approach or Hyper tuning by BO

Bayesian inference technique served as the inspiration for the area of optimization known as BO. The algorithms are typically applied to complex black-box functions in which all new assessment demands a significant investment in processing power. From Sequential Model Based Optimization (SMBO) algorithm, class of BO is involved that enables to use the outcomes of one iteration in enhancing the sampling strategy for the subsequent one. This falls under the category of global derivative free optimization, and its primary distinction from other algorithms in the same classification. This is an effective in terms of the function evaluations necessary to accomplish the optimization. Equation 1 expresses the BO algorithm, which has been focused on problem solving.

$$\min_{y\in\Omega} f(y) \tag{1}$$

Where,

$f : \mathbb{N}^r \mapsto \mathbb{N}$ is the objective function and available with the only recognized values considered from the n sample set size. Ω = compact subset of $\mathbb{N}^r$

In general, the hyper-rectangular is considered to be subset of the BO is expressed in equation 2

$$\Omega = \prod_{m=1}^{r}[a_m, b_m] \text{with } a_m, b_m \in \mathbb{N} \text{ and} a_m < b_m \tag{2}$$

This formulation has no loss of generality because maximizing issues can always be converted into minimization issues and generating a link between the aforementioned theory and the prediction process is said to be the Gaussian process prediction. Let sample set is represented as $y = (y_1, y_2, \ldots, y_n)^T \in \Omega^n$ and evaluation set is represented as $x = \left(f(y_1), f(y_2), \ldots f(y_n)\right)^T$. Moreover, $y^* \in \mathbb{N}^r$ has represented the point that not yet sampled. Random Gaussian vector with an infinite is realized for an uncertain expectation vector and covariance matrix, if the GP context is taken to be an objective function actual value. This viewpoint interprets the evaluation vector y as a realization of X. When anyone get interested in the potential value of $x^* = f(y^*)$ at a not yet sampled pointy^*. The individual actually do unknown more than requesting, the conditional law X^* followed by x^* has provided the previously identified realization X=x. The squared exponential kernel is presumptively employed for the covariance matrix estimate with respect to the hyper parameter estimation. Initially, this kernel has been parameterized by hyper parameters α and θ1, θ2, θ3, …,θm. In real-world scenarios, such parameters must also be calculated. The settings in the 1D instance from earlier are manually set, and even though it appeared arbitrary at the time which is driven by mathematical reasons. This estimate is in accordance with information that is currently available, specifically the samples and the values of the related objective functions. Traditionally, the Maximum Likelihood Estimator has been used to estimate the hyper-parameters. It is a statistical technique that relies on the underlying distribution, which must be understood or taken for granted. In GP context, representation of the evaluated values $x_k = f(y_k)$ are considered as realization of a Gaussian random variable and an entire distribution is a multivariate Gaussian. When$\mathbb{C}_X$signifies the covariance matrix and E_X represent the expectation vector, then the resultant Likelihood has the subsequent analytical formulation is expressed in equation 3.

$$L(\alpha, \theta_1, \theta_2, \ldots, \theta_m | x_1, x_2, \ldots x_n) = \frac{1}{\sqrt{(2\pi)^n |\mathbb{C}_X|}} . \exp\left((x - E_X)^T \mathbb{C}_X^{-1}(x - E_X)\right) \tag{3}$$

Hence, the hyper parameters evaluations have been acquired by exploiting the likelihood function L. To use a Gp for BO, let the domain of the Gp, Y represent the hyper parameters space, and describe certain kernel that exactly matches the correspondence of two hyper parameter assignments. In general, the setting of kernel is based on the corresponding problem awareness. And even setting done based on earlier work in the literature that assist the typical kernel to become another hyper parameter which need to be set. Once done, the Gphas the ability in using as an earlier kernel to both observed as well as unknown values of the loss function f to the hyper parameter. Gaussian process prior with BO algorithm is explained below. Typical shaping of hyper parameter using BO is discussed in Algorithm 1. The k sub-index represent the variable state at iteration k and the instance GPkrepresent the model of Gaussian process at the kth iteration.

Algorithm 1Hyperparameter using BO

Input = Iterationas k, loss function as f and loop count as n

Step 1: Fit the Gaussian process with the respective kernel as Gp_k to the data Y_k and X_k

Step 2: For k=1 to n do and select y_k by random sampling.

Step 3: Compute the exact loss function $x_k \leftarrow f(y_k)$

Step 4: If $x_k \leq x_{best}$ then

$y_{best} \leftarrow y_k, x_{best} \leftarrow x_k$

End if

End for

Step 5: Maximize the infill criteria IC_k over Ω to find the new iteration

$y_{k+1} = \underset{y \in \Omega}{\operatorname{argmax}} IC_k(y)$

Step 6: Evaluate f and set $x_{k+1} = f(y_{k+1})$
Step 7: Update the data of hyper parameter as
$Y_{k+1} = Y_k \cup \{y_{k+1}\}$ and $X_{k+1} = X_k \cup \{x_{k+1}\}$
Step 8: Repeat 5 to 7 till the y_{best} and x_{best} is attained
Step 9: Return

The essential hyper parameters involved in the LGBM Boost are (i) Learning Rate, (ii) N_estimators, (iii) max_depth, (iv)Min_child_weight. This can assist in creating of the new node over the tree architecture requires certain suitable minimum weight. According to LGBMRegressor, the hyper parameter utilized to fit the model with better understating is defined through parameters. In the case of BO, model is considered with default hyper parameter with improvement in learning rate shown in figure 7. In the case of importance_type parameter by considering the gain function that focuses on improving the accuracy of model through information gain which is the simple measure to select whether a feature that need to be used in splitting a node or not. This kind of modification done through hyperparameter, called Revolutionized Gradient Boaster, has assisted in improving the learning performance of the model in the training. This assist in enhancing the accuracy of model by BO with LGBMRegressor as the tuned LGBMRegressor.

RESULT AND DISCUSSION

In this work, Google Colab is used with Jupiter IDE which assist to share and create document that can be narrated with text, live code and visualizations. The ATM bank transaction dataset is collected and split it into 80% train dataset and 20% test dataset. The tunability hyper parameter utilizes various tools like Pandas, Scipy and Seaborn. To determine the efficient untuned regression technique in predicting the demand of cash withdrawal. Light Gradient Boosting Machine (LGBM) Regressor is identified as best untuned ML model and the parameters of LGBMRegressor is represented with range of parameters and Bayes search CV parameter distribution is listed and iterated with hyper parameter tuning. Statistical metrics are used to assess the performance of the predicted value using evaluation ERR metrics like Mean Absolute Error (MAE), RMSE, Mean Square Error (MSE), R2 and Adjusted R2. The tuned LGBMReggresor is best by generating high accuracy level of prediction in ML model which represent the quality of prediction in tuned LGBM Reggresor. Hence, the prediction of cash demand in the bank ATMs can be recognized well in advance and cash flow management from the bank may assist in initiating ATM Replenishment Process. The revolutionized gradient boaster, is deployed in prediction with the test data. The comparison of original test data vs the prediction can be shown by below figure. In this research work of revolutionized Gradient Boaster, the tuned hyper parameter with BO in LGBMRegressor has produced better accuracy as 93.39% in R-squared and 93.36% in adjusted R-Squared value than untuned LGBMRegressor. The prediction of existing data coverage (test data) has a lower error percentage ie around 10% Cash withdrawal are discrete in nature and prediction of demand to a reasonable level accuracy will make the Financial Institutions, in deploying money effective and efficient manner

CONCLUSION

The paper proposed an LGBMRegressor with BO hyper parameter based model inpredicting the replenishment cash of ATM. This became a major challenging issues in identifying the exact cash flow that constantly available to the customers in transactions. The scheme of backend database has the replacement log from ATM software that utilized for formulating the model. Finally, the model has achieved quite better for both training as well as testing dataset. It is an essential operational issue for all banks that required likely in optimizing it ATM replenishment activities. This research has review the impact of the exogenous features such as holiday sequence as well as working day (weekday) variables on the predictions of cash withdrawal in the bank ATMs rather than using the data of raw time series. Forecasting of withdrawal may quite difficult but predicting of cash flow demand can be analyzed through various predictive analysis studies. In the future, research work focuses in building analysis over 'On-Us' and 'Off-Us' transaction. This may lead to analyze transfer learning that applied to tuned hyper parameter which may

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enhance the accuracy performance about the 'On-Us' and 'Off-Us' transaction occur in the bank ATMs using bank transaction datasets.

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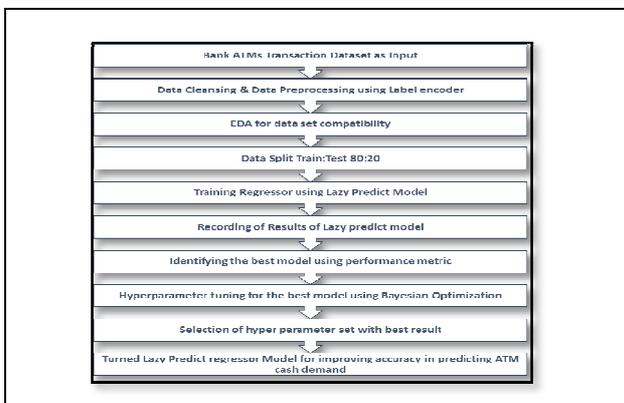
Figure 1: Proposed architecture of predicting cash demand using ML regress or with hyper parameter
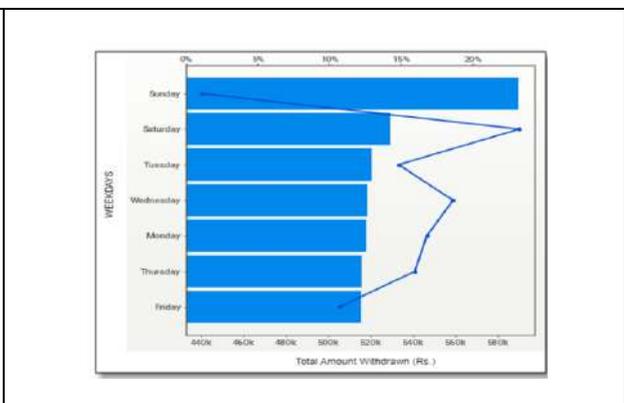
Figure 2 :Total amount withdrawn for weekdays
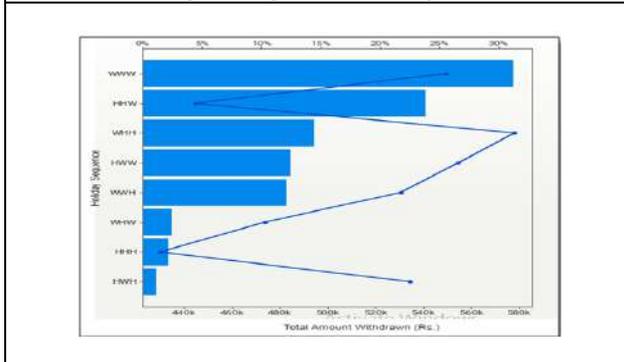
Figure 3: Total amount withdrawn based on holiday sequence
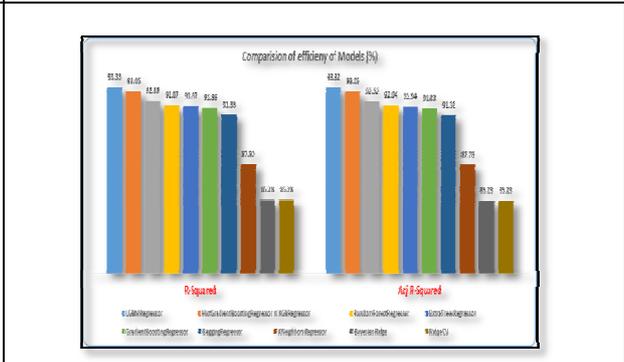
Figure 4: Top 10 regress or model from lazy predict regression

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Figure 5: Hyper parameter involved in Bayes search cv library

ERR Metrics	Untuned LGBMRegressor	Tuned LGBMRegressor
MAE	61465.35899	61347.94724
MSE	6930410395	6892264987
RMSE	83249.08645	83019.66627
RMSLE	11.32959243	11.3268328
R-Squared	93.34750171	93.38549349
Adj. R-Squared	93.32058555	93.35872548

Figure 6. Tuned Vs Untuned ERR Performance
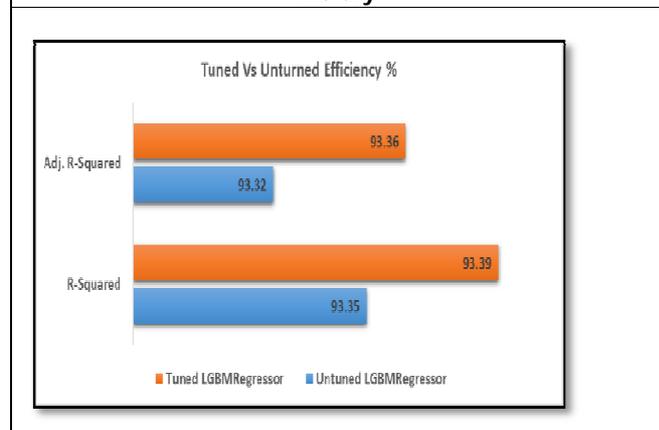
Figure 7: ERR metrics for untuned and tuned LGBMRegressor
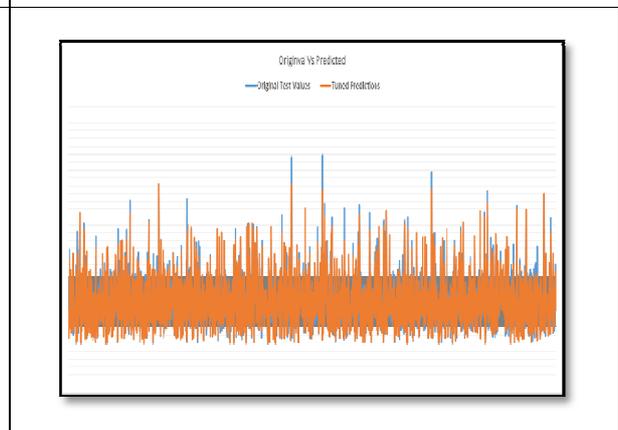
Figure 8: **The comparison of original test data vs the prediction**

REVIEW ARTICLE

Self Attention Based Legal Document Summarization - A Technical Review

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ABSTRACT

In the age of technology, readers have access to a wealth of information in digital media, but it can be difficult for people to quickly and efficiently extract only the pertinent information from all of them. There is a requirement for an automated system that can only retrieve pertinent data from these data sources. Text summarization automatically creates a summary that contains key phrases and all-important information from the original document. One must mine the papers' text in order to accomplish this. The technique of extracting enormous amounts of text to provide high-quality information is called text mining. Text mining establishes some of the techniques of natural language processing (NLP) such as tokenization, lemmatization, parts-of-speech (POS) tagging, parsing, etc., to perform the textual analysis. The focus of legal argument mining is the argumentative elements of a legal text. We have compiled a substantial set of cases and summaries prepared by professionals, annotated in terms of legal arguments that encapsulate the most significant skeletal argument structures in a case. In order to improve case summary, it is important to comprehend how to use legal argument mining. Numerous papers that offer a comprehensive view of the state of research in this area have been published as a result of numerous achievements in the acquisition of datasets, methods, and techniques. A thorough and organised evaluation of text summarising research that was published between 2016 and 2022 is presented in this study. We begin with an overview of text summary before delving into extraction-based legal text summarization.

Keywords: summarising research, information in digital media, tokenization, lemmatization

INTRODUCTION

Internet usage and big data are expanding simultaneously and people are overwhelmed by the large amount of information and documents on the internet. Utilising information has evolved into a costly and time-consuming process as a result of data expansion and the inclusion of noise or unnecessary stuff. Many researchers are motivated

by this to create technological solutions that can automatically summarise texts. The automatic text summarization process involves extracting or collecting vital information from the original content and presenting that information as a summary [1]. It fastens the process to get to the crucial points of the data.The need for summarising can be observed for a variety of reasons and in a wide range of contexts, including the summation of news items, emails, market research, information pertaining to governmental bodies, patient medical histories, and diseases, among other things. There are different types of summarizations because it can be done on a single page which is called single-document summarization[24] as well as on several documents which have been named multi-document summarization. Online summarization tools are also accessible based on the kinds of data that need to be processed for various disciplines like Sum Basic [2] which is a medical field related text summarizer. Text summarising is categorised based on a number of standards [3]. Three standards are established based on these principles: the type of the input document, main objective, output document criteria [4]. These text summarizers are also used in several languages like German [50], Korean[51], Arabic[52], Spanish[53], Hindi[54] and many more across the world. Legal case judgement summaries pose a significant challenge because of the complexity and size of the original papers, which make them challenging to read as a whole. Legal professionals frequently need to come up with a set of plausible defences for their claims in order to address case-related problems. For this, they must rely on the summaries produced by humans. When the need is urgent, it results in delays and unwarranted dependence. Instead, they can independently search the documents with automatic summarizers and select the ones that would be relevant based on their subject expertise. Instead of having to search for documents, they may concentrate more on legal issues. For nations that adhere to the Common Law System, such as India [26], USA [19] or Australia [20], where precedents (previous cases) and statutes (existing laws) are the two main sources of law. ROUGE metrics are used in conjunction with several criteria to evaluate summarised texts.

Text Summarization Techniques
There are two standard methods for summarising: extraction summarization, which combines the source sentences into a summary, and abstraction summarization, which creates new sentences for the summary.

Extractive Summarization
The aim of the extractive text summarization approach is focusing on extracting sentences without changing the content of the actual document. Extractive summarization techniques take input as sentences and produce the output as a vector of probability. The vector has elements that represent the possibility of a sentence being present in the summary. The best sentence from these vectors is chosen for the finalised summary based on the length of the summary. It avoids redundant data and is easier to bring out the summary compared to abstractive summarization. For this goal, numerous graph-based, linguistic scoring-based, and machine learning models have been put forth to date. Some of the methods used for extractive summarization is: TF-IDF i.e., Term Frequency-Inverse Document Frequency, cluster-based technique, graph theoretic method, query based method, latent semantic analysis (LSA) algorithm, using fuzzy logic, using neural networks [5].

Abstractive Summarization
In contrast to extractive summarization, abstractive summarization is a more effective method of summarization since it gathers data from a variety of documents to provide convenient data summaries using advanced NLP techniques. Abstractive summarization involves sophisticated techniques including meaning representation, content organisation, and surface realisation. By starting from scratch, abstractive models can generate shorter texts, but this comes at the cost of sluggish and inaccurate encoding of very long documents, which forces the attention model to read every encoded word (in lengthy paragraphs) in order to decode each generated summary word (slow and sequentially) [6]. Redundancy (repetition) plagues abstractive models, especially when creating multi-sentence summaries. Abstractive summarization has been divided into: semantic based and structured based. Semantic based methods implement NLP on documents and recognise nouns and verb phrases using techniques like semantic graph based (SGM)[8], multimodal semantic method (MSM)[7], or semantic text representation model (STRM) [9]. The most often used algorithms for ontologies are those based on trees, templates and rules [10].

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Literature Review of Existing Survey

We examined the existing surveys on text summarization and presented a few of the publications. Throughout the literature, there have been different approaches applied to generate a summary, in various situations and several types of documents. DK Gaikwad *et al.* [2] reviewed various papers and studied text summarization, its features and the different techniques used in text summarization. They mainly focussed on Indian languages and compared which type of summarization works better for it. They found that abstractive methods of summarization require less work compared to extractive methods while working on Indian origin languages. Aries, Abdelkrime *et al.* [4] classify different methods of ATS using various criteria like input and output document with its purpose. They present workshops, campaigns and evaluation methods with the challenges they face. An exhaustive survey conducted by Moratanch *et al.* [10] analyses a variety of approaches, limitations, and problems on abstractive summarization methods. These summaries are provided with two outlooks that are structured based approaches which use prior knowledge to produce an output and a semantic based approach that uses NLP based generation, by reviewing the works from the past. There has also been text summarization that uses video formats, In Sah *et al.* [9] proposed methods to produce visual summaries of videos and uses encoder-decoder recurrent networks to develop a method to annotate and produce textual summaries of them, here the interesting part of the video is extracted based on an ablation analysis over the six features of Attention, Boundary, Contrast, Face impact, Saturation and Sharpness was performed across all 25 videos. Some of the recent papers on text summarization have been reviewed, as shown in Table 1.

Summary of Papers Regarding LegalATS

Currently, a lot of work goes into preparation, where summaries of cases are written by hand. This procedure is time-consuming, labour-intensive, and costly. Certain cases are forwarded by attorneys and judges to legal editors so that they can summarise. But since the web and technology have advanced, there is a growing demand for efficient automated legal text summarising due to the massive amount of unstructured legal papers that are made public every day. A lawyer might prepare the legal argument by consulting prior decisions to comprehend the court's resolved cases in matters with comparable circumstances, which is commonly known as precedents. The lawyers need to sort and refine these documents based on their requirement of the case, this can be a tedious task, since the legal content is very dense and meticulous. This can be an exhausting process even for a legal expert. Summaries of the case rulings are helpful in situations like this. There have been few papers in recent years, as shown below in Table 2.

Transformers And Self Attention

Prior to transformers, the majority of state-of-the-art NLP systems depended on RNNs, such as Gated Recurrent Units (GRUs) and Long-Short Term Memory (LSTMs) with added attention mechanisms, which is still evident in the study [13,14]. In a simple RNN, like the sequence-to-sequence model, [16,17] we continuously input the sentence, one word at a time, to obtain word embeddings. Every word depends on the one before it, thus we have to feed it one step at a time because its hidden state behaves accordingly. Recent studies have demonstrated that neural networks can benefit from techniques that let us concentrate on the most vital information while eliminating the rest. This technique, commonly referred to as "attention" [15], aids in the development of neural networks that can effectively tackle challenging tasks such as sequence processing, where simple sequence to sequence models fail. We no longer think of NLP and artificial intelligence in the same way thanks to the transformer and its accompanying architecture and models. The architecture of the transformer abandons RNNs and CNNs in favour of a new paradigm. In 2017,Vaswani *et al.[*11], has replaced recurrence, which requires an increasing number of operations as the distances between two words increases. The attention mechanism operates word-to-word. The attention mechanism will determine how each word in a sequence, including the word being examined, is related to every other word in the sequence. The strongest connections between a word and all other words in attention will be found by running dot products between word vectors. A transformer has the ability to concurrently determine the word embedding and process all the words in a sentence.

Transformer Models In Text Summarization
T5 MODEL
Text-To-Text Transfer Transformer is known by the acronym T5. T5 is a pre-trained encoder-decoder model that has been trained on a number of supervised and unsupervised tasks, each of which is converted into a text-to-text format. T5 uses relative scalar embeddings and is trained using teacher forcing. Tasks like answering questions, language translation, classifying are given as feeding to the model as input and training it for a target text. T5 model was first proposed by Raffel, Colin, *et al.* [38] and Table 5 consists of the papers that implement BART model:

GPT-2
Generative Pre-trained Transformer is an open-source AI created by Open AI. GPT-2 implements deep neural networks, which replaces earlier recurrence- and convolution-based systems with attention-based architectures. This model beats earlier benchmarks for RNN/CNN/LSTM-based models and permits far more parallelization. GPT-2 is capable of translating text, responding to inquiries, summarising sections, and producing text output on a level that, while occasionally indistinguishable from that of humans, can also occasionally become monotonous or absurd when producing lengthy passages. Some of the papers as shown in Table 4 implement this transformer model:

Bart model
Bayesian additive regression trees is a denoising auto encoder that is trained by intentionally tampering with the data using noise-reducing techniques and then training the model to recreate the original text. Sequence-to-sequence models are pretrained using BART. The BART model was proposed by Mike Lewis, Yahlin Liu, *et al* [29]. It employs a typical neural machine translation architecture based on the Transformer. A fine-tuned BART model can be used for text summarising (generating a paraphrase or a summary of lengthy text document), machine translation (the process of translating text between languages), question-answering (generating responses for a given question on a specified corpus), or sequence classification (categorising input text sentences or tokens). Here are the papers that implement the BART model with respect to the task of text summarization in Table 5.

Analysis
Evaluation metrics used in the discussed papers

Rouge Scores
ROUGE (Recall-Oriented Understudy for Gisting Evaluation). Comparing automatically generated summaries against a group of reference summaries is how measuring is done and to assess the quality of summary. As its name suggests, 'recalled-oriented', in essence, it considers both Recall and Precision between system (model-generated) and reference (golden-annotated) summaries. Lin *et al.* [18] presents ROUGE scores, which evaluate the quality of summaries by counting overlapping elements such as word sequences, n-grams and word pairs between the system and reference summaries. While recall measures whether information is being captured, precision ensures that the information that is being tokenized is relevant. The ratio of N-grams in the candidate and reference summary can be used to calculate precision. In general, shorter summaries have higher recall but lower precision, and vice versa for longer summaries, [28] uses F-score to compare two neural network (NN) techniques for the classification task: a recursive NN and a feed-forward NN built on LSTM for varied summary lengths. Burman *et al.* [19] evaluated 100 datasets for their T5 model and obtained the average ROUGE-1 F1 of 0.3 before training and greater than 0.6 after being fine-tuned and also evaluated ROUGE-2 F1 scores of 0.17 and 0.52 before and after training the legal documents. Case Summarizer [20] used rouge scores to compare six automated systems on a collection of five randomly chosen documents, highlighting the commonalities between automatically generated and expert generated summaries. The combination of statistical features is obtained using tf-idf and semantic text features extracted from LEGAL-BERT, the joint text feature model [22] was tested on 5233 sentences and trained on 20000 sentences of the legal writing and achieved an accuracy of 0.75 and 0.747 with SVM classifier and Logistic Regression classifier respectively. These summaries were assessed based on the ROUGE scores they received. LawSum[47] uses standard ROUGE-F metrics for comparison across the 5 different legal domains that include Land & Property, Constitutional, Labour & Industrial, Intellectual Property and Criminal Law. The sentences present in the Indian Legal Judgments

are lengthier than typical text. While comparing techniques that use sentences as a unit of length versus approaches that utilise words as a unit of length, we can observe that precision is higher for the later approaches. LSTM-CNN based deep learning[48], which employed the Daily Mail and CNN datasets, increased the ROUGE-1 by 4.4% and the ROUGE-2 by 1.6% compared to existing models. There is a possibility that if one word from a phrase is selected for the system summary that appears in the reference summary, the remaining words in the phrase will also appear in the reference summary. As a result, Rouge is advantageous to this model.

Kappa Coefficient

The degree of agreement between the true values and the anticipated values is measured by the kappa score. Here, the Kappa value is used to find the perfectness between the automatic summary and the human annotated summary. The kappa score considers how much better the agreements are over and beyond chance agreements. Kappa scale ranges from 1 being the perfect agreement to 0 indicating poor agreement. Legal Ontology [21] have used a sample judgement containing 68 sentences that was taken for experiment. The Kappa value obtained is 0.843 that indicates a very good agreement between the summary produced by the Proposed System and that by the High Court Judge.

CONCLUSION

Text summaries allow for the extraction of key information without distorting the main points of a lengthy original document. Despite the extensive research that has been done on extraction-based summarising, the automatic synthesis of abstractive summaries from text sources is still a relatively unexplored area. Long sentences are a common element of legal documents that distinguish them from other kinds of writing. Although there has long been a need for automatic summaries of legal documents and other sorts of text processing, computer scientists have only recently begun to pay attention to this issue. Hence, we reviewed papers that implement state-of-the-art models on automatic text summarization across extractive and abstractive summarization. The focus then shifts towards legal documents which are challenging currently, because of its size and complexity. In this paper we also reviewed various transformer models like T5, BART, GPT-2 and it is seen that BART is much more effective to generate summaries, this is then assessed using ROUGE, among the most widely used measures. Despite the fact that it is not possible to fully explain all diverse algorithms and approaches in this work, we believe this paper offers a useful overview of current trends and advancements in text summarization techniques and outlines the state-of-the-art in this field of study.

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Table 1. Papers on Text Summarization and their methodologies.

Reference	Published Year	Objectives	Methodology
[2]	2016	Review paper on text summarization.	Performance comparison of the different types of text summarization
[9]	2017	Semantic text summarization of long videos	creates textual and visual summaries of videos using encoder-decoder recurrent networks, as well as visual summaries of videos.
[6]	2018	Rapid abstractive summarization using sentence rewriting for specified reinforcers	A hybrid extractive-abstract model with reinforcement learning(RL) is proposed. Formally, given a training set of document-summary pairs is fed to the model to make it aware of word-sentence hierarchy.
[4]	2019	What's been done and what needs to be done in ATS	Classify different methods of summarizer using various criteria
[48]	2019	Deep learning based on LSTM-CNN for abstractive text summarization	ATSDL(Abstractive text summarization deep learning) firstly applies a phrase extraction method on both semantics and syntactic structures to get essential phrases from sentences followed by the LSTM model to understand the phrase collocation. After the training phase is finished,a series of phrases will be generated by the new model, which is the summary of text and it is made up of natural sentences.
[7]	2020	Summarization of multimodal information using multimodal references	In this paper, the multimodal reference is the intended target to guide multimodal summarization and to evaluate multimodal outputs as a whole.

Table 2. Existing Papers on Automatic Legal Text Summarization.

Reference	Published Year	Objectives	Methodology	Dataset
[19]	2016	Building an Optimised algorithm that provides summaries of legal documents.	To provide more accurate summaries of legal documents, an algorithm that trains the T5 algorithm on the legal domain has been devised.	Every single file from the US Supreme Court is included in the special master dockets for fine-tuning, which divides the data into training and testing in proportions of 70/30.
[20]	2017	A System for ATS of Legal Texts, named as Case Summarizer	This summary engine was created utilising pre-processing, domain processing and sentence relevance scoring that focuses in the legal domain.	Uses a set of documents chosen at random from a dataset similar to LEXA [27] from the Federal Court of Australia (FCA) that contains 3890 court cases, during the years of 2006 and 2009.
[21]	2018	A Judgement Summarization System based on Legal	The legal ontology postulated plays a decisive role for returning the	It uses downloaded databases from the website www.indiankanoon.org. For

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		Ontology that uses Fuzzy Logic and Conditional Random Field Algorithm.	relevant judgments in the summarizer. The Fuzzy Logic is employed to generate a document summary and Conditional Random Field Algorithm is employed for structured summary.	evaluation purposes, they use 50 judgments each from Service Law, Constitutional Law and Industry Law.
[26]	2019	Comparative Analysis of Summarization Algorithms used for judgements of legal cases.	They explore the methods of automatically condensing Indian court rulings from the Indian Supreme Court and analyse the prior works in the development of text summarising approaches.	Collected 17,347 legal court records during the period of 1990–2018 from the Supreme Court of India found on Westlaw India website.
[28]	2019	Legal text summary using efficient deep learning techniques.	They proposed a technique for the summarization of Indian Legal Documents, using neural networks. They eliminate the problem of labelled data not being available by using human generated head notes.	The Indian Supreme Court judgements during the period of 1947 to 1993, obtained from the site udic.nic.in, following 80%-20% train-test split.
[22]	2021	Using Joint Text Features and Transformers for Legal Text Classification and Summarization.	The method uses LEGAL-BERT to categorise sentences totally pretrained on legal domain data.	500 document- summary pairings with 72192 sentences each were included in the training dataset offered by AILA [23]. 50 head notes that were annotated with 7 rhetorical roles that made up the test data.
[47]	2021	Indian Legal Document Summarization, a weakly supervised approach called LawSum.	Produced a dataset with 10,764 from Indian Supreme Court decisions that have been annotated and also produced an appropriate handwritten summary, called headnote. The dataset undergoes abbreviation normalisation and sentence tokenization.	Uses 8648 Supreme Court rulings as the training dataset.
[49]	2022	Legal text summarization that uses deep learning based on modelling of automated glowworm swarm optimization.	The summary of the judicial textual information is generated automatically using a novel ODL-ITS technique.	Dataset is collected from the judgements of the Indian Supreme Court, which uses a set of 100 judgements that comprises various cases.

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Table 3.The table presents datasets and methodologies used in T5 Transformer models.

Reference	Published Year	Objectives	Methodology	Dataset
[39]	2021	Training T5 to Perform Numerical Reasoning	Utilise T5's multitasking capabilities to provide a sequential training pipeline that uses little resources, is tolerant of experimental cycles, and even performs well with lower scale models.	Discrete Reasoning Over Paragraphs (DROP) [40], Two artificial datasets designed to improve performance on DROP [41], SQuAD [42]
[43]	2020	Pretraining and t5 model validation using Brazilian Portuguese data (Ptt5)	They improved the T5 model tasks by pretraining it using techniques such as sentence entailment prediction and named entity recognition, on Portuguese language tasks.	Uses Brazilian Portuguese datasets namely BrWac [44] for pretraining, ASSIN 2 [45] and HAREM [46] for evaluating and fine-tuning their pretrained models.

Table 4.The table presents datasets and methodologies used in GPT-2 Transformer models

Reference	Published Year	Objectives	Methodology	Dataset
[55]	2020	How to effectively reuse English GPT-2 models to create translations for other languages.	Developed methods to adapt GPT-2 where lexical embeddings are retrained to force the model to understand English and the target language representations that are compatible.	The GPT-2 models are pre trained with Italian and Dutch data(nld). The Italian(ita), a similar collection of data, was used to develop the GePpeTto model[56]. It is a mix of data from Wikipedia and web texts from the ItWaC corpus. The Dutch dataset consists of a mixture of Wikipedia, newspaper articles, books and articles from Dutch websites.
[57]	2020	BERT and GPT-2-based ATS of Medical Research Articles on COVID-19.	Multiple choice (mc) prediction tasks and language modelling tasks are used to train the GPT-2 transformer model. When lm task is given prior tokens and context, the model forecasts the next word token. For the mc task, the model selects the appropriate gold summary from the available options.	The CORD-19 (COVID-19 Open Research Dataset) includes more than 59,000 research articles about COVID-19 or related illnesses, including roughly 47,000 full-text articles.

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Table 5.The table presents datasets and methodologies used in BART Transformer models.

Reference	Published Year	Objectives	Methodology	Dataset
[30]	2021	Summary of Abstractive Text with Entity-level Factual Consistency (They use new metric prec-s and recall-s, can include in analysis)	They propose a new metric called $prec_s$(precision-score) to measure factual-consistency at the entity-level. In order to enhance performance they suggest a number of strategies, such as data filtering, joint sequence generation and multi-task learning.	They evaluate the $prec_s$(precision-score) in accordance with the ground truth summary of three datasets: CNN/Daily Mail[31], Newsroom[32] and XSUM [33]
[35]	2022	Training Dynamics for Text Summarization Models	Attempt to understand the fine-tuning process of pretraining language models for summarization. They propose a token-level loss truncation technique that can improve the abstractiveness and factuality.	They show that training considerably increases the factuality of summarization models on noisy datasets such as: XSUM [33], CNNDM [36] and MEDIASUM [37]

RESEARCH ARTICLE

Prediction of Crypto currency trading volume in India using CNN-LSTM model

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ABSTRACT

Crypto currency had gained popularity and emerged as a new asset class. Most of the developed countries had accepted crypto currency as one of the mode of transaction. Despite the regulatory hurdles, emerging markets dominate the worldwide crypto currency adoption and India remains at the fourth spot. There are many factors influencing the crypto currency adoption index. Among them volatility of crypto currencies, stock indexes and macroeconomic factors are considered as important factors. The trading volume of crypto exchanges in India can be used as a measure for finding the crypto adoption in India. This study aims to predict the trading volume of crypto currency using various factors. There are many advanced statistical models available for developing prediction models. Deep learning hybrid neural model Convolution Neural Networks (CNN)with Long Short Term Memory (LSTM) is chosen for this study since it works well with time series data. It is found that the CNN with LSTM hybrid neural model is a better predictor of trading volume and the results suggest that the deep learning model can be used for prediction of crypto trading volume.

Keywords: Cryptocurrency, emerging markets, deep learning, CNN,LSTM

INTRODUCTION

Cryptocurrency is a digital virtual currency which was created with an objective to function as a medium of exchange. Cryptocurrency is enabled using Blockchain technology which is fundamentally a digital distributed ledger.It allows transactions to be recorded, verified and exchanged in the ledger without the need for any central

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authority to approve the transactions. It uses cryptographic signatures, public and privates keys to validate all the transactions. There are more than 10,000 crypto currencies in existence but only a handful of them are in vogue. Cryptocurrency had emerged as a most popular asset class and moreover the covid pandemic had accelerated its growth(Sarkodie, Ahmed, & Owusu, 2022). There is a widespread adoption of crytocurrencies in financial markets particularly among emerging economies. Asian Markets, particularly India had increasingly adopted crypto assets since 2019(Choueiri, Gulde-Wolf, & Iyer, 2022).Figure 1 shows the trading volume of cryptocurrency in various financial markets. In recent years during and post pandemic there is an increased adoption of cryptocurrency in several Asian markets. According to the global crypto adoption report India was ranked fourth and invests in top cryptocurrencies. There are studies which forecast the price of the popularly traded cryptocurrencies. Several machine learning and deep learning models like Support Vector Machines (SVM), Convolution Neural Network (CNN), Long Short Term Memory (LSTM), Recurrent Neural Network (RNN), etc were used to predict the cryptocurrency prices. Convolution Neural Network (CNN) an advanced machine learning technique is widely used for the prediction of stock price data because of its superior performance (Zhang et al., 2020). Forecasting the trading volume is very important for the investors in understanding the financial market. The forecasting was done using various techniques like LSTM, Support Vector Regression and time series models. It was found that LSTM method yielded a more accurate forecast(Libman, Haber, & Schaps, 2019).Cryptocurrency adoption is based on various factors which include macroeconomic, market and price data.

The price of cryptocurrency is extremely volatile and remains as a risky asset class. There are studies which try to explain the reasons behind the cryptocurrency volatility (Lopez-Cabarcos et al., 2021).Volatility of cryptocurrencies is forecasted using investor sentiment and data from prominent social media platform twitter(Akbiyik et al., 2021). Several time series models like GARCH, EGARCH, HAR had been used for predicting the short term price volatility of cryptocurrency. The models are compared on the basis of performance metrics like Mean Absolute Percent Error (MAPE), Mean Absolute Error (MAE) and Mean Square Error (MSE) (Bergsli et al., 2022). Machine learning based time-series models were used to predict the future volatility of cryptocurrency market and it was found that they were effective predictor of price volatility (Iqbal et al., 2021). In similar research CNN with LSTM was used to forecast one of the most well-known cryptocurrencies, bitcoin. Results had shown that CNN-LSTM hybrid model can effectively predict the prices in both long-term and short-term (Li & Dai, 2019). Likewise, RNN with LSTM method had been used for the prediction of bitcoin priceeffectively (Ferdiyansyah et al., 2019).It is important to study the crypto market in India as the regulation is not supportive to the growth of the Industry. In this study, crypto trading volume in India is predicted using prices of the popularly traded cryptocurrencies and stock index data. Deep Learning hybrid model CNN with LSTM is the method used for the prediction of the crypto volume in exchanges.

DATA AND METHODOLOGY

Data

The crypto trading volume, stock market data and prices of top five cryptocurrency are obtained using web scraping method. The top cryptocurrencies price data is chosen based on market capitalization; see *www.in.investing.com/crypto*. Crypto trading volume is obtained from the crypto exchanges in India. The stock market data is obtained from see *www.moneycontrol.com/indian-indices/nifty-100-28.html*. Stock prices are deeply connected with cryptocurrencies as majority of investors and traders treat it as asset class rather than a currency. So, stock market indices are used as input data for the CNN prediction model. Also, volatility of top five cryptocurrencies based on price is chosen to be included as input data. The cryptocurrencies chosen are Bitcoin, Ethereum, Tether, USD and Binance. The trading volume, price and stock index data – NIFTY 100* included in the model are cross-sectional data.Table 1 shows data used in CNN – LSTM for the year 2020 to 2022. Day-wise data which includes 1026 data points from Feb 2020 to Dec 2022 is included in the model.

CNN with LSTM Framework

Figure 2 shows the framework for the development of CNN model with LSTM layers for the prediction of trading volume in crypto exchange. The data for the input and target variable is obtained using web scraping technique. In the data pre-preparation stage, data is cleaned, formatted and normalized. After this stage, the formatted data is split into training and validation data. There are several deep learning models used for prediction of financial data viz., MultiLayer Perceptron (MLP), CNN, RNN and LSTM. The CNN model is selected for the prediction of crypto trading volume since the data represents multidimensional time series. The basic structure of CNN consists of three layers viz., convolution layer, pooling layer and full connection layer((Li & Dai, 2019; LeCun & Bengio, 1995). The convolution layer will receive output from the previous layer and performs the convolution operation. The convolution has convolution kernel which can extract a feature from input data of each layer and finally obtains a high-quality feature. This high dimensional feature provides ability for data prediction. The last component of the convolution layer is the activation function. This is applied to the output of the previous convolution layer to generate feature maps. The pooling layer reduces the dimension of feature maps and size of data volume. Down sampling is performed along the spatial dimensionality to reduce the number of parameters within the activation. The full connection layers will perform the same function as Artificial Neural Networks which try to produce class scores from the activations to be used for prediction. We have used CNN along with LSTM network for forecasting the crypto currency trading volume.

The model with LSTM layers are trained using the training data. The parameters of the CNN model include dimension, kernel size, activation function and Max Pooling Layer size. There are 1D, 2D and 3D which can be chosen as dimension in the model. We are using 1D CNN model since the financial data is used in the input layer. The activation function chosen is non-linear Rectified Linear Unit (ReLU). The pooling layer is applied to all output matrices of convolution layer which are merged by concatenating feature vectors. Epoch refers to one cycle (one forward pass and one backward pass)through the full training data and we have chosen 40 epochs. Batch size refers to number of iterations and we have 40 iterations in the model. Bidirectional LSTM Layers are further added to the CNN model with a dropout of 0.3 which is applied to the merged matrix. Finally it is fed into two sequential fully connected layers. The CNN model is validated using validation data. Finally, the developed model is evaluated using two performance metrics namely Mean Absolute Errorand Mean Square Error. Figure 3 shows the chart plot of the input and output data. Day-wise price data of Bitcoin, Ethereum, Tether, USD, Binance (BNB) and stock index of India - Nifty 100 are used as input data. Crypto trading volume is used as output data.

Evaluation

The ability of CNN model and CNN-LSTM model to predict the crypto trading volume is evaluated using MAE and MSE. Figure 4 shows the error plot with training and validation loss at various epochs for MAE and MSE.

Mean Absolute Error (MAE) $= \frac{1}{n} \sum_{i=1}^{n} | (y_i – f_i) |$

Mean Square Error (MSE) $= \frac{1}{n} \sum_{i=1}^{n} | \frac{(y_i – f_i)}{y_i} |$

y_i is the ith actual crypto trading volume, f_i is itsith predicted value based on the hybrid model and n is the number of data to be evaluated. The performance metrics reflects the degree of deviation of the predicted trading volume from the actual trading volume. Table 2 shows the comparison of performance metrics of CNN-LSTM hybrid neural model and CNN model. Since the MAE and MSE are low, the performance of CNN – LSTM hybrid model is better when compared with CNN model. Hence CNN-LSTM model is a good predictor of crypto trading volume. Figure 5 shows crypto volume prediction. It shows the comparison of predicted and real crypto volume. The chart plot shows that the CNN – LSTM hybrid model is able to predict crypto currency trading volume than CNN model alone.

CONCLUSION

This paper uses deep learning method CNN and CNN with LSTM hybrid neural model. Based on the performance it can be seen than CNN-LSTM hybrid model performs well when compared with CNN model alone in predicting the

crypto currency trading volume of the crypto exchanges in India. This model will be useful in prediction of future crypto currency trading volume and presents the important factors that influence the crypto industry in India. The CNN-LSTM model works well with the financial time series data. This model can be used by the market participants to understand the crypto currency market.

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Table.1: Data used in the CNN – LSTM

Year	Price of crypto currency					Crypto Volume(M)	NIFTY ('000)
	Bitcoin	**Ethereum**	**Tether**	**USD**	**Binance**		
2020	11319.79	321.52	1.0013	0.9994	21.72	23.45	37.48
2021	47428.33	2772.18	1.0005	0.9995	377.38	19.87	53.74
2022	27104.08	1898.17	0.9999	1.0002	316.41	7.35	5748.70

Source: Data obtained from web scraping; M - Million

Table.2: Comparison of Performance Metrics of deep learning models

Dataset	CNN –LSTM Model		CNN Model	
	MAE	**MSE**	**MAE**	**MSE**
Training data	0.4766	0.3629	0.2846	0.1335
Validation data	0.3119	0.1530	5.9434	35.3696

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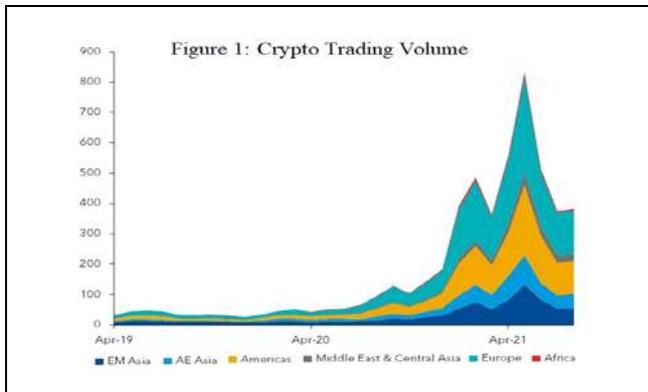
Fig.1: Crypto Trading Volume
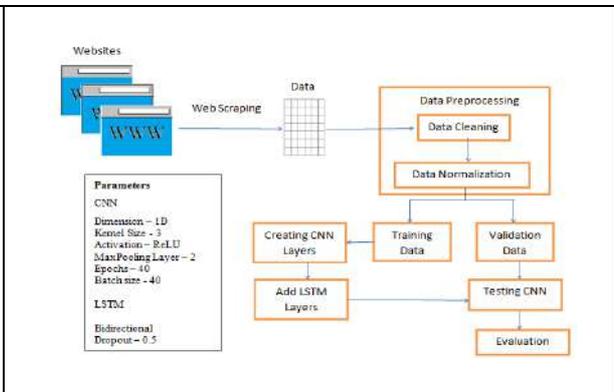
Fig.2: Model Framework
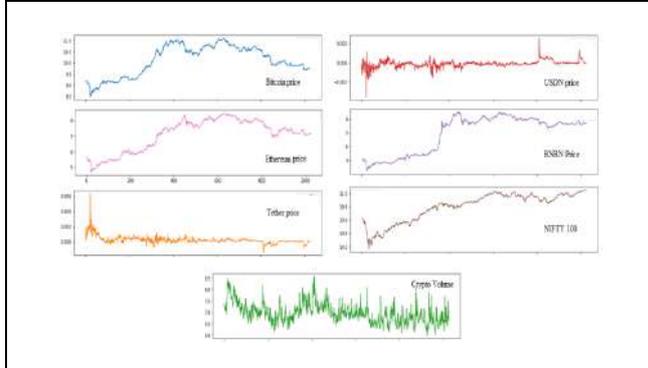
Fig.3: Chart plot of data
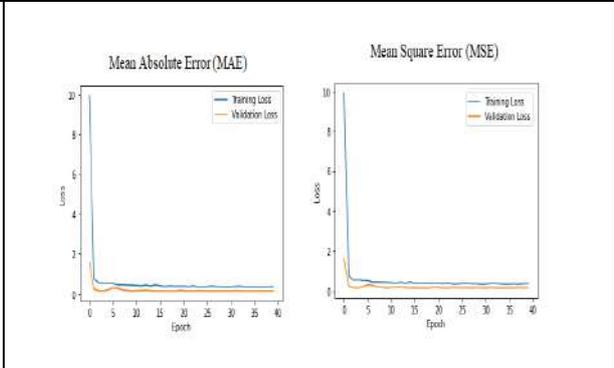
Fig.4: Error plot
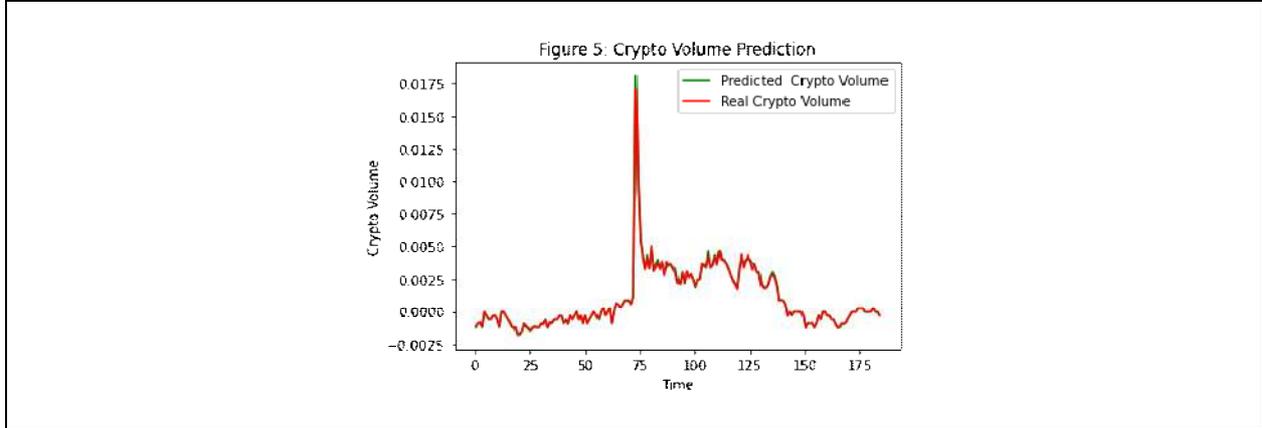
Fig.5: Crypto volume prediction

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RESEARCH ARTICLE

Classification of Traffic Violati ons with Helmet Detection using Open CV and YoloV3

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ABSTRACT

Due to urbanisation, industrialisation, and population growth, traffic has increased significantly. According to a recent study on traffic management market statistics, more traffic offences were reported in 2021 (1.38 million) than in 2019 (1.05 million). Using intelligent traffic solutions based on information and communication technology, urban city planning can improve traffic management and the commuter experience. A component of the smart city system is smart traffic management. Vehicle-mounted cameras can provide real-time traffic information. These systems' benefits include lane occupancy, traffic violation detection, vehicle detection, and traffic monitoring. Traffic violations includes signal jumps, riding without helmet, driving without seatbelts and vehicles not following rules of the Traffic System In many developing countries like India, traffic violations are manually monitored by traffic authorities either manually or monitoring the recorded or live videos CCTV surveillance cameras. This project proposes an intelligent model that recognizes objects, classifies vehicles into cars and bicycles, and finally builds a model that recognizes helmets worn by motorcycles using Computer vision algorithm.

Keywords: These systems' benefits include lane occupancy, traffic violation detection, vehicle detection, and traffic monitoring.

INTRODUCTION

Road safety is the culmination of all actions taken to prevent accidents or lessen their effects. Seat belts, airbags, laminated glass, and other passive and active safety features have all been linked to preventing or lessening the effects of accidents, but more needs to be done. Systems with intelligent driver assistance are another way to prevent traffic accidents. In order to extract relevant data for providing driver assistance, intelligent systems research represents a field that necessitates technical and sophisticated image processing algorithms. It is also a very active

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research area aimed at reducing the number of traffic accidents. Riding without helmets, Reckless driving, and Triple riding are a few of the measures to be in control to avoid road accidents, hence detections of these violations help in keeping a fear touch for drivers and passengers. The tracking of these violations is done manually, and automation has been minimal in recent years. Many other traffic violations include not wearing a seatbelt, emission test updates, insurance details, and more. Cameras, computer vision, and machine learning techniques like image processing are used to automatically detect traffic violations, one of the most significant violations.

Literature survey

An article from Math Works [1] defined to find instances of objects in an image or video, object recognition is a computer vision technique. Object detection algorithms frequently make use of deep learning or machine learning to generate meaningful results. When viewing a photo or video, people can locate and identify current objects of interest. To have computers mimic this intelligence is the aim of object recognition. In recent years, many object detection algorithms have been stated and proven. Zhao *et al.,* [2] proposed a model for deep learning for object detection in pictures and videos. It is designed to quickly and accurately identify and locate many objects of a given category in a given image. Then presented public and specific data sets commonly used for target detection, and analyzed and compared various representative algorithms in the field. Humans will merely notice and identify the objects in a picture. The human sensory system is quick and precise, and it can perform difficult tasks like sorting through a large number of objects and identifying obstacles without much conscious thought. According to an article from hacker earth, [3] thanks to the availability of enormous amounts of data, faster GPUs, and better algorithms, we can now easily train computers to observe and classify multiple objects within a picture with high accuracy. They studied ideas like object localization, object detection, and loss operators for object localization before examining an algorithmic rule for object detection. Moving object detection is frequently a prerequisite for video-based computer vision applications. The background and foreground are then separated using background subtraction.

In the methodology proposed by Garcia *et al.,* [4]. Background subtractions certainly one of the most researched areas in computer vision, with many publications available. Most of them involve applying mathematics and his machine learning model to make it more robust to video challenges. The ultimate objective is to enable the background subtraction technique created through the research to be used in practical applications like traffic monitoring. Cao *et al.,* [5] proposed a paper with techniques and a real-time traffic tracking algorithm. The area of the moving vehicle is identified in real-time moving vehicle detection by lane detection. Then, using frame differencing, the primary color information of moving and still areas is obtained. A similar background image is generated by entering the primary color information in the moving area of the vehicle. Finally, moving vehicles are determined by differences in adaptive background subtraction. Guo *et al.,* [6] proposed the comparison between deep neural network method and background subtraction method and stated that currently, Vehicle recognition in videos is frequently performed using deep neural network models, and the recognition precision is comparatively high. Neural network models, on the other hand, demand a lot of computational power and network bandwidth.

The devices used for edge computing frequently have low computational power, so neural network models cannot be applied. Because of its quick detection speed and accuracy, low hardware computational requirements, and ease of implementation, the background subtraction algorithm is widely used. Varghese *et al.,* [7] best explains that the background subtraction method, which makes use of a collection of previously recorded background pixel values, is used to model the background at the pixel level. Input pixel is designated as background if the model's pattern and the necessary number of matches are found. According to the consistency of pixel observations over time, the background dynamic region and stability make better use of area patterns by continuously adjusting the number of matches necessary for a pattern in the model to classify an input pixel as background. As a result of the work by Ramadhani *et al.* [8], Using cascaded Haar classifiers, a vehicle counter programme was developed based on the video traffic streams of particular kinds of vehicles. Prior to using the Ada Boost machine learning algorithm to combine particular classifiers in a cascade filter to create a robust classifier to quickly remove background regions from the image, we first use a Haar-like function to represent the visual appearance of the vehicle. An algorithm was presented by Browne *et al.,* [9] that uses a single visual camera to determine a region of interest (ROI) in front of the

road where a vehicle may be present in a particular area. These ROIs are then classified into different priorities based on their location in the image. Area of interest is a particular area of an image that is significant for gathering data for this study. Prajwal *et al.,* [10] deployed a system to detect drivers without a helmet. It's about automating traffic violation detection without a helmet. The basic principle is object recognition through two levels of deep learning. Objects detected at level 1 are people, motorcycles/mopeds using the Haar cascade classifier, and helmets at level 2 using YOLOv3. Since this task uses video as input, speed is important.

Objectives and methodology
Object Detection
In this section of project, we use BACKGROUND SUBTRACTOR METHOD AND EUCLIDEAN DISTANCE TRACKER. Removing background is a common method for locating moveable objects in a series of still photos taken by stationary cameras.

Classification of vehicles
In this project, we present a method for classifying and recognising vehicles in monocular image sequences of traffic scenes photographed by a stationary camera using their distinctive visual characteristics. HAAR CASCADE CLASSIFIERS are used to classify vehicles by estimating their size or shape as they pass.

Detection of helmets
In this section of the project, we suggest using the YOLOv3 (You Only Look Once version3) algorithm to identify two-wheeler riders who are violating the law by not wearing a helmet.

Computer Vision
The study of how computers perceive and recognize virtual images and videos is known as computer vision. Wiley *et al,.* [11]. Computer Vision is studied from many perspectives. It helps to analyze image or video and to extract important information, recognizing patterns and used for detection and classification. PC vision involves observing or sensing a visual stimulus, understanding what has been observed, and extracting complex statistics that may be applied to various machine learning tasks.

Object detection
Object detection is a computer imaginative and prescient approach for finding instances of objects in pictures or motion pictures. Dahiya *et al.,* [12] explains Object detection is detecting the object in particular scene. On using the background subtraction algorithm detection of object is efficient. Detecting the item mainly region at its static mode is referred to as item Detection. Object detection algorithms typically leverage system getting to know or deep learning to provide significant consequences. Humans are capable of quickly understanding and locating recreational equipment when they view images or videos. The goal of item detection is to use technology to simulate this intelligence. Advanced driver assistance systems (ADAS), which enable vehicles to detect pedestrians or use lanes to detect traffic, rely heavily on object detection. Along with detecting traffic infractions, video surveillance, or photo retrieval systems, object detection is useful in packages as well.

Classification of vehicles
Nowadays, finding the best daily transportation is a top priority for every person. However, there is currently a major issue. The unchecked growth of private vehicles has emerged as one of the major transportation issues. A previous study by the Indonesia Ministry of Transportation revealed unexpected results for Indonesian vehicle growth: 12% for motorcycles, 8.89% for cars, and 2.2% for buses. Classification is the systematic grouping of things into groups and classes according to their properties. To bridge the gap between computer vision and human vision, image type was developed by teaching the computer with statistical data. The photograph is complete once it has been categorised into the appropriate category based solely on the content of the vision. By giving the computer information to learn from, image types were developed to close the gap between computer vision and human vision. The monitoring of site visitor drift, automated parking structures, and safety enforcement are just a few examples of

the programmes that make extensive use of the automobile class (VC), an underlying approach in a smart transportation device, this is due to the truth automobile classification is an inherently hard hassle. vehicle classification is to categorize all detected motors into their specific sub-training. vehicle category is a critical a part of clever transportation systems by using enabling series of precious records for diverse packages, inclusive of road surveillance and system planning. in this venture, we present a set of guidelines for the visual classification and detection of cars in monocular image sequences of traffic scenes captured with a desk-mounted digital camera. By calculating the size or shape of a passing motor, the type of automobile is determined. Furthermore, in the venture of the automobile category, detection and monitoring are really first steps. Vehicles are classified using Haar Cascade Classifiers.

Helmet detection

Two-wheeler is a very popular mode of transportation in almost every country. However, there is a high risk involved because of less protection. To reduce the involved risk, it is highly desirable for bike-riders to use helmet. Observing the usefulness of helmet, Governments have made it a punishable offense to ride a bike without helmet and have adopted manual strategies to catch the violators. Two-wheeler is a very popular mode of transportation in almost every country. However, there is a high risk involved because of less protection. To reduce the involved risk, it is highly desirable for bike-riders to use helmet. Observing the usefulness of helmet, Governments have made it a punishable offense to ride a bike without helmet and have adopted manual strategies to catch the violators. Ji *et al.* [13] proposes the helmet detection using YOLO classifiers for the safety of riders of motorcycle. In almost every nation, two-wheelers are a very common mode of transportation. Because there is less protection, there is a significant risk. It is strongly advised that bike riders wear helmets in order to reduce the risk. After realizing the importance of helmets, governments made it against the law to ride a bike without one. have implemented a strategy to catch offenders, and the requirement to wear helmets. For two-wheeler safety, wearing a helmet is required. The current video surveillance-based techniques require human interaction and are passive. These systems are generally workable, though their efficiency degrades over time. Sannidhi *et al.* [14] proposes the detection of helmet using deep learning technique for object detection and yolo classifier to classify more efficiently with high precision and accuracy. Automation of these type of system is at need and many have proposed and are under the usage at efficient accuracy.

Implementation

Using the Background Subtraction method of an Open CV module, objects are identified in this project. Finding moving objects in a collection of still pictures taken by stationary cameras is frequently done using the background subtraction technique. This method, which identifies moving objects based on the difference between the current frame and the reference frame, is based on the "history photograph" or "heritage version". Given that the history subtraction is typically carried out by identifying the foreground objects in a video frame, foreground detection is the primary task of the entire method. It can be very challenging to establish the appropriate historical context when there are shapes, shadows, and moving objects present. When defining the history, all of the methods make the assumption that the colors and intensities of the stationary objects may change over time. A strong foreground model that is resistant to long-term changes, repetitive movements like leaves, waves, and shadows should be the foundation of any good foreground system.

Flowchart on background subtraction

Fig 2: Background Subtraction

Algorithm of background subtraction method

Any variation of strong background subtraction must be capable of coping with repeated motion and variations in light intensity brought on by long-term scene modifications. One can mathematically analyze this method by using a feature P (x, y, t) consider as a sequence of input video where t is the time dimension and x and y are the locations of pixel. P (4,5,2), for instance, is the pixel depth at the 4,5-pixel area of the image at time = 2 in the video collection.

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The following illustration will help to clarify
This study aims to construct a actual-world video surveillance machine that could efficiently discover moving motors the use of confined assets. To this end, we propose a straightforward method that combines historical subtraction at ROIs with outdoor CCTV video footage to detect and detect moving objects (location of interest). Each video frame is first subjected to a heritage subtraction algorithm to identify the regions of interest (ROIs). Our approach a lot reduces the computation complexity in assessment to different item detection algorithms. For examples, item detection is used for detecting visitors violations along with wearing helmets, leaping indicators, triple ridings, and others.

Modules used and implementation
Modules
cv2(OpenCV-python) and tracker(Euclidean distances) EuclideanDistTracker ()-used for creating tracker object cv2.VideoCapture(#location of video) used for specifying input video cv2.createBackgroundSubtractorMOG2(#history, #varThreshold) used for Object detection from Stable camera roi = frame [340: 720,500: 800] used to Extract Region of interest

Screenshots of output
Fig 5: Background Subtractor, Fig 6: ROI, Fig 7: Object Detection

Haar cascade classifiers
Strong classifiers like the Haar cascade are used to find objects. Because it was developed by Paul Viola and Michael Jones using quick object detection and a boosted cascade of essential features for face detection, the Haar Cascade Classifier is also known as the Viola Jones technique. This technique employs four elements to find objects: a key image, AdaBoost mastery, a cascade classifier, and a Haar-like feature. Choudhary *et al.*, [15] proposes the detection of vehicles that is two-wheelers or cars through Haar cascade classifier which is similar in detecting the face or used as in face recognition. They also used real time datasets to detect and the is efficient according to the analyses. Ramadhani *et al.*, [16] depicts the object detection through more efficient established monitoring system images or videos as data and on using of Haar cascade the vehicles are classified. In combination with ad boost machine learning algorithm which resulted in efficient detection and classification model. The classifier is taught using a variety of good and bad images using the system learning approach known as Haar Cascade. Positive photos: These photos include the ones that we want our classifier to find. Negative images: Pictures of everything else besides the thing we need to stumble upon.

Region/Specific Area of Interest
The phrase "Region of Interest" or "Specific area of interest" designates a specific area of an image that is important for gathering data for this study. Because data collecting methods concentrated on certain picture regions for object recognition, object tracking, and object counting, the Haar Cascade Classifier would not need to scan all of the image regions, as shown in Figure.

Screenshot of vehicle classification: two-wheeler and four-wheeler.
Fig 12: Classification of Two-wheeler and Four-wheeler, Fig 13: Car and Bike Classification

Yolo classifers
On this trendy task, To discover the visitors' violations, we suggest using the YOLOv3 (You look only once version3) algorithm. Classifiers are used to perform detection in earlier work on item detection. We see object detection as a regression problem with respect to spatially separated bounding containers and related class probabilities, in contrast to state-of-the-art detection systems. Although YOLO makes more localization mistakes, it is much less likely to be looking for phoney detections where none exist. Eventually, YOLO adopts the most well-known symbols of modern technology. When generalising from natural pictures to paintings on both the Picasso Dataset and the humans-artwork Dataset, it significantly outperforms all other detection techniques, including DPM and R-CNN.

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Regression-based algorithms - rather than the modern exciting elements of a picture, we run the algorithm only once to forecast the classes and bounding boxes for the entire picture. The real-time item detection method known as YOLO is the most well-known modern application of this innovative algorithm (You only look once). We use cutting-edge visitor roads and real-time surveillance video to determine whether or not bikers are wearing helmets. We quickly move the attention from picture pixels to bounding field coordinates and class probabilities by recasting object detection as a single regression issue. A single convolutional community can predict multiple bounding bins and class probabilities simultaneously for those packing containers. Dishant Padalia [17] depicts the scenario of losing lives while riding motorcycle without the usage the helmets. Hence, the paper was made on detecting and classifying the persons who didn't wear helmet using YOLO v3 classifier and also detects the number plate or license plate.

Algorithms with a classification component
They operate in two phases. We choose interesting regions of the image in the first step. Then, we use convolutional neural networks to categorise those regions. This is a very slow solution because we have to run the prediction for each selected region. The most well-known examples of this kind of algorithm are the Region-based Convolutional Neural Network (RCNN) and other CNN models.

Regression-based algorithms
YOLO practises on complete images and improves detection performance right away. Comparing this unified version to conventional object detection methods has many benefits. The YOLO algorithm's objective is to predict an object's class and the bounding box that identifies its location on the input image.

Comparison And Discussion
Why haar-cascade classifier?
Haar cascades are quick and effective in real-time, easy to use, and require little processing power.

Why yolo classifier??
- When making predictions, YOLO considers the big picture. YOLO sees the big picture while learning and looking back in time, unlike sliding windows and place thought-based strategies, so it implicitly encodes instance-based data about lessons as an add on to their visuals. A top-notch object detection method called speedy R-CNN sometimes misinterprets background patches in an image as objects because it might be blind to the wider context. Compared to rapid R-CNN, YOLO makes less than half as many historical past errors.
- Using YOLO, an object's generalizable representation is learned. Top detection methods like DPM and R-CNN are significantly outperformed by YOLO when trained on real-world images and put to the test on artistic materials. It is less likely to fail when used with brand-new domain names or unexpected inputs because YOLO is so generalizable.
- YOLO has a wide range of practical applications because it can handle object detections, one of the most prevalent issues in computer vision.
- Among them are:
(i) In autonomous vehicles, YOLO can be used to detect objects like cars, people, and traffic signs.
(ii) Security measures like spotting people in prohibited areas.
(iii)Finding production anomalies in a factory
(iv)Tracking players in sports, among other things.

RESULTS

Screenshot of real time video outputs
Fig: 14: Results showing person with a helmet detected, Fig: 15: Results showing person with a no-helmet detected

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CONCLUSIONS

Two-wheeler is the most common type of vehicle used on daily basis for their moving from one place to other for any little piece of work why not be a purchasing of vegetables, going for office, dropping their children to schools etc. At the same time maintaining the rules and regulations of traffic is an important criterion. It is for the safety of people and passengers as there are several accidents, deaths occurring on high rate. Hence, wearing helmet is important and to check if the people are wearing it or not many machines learning algorithm is used. All the datasets are real time captured through cameras as images or videos those are utilized as input to model. In this paper, to identify and classify objects such as two-wheelers and cars, the YOLO V3 Classifier is used to detect them using the Background Separation Method and the Haar-Cascade Classifier. On implementation, detection and classification are highly efficient and accurate.

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Fig 1: Example of object detection

Fig 2: Background Subtraction

Fig 3: Algorithm for Background Subtraction

Fig 4: Example

Fig 5: Background Subtractor

Fig 6: ROI

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Fig 7: Object Detection

Fig. 8: Haar Cascade classification process.
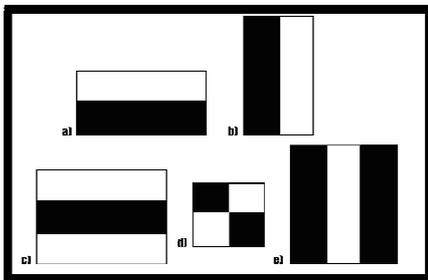
Fig 9: a] Edge Feature b] Edge Feature c] Line Feature e] Line Feature d] Four-Rectangle Feature
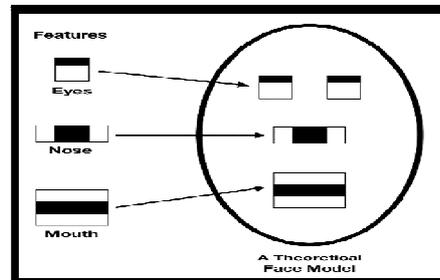
Fig 10: Face Detection using Haar Cascade Algorithm
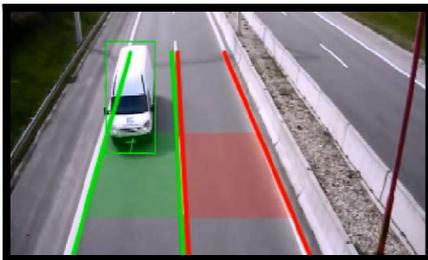
Fig 11: Illustration of ROI (Region of Interest)
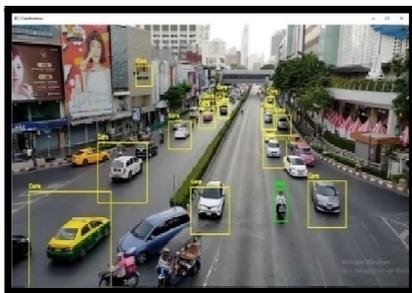
Fig 12: Classification of Two-wheeler and Four-wheeler

Fig 13: Car and Bike Classification

Fig: 14: Results showing person with a helmet detected	Fig: 15: Results showing person with a no-helmet detected

REVIEW ARTICLE
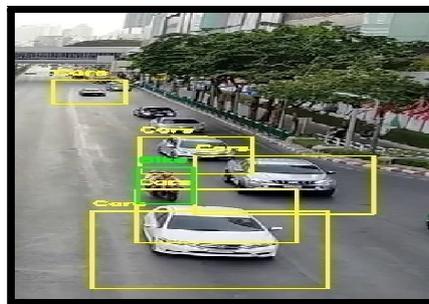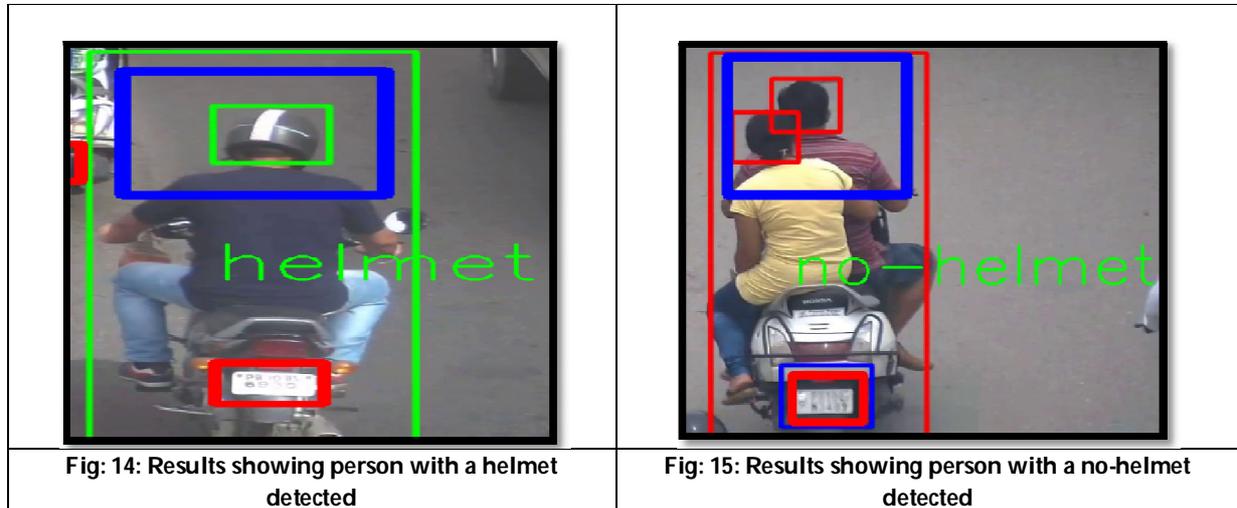
A Review of Structural Protein Sequence Deep Semantic Segmentation For Disease Detection

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ABSTRACT

Proteins are multiplexed textures that exist in all lifeforms. Protein structure is a linear sequence that can be normally represented by threads of characters like human language. Additionally, naturally derived proteins in general, involves recovered molecular elements depicting minute changes, which can be reconstructed and gathered in a hierarchical approach like natural language. Apparently, it is spontaneous to put in machine learning (ML) and natural language processing (NLP) techniques to protein sequences by considering the resemblance in their configuration. This paper focuses on the methods that can be used to classify proteins using natural language processing and machine learning techniques Support vector machine (SVM), Random Forest(RF) model and K nearest neighbour (KNN) algorithms, which can be applied to make classifications and predictions among different protein sequences. We also consider masked language models such as BERT to obtain information on protein architecture for disease detection.

Keywords: Masked language modelling, BERT, ELECTRA, Random Forest, Natural language processing, K-Nearest neighbour, Receiver Operator Curve (ROC), GPCRpred, Support vector machine, Supervised learning

INTRODUCTION

Proteins are macromolecular polypeptides comprised of many peptide-bonded amino acids. In comparison with sugar and salt molecules, molecules of proteins are very large and comprise of multiple amino acids that are fused to form long chains as a sequence. There are 20 common amino acids (AAs), present in each protein chain. Natural language processing, a subfield in linguistics and artificial intelligence, deals with processing and analysing enormous natural language data [1]. Due to various similarities between natural language and proteins, NLP and various ML models can be used in protein sequence classification. Our main aim is to review various papers to gain knowledge on how

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different NLP and Machine Learning models can be used in protein sequence classification and which among them can be best used for the purpose of disease detection.

Language of Protein

Humans attempt to express their thoughts through language, and proteins adhere to certain amino acid sequences. The linear amino acid sequence of each protein and peptide is crucial information for comprehending them, identifying them in samples, and categorising the post-translational modifications they go through. Protein sequencing is the technique of determining the amino acid sequence. The sequence is often notated as a string of letters, matching to the position of the amino acids from the amino-terminal to the carboxyl-terminal of the protein. Each amino acid in the sequence could be characterized by a one- or three-letter code. In nature, there are 20 different amino acids eq. Alanine (Ala, A). The different ways that these 20 amino acids can be combined result in the protein sequence for a certain element, such as haemoglobin, which is comparable to our own natural sequence as humans, which is also the order of letters or words. Therefore, it seems reasonable to use natural language processing (NLP) techniques given these affinities in structure and substance. This study will examine numerous NLP methods that can be used to predict protein sequences [2].

Models
BERT model

BERT that is the intelligent deep self attention based transformer model which is a NLP model to demonstrate language modelling of amino acid sequences. BERT is outlined for deep bidirectional representations by pre-training untagged contents by collectively deciding equally on right and left context. The two steps in the scheme includes pre-training and fine-tuning. Here, traditional language model is not used to pre-train the Bert, instead Bert is pre-trained using unsupervised tasks. The tasks includes encoder sequence which hides the portion of input tokens to train deep bidirectional representation. It is also specified as cloze tasks. Another task is next sentence prediction (NSP) where the models are trained to understand the relationship between the sentences. Fine-tuning Bert is straightforward task that allows modelling of downstream tasks. All the Bert results that are presented have used fine-tuning approach.[4] The context of the masked tokens are examined by the model, rather than just looking by the preceding tokens. ELECTRA (Efficiently Learning an Encoder that Classifies token Replacement Accurately) which is a Bert variant will predicts the tokens that has to be restored with the induced tokens. ELECTRA is a vast pre-trained model that can be drawn on and correlated to comprehensive language tasks beyond added training. This approach trains the following transformer models, they are generator and discriminator. The generator recovers tokens in the trained sequence as per the masked language model. The discriminator aims to analyse tokens that the generator will restores in the protein sequence. The generator will be trained maximal by reason of crisis to utilize texts. Subsequently, generator is discarded and discriminator is fine-tuned after pre-training. This pre-training task is more adequate than the masked language modelling. ELECTRA yields approximate outcomes to Bert with compute time not more than 10%. This variant achieves higher accuracy on downstream tasks when trained fully [5][2].

The main focus is on BERT base model and ProtBERT model. ProtBERT is evolved from BERT model which pretrained on wide collection of protein sequences. This implies it was pretrained only on the raw protein sequences with no humans marking them. One major dissimilarity between BERT model and ProtBERT is dealing with the protein sequences. The term Bertology means describing information of BERT model about language tasks. The diagnostic classifiers are used to clarify the Bert's outputs. The sentence input received by the ProtBERT model is of fixed length [15]. MLM is a training approach that gives sentence to the BERT and weights are been optimized inside the BERT where same sentence will be seen as an output on the other side. BERT model is pretrained using masked language model. MLM masks definite tokens in the input sequence and masked tokens are predicted by neighbouring tokens using the contextual information randomly. Masked tokens are anticipated by General Language Models by analysing preceding tokens but BERT will consider all tokens in the sequence and then predicts the masked tokens. MLM is just like a fill in the blank task where masked word is predicted [4]. Consider X which indicates protein sequence, suppose percentage of amino acid is 15, will be drafted randomly then one of the

following method will be selected randomly amino acids selected x_i. x_i will be replaced along the token which denotes an unstated amino acid for 80% of the instances. For 10%, x_i will be replaced with one among the twenty amino acids. Eventually, for the last 10% of amino, x_i will be kept unbroken. This is done to incline the accurate amino acids [3]. Masked protein chain is converted within the sequence of representation. Then, MLM decoder is used to enumerate log possibilities from the given depiction under 20 amino acid groups. In order to intensify the feasibility parallel to masked tokens, MLM will directs the model to forecast the word that has been masked from contextual information. This model will accurately predicts masked amino acids randomly without human annotation, learned representation should fetch semantic and syntactic information within proteins [3].

Random forest model

Random Forest is a blend of tree structure classifiers. It is widely used in classification and prediction. The breadth of application of Random Forest is very high. It utilises several decision trees to enhance the learning pace for a huge database. Here we discuss different studies to learn how random forest can be used on protein sequence classifications in different scenarios [6]. A study on predicting the structure of a protein was done using the random forest method. Since the number of protein structures known to humans are very less, the secondary structure of a known protein is used to predict the structure of an unknown protein. In this study the model proposed, segregates the dataset considered into two parts, the training data and the test data. A classification technique was used on the training data to generate the model and the accuracy is predicted by the use of test data. After this, Receiver Operator Curve (ROC) is used to validate the model by taking the area under the curve (AUC). Both decision tree and random forest classifier were considered to create the ROC, where the random forest classifier showed the outcome with the most accurate prediction with AUC (0.963) and decision tree with AUC (0.6333) [7]. A study to differentiate HIV-1 and COVID-19 viruses based on their protein sequence classifications was conducted. About 18,476 protein sequences for both the viruses are subjected to feature extraction, data labelling and six classifiers. The conjoint triad method was used, in the feature extraction phase, to extract eight features from 20 amino acids. Then in the data labelling phase, binary numbers were assigned to each virus with HIV-1 as 1 and COVID-19 as 0. In the final phase of classification, six classifiers were applied to train the proposed model and evaluate based on their accuracy. The classifiers are decision tree, K-nearest neighbour, support vector machine, linear regression, random forest and naive Bayesian. Out of these, the random forest classifier achieved a very high accuracy which gave 97.80% for two features and 99.89% for eight features. In general, the outcome proved that the RF classifiers had the largest impact on differentiating the two viruses based on its accuracy measure [6]. In any protein the amino acid solvent accessibility is strongly related to its function and structure. Therefore a study on the prediction of amino acid solvent accessibility was considered to interpret the relationship between protein sequence and its structure,, RSARF was proposed. Solvent accessibility refers to the area that is exposed to the solvent in an atom.

Five different thresholds (50%, 25%, 10%, 5% and 0%) were used to classify as buried residues and exposed residues. Cross-validation is performed by RF using not in bag samples. Each tree was grown with the training sequences, on an average. The measurement of the prediction scheme is done using sensitivity and specificity using four quantities (true positives: buried residues classified correctly, false positives: exposed residues classified incorrectly, true negatives: exposed residues classified correctly, false negatives: buried residues classified incorrectly). On testing the test dataset proposed the RSARF achieved 72.9% for 0%, 78.25% for 5%, 78.12% for 10%, 77.57% for 25% and 72.07% for 50% thresholds [10]. A different study focuses on identifying DNA binding proteins from its protein sequence by the use of random forest classifier. In this study an accuracy of more than 80% was achieved while using this approach on test datasets, and independent proteins that are non-DNA-binding and DNA-binding. Further, the DNA binder method was used on the same to find that it only achieved an accuracy of a little more that 60%. [9] Another study on classification of secondary structure of proteins was conducted for different domains. Random forest, trained on a version of Structure Classification of Proteins (SCOP), achieved 94% of predictive accuracy on a test set that is impartial and without overlap. In accordance with Matthew's correlation coefficient (MCC), for classification to the Super-family or Family levels, Fold, SCOP Class, 0.61 to 0.83 was the range of prediction quality. It was found that the number of constituent SSEs increases as the MCC for the classification was decreased [8].

KNN model

KNN can be used in protein-protein interaction models in order to have the single variance and zero meanso that the scale that are used in PPI model Classifier can be comparable. KNN models equally apply on the different topologies for unique PPIs Network. The features which are needed in identifying disease genes in protein when there is assuming the features are breach. This paper mainly focused on Cross- validation techniques which can be used to know performance on unseen data can be done using a classifier. During the performance process 10% of data which matches the disease genes can be taken as a test sampleand other remaining data can be used for training in order to know the class. The whole prediction accuracy is used to check prediction quality [21]. The separation between two cases must be determined using the KNN algorithm. The Minkowski distance,the Chebyshev distance, the Euclidean distance, and the Manhattan distance are the four techniques we useto measure distance. To evaluate the effectiveness of the classification results, we use 10-fold cross- validation. There are ten folds in all, nine of which can be used as training samples and one of which can be used as test samples. We receive a total of 10 sets, and the precision of those 10 sets allows us to infer the result. We additionally utilise SMOTE techniques, which are applied to various data units, to prevent the test sample from becoming corrupted [14]. In this we use three-fold cross-validation technique which is performed on a total 33,300 sets of protein sequences where 94.29% observed as an accurate result with a total ten minutes of execution time. From human protein this set of data contains 38,167 protein sequences among 25,661 proteins. These interaction results are equally taken from professionals. Totally we take 16,650 sequences randomly and perform different operations to get unique components [19]. We use BS-KNN algorithm to predict the sub chloroplast localizations. In addition, it uses pseudo-amino acid structure to compute BS-WED. In that we selectively choose greedy technique to get the best appropriate feature. We use this greedy technique with particular sequence of 20 amino-acids where n can be denoted as sets of feature size. This algorithm is basically divided into three steps which can be named as Growth-one phase, Growth-two phase and Reduction phase. Where feature sets gradually decreases in its size, removal of one amino acid occurs at this phase, and remaining amino acids that is n-1 sets can be used to estimate BS-WED [20]. It also aims at the comparison between two algorithm methods that is KNN classifier and lin-sim KNN classifier. The end result shows that KNN classifier has less accuracy when compared to lin-sin KNN classifier and it is also very time consuming. Total 2,869 human proteins were taken from three different data sources, out of which 1,302 proteins were selected as test data sets for the analysis where prediction performance occurs on these 1,302 protein data sets. After Excluding 1,302 protein sets, we end up with only 392 distinct sets of data for this performance [22].

SVM model

Support Vector Machine is one among broadly used Supervised machine learning algorithm. Regression and classification issues can be resolved using this technique. In Machine Learning it can be used for classifying problems. Finding the optimum line or decision boundary for classifying an n-dimensional space is the basic goal of the SVM algorithm, which enables various data points to be quickly and accurately classified. SVM models can be used to characterise membranous protein families based on the amino acid compositionof their transmembrane domains. SVM is used to determine whether or not a protein belongs to a specific family. They have used my SVM version 2.1.3 for SVM implementation. The SVM model is used to set the parameters, run the tests, and evaluate the performance as well as classify a protein into one of multiple families [17]. The Reduce amino acid alphabet is sufficient for appropriately identifying fundamentally disordered proteins when using the SVM model. To find proteins with inherent disorder, SVM is utilised. As part of the SVM implementation procedure, data sets are first moved into a higher dimensional space. The next step is to choose a hyperplane that best separates the two classes. Finding the hyperplane in an N- dimensional space where the classification of the data points is clear is the algorithm's main goal. The quantity of features affects the size of the hyperplane. The hyperplane will only be a line if there are only two input features. The hyperplane is a two-dimensional plane created from three input properties. It gets impossible to imagine if there are more than three features [18]. G-protein coupled receptor families and subfamilies, were predicted using the SVM based method- GPCRpred. It is employed in the identification of GPCRs from protein sequences [12]. SVM model is used to classify the sub-Golgi proteins. It consists of three parts: cis-Golgi, medial, and trans-Golgi. Cis-Golgi is in charge of protein reception, while trans-Golgi is in charge of protein release. The received proteins from the cis-Golgi are synthesised in the medial-Golgi [11]. Mismatch kernel application in an SVM

approach to remote homology detection. SVM methods, such as SVM-fisher and SVM-Pairwise, are also used for protein classification [16].

CONCLUSION

In bioinformatics, NLP and several ML methods have become a significant influence. The latest successes in solving the protein structure prediction issue and the advances in protein research may well be considered as an important milestone for the field. Diving into various studies on protein structure and sequences havelet us to conclude that the random forest classifier and the BERT model has shown the most promise by giving highest accuracy in predicting the protein structure among other models reviewed.

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Table.1: An overall comparison between different models based on protein sequences and itsclassification.

Reference paper no	Model used	Implementation	Advantages	Disadvantages
1.	KNN	KNN model equally applyon the different topologiesfor unique PPIs Network. Cross-validation technique, which can be used to know performanceon unseen data, can be done using classifier.	Less time consuming, it is an easiest algorithm to make prediction. It is very useful for classification and regression. High accuracy than other supervised learning models.	It uses large number of data, sothat the stage of prediction might be slow.
2.	KNN	To evaluate the performance of classification result we use 10-fold cross-validation.in total 10 folds, 9 folds of overall data sets can be used as training dataset and remaining 1 fold is used as test sample.	We use SMOTE technique that are used on different data units where wemust perform some measurement in order to stop the testsample that can be corrupted.	Since the need to store larger number of data, itrequire more space.
3.	KNN	In this we use three-fold cross-validation technique which is performed on total 33,300 sets of protein sequences where 94.29% observed as accurate result with total ten minutes of execution time.	Uses cross-validation technique which is used to perform different operations to get unique components.	Since it stores many training setsfor performance, it is very expensive.
4.	KNN	It uses pseudo-amino acid structure to compute BS-WED. In that we selectively choose greedy technique to	We selectively choose greedy technique to get thebest appropriate feature.	Feature sets gradually decreases in its size and

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		get the best appropriate feature. We use this greedy technique with particular sequence of20 amino acids where n can be denoted as sets of feature size.		removal of one amino acid occurs at each phase.
5.	KNN	Total 2,869 human proteins were taken has three different data sources, out of which 1,302 proteins were selected as test data setsfor the analysis where prediction performance occur on these 1,302 protein data sets.	It aims at comparison of two algorithm methods tochoose distinct components using distinct operation	At the end result shows that KNN classifier has less accuracy when compare to lin-sinKNN classifier and it is also verymuch time consuming.
6.	SVM	SVM is used to determine whether a protein belongs	To determine whether a protein	It does not execute very well.
		to a specific family. For SVM implementation, they used my SVM version 2.1.3. Implementation of protein classification into one of various families, size limitation of available data, parameter setting, tests, and performance measurement.	belongs to a specific family, to set parameters, to test and measure performance.	
7.	SVM	Application in detecting intrinsically disordered proteins. In two stages, data sets are mapped into higher dimensional space, followed by a hyperplane that optimally separates the two classes.	Tools for predicting disordered proteins that are effective.	Some target classes are overlapping because of using SVM.
8.	SVM	SVM model implementation for identifying GPCRs from protein sequences. They used a three step approach to identify GPCRs.	Used to identify GVPCRs based on protein sequence.	SVMs are not suitable for large datasets of proteins.
9.	SVM	SVM model implementation for classifying sub-Golgi	The classification of Sub-Golgi proteins is	Sometimes it will not be executed

		proteins.	critical for more effective drug development.	clearly.
10.	SVM	Mismatch kernels are used in an SVM approach to detect remote homology.	Used to detect homology.	SVMs are not suitable for large datasets detection.
11.	RF	Features extracted from both the viruses are applied among different classification models. Among them random forest model had the highest accuracy.	High classification accuracy compared other models.	More computational power due to its complexity.
12.	RF	Used in predicting the structure of an unknown protein keeping in reference, a known structure of secondary protein	Among the two models used random forest and decision tree models, RF models gives the most accurate prediction.	A forest is less interpretable than one decision tree.
13.	RF	Implemented to predict the amino acid solvent accessibility for different thresholds.	Accuracy was found to be more than 70% for various thresholds	Less accurate prediction for small data
14.	RF	Implementation of RF model was done to predict DNA binding proteins among non-DNA binding proteins.	Achieved more accuracy than DNA Binder method.	Much less control over the model.
15.	RF	Was implemented to trained on structured classification of protein in prediction of different	Achieved an accuracy of more than 90%.	Training time is increased due to increased number of trees.
		secondary structure proteins.		
16.	BERT	Implementation of mask modelling approach to predict masked tokens. accurately predicts masked amino acids	The MLM task instructs the model to expand the possibilities reciprocal to the masked ones.	Before training a model to replicate the original tokens, BERT modified the input by renewing some tokens with a mask.
17.	BERT	Implementing pre-trained	Success of BERT	BERT and

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		transformer models BERT and protBERT model and how BERTology interprets about the BERT model	manifested that wide-ranging models trained on untagged data allowed to gain high-powered presentation	ProtBERT model is broad by cause of training structure and aggregation. Its unusable as language model since it is bidirectional
18.	BERT	Implementation of two framework that is pre-training BERT and fine-tuning BERT. Mask LM and NSP tasks are used to allow deep bidirectional representation to complete the downstream tasks.	These insights into deep bidirectional architectures allow the same pre-trained model to vigorously test a variety of NLP jobs.	To benefit from deep unidirectional architectures, issues approve even collapsed tasks. Prior to the token discontinue entering over fine- tuning, we run the risk of creating an inconsistency between pre-training and fine-tuning.
19.	BERT	Application of ELECTRA, the BERT variant to predict how it restores the generated token.	Model is trained to repair the primary tokens, effectual and creates finer outcomes.	Resource allocation is main challenge; training structure of ELECTRA is large.
20.	BERT	Deep language model that is BERT implementation, comparison of ELECTRA approach with Bert.	Using ELECTRA it is possible to train the language by own, achieves state of the art performance.	Expensive as to train large data models, more computation needed.

Note: - SVM- Support vector machine, KNN- K-nearest neighbour, BERT- Bidirectional encoder representationfrom transformers and RF- Random forest

RESEARCH ARTICLE

Ride Sharing / Pooling using Blockchain

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ABSTRACT

Block chain is a widely used technology that acts as an immutable ledger for recording transactions and overseeing asset management across a network of enterprises. It keeps data in units called blocks, which are connected to form the block chain, a continuous line or chain of blocks. Public, Private, Hybrid, and Consortium Block chains are the four main subtypes of block chain. Decentralization in the context of block chain describes the movement of power and decision-making from a centralized body to a dispersed network (such as individual, organization, or group of users). It is an emerging technology that can power the decentralization of systems. Decentralized networks weaken the level of trust that participants must place in one another in order for the network to function, as well as their capacity to exercise authority or control over one another. This paper's main objective is to develop a P2P ride-sharing or pooling application with less error and more efficiency using block chain technology. A service called ride-sharing or pooling enables users to share their destination with other users traveling the same route, which helps to ease traffic congestion and lower shared travel expenses. Block chain and decentralization are used in peer-to-peer ride-sharing and pooling technology to address the issues that traditional centralization-based systems have. The ride-sharing or pooling system will be implemented on block chain, making it truly decentralized and independent of a third party.

Keywords: Peer-to-Peer, Pooling, Ridesharing, Block chain, Decentralization, Encryption.

INTRODUCTION

Aggregators of ridesharing services currently use a centralized approach or methodology to deliver the services and run their daily business. The rules, regulations, and legislation that the user and the driver must follow can also vary from one company to the next. Which also includes advantages as well as shortcomings of such methodologies. To book the cabs we need a third party system to process the payment. With this kind of centralized system, it might lead to lack of transparency. These problems lead us to find solutions in the block chain domain. Here we are trying to connect with the existing issues in the current system and invest in the decentralized network. Ride sharing refers

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to the use of digital platforms and services that connect drivers and passengers for the purpose of providing transportation. One way in which these two technologies can be combined is through the use of decentralized ride sharing platforms that are built on top of a block chain network. These platforms would allow drivers and passengers to connect and transact directly, without the need for intermediaries such as traditional ride sharing companies. The use of block chain technology in ride sharing could provide several benefits, such as increased security, reduced transaction costs, and improved transparency.

What is a Blockchain?

Block chain is a platform that is used by many people and an unchangeable ledger that handles recording transactions and managing asset monitoring in a network of businesses. It keeps data in units called blocks, which are connected to form the block chain, a continuous line or chain of blocks. It can be divided into four main categories: consortium, public, private, and hybrid Block chains. It is a method that stores data, making system alteration, hacking, and fraud difficult or impossible. The entire network of computer systems uses a block chain, which is effectively a duplicated, distributed record of digital transactions. It consists of a database that hashes both the transaction information for each block it records and the cryptographic hash of the block before it. The sender broadcasts to all other nodes in the peer- to-peer network whenever a new transaction is created. As the transaction is being received, the nodes authenticate it and store it in their transactional pools. Executing established controls about the transaction's operations and structure constitutes verifying the transaction. Some of the available transactions in a transaction pool are grouped together by special nodes called miners when they create a new block. After that, the block is mined, which is a method for discovering the proof of work by utilizing dependent variables from the new block's header. Calculating a hash code that satisfies the required complexity aims to find a work-related proof. Each block holds the transaction as well as meta-information and the block's prior block's hash value.

Techniques in Ridesharing

There are several different approaches to ride sharing, and the specific approach used can vary depending on the context and the goals of the ride-sharing service. Some common approaches to ride sharing include:

- Peer-to-peer ride sharing: This approach involves individuals using a ride-sharing platform or app to connect with other individuals who are looking to share a ride. In this model, riders and drivers are matched based on their location and destination, and the cost of the ride is shared between the individuals involved.
- Shared ride services: This approach involves a ride-sharing company or organization providing a fleet of vehicles that are available for multiple passengers to use. In this model, passengers are picked up at designated locations and dropped off at their destination, with the cost of the ride shared among the passengers.
- Dynamic ride sharing: With this strategy, real-time matching of riders and drivers is optimized through the use of sophisticated algorithms and data analytics. According to demand and other parameters, the price of the ride is changed in this model, which matches riders and drivers according to their current location, destination, and other details.
- Overall, the particular strategy for ride sharing will be determined by the aims and purposes of the service, as well as the distinctive qualities of the market and the consumers.

Applying Blockchain and Avoiding the Third Party

The current applications involve a third party, which has a number of negative effects, including an increase in traffic congestion, pollutants, total vehicle miles driven, and the poor pay—often below minimum wage—of drivers. By utilizing the decentralized network of the block chain, which will boost security, transaction transparency, and data security, we can develop a method to get rid of all this. Direct communication between riders and drivers reduces the need for additional expenses. Peer-to-peer transportation options have two opposing effects on car ownership. Peer-to-peer transportation reduces the appeal of owning a car in the first place by offering a convenient, affordable, and flexible substitute. Second, peer-to-peer transportation increases the appeal of owning a car since individuals can supplement their income by providing peer-to-peer transportation services using their vehicle. Within a city or town, cutting down on travel time might have a favorable impact. Cities are successful primarily because they bring together people and businesses in one region, giving them convenient access to each other's information, talents, and

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productivity. Goods, services, and labor will all become more plentiful and competitive when more businesses and employees enter a given geographic market. Cities become productive due to these agglomeration benefits. Employment is generated in the short term for every trip that transitions from personal vehicles, bicycles, or foot travel to peer-to-peer transportation. Two factors make a drop in emissions likely. First, there will be a 3 percent reduction in automobile journeys. We anticipate that emissions will fall according to the decline in car trips. With an expected reduction of roughly 13 million trips per year and an average journey length of 13.5 km, we estimate that in total, a well-functioning peer-to-peer service can cut the distance travelled on roads by up to 180 million kilometers, which translates into a decrease in emissions.

Peer-to-peer ridesharing/pooling concept.
By registering in an application with his or her information, the riders can use the peer-to-peer idea to match their rides with the drivers. The rider must specify the type of vehicle he/she needs and the destination. The server takes the rider's requirements and confirms his/her needs. The travel cost depends on the number of riders, vehicle type, and distance along with the fuel prices. Also the Driver registers into the App and enters his/her vehicle description type along with its occupancy. The driver before starting his journey enters his/her destination. The server then takes these details and puts them into a queue and finds suitable Riders that are taking that path. The cost of the ride depends on the type of vehicle and the number of km that the driver drives to reach the rider's drop-off point.

Ride Types in Ride Sharing
In a hurry and on a tight budget, ride-sharing is a very practical option. Finding nearby transportation whenever you need it the most will become easier as ridesharing grows. Now we can add various types of vehicles for our application and not restrict it to just one, that is we can include:

1. Motorcycles
2. Electric bikes /scooters
3. Auto
4. Carpool
5. Vanpool

This way we can satisfy the needs of the drivers and riders accordingly. Now to become a legitimate driver you have to check the following parameters:
1. Pass a background investigation
2. Maintain a spotless driving record
3. Possess a current driver's license and
4. Always have current automobile insurance

So that the riders will trust the app and have no issues along the way. A feedback system can be implemented so that the customers and the driver both can rate each other based on their behavior.

Source and Destination Sets
Peer pooling or sharing is a way to share transportation services which has been implemented by many multinational companies (like Uber etc.). It not only helps in saving fuel costs but provides a cheap alternative to personal rides, due to which it is widely adopted. If we consider a case or scenario where one user has to go from a source to a destination. Take into account that a second user may need to go to the same area or to a different set of sources and destinations that are en route to the first user's sources and destinations. As a result, numerous source and destination subgroups are created. Pooling allows the user/driver to efficiently pick-up the other users/riders and drop them according to the route set by a routing algorithm, which is based on the sets of source and destination of both the users. A ride sharing or pooling platform's ability to offer a reliable and effective ride matching system is a key component. A system like this would be able to pair the user/rider with a number of possible users/drivers. Only those users/drivers nearby the user/rider would be selected for this group.

System Architecture
Figure 3. System Architecture Design, Figure 4. Car/Ride Pooling Server

Payments Services in Ridesharing/Pooling
Online payments using block chain technology work in a similar way to traditional online payment methods, with the added security and transparency provided by the distributed ledger. To make a payment using block chain, the payer and the payee would need to have a digital wallet that is connected to a block chain network. The payer would then initiate a transaction, which would be recorded on the block chain and verified by network participants. Once the transaction is verified, it would be added to the block chain as a new block, and the payment would be complete. Because the transaction is recorded on the block chain, it is transparent and secure, making it a potentially useful tool for online payments. Online payments using block chain technology are becoming increasingly popular, as they offer a secure and efficient way to transfer funds over the internet. To make an online payment using block chain, the payer and the recipient must first have a digital wallet, which is a software program that allows them to store and manage their digital currencies. The payer can then use their wallet to initiate a payment to the recipient's wallet, which the recipient can then confirm and accept. The payment is then recorded on the block chain, which is a public and transparent ledger of all transactions. This allows for secure and efficient transfer of funds without the need for intermediaries such as banks. There are several types of online payment methods that use block chain technology. Some examples include:

- Crypto currency payments: These are payments made using a decentralized digital currency, such as Bitcoin or Ethereum that are recorded on a blockchain.
- Smart contract payments: These are payments made using self-executing contracts that are stored and executed on the blockchain.
- Decentralized finance (DeFi) payments: These are payments made using decentralized finance applications that are built on top of blockchain technology.
- Central bank digital currency (CBDC) payments: These are payments made using digital versions of fiat currencies that are issued and controlled by central banks.
- Using incentives and rewards: A reward mechanism is designed to encourage autonomous vehicles to distribute Firmware updates for the consortium blockchain by maintaining a positive reputation for each distributor account in the blockchain.
- Overall, the use of blockchain technology in online payments offers a more secure and transparent alternative to traditional payment methods**.**

Merits and Demerits of Blockchain Based System
It's difficult to say what the specific merits and demerits of using blockchain for ride sharing may be, since the use of blockchain in this context is largely theoretical at this point.

Merits
- Here, a permanent and recognizable blockchain record is created by the decentralized, consensus- based check process, protecting against double spending without the need for third parties.
- The reputational system, verification standards, and time-locked deposit contracts all protect against dishonest users and drivers who provide unfair remissions or offers to other users and riders.
- It provides increased security and speeds up information revalidation. If a hacking assault modifies the information, it will reveal the specific block that was compromised, rendering the blockchain invalid.

Demerits
- Cab drivers are forced to submit to more thorough security checks, including biometric checks, but ride-sharing firms have a reputation of merely performing minimal background investigations on users and drivers.
- The amount of the data in blockchain makes it challenging to constantly maintain confidentiality and safety. The organization and communication between the sender and the receiver are hampered by the blocking of bogus requests.

- When a passenger confirms their arrival at the pick-up location, the down payment they made goes directly to the driver. Because of this, dishonest drivers may collect down payments without keeping to their promise.

Issues with ride-sharing or carpooling

- Cost Cases Owed to Interposers: When reserving taxis, third-party businesses are needed to handle the payment procedure, agent-shadowing, etc. Each of these intermediaries will charge a sizeable sum per sale. This will lead to a rise in the price for the passengers as well as a decrease in the hiring of drivers.
- Lack of Transparency: Numerous companies with a diversity of labor situations that are unfamiliar to both riders and drivers dominate the current, centralized system. Drivers and passengers are not informed of the causes of unpredictable freight adjustments and organizational procedures due to the influence of several undisclosed places. Additionally, the firm maintains its own database of all transactions and reservations, making it inaccessible to the general public and allowing any tone- verification requests from riders or drivers.
- Inconsistency in Data and Security: The organization's database houses a lot of private data, including the current location, contact information, and residential address of each drug user. Although associations offer a lot of training on data privacy and user validation, cases of pseudonyms and database breach are common.
- Worker exploitation by businesses: Ridesharing Due to their exploitative connection with employees, businesses are currently dealing with a labor situation. Businesses are being sued repeatedly for their labor policies. Due to the centralized nature of the exclusive system, commercial directors alone are responsible for creating labor rules, with no input from actual workers.
- Trust-Grounded Centralization: As stated before, the company is the rightful owner of a substantial database of user and driver data.. From the trust established by the drug users in the institution, credibility and accountability follow. Due to the Association's centralization, there is also a single point of failure. In other words, it only takes one dishonest act or one nasty rush for the exclusive system to fall.

Literature Review

o Matching key: The process through which an organization evaluates queries through both riders and drivers to find a good match. Routing and Time: Identifying comparable routes that can offer options and the quickest times. Dynamic Time Warping: This technique is capable of figuring out how two sequences with various phases and lengths diverge[7].

o Enhance Consistency: Most of the users are unaware of how ridesharing platforms operate. For instance, the recent spike in pricing is questionable. The system's users do not fully comprehend the price increase. Quick Transactions: Thanks to the decentralized network, riders and drivers would be able to connect more quickly and directly. It reduces the additional expenditures necessary as a result of the involvement of a central party in the current systems[10].

o Includes the following six stages: trip data generation, tendering and selecting, time-locked deposit protocol, fair payment, and reputation management. Drivers and passengers can find out if they are able share rides while keeping their trip information, such as the pick-up and drop-off locations, the departure and arrival dates, and the cost of the journey[11].

o Due to the decentralized nature of the system, no specific business or organization is needed to operate it. By removing the need on a central authority, this blockchain-based design also guards against malicious assaults and enhances security[17].

o Without a central system, drivers can offer transportation services. The passenger and the driver will be made aware of how to share trip details, secure their travel information, including "pick-up" or "drop-off" locations, arrival and departure timings, and secure payment using the Ethereum blockchain. Drivers and riders might develop a more user-driven, value-oriented economy using a distributed ledger[18].

o Maintains the ride's transparency, as well as the entire system is stable in light of the participants' increasing participation and frequency of rides. The platform enables the user to act as both a rider and a driver in accordance with his personal needs without switching accounts[19].

o   The ability of systems to run our proof-of-matching technique, which necessitates comparison bud filtration data at high rates, is the basis of this ecosystem. We demonstrated that we can use embedded GPUs to obtain 10K matches per second (10KMs) per node[20].

CONCLUSIONS

The present ridesharing/pooling services, while useful and frequently used, nevertheless have need for development in terms of pricing strategies, stoner safety, a loss of financial transparency, and data protection. All of these issues can be solved with the help of systems utilizing blockchain technology, which also offers new features with improved usability. Through the decentralized network of the blockchain, riders may communicate directly with drivers, cutting down on new costs. People with smartphones and secure modern automobiles have more request opportunities because there are no intermediaries. Due to blockchain's ability to establish accountability, users may evaluate how a lift-sharing business operates. Based on the essential pre-established conditions, smart contracts enable participants to employ peer-to-peer car leasing for two parties directly participating on the blockchain. As a matter of fact, it continually provides competitive rates, and the system grows more trustworthy and transparent. By providing a suitable ranking for riders, the limits ensure that drivers don't engage in any illegal activity. Blockchain technology, for instance, can be used to create customized bus insurance based on specific information obtained about auto operating. Similar to this, statistical studies demonstrate that an automobile spends a substantial portion of its lifetime inactive. Blockchain offers a way for large shareholders to make money off of their capacity to utilize it at a very high level and pay for transactions.

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Figure 1. P2P Flow Diagram

Figure 2. Flow Diagram of the System

Figure 3. System Architecture Design

Figure 4. Car/Ride Pooling Server
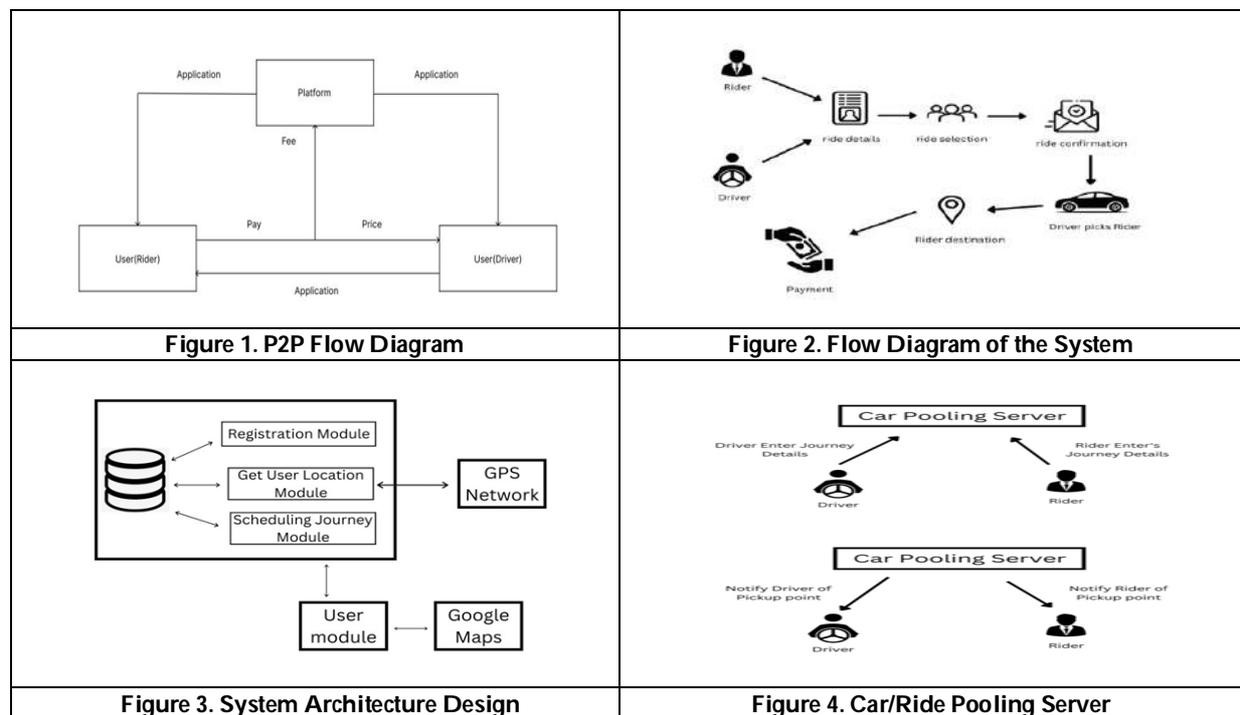
An Exploratory Study on Ensemble Methods used for Secure Data Transmission

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ABSTRACT

During last few decades, digital communication plays a vital role for various sectors such as healthcare departments, banking sectors, information technology companies, industries and several other fields. Nowadays, all data are transmitted over internet, which needs high protection for transmitting the original data from source to destination. Because there are countless ways to improve network security, we discuss the significance of coming up with hybrid approaches for providing high protection of data as well as resources. In order to secure digital communication, cryptography and steganography methods are used to achieve data security over insecure and the open networks like internet. We also explore various Machine Learning and Deep Learning strategies that can be used to develop secure environments. Cryptography is the method to encrypt the secret information in an unreadable structure. On the other hand, steganography is the technique to cover the secret data such as audio, image, text, and video. It can hide the message while transmitting the original information from one end to other end. Machine Learning and Deep Learning are usually applied now a days and they are used a solution to different attacks in network. In this paper, it gives an analysis based on the concept of Cryptography,

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Steganography, Machine Learning and Deep Learning. It also presents several data hiding approaches and its merits and demerits.

Keywords: Security, Cryptography, Steganography, Data hiding, Machine Learning, Deep Learning

INTRODUCTION

The fast improvement of science and technology has enormously worked with information transmission and search on the Web [1]. The digital multimedia documents including texts, images, videos and audios are more susceptible to hack due to the advancement of the internet. This problem increases the necessity of data security machineries for protecting the data from illegitimated access via shared medium. Nowadays, the cryptography and data hiding approaches play an important role in data security machineries. In cryptography, the secret data is converted into a cipher text without any meaning and hence it allows the authorized user to decrypt the data [2]. However, the meaningless of the transmitting message indicates the presence of secret info in the message and hence it is susceptible to unauthorized persons to decode the secret data. Alternatively, data hiding approaches conceal the secret information into multimedia files that reduce the doubt of the presence of secret data [3]. One of the famous methodologies employed for safeguarding sensitive information is known as data hiding. This hiding approach utilizes distinct media (e,g,. digital images, audio and video files) as cover elements for hiding secret data to generate stego-media [4]. A secured transmission system allows the transmitter to embed the data and the receiver to extract the data. The digital images are broadly utilized on the internet for different applications. Hence, one can utilize the digital images to make secure transmission. The data hiding approaches are utilized in the applications of military and medical data transmission for avoiding the third-party intervention or foraging [5]. Along with the steganography approach, cryptography is used to increase data security. Both methods play an important part in information security. When sensitive data is moved from one device to another, the encryption process must be carried out. By using encryption, you can guard against hackers accessing your data[6-7]. Integrity, authenticity, and confidentiality are a few of the primary objectives of cryptography. Then, concealing the encrypted data in order that nobody may surmise that a secret data exists. If three processing factors capacity, security, and image quality are taken into account, the steganography strategy appears to be a good one. Cryptosystem is required to implement a cryptographic method specifically for security services. The basic block of secure data transmission that used both cryptography and steganography is illustrated in Figure 1.

Cryptographic algorithms

Scientifically, cryptography makes the conveyed data more secure. A data encryption is provided by this approach to make secure transmission. In this case, the data is encrypted prior to transmission and decoded following reception. Cryptography uses secret key to generate cipher text from the plain text and this ciphering approach marks the plain text as unreadable format. Hence, the deciphering process can be performed only by the person who hold the secret key [8-10]. Cryptographic methods can be categorized as symmetric key and public key methods. A single key is utilised in the symmetric key approach to carry out in encryption and decryption tasks.[11]. The speed of Symmetric encryption is high even for huge numbers of data as images. But their usage is limited due to the problems of key management and distribution. The key might be intercepted by the adversaries while distributing the key in the network at the time of transmission. Furthermore, the number of keys will be incremented intensely while increasing the number of users, which signifies a trouble on the network. To tackle this issue, an asymmetric key encryption approaches have been developed. They utilized two distinct keys: public key and private key [12-13]. Here, the public and private keys are used for encryption and decryption processes respectively. The derivation of private key from the public key is not an easy task. However, the public key/asymmetric key encryption methods cannot be used for transmitting long-length data. Also, they provide lesser efficiency while handling with random length messages. This issue can be tackled by the use of randomly selected keyed symmetric encryption for encrypting the data and by the usage of a public key encryption method for encrypting the key utilized in the symmetric encryption method. This approach is named as the Hybrid encryption (HE) method [14-15]. Block

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encryption techniques are typically used by cryptographic systems, such as Data Encryption Standard (DES), Advanced Encryption Standard (AES), and other systems. But the conventional encryption approaches faced complications in scrambling huge quantity of data. Chaos holds several natural relationships with cryptography due to its randomness in nonlinear systems. Chaos system offers a suitable source incredibly to generate abundant pseudo-random sequences and construct nonlinear encryption mechanisms as well [16]. Hence, huge amount of keys can be generated rapidly with the use of chaotic systems. The security of any block cipher system is heavily influenced by S-Boxes (substitution boxes) because this is the nonlinear element in a block cipher system. Applying chaotic system for generating S-boxes and applying them to image encryption is the most promising field of chaos system.

Steganography algorithms

Steganography methods embed significant data into regular files for enhancing the protection of data transmission [17]. The secret data is embedded into selected cover image for obtaining the stego-image. The cover and stego-images are identical to each other and hence an unauthorized person is unaware about the presence of secret data on stego-file. Hence, it allows safe transmission between the transmitter and receiver [18]. Generally, the steganography methods such as least significant bits (LSB) every cover picture pixel contains an equal amount of hidden bits.[19-20]. As a result, the cover image's embedding distortion is of an equivalent magnitude. However, each pixel in a digital image has intricate statistical relationships among it. Accordingly, the nature of picture is consequently decreased while performing equivalent number of pieces changes in all pixels of cover picture. One of the most famous versatile implanting process is pixel difference histogram (PVD) steganography [21]. This technique inserted less secret info into the smooth parts and more into the edges. But, the pixel difference histogram (PDH) analysis could attack the PVD methods. In the last few decades, research priority of adaptive steganography has abruptly increased because of its greater undetectability. Nowadays, the steganography approaches are developed by minimizing the additive distortion that allocates an adjustment cost for every cover element and describes the distortion function by summing cost of all the cover elements. Data hiding method can be categorized as reversible data hiding and non-reversible data hiding based on restoration ability of the original image. The non-reversible data hiding approach allows the receiver to extract secret data alone. Hence, the receiver can't use the stego-image for any other purposes due to the distortion of significant data in the image. Alternatively, reversible data hiding method recover both the secret data and original version of cover image. Hence, it can be applied for wider range of applications than that of non-reversible method [22-23]. Furthermore, the data hiding method that generates single stego-image has very less embedding capacity. Hence, the embedding capacity can be improved by producing two stego- images. The data hiding method that generates two stego images are named as dual data hiding method. The total number of bits that are saved in one pixel is represented as embedding rate (stated as bpp). Alternatively, the total number of bits that are inserted into entire image is termed as embedding capacity. When the secret data is embedded into cover image, the visual quality of the cover image will be automatically decreased. Peak signal to noise ratio (PSNR) and structural similarity index measurement (SSIM) metrics are utilized for measuring the visual quality c2hanges.

Machine Learning and Deep Learning methods in security

A key element of artificial intelligence (AI), machine learning (ML) can be utilized to provide computer systems more intelligence in terms of context, patterns, and connections. Different hybrid ML techniques are being developed in addition to conventional security services to engage with threats at different network security layers. Machine learning algorithms can be used to improve an application's features and knowledge. Generally, machine learning algorithms take in and process data to find patterns relating to people, business processes, transactions, events, and so forth[24]. Detailed classification and various types of machine learning techniques are depicted in Figure 4.A larger family of machine learning approaches using artificial neural networks (ANNs) and representation learning includes deep learning as a part. Deep learning integrates a number of processing layers to produce a computational architecture for learning from data, comprising input, hidden, and output layers.

Literature Review

Independently cryptography and steganography gives secrecy to the information however they have some weakness. So as a third choice we can go for a blend of cryptography and steganography. A portion of the new examination works connected with the safe information transmission utilizing mixture way to deal with information concealing in picture handling are recorded as follows: Patani *et al* [25] proposed a 3-bit LSB method to embed secret data into cover image. Also, ECC algorithm has been utilized for keeping the data more secure while transmitting the stego images over internet. Wang *et al* [24] proposed a Compressed Sensing approach to perform joint selective encryption and data hiding for secure transmission. Here, the sign bits of the compressed sensing quantities have been specifically encrypted at the time of its quantization phase. Also, a non-separable histogram-shifting basis data embedding strategy has been proposed for inserting the authenticated data. Here, the sign encryption approach has been considered due to its randomness in Compressed sensing measurements based on random subspace projection. Zhang *et al* [26] presented a new data hiding approach by considering a multidirectional line encoding (MDLE) and integer wavelet transform (IWT). Initially, IDWT has been used to separate the image into four wavelet sub-bands. Subsequently, the wavelet bands have been split into 3×3 coefficient blocks for exploiting the embedding portions. Then, MDLE model has been developed for embedding data into blocks of 3×3 sizes. In addition, an edge detection approach has been proposed for embedding more data in the edge portions of the image. Kadhim *et al* [27] proposed a DT-CWT based image steganographic method for embedding the secret data into the suitable coefficient planes of cover image. Here, a super-pixeling and intensity mapping approach have been introduced to increase the embedding capacity without causing any embedding error. The embedding error has been minimized by measuring the similarities of secret data and DT-CWT planes through template matching.

They adopted machine learning models to select the optimal cover coefficient planes. The embedding process also generates a secret key to make support for the retrieval of secret data at the receiver. Zhang *et al* [28] proposed a spatial image adaptive steganography approach on the basis of Zernike moment. Initially, the cover image has been processed to obtain its Zernike moment. After that dithering process has applied to get alternative cover image. They used Spatial UNIversal WAvelet Relative Distortion (S-UNIWARD) and syndrome-trellis codes for minimizing the distortion of embedding process. At last, the Zernike moment has been changed based on the altered amplitude of cover image to get stego image. Yeung *et al* [29] minimized the flipping distortion over the measurement of local texture pattern (LTP) to construct a variable STC code in binary image steganography. Jiang *et al* [30] proposed an encrypted image-based data hiding (EIRDH) algorithm with homomorphic public key cryptosystem. Here, the image has been encrypted using Paillierhomomorphic public key cryptosystem. Also, the cover pixels have been exploited based on difference expansion (DE) approach for the construction of pairs of pixels to hide data. Bhardwaj *et al* [31] developed a block basis joint EIRDH method that performs the embedding process by considering m secret bits for each block. This improved the embedding rate and visual quality as well. Shaji *et al* [32] proposed an RDH approach based on dual encoding with sequence folding for the generation of dual stego images. Here, the data has been encoded using two encoding tables which included the index and message intensity based code series. When the previous or following half portion of the encoding tables have coordinated with one another, the code series in the 2nd encoding table would have been folded. Moreover, the extreme intensity of the codes in both encoding tables should be positioned at the most succeeding end to perform folding process. This procedure has been imitated for entire message intensities. Finally, the encoded data has been embedded into cover image to get dual stego images.

Lu *et al* [33] proposed a JPEG steganographic approach on the basis of auto encoder with flexible Bose-Chaudhuri-Hocquenghem (BCH) encoding. Initially, the autoencoder has been pretrained for fitting the conversion relations among the original and compressed JPEG image. Furthermore, BCH has been flexibly usedin light of the content of the cover image for decreasing the error rate while extracting the secret data. In addition, the robustness and statistical security have been improved due to the adjustment of Discrete Cosine Transformation coefficients on the basis of the real-time properties of JPEG channel. Lu *et al* [34] analysed and encoded the secret information by regulating the level of pixel distortion based on two factors namely, NC and MXD. The number of codes required for re-encoding a secret data has been controlled by the factor NC. As a result of this, the amount of code combinations has been limited. Furthermore, the distortion level of every code combination has been specified using MXD factor.

The occurrences of the secret numeric messages were used to assign a digital combination pairs for improving the encoding efficiency. Ertam *et al* [35] in their research offers a summary of effective hybrid deep learning techniques for internet security. They developed a hybrid solution for firewall security employing a variety of classifiers based on deep learning techniques. The data gained demonstrates that deep learning approaches are more accurate than machine learning techniques R. Geetha *et al* [36] has directed an overview on various ML/DI based strategies that can be utilized to guarantee security in network and furthermore to distinguish different assaults of various classification. They conducted a detailed analysis of various Machine Learning or deep Learning solutions to these attacks. Salloum *et al* [37] in their study focuses mainly on ML/DL and also on Data mining approaches for security. They discuss about different datasets used along with their advantages and disadvantages. In [38] Apruzzese *et al* conducted an extensive review on the effectiveness of ML/DL techniques for cyber security. They concentrated on categorising machine learning algorithms for cyber security and a detailed report has been given. They also relied on using machine learning algorithms for cyber security. Their research shows that there are still a number of issues with current machine learning approaches that limit their usefulness for cyber security.

Findings

Due to the advancement of technology, data protection is a major factor that cannot be compromised, which leads to multiple hybrid approaches. It clearly denotes the importance of security of data from the source to the destination from various attacks by the intruders. The existing approaches has their own merits and demerits which needs to be improved on every aspects. In future new techniques can be applied for the data protection and safe transmission along with the furtherance of technology.

CONCLUSION

Cryptography plays a major role to achieve the basic needs of security measures like confidentiality, no-repudiation, authentication and integrity. It has also involved in providing reliable, robust network, strong and data security. On the other hand, this paper also includes the steganography process for data hiding while transmitting the information. The combination of both cryptography and steganography method has achieved a secure transmission of data with encryption and data hiding. In order to reduce network security concerns, ML/DL-based systems are a necessity. According to this study hybrid approaches are the better choice for secure data transmission.

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Table1. Hybrid Methods and its merits and demerits.

References	Method	Contribution	Advantages	Disadvantages
Patani *et al* [25]	Steganography and cryptography	3-bit least significant bits for embedding; ECC algorithm for data security	It improved the security level.	Debase the stego picture quality since it disguise equivalent number of secret bits into every pixels of cover picture.
Wang *et al* [24]	Steganography and cryptography	Compressed sensing based sign bits encryption; non-separable histogram-shifting based data hiding	Robust against known error concealment attacks.	It degraded the visual quality level while considering image application.
Zhang *et al* [26]	Steganography	Introduced edge detection approach to embed different number of bits using MDLE	Improved visual quality of the stego image due to the embedding of more bits into edge pixels.	Not minimizing the distortion due to the lack of an efficient distortion cost analysis.
Kadhim *et al* [27]	Steganography	Introduced DT-CWT, super pixeling, intensity mapping, machine learning for optimised embedding	Diminished the inserting mistake utilizing super-pixeling and intensity mapping	Extremely complex due to the stacking of more signal and image processing methods
Zhang *et al* [28]	Steganography	Zernike moment and Dither modulation for cover extraction; minimized distortion embedding using S-	Robust to scaling attack	S-UNIWARD embedded a single bit per pixel. Hence, the detection probability of such approach is increased.

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		UNIWARD		
Yeung *et al* [29]	Steganography	Local texture pattern (LTP) to minimize distortion	Improved embedding efficiency due to the use of STC coding	Not well supported for distortion minimization because LTP didn't consider the statistical characteristics of Uniform Embedding
Jiang *et al* [30]	Steganography and cryptography	Introduced EIRDH algorithm with homomorphic public key cryptosystem	Increased payload capacity.	Vulnerable to quantum attacks due to the recent improvements in quantum computers
Bhardwaj *et al* [31]	Steganography and cryptography	Symmetric key cryptosystem for data encryption and block based embedding	Increased visual quality and embedding rate	The key can be intercepted by the adversaries in Symmetric key cryptosystem. Didn't adjust the embedding probability in each and every element
Shaji *et al* [32]	Steganography	sequence folding for encoding the secret data and minimum index measurement for non-uniform embedding	Improved PSNR, SSIM and payload capcity	Security level is decreased due to the lack of proper cryptosystem and the detection probability of such approach is increased. Susceptible to different attacks.
Lu *et al* [33]	Steganography	Autoencoder with an adaptive BCH encoding	Provides statistical security.	The embedding is followed by an auto-encoder for image compression While this is extremely complex, for the comparison and record.
Lu *et al* [34]	Reversible data hiding	Controlled the level of pixel distortion using constant parameters	High payload capacity	Not suitable for all kinds of image due to the use of constant parameters. They control image quality.
Ertam *et al* [35]	Deep Learning	Provide more accurate solution for firewall protection in network	Improved accuracy with better performance	Precision and recall values in the classifiers using deep learning techniques were found to be high.
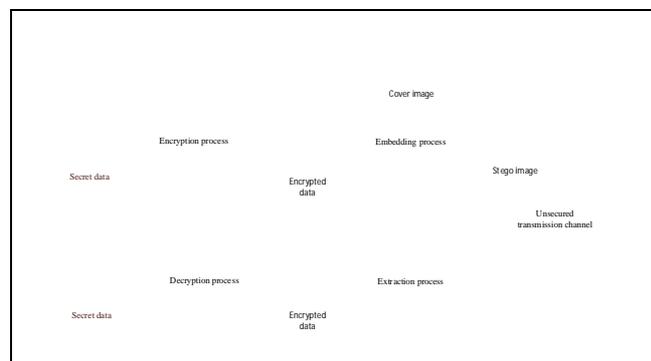
Figure 1 Secure data transission based on intelligent cryptosystem and data hiding process
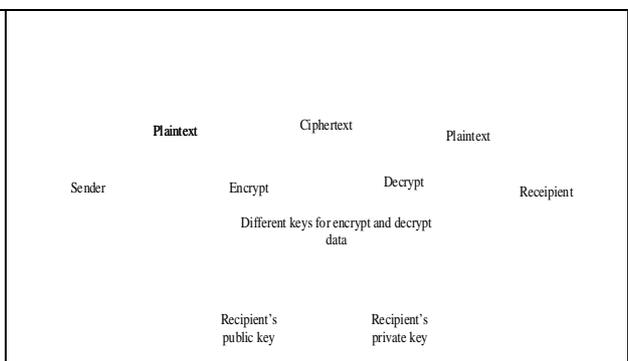
Figure 2 Encryption and decryption process

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Figure 3 Steganographic approach

Figure 4 Various types of machine learning techniques[24]

Figure 5 Various types of deep learning techniques

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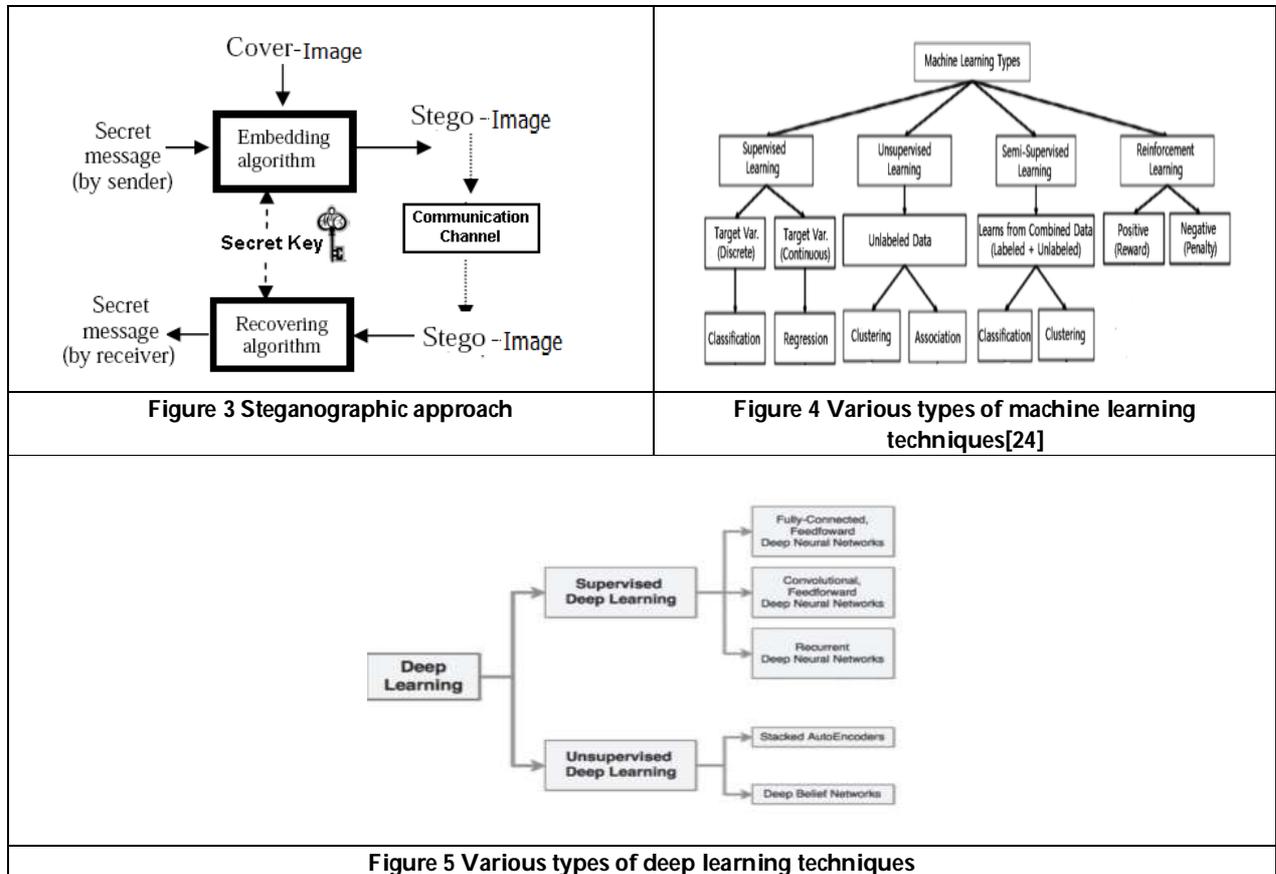
A Comprehensive Study of Machine Learning and Deep Learning Methods for Cyber Security Threats

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ABSTRACT

Smartphone innovation and its vast increase in everyday life have imposed severe security threats. With the recent advancement of the Internet, adversarial attacks are also increasing in fast phase. Data must be protected from being leaked or lost. Many Machines Learning (ML) and Deep Learning (DL) models are proposed for this purpose. Several models are designed for network security, like the convolutional neural network with Intrusion detection system, which categorizes network congestion packets into benign and malignant. Higher versions of this model were formed, such as Tree-CNN combined with Soft-Root-Sign (SRS) model and OCNN-HMLSTM (Hierarchical Multi-scale LSTM) for higher detection rate and accuracy. Also, AB-TRAP (Attack, Bonafide, Train, RealizAtion, and Performance) is carried out to build invisibility shields to protect the network devices and to train the machine learning model for evaluating the performance. Auto encoder is implemented for detecting zero-day attacks. The execution of various constructions that are based on Recurrent Neural Network (RNN) is compared by estimating to detect domain generation algorithms that attackers use. Brute-Force Black-Box Method is multifunctional; it is used against ML-based systems, Incorporating host intrusion prevention systems and antimalware systems for Android devices, and IDS. This paper compares various techniques for detecting several cyber threats that expansively involve ML/DL.

Keywords: Deep learning, IDS, CICIDS 2017, Machine Learning

INTRODUCTION

In the last few years, with the tremendous growth of internet and its capacities, it has become most popular option for the attackers for intrusion. It is critical challenge to build intrusion detection system (IDS) that detects all the malicious software. Malware creators create malware keeping in mind all the possible ways it could be detected and stopped. Therefore, security has become major concern as e-commerce, e-learning and other internet usages are

inevitable part of daily life. A single vulnerability in an organization system can cause large damage to organization. The main intension behind the attacking is to steal information, to get their control and earn revenue or to find new targets to take advantage. Cyber security is seeing an increase in the use of machine learning (ML) and deep learning (DL) techniques, where data-driven detection techniques exceed conventional signature-based techniques against emerging types of assault. It is employed to accomplish two vital objectives. 1) To spot practices of network tasks along with familiar threats through networks 2) To recognize concealed invasions that infringe the safety code in systems. An audit trail is grounded on two approaches: signature-based and anomaly-based. Hybrid ID approaches are also used.[13]This raises the need for building effective IDS which can prevent this malware from attacking. The main motivation of IDS should be to detect malware as early as possible and to classify the malware more efficiently than the traditional methods. IDS that have the ability of discerning zero-day attacks are the primary way of addressing the augmentation in cyber-attacks. ML approaches have been broadly employed for scheming and assembling sturdy detection systems. The current IDS frequently falls short to perceive new zero-day attacks because of its hindrance of the performance and their actual utilization in corporal implementation [11].

A primary analysis conduct to identify zero-day attacks depends on ascertaining circumstances that diversify from cordial traffic. Although, the major downside of these approaches is their proportionately shallow accuracy values. The elevated rates that are false-negative make the process prone to vulnerabilities, whereas the excessive alpha error values gratuitously preoccupy the schedule of IT security functioning centres [11]Domain Generation Algorithms (DGA) is a broad family of algorithms that help malicious software intermittently produces a heaps of hostnames that can be utilized as communication areas with control and command servers to receive directions on what to do with the infected host. It is possible to implement a variety of procedures to setup a DGA which outcomes in a scale of developed domains from consistently produced domain names, to the processes that try to act in accordance with the actual hostname administrations [12]. This paper provides survey on the different machine learning and deep learning methods that have been implemented to detect the malwares. This paper also provides overview of existing systems and comparison between different IDS system on their efficiency to detect unknown attacks, false alarm rates and performance comparison. This paper also gives suggestions on best model, depending on the method of attack. It also highlights various classification approaches, benchmark datasets, types and operations of intrusion detection system for the detection, and the carrying out of a plain methodology by making use of various RNN constructs to analyze DGAs. ML has got various approaches like supervised, unsupervised and reinforcement learning models. But deciding on the valid approach is a critical role for solving a particular issue [14].

IDS based on conventional neural network (CNN) system by [5] are built which can classify the network traffic into packet of chunks and divide them benign and malign and has capacity to identity new attacks. The complicated network traffic pattern is learnt using convolution and pooling processes of CNN. [3] performance of OCNN is optimized by CNN (OCNN) and HMLSTM has unified, which categorizes spatial features and HMLSTM which categorizes temporal features, which enhance the classification of network data automatically. This model used three datasets NSL-KDD, ISCX-IDS and UNSWNB15 for training and testing. Establishing a host site intrusion prevention system on the user computer meantime a network-site intrusion prevention system occupies on the network. Intrusion prevention network tasks by either trying for variations from normal activity or designation of known invective. These variations or irregularities are scan at the concord and application layer and moved up the stack. They package is great to find events including DNS corrupting and Christmas tree examine.[7]. A software application which is CMS is familiar with managing, create, and modify website content, such as sketch content, or format . Backend hardware and software that is a web server that reserve the information close with a network site and supply network site data to client. An injection attack is a poisonous code injected in the network which bring all the details from the database to the traducer. That invective permit an invective to insert code into a insert malware either program either query against a user in order to perform distant instruct this could be study or change a table, or change details about webpage. That traducer type is study a great problem in web security. In this paper hint to setup on antagonistic attack model depend on GAN called invective GAN. To perform efficient attack

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opposed to the Blackbox intrusion detection system created a new loss function on the premise of make sure in the network traffic purpose.[9] . In real time, finding vulnerabilities black box analysis takes place, that an traducer could utilize time the request is trot in making., the knowledge-based organisations are endangered to adversarial invective which is used to save cell phone clients from illegal access. In this paper, to keep away from the endless instruction of the GAN-fixed antagonistic invective techniques and produce adversarial sample more systematic . ourselves plan a latest and easy black-box invective technique called as the BFAM[8]. Brute-force attack method (BFAM) is a black- box invective technique, reduce the observation cost of the attack classifiers opposed to antagonistic poisonous samples extremely besides modify basis of poisonous sample.[8]

Related works

Learning based IDS models can predict with good accuracy. Tree-CNN with Soft-Root-Sign (SRS) activation function model [4], is evaluated using dataset CICIDS 2017, this algorithm was able to classify the DDoS, Infiltration, Brute-Force attack, and web attacks. This model was compared with the Deep Belief Network (DBN), the best results of the DBN model for DDoS was 0.96, Infiltration was 0.96, Brute force was 0.97, web was 0.98, whereas this model achieved higher F-measure, 0.99 for DDoS and web, 0.98 for Brute-Force and Infiltration. On an average this model reduced the detection speed by 36% as compared to DBN system. IDS based on CNN model [5], was also evaluated using CICIDS 2017 dataset, this model turned out to be better than the nine well-known classifying models in the category of multi-class. This dataset had 14 available attack classes, and for 10 attack classes this model reached highest detection rate (DR) than the available models. Also achieved lowest false alarm rate (FAR) and highest True Negative Rate (TNR). And this model has the shown potential for detecting unknown attacks, which were not able to detect by the traditional IDS models. The AB-TRAP (Attack, Bonafide, Train, Realization, and Performance) framework [16] was created for both local (LAN) and internet contexts to identify TCP port scanning attacks. This framework utilises the most recent network traffic and is replicable. The f1-score for LAN was 0.96 and the area under the ROC curve for a decision tree that used the least amount of CPU and RAM in kernel space was 0.99. With regard to the internet, an average of 0.95 f1-score and 0.98 average area under the ROC curve were produced using 8 machine learning techniques. Authors at [14], have looked into a comparison assay on criterion datasets CIDDS-001 and NSL-KDD by applying numerous deep learning and ML classifying algorithms. To estimate the accuracy and performance of datasets, six classification algorithms have been implemented. Based on the assessment standard effect, it is winded up that the suggested task based off of SVM, k-nearest neighbour, and deep neural network classifiers accomplish approximately hundred percent on the basis of performance appraisal benchmark on the NSL-KDD dataset.

One of the IDS's classification is anomaly-based IDS which performs better on unknown and complex attacks. Many researchers have developed several techniques to intensify the strength of IDS that are anomaly-based. This gave rise to the need of machine learning to detect cyber anomalies. CNNs and RNNs are approachable heavy studying algorithms in the branch of ID. A 1-D cCNN can be common to distinguish the or the original characteristics data or the network traffic characteristics data, can be set up on the invective effect of the heuristic, a voting method is proposed to determine even if the insert dataset are an invective whichever. Hassan et al. design a method depending on conventional neural network and WDLSTM hybrid heavy studying method to efficiently find web invasion, utilizing a heavy conventional neural network to derive important characteristics from intrusion prevention systems Big Data and a WDLSTM to store continuing holding between the deport characteristics.[7]. Android malware are increasing in number that has turn into a concern for both educational and industry. It is an approach to have accelerated and automated in detecting the mechanism significantly. ,DT, SVM, NB, and k-NN are methods usually utilized by educational and business analyst in finding humanoid poisonousTo resolve many exercise in that area intrusion detection together with spam filtering , malicious observation,ML methods are diffusely adopted. The ML methods were accommodate to determine a present ID support to control the variations of many kinds of data in web criticize and the non-identical dispensation linking the test place and the training place.[6]. In 2016, the DroidDelver was proposed. So be it is an cell phone malicious observation system utilize deep belief network depending on Application programming interface blockage.

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They had classify the Application programming interface label of the Smali cipher which be include in to the common process into a chunk.6]. Further task absorbed on the background grading of cell phone malicious and request, using the system Application programming interface-call ordered and calculated the usefulness of LSTM and CNNs.[6]. Over another method, focused in mechanical drone classifications extraction. Then next modify is drone app digit-cipher into RGB shade cipher. These outcome of encrypt shaded pictures, are pre-owned as insert classifications to conventional neural network that is teach along above   sum benign samples and sum malware examples.[6]. The two dynamic and huge testing fields are adversarial learning and malware detection. These take aside heavily to help on physical or semi-electric analysis of find design together with, organisation label , Application programming interface calls, study of app ,part, authority protected strings, opcode sequences ,and various fancy malware behaviour in a set Android Application package.[10] .The next modify is considering one organisation label order of an cell phone malicious and it is put it into two Long short-term memory speech design to teach malicious and warm examples.[6].The ML is globally applied in cybersecurity, in order to listen to Authenticated encryption, which create present warning to the ML form organisation in this place and control the extra request of ML methods in this safety- analytic record. They enlarge the Jacobian silency map attack to produce Authenticated encryption opposed to the heavy studying -form AMDS. They take on the box-force finite disk estimate of the L-BFGS algorithm to produce Authenticated encryption opposed to the heuristic in CPU sight in depth.[8].The criticize showing of inherited black-box antagonistic criticize opposed to heavy studying-design NIDS. The 3 in a way of black packet criticize technique are: zeroth-order development attacks, GAN-based criticize methods, and training a substitute model. These three in a way of black packet criticize technique is basically common to estimate the soundness of DNN for NIDS. [8]

Auto encoder comparison
In comparison with the most recently available implementation of auto encoder for discerning zero-day attacks, the NSL-KDD dataset auto encoder outperforms all the other auto encoder's performance. Considering a hybrid two stage auto encoder comprising of KDDTrain+ and KDDTest+ files, to detect abnormal and normal traffic, has lesser accuracy of results when compared with NSL-KDD approach [11].There are two intrusion detection techniques, that is, anomaly based and signature based that are implemented. But state-by- state protocol analysis performs superior to Signature based and Anomaly detection processes. It reacts on the application, network, and transport layer. To detect the divergence of suitable protocols and applications, it applies pre-decided vendor's description settings.[13].RNN based DGA classifiers perform well when evaluated on publicly available datasets. Manual feature creation is not required which is inconvenient to maintain, as it employs only the coarse hostnames as input.[12]

Integrated unsupervised feature learning and deeper neural networks against machine learningapproaches
In paper [2], a DL system for NID was put into practise and assessed. As can be observed in the test dataset, each larger category contained numerous new invasions. In comparison to test set accuracy, where fresh incursions are seen, the model performance was relatively good when it was trained and tested on the train- validation split. With a 0.793 accuracy on the test set, the deep neural network outperforms all other classifiers in terms of model fitting and accuracy. Despite performing less well at identifying the invasion trends in the testing dataset, its other systems appear to recur in the training samples. The Software - defined networking Network parameters are the focus of a different strategy for training and evaluating models. The proposal contains both a DNN with an unsupervised feature selection associated with it and a DNN without one. After conducting a study on hyper sparameter selection,.a 5-layer deep neural network was developed. A more sophisticated version of the traditional feed-forward network is the DNN. Along with the input and output layers, the DNN also includes a number of hidden layers, as its name suggests. A rise in the number of layers causes the disappearing and expanding gradient issue in FFN. The non-linear ReLU stimulation addresses the disappearing and growing gradient issue. ReLU aids in preventing weight disappearance due to gradient inaccuracies. ReLU is more resistant to the first-order derivatives functions than other non-linear functions since it doesn't zero for high positive and low values of the domain. An input layer, five hidden layers, and an output layer make up the proposed DNN architecture. The

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sigmoid activation function of the DNN output layer contains a unit that generates a score of 0 or 1. An attack is indicated by a value of 1, whilst normalcy is indicated by a score of 0.

Utilising Deep Reinforcement Learning techniques, defend botnet detectors from hostile attacks
In [17], While adversarial samples can be used by intruders to bypass current detectors built on machine- learning classifiers, they are getting more and better at detecting fraudulent network traffic. The shortcomings with existing systems make it virtually impossible for them to offer reliable security. The subject of evading assaults against stream botnet detectors is addressed by describing the first common approach that makes use of deep reinforcement learning to reduce adversarial fluctuations over machine learning-based intrusion detection systems for networks. Consider elements of a realistic cyber security environment, such tiny, reasonable changes to the input sequence, high levels of evasion with few queries, and evaluations of alternative defensive settings. When this strategy is put into practise, an architecture that automatically creates evading samples for a targeted botnet sensor is produced. The framework then makes use of these samples to take advantage of the detector's adversarial training-induced hardening. The proposed technique is superior to cutting-edge technologies in a number of respects, according to an experimental inquiry operation modelling real network settings of contemporary firms. Without impairing performance against well-known and creative evasion tactics, it enhances performance in non-adversarial situations. By sending the detector few more questions, the procedure of producing malicious samples can escape being discovered. This finding may open the door for more research into the creation of robust detectors that continue to function even in the presence of hostile disturbances in order to thwart evasion attacks.

Adversarial attack methods
Adversarial machine learning is a relatively new subfield that's concerned with developing algorithms and models that can handle someone trying to fool them. There are a lot of issues with models that aren't trained to deal with attacks at all, and it's clear that it's a very pressing concern for the use of machine learning in the real world. Generative adversarial networks are a class of neural nets that use an adversarial process in their training. There are two networks, one that tries to generate data like the training data, and one that tries to discriminate between the active data and the initiate data. The neural net is successfully trained when the generator can fool the discriminator, so training consists of the two fighting it out.[10]. GANs are used to produce data (text, images, etc.) and adversarial learning offer with classifying data, so there isn't really an clear connection between the two. The antagonistic invective techniques based on produce Auto encoder (AEs) can be classify as white-package and black-package independent on the understanding of the task heuristics own by the adversaries. The white-package invectives usually take it, that the adversaries possess the entire understanding of the attack heuristics including interior variable, teaching dataset, architectures. The black- package criticize to take it that the adversaries own finite understanding of the target heuristic, which avoid insert the design variable. This private source of the target classifiers is unspecified to the antagonistic usually. The white-package invective do not effort here even if the generative adversarial network-depend invective design require limited understanding of task heuristics, Authenticated encryption produce with it perform an outstanding outcome in ambiguous the attack design. The bring out operation of generative adversarial network-depend methods is usually unlimited since the agent is normally DNN whichever are consider as black-package designs.[8]

CONCLUSION

Social engineering tactics and advanced cybercrime strategies are aimed at computer users. Cybercriminals are becoming more adept and determined in some cases. Cybercriminals have shown they are capable of hiding their identities, hiding their communications, keeping their identities distinct from their unlawful gains, and using hard to hack infrastructure. In order to protect computer systems, advanced intrusion detection technologies that can identify modern malware are essential. It is important to have a firm knowledge of the benefits and constraints of the existing IDS research before developing and deploying such IDS systems. This work has an in-depth review of the methods, categories, and technologies employed in intrusion detection systems and discusses machine learning

techniques that have been proposed to acknowledge malicious programs as well as zero-day attacks. However, using such techniques could lead to a significant number offalse alarms or obsolete or inaccurate data about fresh attacks. This paper also covers how different auto encoders using the ML techniques, surpass each other's detection accuracy and also looked into a comparative analysis of various benchmark datasets by using various DL and ML classification algorithms. The existing approaches to detect the detects and their limitations have also been analysed. Different approaches have been evaluated using different metrics and the relevancy of the best approach is discussed.

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REVIEW ARTICLE

Automated Extraction and Analysis of Usability Attributes from Play Store Reviews

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ABSTRACT

Though a wide range of tools exist for depicting the usability of an app, the user reviews of the app on Google Playstore provide a plethora of information regarding the usability of an app, covering a wide range of test cases. However, the data is in a highly unstructured text format with noise in the form of emoticons, acronyms and abbreviations. The user reviews are of varying quality, and in some cases, the users have failed to fully express their intent. Previous studies stated that more than 60% of user reviews do not contain substantial information. The user needs and keywords in the reviews are usually domain-specific and thus require further insight. This demands the use of proper pre-processing and feature extraction techniques, to vectorize the corpus to machine understandable notations. Reliability and user satisfaction are some of the attributes that affect the usability. Our model was able to segregate the reviews to clusters. From the keywords obtained in the clusters, we assigned Reliability and Satisfaction scores to the applications.

Keywords: User reviews, play store, usability, Bag of words, cosine similarity, clustering.

INTRODUCTION

Society is impacted by the new development in technology. Mobile communication has integrated so much in our lives. There is no denying the fact that mobile phones are useful gadgets for our everyday chores. Mobile apps can be seen as a new and dominating medium and continue expanding their coverage and heading towards more mobility. Mobile application is a very aggressive market, there are hundreds of platforms to choose from. Because of many advantages, they provide a lucrative business and Google Play store is one among them. Play store provides user feedback in the form of reviews and ratings which would be helpful to app vendors for providing

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better services to the users. If app vendors examine reviews and ratings from time-to-time, it will help them increase the usability index. According to ISO 9241-11 standard[1], usability defined as - the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. According to Constantine et.al. [2], user satisfaction and reliability are some of the attributes that can affect the usability of an app. But, it is a very difficult task to calculate the user satisfaction and reliability by analyzing the user reviews because they are larger in volume and also in unstructured manner. Previous studies stated that more than 60% of user reviews do not contain substantial information[3]. Most of the users gave reviews with emojis and abbreviations. This demands the use of proper pre-processing and feature extraction techniques, to vectorize the corpus to machine understandable notations. We gave reliability and user satisfaction score by analyzing the user reviews and ratings. For this, we used exploratory data analysis for analyzing the reviews and identified the frequent words. Next, we pre-processed and vectorized the data. And then, extracted the features by using Bag of words and used cosine similarity distance model for finding similarity.

METHODOLOGY

Our model assigns the scores for reliability and user satisfaction of the app from the user reviews. It contains five phases namely data collection, exploratory data analysis, pre-processing, feature extraction and modelling the data and diagrammatically shown in figure1. We investigated the reviews from the two famous online shopping apps namely Flipkart[4] and Amazon[5].

Data Collection
The necessary reviews of "Flipkart" and "Amazon" were scraped from the Google Play Store Website. It is to be noted here that the website is auto/PHP- generated and thus the basic HTML tags are obfuscated. Hence we analyzed the webpage and found a recurring pattern in the occurrence of user reviews. This pattern was then supplied to a Regular Expression Parser[6], which then extracted the reviews and the corresponding rating given by the user. Sample review and ratings given by users is shown in figure 2.

Exploratory Data Analysis
Now that the raw data has been obtained, we try to gain a deeper insight into the data by performing some basic data analysis. First, we generate a Word Cloud for all the reviews obtained for an application to get the basic user sentiment associated with the app and shown in figure 3. Not only it is an effective visualization of the data we are dealing with, but also reveals the noise in the data as mentioned above, which is helpful as we can then deal with it accordingly in the pre processing phase. We have also collected some of the most common n-grams(n in the range of 1 to 3) in the data and shown in figure 4.

Pre-Processing
In this step, we remove the irrelevant and redundant information, to ensure that we can fit our model on cleaner data. For this, we undertook 3 steps.

Contraction/Translation mapping:
 To deal with contractions and abbreviations, we have created dictionary that contains the most commonly occurring word contractions and abbreviations (e.g. *isn't* is mapped to *is not, app* is mapped to *application* and so on). Since the reviews collected are for apps used by Indian users, presence of vernacular language is not uncommon in the reviews, Here, based on the results obtained in the WordCloud, we also add some entries in the dictionary to deal with the vernacular entries. We have also incorporated some measures for possible spelling correction, especially because we observed that users tend to frequently use repeating characters(eg. *The app is amazingggg !*). We have created a basic spell corrector based on edit distances as such trends hamper the performance of any model and hence need to be curbed as much as possible.

Stop words Removal

Our next step for cleaning the text is the removal of punctuations and stop words. Stop words are commonly used words in the English Language that do not convey any special meaning to the lexeme, and can be omitted without sacrificing the semantic expression.

Lemmatization

Almost all words in the English Language consist of base forms and affixes. The affixes create new word forms from the base, and the process is known as inflection. However, for our purpose, we need to obtain the base form, as otherwise, different affixes attached to the same base form (e.g. tenses) may impart different meaning, derailing our efforts in making a robust model. Lemmatization is the process of obtaining the root word from a given word. Unlike stemming, it yields a lexicographically correct word (i.e., the root word or *lemma* is always present in a dictionary). We have used the Stanford Lemmatizer[7] and snippet of lemmatized reviews are shown in figure 5.

Feature Extraction

Bag of Words*:*

We have used the Bag of Words model to obtain vectors from the text corpus obtained after pre-processing. Specifically, we have used the n-gram Bag of Words Model, with the n-gram range=(1,3)

Similarity Metrics

Now that we have obtained the vectors, we have to choose a metric to obtain the degree of closeness between two vectors. Out of the various distance metrics, we have decided to use the Cosine Distance to find the similarity between the vectors[8], which is based on the cosine\scalar product between two vectors.

Modelling

Clustering

We have used the K-Means clustering Algorithm[9] to segregate the data into clusters. Based on our distance metric, each cluster is bound to have a set of common attributes.

Labelling

Now that the clusters have been obtained, for each cluster, we inspect the keywords and bigrams (similar to step 2) to assign reliability and satisfaction scores for each cluster, based on our assumption that the reviews in the clusters will have semantic similarity. To prevent bias, the labelling process was done by 2 people, 3 times each. Conflict was resolved by a person not involved in the research.

RESULTS

From the labelled clusters, we proceed to fit the data to a Support Vector Machine[10], to create a model that is capable of predicting the usability parameters from a given user review. Table 1 explores the evaluation of reliability and user satisfaction from the reviews

Validation

Furthermore, to validate the results obtained from the model and the very nature of the data, we introduce a new factor

Data Trust Index

The integrity of the data collected is estimated by an ANOVA(Analysis of Variance Test) on the population, for which first we cluster a test set using our K-Means Clustering algorithm, like we did in our Unsupervised Learning phase. Now we classify each of the reviews in this test set with the Classifier we have trained. The f-statistic is: f=with

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in group(cluster)variance/between group(cluster)variance. This f-statistic[11]is used as a quantitative measure, which we have promptly named the Data Trust index and shown in figure 6.

CONCLUSION

Following the methodology stated above, we conducted the experiment for 2 e-commerce applications available on Google Playstore. From Table 1, we observed that the dataset is skewed, based on the clusters obtained. This is due to the fact that Users have submitted their reviews mostly when they have faced some problem in the applications, and have refrained from writing reviews when things run smoothly.

Further Research
In this work, we introduced a model for automated extraction and clustering of reviews. A proposed idea for further research would be to use novel deep learning techniques for sentiment analysis to assign the satisfaction index. Recurrent Neural Networks have been used for text classification tasks. For the aforementioned Usability attributes, various approaches can be explored to normalize the dataset, by means of data augmentation (e.g. synonym replacement), to ensure the inherent bias in the data does not affect the evaluation of Usability attributes.

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Table 1: Evaluation of reliability and user satisfaction from the reviews

User Star Rating	Reliabilty				User Satisfaction			
	Precision	Recall	f1-score	Support	Precision	Recall	f1-score	Support
0	0.96	0.98	0.97	195	1	1	1	5578
1	1	0.98	0.99	6826	0.99	0.94	0.97	1673
2	0.84	0.92	0.88	553	0.81	0.9	0.86	389
3	0.79	0.92	0.85	216	0.83	0.96	0.83	152
4	0.81	0.94	0.81	64	0.95	0.9	0.93	93
5	0.87	1	0.93	45	0.54	1	0.7	14
Accuracy			0.98	7899			0.98	7899
Macro Avg	0.86	0.96	0.9	7899	0.84	0.95	0.88	7899

Figure.1: Proposed model for investing the usability attributes from playstore reviews

Figure.2: Sample review and ratings given by users in one of the online shopping app

Figure.3: Word cloud of reviews

Figure.4: Collected n-grams range=(1,3)

Figure.5: Snippet of lemmatized reviews

Figure.6: Calculation of the data trust index

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RESEARCH ARTICLE

Survey of Technologies for Web Scraping

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ABSTRACT

The act of gathering information from websites and putting it on a spreadsheet is known as data scraping. An automated method for gathering copious volumes of data from websites is called web scraping. Using automated bots, the current web scraping approach can be made more accurate and error-free. An Intelligent model can be proposed using RPA, when projects require extracted data from hundreds or even thousands of web pages. The automated web scraping tools can do the job more quickly and efficiently. The goal of this paper is to present a study of various RPA tools that can be used to automate the process of information extraction from websites. This review paper also consists of the comparisons of different tools that can be used to scrape the data from websites. In this paper it is concluded by presenting the various tools used in Robotic Process Automation that can enhance the process of data scraping. This paper describes the extraction of various website elements such as images, product names, data migration, data entry testing, and so on. With the help of web scraping tools and automated testing, we can scrape all the content automatically by the official Lambda Test, Youtube channel and convert them into JavaScript Object Notation (JSON) easily and efficiently. So, gathering data for analysis using JavaScript can be automated with web scraping easily. The survey on RPA among the several years states, that the use of RPA bots are Increased year by year. The reason mentioned, By top IT Companies says that RPA bots or Applications using RPA reduces 19% of employees work and time consumption. In conclusion, RPA Technology is useful for web scraping, screen scraping, optical character recognition, information processing etc. The RPA bots helps in interacting with users and performs the actions of humans with software and digital systems.

Keywords: Web scraping, Data scraping, Robotic Process Automation, Intelligent model.

INTRODUCTION

Web Scraping is the Automation Technique used to retrieve Data and Information from the websites. It can be Google, Amazon or other HTML pages. The gathered data will be saved in user files, spreadsheets, databases, etc., where the unstructured data will be transformed into structured data for usage in a variety of applications. There are APIs on a lot of big websites that let you access their data in an organised fashion. However, there are some websites that either lack the necessary technological sophistication or do not permit users to access vast amounts of data in a structured format. In that case, collecting data from many websites using web crawlers is the ideal option. In Today's digitalized world the data is very useful, valuable of things with respect to individual or in industry. As data can be accessed by different sources, the most used one is web sites, Use cases for online scraping include looking at market trends and consumer reviews of a particular good or service. Web scraping has shown to bean effective tool for making sensible decisions. In multiple websites BOTS and CAPTCHA are introduced to secure the data from hacking or Dark web. Using RPA and its tools will help the users to utilize the website according to new designed way of installed bots which will guide and help in web scraping automatically, including log in, log out, information gathering and notification on next use. Research has proven that by using RPA BOTS reduces human interaction and mainly saves Time and Costs. Web Scraping Applications includes students ERP system automatic notification, Exam results etc, and in healthcare for booking online consulting doctors, Experimenting with OCR engines, Customer ordering processes. Captcha and RPA bots are made to gather, record, store, and display data. The RPA software survey indicates that it performs on par with 4 or 5 people. The best Tool for RPA Software is UIPATH Studio which automates the Web applications and data can be stored in spreadsheets for future works. For using RPA Software there is no need for any Programming skills to learn, this helps the developers. The RPA assistance device uipath is the studio used to create bots using different RPA features, Advanced automation techniques like screen scraping, data scraping, recording, and tasks like form filling, application transfer, website testing, and website production are all made possible by web automation. This tools also helps in calculating, completing tasks, writing programs and see the output in uipath path using various activities. Large amounts of data are collected from websites using web scraping. Python is one of the tools/platform through which we can scrape data from websites efficiently.

The following features attract python as one of the tools of web scraping:
1. Collection of libraries: Python also provides variety of different libraries to perform the scraping. The libraries such as Numpy, Pandas could be used in the web scraping process.
2. Need of a small code for performing large tasks: The main objective of web scraping is to save time. Python helps in writing a few lines of code, to accomplish the big task of scraping.

Technologies Used For Web Scraping
Web crawlers
A bot called a web crawler visits numerous websites and gathers information from them. A short list of links is loaded by web crawlers to function. When the program finds further links on those pages, it adds them to a new list called Crawl Frontier for further analysis.
The several varieties of crawlers include:
1. Focused web crawler
This kind of web crawler searches for web pages pertaining to a specific user field or subject. It tries to more correctly locate pages that are more pertinent. It ignores pages that are not pertinent to the issue and only downloads pages that are. The ranking of websites
enables this.
2. Incremental crawler
This web crawler repeatedly visits newly updated online pages. The content of the website is updated by these crawlers as they routinely visit web pages and save the most recent version of the page.
3. Distributed crawler

Assigning crawls to other crawlers is how these crawlers operate. Node synchronisation and communication are controlled by a central server.

4. Parallel crawler

Creates a parallel crawler by combining several crawler processes. This crawler will collect URLs from each process and execute URL filtering and fetching for each process.

5. Hidden Crawler

The hidden web refers to information concealed behind a website that the general public cannot access. These data are gathered by crawlers referred to as hidden crawlers.

Development of Web Scraping tools in Python
Beautiful Soup

The HTML and XML documents can be parsed using this Python tool. It assists in the creation of parse trees, which facilitate simple data extraction. For each parsed webpage, a parse tree is built, from which the data on the web pages can be retrieved.

Selenium

Selenium is a free, web-based automation tool that may be used to scrape websites. It is a library for web testing that is used to automate browser operations. Selenium includes a web driver with a number of features that let users move between various sections of a web page and extract data from that particular section. As a result, a lot of information from various web pages relating to the user's query can be successfully retrieved.

Pandas

Data analysis and data manipulation are done using this library. In order to store the data in the proper format, it is used to extract the data from the web page. Pandas library facilitates the scraping of different tables on the web page, which is obtained as a data frame. This data frame could then be converted to a .csv file or an Excel file.

Scrappy

This module is used to scrape data more efficiently and effectively. It also helps improve the performance of the scraper. Scrappy includes features such as creating a spider, running and then saving the data by scraping it.

Web Scraping Methods

UzunExt Mechanism

According to the author Erdinc Uzun[2], This model of UzunExt can be used to extract the data from websites using fewer resources and the extraction process can be completed in a shorter time frame. It's a two-fold mechanism which consists of extracting information from the webpage and to predict the values of the additional stored data. Without building a DOM Tree, UzunExt efficiently extracts content utilising string techniques and additional data. This approach's string methods extract data 60 times faster than the DOM-based solution does.

CRISP-DM

In scholarly web repositories, academic articles are centrally preserved and kept online. Due to the nature of the unstructured and semi-structured information/metadata within these archives, literature analysis for academic writing becomes difficult. This issue can be resolved by using CRISP-DM by creating a somewhat improved method for a pertinent literature search. According to the author Hossam El-Din Hassanien[3], In order to implement the concepts of systematic reviews, the Cross-Industry Standard Process model for Data Mining (CRISP-DM) is being used as the study technique.

Web Scraping using NLP

In this study, machine learning methods, Natural Language Processing (NLP), and the Natural Language Toolkit (NLTK) are utilized. This will facilitate the creation of logical text summary systems that employ an extraction

strategy to provide precise and fluid summaries. This tool's goal is to effectively extract a compact and coherent version of a lengthy text or input document that only includes the essential key outline points, avoiding repetition of language or material that has already been mentioned before the text. The authors Kishor Kumar Reddy C , Anisha P R ,Nhu Gia Nguyen and Sreelatha[4] have proposed asystem for providing users with accurate summary , along with the option to fetch and summarize content from the website itself.

RPA BASED WEB SCRAPING

Robotic process automation (RPA) is a Productive tool which helps the users to design the process to make particular process ready for automation, where some vendors refer it as "bots" to activate specific processes or projects in an automated fashion. Using RPA bots for web scraping does not make any changes in the existing systems. Although it is beneficial for saving much time and doing almost 20% of employees work as compared with, it works fast. The Analysis states that when RPA was found in Year 2012 slowly it started gaining popularity in Year 2014 and 2015 and that was the time when companies announced the savings from using automation. According to the author Vrushil Gajra[6],Based on Survey on RPA bots and humans comparison based on their performances says, Manual operation done by humans takes two mins 41seconds to complete a small reading email task, whereas By contrast, the robots did it all in 19 seconds, which states bots are seven times faster than humans. Using Robotic Process Automation, it automates the existing tasks and trains the software to perform the repetitive tasks. So, The current system will not be affected by introduction of RPA, so there is no need of modifying the existing systems. RPA helps in automation for Complex assignments and gives the result precisely.

The Advantages of RPA are
1. Boost Productivity Across the Board.
2. Improve Efficiency to Generate Savings.
3. Hit Accuracy Goals with Reliable Consistency.
4. Improve Business Data Security.
5. Seize Opportunities for Scale.
6. Create a Better Customer Service Experience.

These Robotic Process Automation, as a technology being increasingly used as a tool that allows users to do various operations like automating, management, analysis and updating the existing databases efficiently without causing any errors. The manually doing the process for input, indicates maximum in inefficiency and prone to error results which lead for unpaid for services that has been provided and it also increase the labor costs. Finally by Research RPA is used in Industries, Educational sector, Healthcare websites, Online Booking platforms etc.

The Applications of RPA in different Fields are
1. Web scraping in Student Management systems using RPA to create BOTS and Automating the management process. This paper is reffered from [1] its highlights is about the ERP system automating, managing and updating all the information for students it can be individually or in group also. The Notifications, prior activity notices, Exam results, assignments, posting posters (advertisements), via post on holidays etc.
2. Using RPA in automating the students Result Analysis, because large amount of students results input manually is difficult. RPA makes easier to store all students results in excel file in a shorter of time. According to the author Vaishnavi Vedantha [7], This RPA technology helps the educational institutions by this process of automation as entering the marks of each student will not get efficient time so, this platform completes the process less than efficient time.
3. As this automates the students marks from website to the excel sheet reduces the work of faculty, where in traditional way the faculty used to enter individual student marks which was time consuming. According to the author Walid Khalifa Abdullah Hasan [8], For this automation using RPA we use Uipath Tool for this process. Using UIPATH software helps the user to design and build robots by using various Tools which is available in UIPATH Studio. UIPATH has Data scraping option to directly select and start the process of data extraction from the website.

Using UIPATH features the restructuring of data format can be designed well organized view for users and PDF extraction is also one more feature by uipath.

4. Example: Using data scraping automation by RPA in E-commerce application. According to the author S. Ganesh [9], UiPath can extract data that most automation systems cannot even see because it resembles a real browser with a real user. UiPath goes beyond simple web-scraping techniques. It can log in to a website automatically, gather data from many pages, filter it, and then transform it into the format of your choice before integrating it into another application or online service.

5. Survey on Captcha: According to this paper author Asmita Kajrolkar[10], it tells the importance of Internet in every individual daily life. As data are exchanged via internet one system to another, group etc. To secure the Large data from attacks we use CAPTCHA. In computers, a challenge-response test known as a CAPTCHA is used to identify whether the user is human. This mechanism offers good security and try to reduce the automatic registration from hackers. The captcha are in different categories like Text, audio. Video. Images etc.

Java script Based Web Scraping

JavaScript is designed to add the HTML pages and the design of CSS in web development, in web applications .It consists of the dynamic typing, object orientation. JavaScript code is directly embedded into documents of HTML and when the browser loads the page, it consists built-in interpreter that analyse the JavaScript code then it finds in the page and runs the code.In modern web browsers, JavaScript code can be executed easily and efficiently. By JavaScript and Selenium web scraping , we automates the extracting data from the Internet and store it to do further processing by the manual process. According to the author S Sirisuriya [11], an automated jobs for the backend engineers. Analysis states that it was JavaScript and Selenium in which we needed a 20 job portals and return around a thousand jobs each through reliable web scraping framework. JavaScript and Selenium are the most open-source web automation framework which are used for Scraping, Scrapy Proxy, Beautiful Soup. There are most reliable framework for automating the testing of browser. By using Web Scraping analysis can be done easily by gathering data.

Advantages of JavaScript are

1. It is fast – JavaScript is very fast and more pages can be saved in very less time.
2. Not resource heavy – JavaScript scraping is not resource heavy, therefore can be used even as a background service.
3. Time Efficiency and Cost Efficiency.
4.Complete Automation and Data Accuracy.
5. Multi-environment setups – JavaScript can be used as a full fledged server scraping websites using Node.js and it can also be used for a quick automation script directly from the browser's console.

Computer can do all the manual tasks in just a few seconds, by using web scraping with JavaScript. The various tasks like analysis of data, implementing an algorithm across a large dataset is easier, faster and more effective than having someone read manually through every document one after the other. Web scraping gives the extract data and extract content by using bots and provides essential services at a ambitious cost as it's more cheaper than hiring a company to perform the same task. This will become more helpful for businesses that require data everyday, as they can save their effort, time and money by doing everything by their ownselves. Web Scraping is a accurate process, it is not only just a fast process. Finally by Research JavaScript is used in Web application, Mobile Applications, web Development, Games, Web server, etc.

The Applications of JavaScript in different Fields are

1. Web scraping for Finding opportunities for investment. According to the author Vanitha T [12], this paper highlights about the reduction of time, money, effort, etc., by putting capital to work., in hopes of a greater payoff in the future that was originally put in.
Investments will be diversified to reduce risk, as it may reduce the amount of time, earning potential. So, investing is absolutely essential for most people.

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2. Analyzing social media web data: social media analytics collects and analyzes the audience data shared on networks to improve decision of organization's business. According to the author Fernandez-Villamor [13], Marketers can analyze performance of various social platforms such as Twitter, LinkedIn and Facebook.

3. Gathering web data automatically by directly accessing the Hypertext Transfer Protocol or a web browser, using World Wide Web. According to the author Karthikeyan T [14], Web scraping can be done by a software user manually, the term refers to automated processes can be implemented using a web crawler or bot. Visual Studio Code, referred to as VS Code is a source-code editor which users can use it and users can change the, keyboard shortcuts, theme, extensions which add additional functionality and preferences.

4. Make a regex expression to extract emails: According to this paper author Smith-Unna R [15], Regular Expressions of JavaScript provide a powerful way to perform pattern matching on certain numbers or characters within strings in CSV file.

5. Survey on Captcha : According to this paper author Broucke S Vanden [16], CAPTCHAs has the features of adding security to various websites by providing challenges that are relatively easy for humans and difficult for bots to perform. CAPTCHAs are useful for preventing bots from automatically submitting various forms with harmful content and spam.

Comparitive Analysis
The performance of several web scraping techniques is summarised and compared in the tables below.

Comparison between various parameters of Regex, HTML DOM and XPATH
Execution time
The following table The execution times for each method of web scraping are measured and shown in Table below. The final row of the table displays the typical execution time after 20 test cases. According to the experimental data, the DOM HTML technique takes an average of 298.55 milliseconds, or 0.29 seconds, the regex method takes an average of 399.75 milliseconds, or 0.39 seconds, and the XPath method takes an average of 435.15 milliseconds, or 0.43 seconds.

Measurement of memory usage
The below table depicts the use of memory during the execution of scraping of web pages using Regex,HTML DOM,Xpath. The Regex method uses an average memory of 564KB; the average HTML DOMmethod uses the memory of 4.8 MB; the average XPath method uses 574 KB of memory. When compared to the HTML DOM scraping method, it has been found that the Regex method uses the least amount of memory.

Measurement of data usage
DOM requires the least data usage compared to the Regex or Xpath.The below figure depicts the calculation of average data usage. Thus from the above stated experimental facts pertaining to the performance measurement of various webscraping tools such as Regex, HTML DOM and Xpath, We may draw the conclusion that the Regex method for web scraping uses the least amount of memory compared to the others, and that the HTML DOM method executes more quickly than the Regex and Xpath methods.

Comparison of different web scraping soft wares
The below table gives a brief comparison of different kinds of web scraping softwares and their data exportformats.

CONCLUSION

Extracting the data and information through web scraping technology are the new activities in the technology. Though there are many companies which are still using the process of extracting data manually but Web Scraping will give solutions to transfer the traditional method of extracting data. With the fast growth in this space the day is not much far when it will become a trend and most of the organizations will realize the importance of scraping

technology and how it significantly helps in staying further to the competition. With Web Scraping API (WSAPI), enterprise customers receives the different solutions that takes into an account extraction of data and provide accurate and desired results in time. In this study, the bot performed showed the efficient and effective results. The data which is gathered by the RPA bot is almost efficient. The work that is taken by 19% of employees time, the bot developed with RPA done in more time as compare to humans. The activities like log messages which consists of contextual information, added directly into the sequence to improve the code readability and reliability. In RPA, the Simple workflow can handle in fast, effective and precise way while more complex workflow requires more work to be done in certain time limit. Web Scraping extracts the data from different websites in the unstructured format using javascript and python. It is useful to collect these unstructured data and convert it in a structured form. Startup companies prefer web scraping as it is a cheap, reliable and effective way to get a large amount of data without any partnership with the data selling companies. Web Scraping with JavaScript and Selenium, we have understood the benefits of web scraping, which cannot be emphasized, the different web scraping tools, and Selenium which stands as the best tool for dynamic web scraping tools and automated testing. It automatically extracts the titles and authors to generate an author matrix by scraping all the contents of Youtube channel and convert them into JSON. UiPath is referred to as the Robotic Process Automation (RPA) software for Windows Desktop which was developed to automate business processes and is an efficient tool that enables us to design automation with the feature of drag and drop. It helps enhance business performance by automating important tasks such as data entry, Online Booking platforms, Healthcare websites, testing, web and screen scraping. We can use UiPath as it is very efficient in restructuring of data format, it is well organized and is well designed for PDF extraction. Recording in UiPath allows users to record the different steps of a manual task and it can be turn into a flowchart. UiPath is highly user-friendly as it is one of the most widely known Robotic Process Automation (RPA) technologies as it helps automate tasks at affordable costs in less time and it can log into a website automatically and gather data from many pages.

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Table.1: Execution time

Experiment	Time (ms)		
	REGEX	**HTML DOM**	**XPATH**
1	375	297	406
2	375	250	407
3	390	360	485
4	391	281	859
5	391	454	422
6	382	265	390
7	446	266	406
8	322	281	422
9	325	265	406
10	377	500	438
11	294	250	391
12	286	265	375
13	422	266	640
14	390	266	390
15	516	250	375
16	406	266	375
17	406	250	375
18	594	282	375
19	391	407	391
20	516	250	375
Avg	**399,75**	**298,55**	**435,15**

Table.2: Memory usage

Experiment	Memory Usage (bytes)		
	REGEX	**HTML DOM**	**XPATH**
1	513.264	4.699.048	713.320
2	664.416	4.739.912	505.904
3	625.552	4.614.448	625.584
4	461.368	5.084.552	486.008
5	572.576	4.707.232	923.528
6	592.123	4.618.816	477.800
7	722.345	4.743.344	461.400
8	772.364	4.703.696	584.720
9	547.326	4.743.400	694.072
10	682.483	4.730.112	461.400
11	469.576	5.098.016	656.416
12	485.976	4.684.760	584.232
13	505.176	5.090.696	469.608
14	489.472	5.091.936	584.752
15	485.976	5.087.408	462.576
16	461.416	4.652.704	461.400
17	461.368	4.679.448	625.672
18	461.368	5.084.200	625.584
19	664.496	4.836.776	625.552
20	657.008	4.652.144	461.400
Avg	**564.782,5**	**4.817.132**	**574.546,4**

Table.3: Data usage

Experiment	Data Usage (Bytes)		
	REGEX	**HTMLDOM**	**XPATH**
1	22.155	6.285	24.790
2	26.758	6.285	11.037
3	27.629	6.671	10.293
4	31.596	5.911	9.705
5	26.758	6.993	19.005
6	53.245	6.297	22.165
7	34.165	6.297	25.921
8	22.456	6.619	23.324
9	34.274	10.529	13.236
10	124.341	8.539	10.039
11	307.084	16.614	9.487
12	52.223	11.749	19.649
13	29.628	16.355	23.625
14	30.188	18.747	18.543
15	32.796	7.257	13.725
16	32.184	6.671	10.963
17	32.875	8.240	11.547
18	28.872	5.911	20.987
19	28.180	7.489	27.246
20	28.494	6.607	30.110
Avg	50.295,05	8.803,3	17.769,85

Table.4: Comparison between different web scraping softwares.

Web Scraping Software	Operating System	Data Export formats
Visual Web Ripper	Win	CSV, Excel, XML, SQL Server, MySQL, SQLite, Oracle and OleDB, Customized C# or VB script file output
Helium Scraper	Win	CSV, XML, MS Access database, MySQL script file
Screen Scraper	Win, Mac, Unix/Linux	Text. HTML, SQL Script File, MySQL Script File, XML file, HTTP submit form
OutWit Hub	Win, Mac OS-X, Linux,	CSV (TSV), HTML, Excel or SQL script
Mozenda	Win	CSV, TSV, or XML only.
WebSundew	Win	Text, CSV, Excel, XML; SQL Server, MySQL, Oracle and JDBC compatible DB (Pro and Enterprise edition)
Web Content Extractor	Win	Excel, text, HTML, MS Access DB, SQL Script File, MySQL Script File, XML file, HTTP submit form, ODBC Data source
Easy Web Extract	Win	Excel (CSV, TSV), text, HTML, MS Access DB, SQL Script File, MySQL Script File, XML file, HTTP submit form, ODBC Data source

Table.5: Comparison between web scraping solutions

Specifications	Manual operations	Customizing Web Browser	RPA
Capacity of scraping	Humans would take more pressure because all operations are done my manually.	The web scraper called chromescraper does scraping operations but one page at a time.	ElectroNeek's is a RPA tool which is used in web scraping bot and it can scrape any amount of data.
Expenses	Its cheaper compared to another two options.	Inexpensive as a paid option. Popularextensions: like ChromeScraper, Outwit-Hub Firefox	Has it does more work than another two options comparitively the cost reduces based on subscription.
Duration / Time	It is based on more data scraping then more	The process is faster than manual one but slower than automation.	It is faster than another two technologies.

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	time consumption.		
Efficiency	More errors occur	Prone to error : Less compared to manual.	Error free .
Flexibility	It's easy to do, but it's all manual, which limits human capabilities.	Less flexible than RPA when it comes to customizing and handling its UI elements .	Installation is easy. It can also handle complex UI elements.

Fig.1.Parsetree

Fig.2.PandasDataFrame

Fig.3.ScrapyWorkflow

Fig.4. Uzun Ext mechanism

Fig.5. Crisp-DM methodology

Fig.6. RPABENEFITS.

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Fig.7.Web Scraping in UIPATH.

Fig.8.Variety of Captcha.
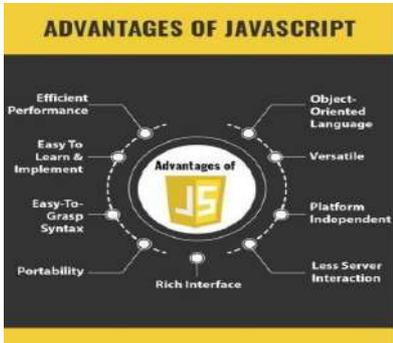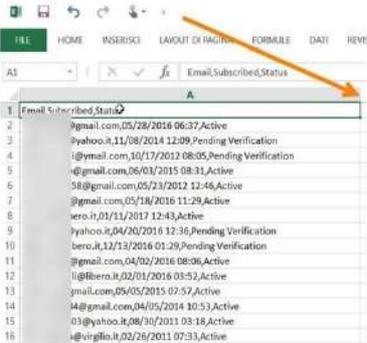
Fig.9. Advantages of Java script.

Fig.10.CSV file.

Fig.11.Captcha

Fig.12. Process of Web Scraping

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REVIEW ARTICLE

Efficient Methodologies used for Resource Allocation in Fog Scenario- A Technical Review

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ABSTRACT

The value of cloud computing in tackling the analytically demanding requirements of implementations has already been established. Due to the considerable delay induced by network connections to data centre and excessive dataflow, which may congest the network, cloud computing is not advised for latency-critical applications, despite its widespread use. Fog computing was created to solve this issue by enhancing the quality of service for these latency-critical applications and expanding the computing performance of Cloud computing. Fog devices are far more important to human beings than data centres. One of the most difficult challenges in running Internet of things in a fog environment is the issue of resource allocation. In order to give a full overview of the research examined planning and performance and what dilemmas require future care, the goal of this paper is to assess previous work on resource allocation as in mobile cloud using a multi - method project technique.

Keywords: Fog computing, Resource sharing, Resource allocation

INTRODUCTION

The study of the network of the businesses of interest to both academics and business. A revolutionary concept called fog computing involves relocating cloud-based networking, storage, and processing to the network's edge.. As a result, it's crucial to protect and use fog resources. Fog nodes are the areas where the fog congregates. Each fog node is made up of several edge devices, such as switches, routers, and edge devices. Administration and maintenance are challenging since fog node equipment is typically located far from the operator's facilities. Different architectural styles and structural layouts may be present in these gadgets. various skills. A fog node may include devices like as switches, servers, routers, and more. Because of this, certain edge devices may contain specialized or potent computing resources like Graphical Processing Units (GPUs), enabling them to handle difficult and

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complicated computational tasks. Other devices could have a lot of storage space, which makes them better suited for caching and storing at the network's edge. Finally, some devices, like switches and routers, can manage more traffic than others due to their great networking capabilities and modest computing capacity. Due to the possibility that certain devices may be expected to do activities for which they are not best equipped, the lack of knowledge on the capabilities of devices at the fog nodes may lead to unneeded delays. Consequently, revealing the fog's resources devices to the supervising entity will assist in effectively sharing the fog activities. In fact, the supervisory entity can use this data to create suitable resource allocation plans.

Literature Review

In a fog environment, the old technique is less effective in identifying and preventing deadlocks. As a result of resource heterogeneity (there is no single conventional resource distribution), the fluctuating demand for resources, resource restrictions, &specificity constraints, numerous challenges occur in fog and cloud formations. By handling quick and emergency resource and service allocations in very efficient and effective ways, fog computing will be advantageous. Table 1 summarizes the research work and its features, which were reviewed and classified using some parameters to determine the existing resource allocation algorithm. This review and advice will be useful for our future research. The characteristics and problems of the traditional resource allocation technique using fog computing are described in Table 1. The rule-based algorithm [16] improved resource utilization and reduced latency. It does, however, have some limitations, such as the need to address the cost issue and the low rate of competition. PTPN [17] has improved resource utilization quality and meets the requirement of the user. The main disadvantage is that verification for average completion time and proper service to users is required. The computationally allocating resources issue is resolved and cost conversion is enhanced by a modification to the Lagrange multiplier [18]. This methodology's drawbacks include the necessity to reduce delays and queue length as well as mobility during the offloading phase. Despite a superior adaptive feature extraction and a cutting-edge local image cache, F-RAN [19] has big flaws, including a major partnership issue and the demand for more mobility.

The NOMA-based F-RAN may have high net value and lower resolution latency in long frequency [20]. The main issues in this situation are the inflexibility of the transmissions and the rising costs. Instant communication is made possible by the selecting the optimal bandwidth classification method [21], which achieves extremely low latency. This methodology's limitations include the need for reduced energy consumption and improved user performance. The MIST FOG-based scheme [22] achieves high computing performance while also addressing cost efficiency concerns. It does, however, have some drawbacks, such as the requirement for real-world trial execution and mobility improvement. The formula for crowd sourcing [23] as cost savings and reducing the sum of violations. main the drawback is that resource utilization and energy consumption must be improved. To implement the double-auction-based method, the greedy algorithm was used [1]. [6, 14, 25] papers address dynamic resource allocation with a variety of factors, including unused resources and heterogeneous resources. For [3] Capacity dispersion is done in a real fog area, and for [11], a map lowering process is employed. Our technique enhances scores. but had to manage tasks with the same hold. With [24],the execution cost in mobile cloud is reduced by utilizing context-aware scheduling algorithm. Parallel execution [15] avoids deadlock resolution duplication but does not support generalized resource requests.

METHODOLOGY

The major feature of the resource allocation strategy is that it does enable consumers to install any added hardware or software in order to utilize the services or develop apps. Utilizing both algorithms For scheduling, use model - based list timing and flexible min-min planning and control. is effective and efficient in terms of resource management. The scheduling process is based on input from the work task in their model, which gives an online setup for proactive task scheduling and use a min-min method on Application hosting devices and systems. Secondly, their technology analyzes general virtual server performance in terms of cloud computing. The key strategy in this segment's procedure is to actively control Virtual Machines in a bid to boost resource usage and bring

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down prices. The technology has shortcomings, as well as a movement during the unloading phase, the need for variations in line length, and delays. has certain limitations, such as a massive problem with resolving collaboration and the need for better skills, but it also has some advantages, like smart edge caching and a base for excellent model selection. This technique demands a boost in user performance and a reductions in energy use. High computational performance is delivered by the MIST fog-based system, which even solves cost-effectiveness problems. Nevertheless, there are numerous issues with it, such as the needs for mobility growth and use in practical trials. Organizations and clients will download programmer at any computer with connection to the internet using the strategy without having to submit their personal information. Technology enables often more efficient computing by unifying storage, memory, bandwidth, and delivery.

CONCLUSION

The study's main goal is to look at resource allocation processes that are relevant to fog computing across a wide range of industries. Because of the erratic incidence of the Iot devices , fog computing, but instead big data within the perception of cloud and fog computing, it is immensely difficult to investigate cloud and fog offloading strategies that can satisfy users' service quality. In order to manage assets and resources, the authors looked at processes, targets, and qualitative beliefs in task scheduling papers. More research will be needed in the future to address the issue of the poor service in FOG computing. To address the problem, the authors will offer a better resource allocation plan. Fog simulators like FOG-Sim or i-Fog-Sim will be used in this research to access latency-sensitive resources in smart cities.

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Table1: A summary of research findings and their characteristics

Reference Paper	Aim of the paper	Algorithm/Findings	Future scope
Paper 16	To decrease competitor ratios and pricing problems	The development of a rule-based algorithm	
Paper 17	To ensure the typical completion time in order to guarantee users receive quality service	Timed Petri nets (PTPN) algorithm	Use Metrix for fairness and average completion time to validate.
Paper 18	Improvement in queue length and delays as well as dynamic movement throughout the unloading time	Low-complexity sub optimal Lagrange multipliers algorithm	Add more fog nodes to the scenario and incorporate dynamic allocation of resources.
Paper 19	Improvements in various caching and model options that are crucial for resolving cooperation issues	F-RAN for EE and SE in F-RANs optimization	Develop IoT applications for smart cities, industrial automation, and mobile vehicle connectivity.
Paper 20	Use cost-effective and adaptable transmission methods.	F-RAN based on NOMA	designed to provide more transmission flexibility

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Paper 21	Client efficiency is improved while power usage is reduced.	Optimal transmission rate selection algorithm	
Paper 22	Testing in the real world revealed improved mobility.	MIST, a fog-based data analytics system	Enhance the architecture by adding a selective sensor module to the fog layer.
Paper 23	Enhancing resource use, lowering energy consumption, and integrating the network's sparse resources	Algorithm for crowd-funding	focusing on the price of service providers and energy use in data center's for fog computing
Paper 1	constructing an efficient multi-resource distribution using trends in a huge data center	A pattern-based mechanism is proposed	

Table 2: **A summary of research findings and their characteristics**

Reference Paper	Aim of the paper	Algorithm/Findings	Future scope
Paper 14	To develop a resource allocation strategy that meets user requests and maximizes storage capacity	A speed increasing (SI) and a speed switching (SS) method	Examine the cloud system with a diverse user base and one that experiences varying rates of user entry and exit.
Paper 6	A dynamic task resource allocation approach based on double auctions	Dynamic programming strategies and an evolutionary algorithm	A procurement auction that allocates underutilized resources and boosts revenue
Paper 25	Resources allocation heuristics for stochastic dynamic tasks	Markov decision-making	Expand the scope of the multi-agent systems' collaborative or cooperative problem-solving
Paper 3	Improved delivery of low-latency services and faster service access	Application algorithm with QoE awareness	Analyzing the performance of the proposed policy in a real-world fog environment
Paper 11	Utilizing service-level agreements and constraint programming, Map-Reduce schedules and distributes resources.	Technique for resource management based on constraints MRCP-RM	Higher priority tasks are more likely to be completed by their deadlines because tasks with the same priority are given access to resources before tasks in a lower priority class.
Paper 24	Resource scheduling and allocation for mobile clouds with context	Program schedule (M)	
Paper 5	utilizing a combined optimization framework to get the best resource allocation strategies	Pairing of subscribers to a fog node data service using a many-to-many matching method	

RESEARCH ARTICLE

A Study on Intelligent Context-aware based Explainable Recommendation Framework

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ABSTRACT

The prime significance of contextual information has been recognized via researchers and practitioners in many fields together with e-trade personalization, information retrieval, ubiquitous and cellular computing, information mining, marketing, and control management. Tremendous research has already been finished in the area of recommender systems, however maximum of the existing approaches do no longer consider additional contextual facts including time, area, being with different people (ontology based) and so forth. This paper depicts that relevant contextual information is essential in recommender systems, and this is, when making suggestions. In distinctive phrases, historically recommender systems address packages which have simplest two forms of entities, clients and items, and do not put them in context while giving guidelines or suggestions. But it is able to no longer be enough to recall most effective users and gadgets. For example, the use of time context, a tour recommendation machine could offer a winter holiday advice which can range extensively from that within the summer time. Likewise, for customized content shipping on a website it's far essential to decide what content wishes to be introduced (advocated) to the client and when. On this basis, we have researched over many published papers, analysed, understood and decided to make a survey on this topic. Furthermore, we have examined the domains that should be valued to enhance recommendation system in many aspects. Each selected article was evaluated for its ability to improvise our decision-making model. Our findings emphasize and accentuate the importance of contextual phrases, cognitive ability, user feedback in efficient recommendation of items to users and also the benefits of improved accuracy by optimization of data sparsity.

Keywords: Cognitive Science, User behaviour, Context Aware, Recommendation Systems, Intelligent Decision

INTRODUCTION

The past decade has seen the tremendous proliferation of P2P networks, PDMS, the Semantic Web, collaborative Web sites, and e-commerce, creating an overflow of available information Adomavicius *et al.,* [1]. State-of-the-art records systems process large amounts of content material and therefore provide a large range of outcomes in reaction to person queries. Situational cognizance provides a clearer knowledge of how specialists combine expertise in the course of hassle solving, offering a not unusual basis for decision-making and expertise sharing. This lets in customers to differentiate among related and secondary content material. A Recommender System (RS) is an effective tool designed to conquer the hassle of facts overload by means of imparting customers with the maximum relevant content. guidelines are calculated with the aid of predicting how users will rate a few pieces of content. Collaborative filtering (CF) is a widely used approach for generating recommendations. The fundamental precept is that recommendations can Guibing Guo [2] be made based totally on the scores of like-minded customers. But the CF inherently suffers from two serious problems, that is the trouble that this study ambitions at. Data sparsity refers to the problem of finding sufficient dependable comparable customers. this is due to the fact active customers normally rated best a small subset of articles. *Cold Start* refers to the issue of producing accurate guidelines for cold users who have evaluated only a few objects. rating predictions are normally based totally on person profiling models that summarize preceding person behaviour. More lately, agencies have all started incorporating contextual information into their advice engines. for example, while deciding on a consumer's music, source Tone Interactive Radio considers the temper (context) of his current listener that they specify. For music recommendations, some contextual data, which include the listener's temper, can be critical in offering better suggestions. however, it is not yet clear whether context subjects for other broader recommendation programs. Belkadi *et al.,* [3] these observations are constant with behavioural research of purchaser marketing choices that located that selections are not invariant but dependent on the context of selection making. accurate prediction of consumer alternatives therefore certainly depends on how well the recommender gadget integrates applicable contextual statistics into the advice process.

Here is the rest of the survey paper Section 2 presents a literature survey, Section 3 continues with a description of the domain, Section 4 continues with data preparation, and Section 5 continues with the strengths and weaknesses of recommender systems. Analysis of the dataset, section 7, finally presents analytical visualizations and conclusions.

Litreature Survey

"Which watch should I buy?", "Which music should I listen to this evening?", "Which country should I visit on my next vacation with my family?" Should I bring one?" - These are very common examples of indecision, often asking for advice from friends and acquaintances. Sadly, almost all of us have had the experience that even with the best intentions, it often doesn't work out in practice because the tastes of others don't always match up with our own. These suggestions are often biased as well. Other insane options we can endure are trying complex theories, diving into the internet, wasting time on complex reviews and suggestions, hiring experts, following the herd, etc. The point is that it takes a lot of effort to pick out accurate suggestions on topics that might interest us. Pramanik *et al.,* [4] described that having a personal advisor to support us in every decision-making process would be of great help. Happily, there's one in the form of an internet application known as the Recommender system (RS). RS is a smart, pc-based technique that allows you to make predictions and pick items from a giant pool of online content based on user reputation and usage. Most Internet users have surely come across RS at some point. For example, Facebook recommends a prospect, YouTube recommends the right video, Glassdoor recommends the right job, TripAdvisor recommends the right vacation destination, and Good reads recommends an interesting book. RS has been surprisingly well-received in e-commerce scenarios. Online business portals (Flipkart, Myntra, Amazon, etc.) use RS to gain clients by offering a high volume of products that they are sure they will love. Jeong *et al.,* [5] put forward a recommendation system based on deep learning that considers user, item, and context characteristics. An auto encoder was used to extract features as input, and a neural network uses the scoring output as a target. The proposed method has higher performance and accuracy than existing methods, especially for datasets with data sparsity issues. Hassan et al., [6]. The motive of clever media-based context-aware RS for studying were to provide internet users with an appropriate studying experience that matches their choices concerning the kinds of materials

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they will need to enhance their learning activities. It became to assist discover items and researching user options and context for correct and useful recommendations. Almost all students have access to smart devices and diffusion of studying substances to be had on the net, making a sizeable contribution to the field of technology-better gaining knowledge of (TEL). Knowledge-based recommendation systems genuinely use understanding. Recommender systems claim to behave intelligently in the event that they have capabilities such as expert representation, gaining knowledge of capability, and reasoning mechanisms. Aguilar *et al.,* [7] Combining those abilities allows knowledge to be broadly used, updated, and derived. Based on these ideas, this paper proposes a brand-new form of recommender system known as the intelligent Recommender system (IRS), that's an extension of knowledge-based RS. The IRS considers studying algorithms, understanding representation mechanisms, inference engines, and greater. This defined the IRS and mainly describes its additives and the relationships between them. In this paper, they proposed a holistic personalized recommendation framework that includes two-character models and one ensemble model based on joint matrix factorization and cognitive information mining. More than one separate method examines unseen relationships between Yin *et al.,* [8] users extracted from the following records in the API.

It also explores hidden relationships between APIs extracted from content information. They proposed an ensemble model. They conducted and did ample experimentation, crawling huge dynamic real-world datasets and comparing our framework to existing methodologies. Experimental facts show that our methodology achieves the best efficiency. Beheshti *et al.,* [9] gives a new kind of information-driven, knowledge-driven, and cognitive-driven recommender system: a vision of cognitive systems. Cognitive decision-making systems understand user choices, detect diversity in user choices over instances of time, predict unknown user preferences, explore adaptive mechanisms, and provide intelligent recommendations within federated and changing environments. It becomes a new type of intelligent recommendation system that enables action. In this paper, a motivational scenario in banking and argue that existing recommendation systems: (i) will not use domain expert knowledge to adapt to new situations; (ii) will not be able to predict the choices or reviews that's customers will give to products (such as loans, deposits, or escrow her services); (iii)may not support the collection and analysis of data related to customer cognitive activity and used to give an intelligent, brave, time-sensitive suggestions. A Collaborative Recommender system depicts articles to customers based on the decisions of different users. It was assumed that people who previously had comparable choices are more likely to share similar preferences later. Mohamed *et al.* [10] explained that in many large applications, both the number of products and the number of consumers are large. In these cases, the consumer-product interaction matrix can be very sparse even though many events are recorded. This problem commonly referred to as the sparsity problem has a significant negative impact on the performance of collaborative filtering methods. Since it's rare, the similarity (or correlation) between any two users given consumers is likely zero, rendering collaborative filtering useless. Many models were built and deployed as solution for sparsity problem in Recommender systems. Behera *et al.,* [11] compared such different models which were built to handle data sparsity problems in the Recommender system.

An intelligent model was also deployed by them in which the item metadata was used to handle data sparsity and non-linearity. This embedded metadata was given as input to the Deep Neural Network model as input. This method of Embedding metadata to handle data sparsity gave good accuracy score as compared to other models. Nilashi *et al.,* [12] proposed a model using Fuzzy logic approach to handle Data sparsity in Recommender systems. The travel Recommendation system was taken as the best domain to implement the proposed model since Covid-19 outbreak resulted in decline of hospitality and tourism industry. Techniques such as Expectation Maximization was used to cluster data, Higher order Singular value decomposition was used to reduce the data dimensionality for similarity identification between user and items. Adaptive neuro-fuzzy Inference system was used for predication and recommendation purposes. Ladislav Peska [13] showed that the user remarks should be taken into consideration with recognize to the context of the page and device. Numerous features were describing such context and contain them into the person remarks feature space. In the purchase prediction task, the usage of context really progressed performance of all mastering methods in predicting purchased objects. A recommendation model was proposed by Salina *et al.,* [14] *via* mining sentiment facts from social client's reviews. They combined person's common sentiment, mutual sentiment influence, and object popularity similarity into a factorization framework based on unified matrix

to gain the top-rated prediction venture. Assembled interpersonal sentimental affect amongst individual and friends. The results showed that sentimental influences make excellent impact in prediction of top-rated items. Also, it indicates huge benefits over present techniques on a live dynamic dataset. Rohit *et al.* [15] introduced a revolutionary approach in recommendation device. The proposed technique used content evaluation. The supervised learning technique was utilized in context material evaluation, it offered an idea of the text categorization algorithm based on the models with cognitive inputs to search the applicable information products primarily based on a number of the credential files.

Domain Explanation

Context aware recommendation system

Traditional recommender systems focused only on users and product under consideration. Given that contextual factors can influence user choices when choosing items, this kind of data further improves the performance of systems. Yujie *et al.* [16] explained with an example that if a user watches a movie by herself, she may use the existing recommendation her system, but if she watches it with her children, she may more likely choose animated movies. When making recommendations for music to users at their home, the emphasis is either on the trendy music or on their favourite music. However, if the user is listening to music near the ocean, exciting or ocean-related music may be recommended. As mentioned earlier, their preferences can change depending on who they are with and where they are. This is called the Context-Aware Recommender System. The main types of contextual factors include time of the day, weather conditions of an area, and the location at which the recommendation is made. In addition to recommended content, traffic conditions and relative information can also be used to make user to have an efficient recommendation.

Cognitive science based recommendation system

Cognitive modelling is a division in computing science concerned with simulating human analytical and mental processing with computer-based representation. Such models enhance human-computer interaction which is used to simulate or predict human behaviour or accomplishment on tasks like those being represented. The recommender system is software that provides item suggestions to users. Every other organization uses recommendation systems to improve their understanding of the customers and propose items and services. Intelligent systems must be designed to connect better with people. Therefore, the ideal structure for interacting with humans would be one that can cognitively interpret its environment, i.e., interpret it in a similar way that humans do.

Optimization of sparsity problem in context free recommendation

The Recommender system Al-Bakri *et al.,* [17] is a smart proposal maker that indicates exciting objects to customers along with books, CDs, merchandise from Amazon.com, and films from the movie-lens website. customers can clear out huge amounts of facts. Recommendation structures profit both solution vendors and customers via lowering the price of product selection and improving the decision-making technique for the duration of on-line purchases. In lots of big programs, Jain *et al.,* [18] number of objects and the quantity of customers is huge. In such instances, the client-product interplay matrix can nonetheless be thinly distributed even if many activities are recorded. This hassle, usually known as the sparse troublehas an extensive poor effect at the effectiveness of collective filtering strategies because of sparsity the correlation (or similarity) among customers is probable to be zero rendering recommendation based totally on collective filtering useless.

Online social recommendation based on customers feedback

Recommendation structures has emerged enormously usual in modern years. It allows client to find out facts and come to a decision choice wherein they do no longer have the desired gaining knowledge of to choose a specific object. It can be carried out as a part of various techniques to inspire client with powerful statistics classifier. Its miles software application device and strategies that offer idea based totally on the consumer's taste to find new suitable element for them through filtering personalized records based totally completely on the person's alternatives from a big quantity of statistics. Ali *et al.* [19] Customer's flavor and choices have to be constructed appropriately to be able to provide most relevant suggestions. The primary procedure of a recommendation system is data feedback, as it

offers the information that recommendation system desires with a particular end intention to offer appropriate recommendations to the customers in view in their preferences. on-line clients' reviews constitute an excellent aid for clients and organizations to select lots statistics that allows to model exact conclusion.

Data Collection And Preparation
All the data and datasets are collected from Kaggle website [20]
1.Crop Recommendation Dataset-Accessed on 25th November 2022
2.Medicine Recommendation- Accessed on 25th November 2022
3.Music Recommendation- Accessed on 25th November 2022
4.Weather Recommendation- Accessed on 25th November 2022
5.Movie Recommendation- Accessed on 25th November 2022
6.Hotel Recommendation- Accessed on 25th November 2022
All the collected data have been cleaned and features are extracted at the requirement of the analysing, then data are normalized and discarded the unrequired features. Finally, the total datasets have been obtained.

PROS AND CONS

PROS
• The model does no longer require records about other individuals or users due to the fact the recommendations are particular to that person. This makes scaling to huge numbers of customers less complicated.
• This model captures a user's unique pursuits and can suggest area of interest items that other customers have little interest in.

CONS
• This technique requires a lot of expertise because some of the feature representations of the items are created by hand. Consequently, the model can best be as true as the hand-made properties.
• The model can most effectively make suggestions primarily based on the person's current interests. In different words, this model has confined capability to increase the consumer's current interests.
• A potential drawback of trust-aware Singh et al., [21], recommender systems is their reliance on explicit social trust information. However, in practice, some people are hesitant to share trust information due to privacy considerations. To address this issue, it can be made to capture information about user trust from social interaction.

Analysing Datasets
In this survey, different datasets were gathered from various websites related to recommendation frameworks. Dependent features were extracted from datasets of different domain and then some random samples were selected for analysing and visualization. The above table 1: (a) shows different features and random samples of crops used for crop recommendation. On the analysing of features and its corresponding values, machine will recommend a suitable crop accurately. Table 2 (a): 10 random sample from music dataset is taken along with the necessary features and its values which can be used for recommendation of songs based on the popularity. Table 3: 10 random sample from hotel dataset is taken along with necessary features and its value which can be used for recommendation of hotel based on ratings. Table 4: 10 random samples from IMDB movie dataset is taken along with the necessary features and its values which can be used for recommending movies.

Analystical Visualization
After analysing the datasets and extracting the essential features, In this section, all the selected random data samples are depicted in visual aspects through plotting graphs with the dependent and independent features. The above graph depicts the various essential features required and plotted a graph which shows dependent variable(x-axis) is labelling of crop which will be recommended based on (y-axis) Independent features and most required essential features is rainfall. The above figure describes different features necessary for music recommendation and their range of values for 10 different songs corresponding to the random sample of music dataset from table 1, popularity

measure of each song is depicted using line graph The above figure describes different features required for hotel recommendation and ratings range from (0-5) which can be used for recommendation of hotel based on ratings.The above figure depicts the variations of different features corresponding to each movie in the movie dataset. It can be observed that "Avengers Endgame" has the highest gross value which is depicted by line graph. The movie "Inception" has the highest Number of votes and has an IMBD rating of 8.8 which is highest among all the movies present in the table.

CONCLUSION

After reviewing 20 research papers, it is observed and understood that recommendation systems are powerful tools because they can predict a user's rating even before the user has submitted a rating. Context-based recommendation system provides personalized recommendations for activities. It intelligently recommends useful learning objects to learners that make a significant contribution to the field of technology-enhanced learning. Privacy Preserving Recommender System provides consumer privacy and also preserves the usefulness of recommendation data. Cognitive science-based recommender systems help maximize revenue from industrial or intelligent companies. The Cognitive Decision Framework can be used to validate whether expert decision making is possible. Sparse problem optimization leads to efficient recommendations and suggestions in the business domain. Studying many research papers and comparing different methods to solve the sparsity problem helps us find the best method to implement in our project. Sentiment analysis is being and it was investigated by several web services to recommend content that matches human emotions expressed through informal texts posted on social networks. The metric used in sentiment analysis only classifies sentences as positive, neutral, or negative intensities and does not detect mood swings according to the user's profile. Many studies and discussions have been conducted on these opinions regarding the use of recommendations in cognitive science, and most findings, evaluations, or feedback suggest that cognitive-based recommendation frames are more efficient than traditional recommendation systems.

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Table 1: Crop recommendation a: Actual Values for Different crops

N	P	K	Temperature	Humidity	ph.	Rainfall	Label
77	38	36	21.8652524	80.1923008	5.953933276	224.5550169	rice
99	50	15	18.14710054	71.09445342	5.573286437	88.07753741	maize
54	77	85	17.1418614	17.0662427	7.829211144	83.74606679	chickpea
18	79	20	20.27514686	23.2353604	5.877347515	139.7521543	kidney beans
25	64	20	33.15122581	32.45974539	4.807776749	105.0380275	pigeon peas
28	68	19	34.63880966	61.38597868	7.69950698	72.43169115	black gram
7	23	35	19.75088482	88.71691157	7.054313823	102.5538035	pomegranate

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98	43	35	25.40785911	76.44048625	7.319952206	188.6372826	jute
120	48	16	22.46054478	75.40989245	7.456971816	71.85436078	cotton
117	32	34	26.2724184	52.12739421	6.758792552	127.1752928	coffee

The above table 1: (a) shows different features and random samples of crops used for crop recommendation. On the analysing of features and its corresponding values, machine will recommend a suitable crop accurately.

Table 2: Music Recommendation. (b)Actual values of features of music recommendation

Title	Beats Per Minute	Energy	Danceability	Loudness	Liveness	Length	Acousticness	Speechness	Popularity
Hey, Soul Sister	97	89	67	-4	8	217	19	4	83
Love The Way You Lie	87	93	75	-5	52	263	24	23	82
TiK ToK	120	84	76	-3	29	200	10	14	80
Bad Romance	119	92	70	-4	8	295	0	4	79
Just the Way You Are	109	84	64	-5	9	221	2	4	78
Baby	65	86	73	-5	11	214	4	14	77
Dynamite	120	78	75	-4	4	203	0	9	77
Secrets	148	76	52	-6	12	225	7	4	77
Empire State of Mind	93	37	48	-8	12	216	74	3	76

Table 2 (a): 10 random sample from music dataset is taken along with the necessary features and its values which can be used for recommendation of songs based on the popularity.

Table 3: Hotel Recommendation Actual features and values of hotel

City	Latitude	Longitude	Name	Postal code	Date	Ratings	Title	User city	Username
Mobile	30.68	-88.06	Berney fly bed and breakfast	36604	2010-08-31T00:00:00Z	4	Just lovely	london	Steven flaskerud
mobile	30.68	-88.06	Berney fly bed and breakfast	36604	2016-04-25T00:00:00Z	4	Looking for a romantic place to stay in mobile	davis	Janice s
mobile	30.68	-88.06	Berney fly bed and breakfast	36604	2016-01-23T00:00:00Z	4	Very comfortable ,clean and friendly	Lake worth	Wedding wife
honolul	21.28	-157.83	Polynesia	96815	2015-09-	4	Combines	Anchorag	541claire

u			n plaza		03T00:00:00Z		great price with amazing location	e	
honolulu	21.28	-157.83	Polynesian plaza	96815	2016-03-02T00:00:00Z	4	Outdated but friendly	Nashua	Live-free or travel
honolulu	21.28	-157.83	Polynesian plaza	96815	2016-07-25T00:00:00Z	4	Dated but in a great location	Vancouver	Clare f
Saranac lake	44.3	-74.33	The point	12983	2015-10-15T00:00:00Z	5	How to feel like truly royalty!	Bingham farms	Drthought
Saranac lake	44.3	-74.33	The point	12983	2015-07-31T00:00:00Z	4	The point of it all	london	szerzek
Saranac lake	44.3	-74.33	The point	12983	2015-10-15T00:00:00Z	5	The most amazing week end!	New york	sarahbnyc83
Soddy daisy	35.25	-85.18	Hometown Inn	37379	2011-07-05T00:00:00Z	2	The name says hometown but don't look for aunt	Warner robins	batct

Table 3: 10 random sample from hotel dataset is taken along with necessary features and its value which can be used for recommendation of hotel based on ratings.

Table 4: Movie Recommendation (d) Actual features and values of movie

Series Title	Released Year	Certificate	Runtime (min)	Genre	IMDBRating (%)	Meta score	Director	Gross (MM)	No of Votes (K)
Inception	2010	UA	148	Action, Adventure, Sci-Fi	88	74	Christopher Nolan	292	2067
Interstellar	2014	UA	169	Adventure, Drama, Sci-Fi	86	74	Christopher Nolan	188	1512
Joker	2019	A	122	Crime, Drama, Thriller	85	59	Todd Phillips	335	939
Gandhi	1982	U	191	Biography, Drama, History	80	79	Richard Attenborough	52	217
The Lion King	1994	U	88	Animation,	85	88	Roger Allers	422	942

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				Adventure, Drama					
3 Idiots	2009	UA	170	Comedy, Drama	84	67	Rajkumar Hirani	6.5	344
Titanic	1997	UA	194	Drama, Romance	78	75	James Cameron	659	1046
Avengers: Endgame	2019	UA	181	Action, Adventure, Drama	84	78	Anthony Russo	858	809
The Notebook	2004	A	123	Drama, Romance	78	53	Nick Cassavetes	81	520
Slumdog Millionaire	2008	UA	120	Drama, Romance	80	84	Danny Boyle	141	798

Table 4: 10 random samples from IMDB movie dataset is taken along with the necessary features and its values which can be used for recommending movies.
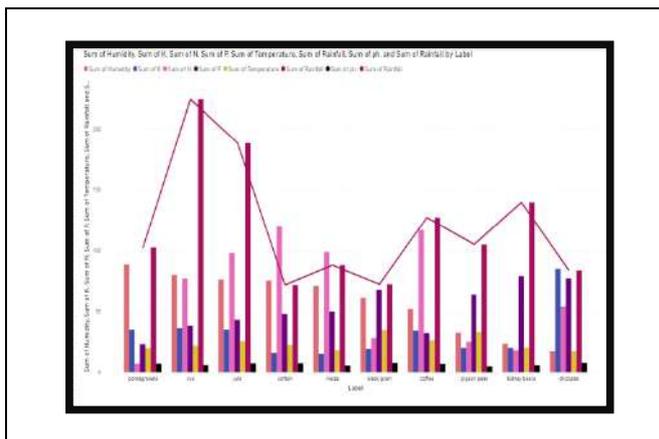
Fig 1: Crop Recommendation
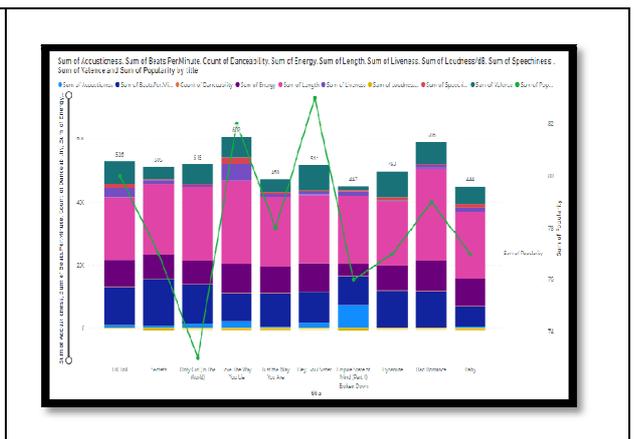
Fig 2: Music Recommendation
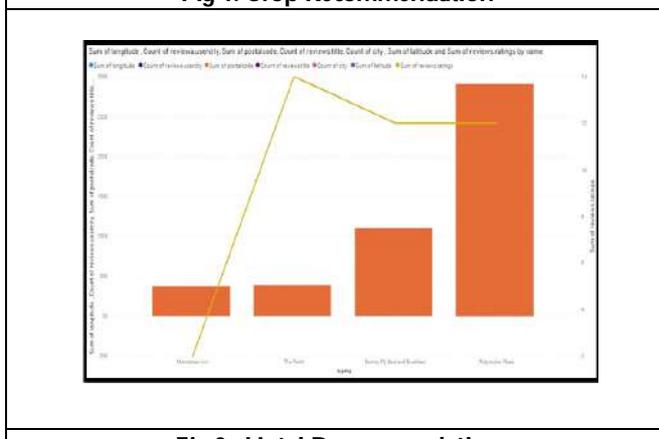
Fig 3: Hotel Recommendation
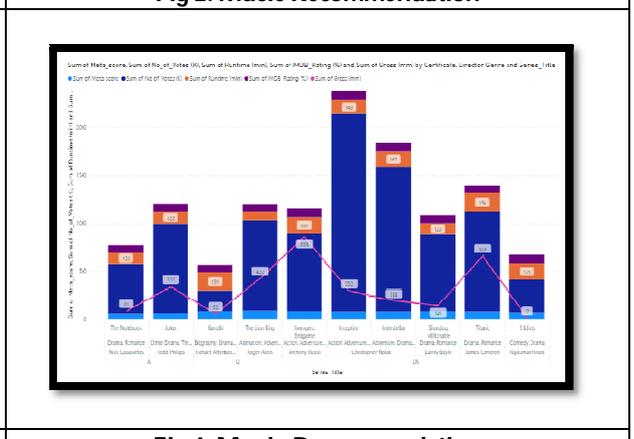
Fig 4: Movie Recommendation

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RESEARCH ARTICLE

Smart Parking for Urban Cities using IoT and Egde AI

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ABSTRACT

With increase in economic growth more and more people are able to afford to buy vehicles to commute. In metropolitan cities like Bengaluru the number of people using two-wheels and cars are highest in records. The number of cars and vehicles in cities have increase in two folds and created issues such as traffic jams, non-availability of parking slots, congestions etc. Using information and Communication technology with sensors and IoT the problem of parking can be addressed. We aim to address the parking availability at malls / smart parking areas in the city prior to the vehicles arriving at the mall or place of interest. Both the vehicles and the parking area of the malls/smart parking area are integrated to the cloud. The customer who wishes to find slot in a particular mall/smart parking area would check list of availability of free slots using mobile app. The App implemented with features to freeze parking slot, cancel the slot and view the list of free slots. Sensors are used to detected if a slot is free or blocked. Edge based AI in the smart parking area/mall parking area is used to give a consolidated report on slots available to reduce the latency to display the free slots. We propose to implement Smart Parking System based on IoT and Edge -AI to predict the possibility of getting the slot based on conditions such as weekdays, weekends, festive days, offer days.

Keywords: Internet of things, Edge-AI, RFID, Mobile App

INTRODUCTION

In the present world trend parking of vehicles in metropolitan city is a hassle, finding the exact and the appropriate parking feasible for a specific vehicle is difficult and time consuming. With extensive growth in the number of vehicles there is a drastic increase in the parking requirements, also the addition in number of vehicles has led to the increase in pollution and traffic congestion. As per recent studies in October 2022 Bengaluru traffic police registered 83,42,692 cases of traffic violations out of which total of 10,06,606 cases were for illegal parking. In recent times modern technologies are being used to accompany human activities completely or partially. A big part of that is IoT,

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Internet of Things (IoT) has changed a lot of human behaviour by providing them with numerous amenities. Recent study conducted on the usage of IoT has shown an exponential growth of IoT devices. Web enabled smart devices which uses embedded system comes under IoT, it is one such platform which allows easy and effective implementation of projects like smart parking system with the help of sensors, hardware communication, processors to collect process and act on data. IoT devices are connected either to an IoT gateway or an edge device through which the IoT devices share the data collected from various sensors which is either transmitted to the cloud to be analysed or can be locally analysed. The exponential growth of IoT and cloud-based smart systems along with the concept of developing smart cities has led us to a new dimension and led to various implementations and methodologies in smart parking system. One more technology which plays a great role now-a-days to make day to day tasks easier is Artificial Intelligence and Machine Learning. Artificial Intelligence in now being used in many fields and even in everyday life. Artificial Intelligence plays an important role when it comes to Smart Parking System as it can help to keep a count of the number of vehicles inside the parking lot. Here, the authors mentioned have listed the various smart parking sensors, tools as well as different approaches to develop Smart Parking System. This paper consists of appropriate prospects for parking complexes along with open parking lots as well as parking complexes and has further discussed about their strengths and drawbacks. It is seen that Smart Parking System depends on functionality; certain Smart Parking Systems are fruitful only in certain cases. Thus, it is important to compare different Smart Parking System based on sensors, networking techniques, methods, services and computational approaches, and services, so as to come up with a feasible and accurate solution.

Literature Survey

As seen, that during peak hours there is lot of traffic congestion and no proper space is being allotted for the citizens to park their vehicles. Hence individuals end up spending a significant amount of time looking for a parking space or waiting in lines to find a parking spot which leads to traffic as well as wastage of resources such as fuels which in turn leads to pollution. This section contains the survey from various reputed publishing sites were referred such as IEEE, IJERT, ICCAIS and so on, dating back to different years. The overall data collected from different research paper ranging over different years is being illustrated in Fig. 1. There are suggestions from authors[6] for the adaptation of a real time cloud-based system which detects and updates the information about the parking lots, reservations etc. Something similar was also noted down by the authors in [1] where IoT-based parking system is being made with the use of various sensors and in order to connect the parking infrastructure to the backend of an application via cloud-based management services all this is being shown to the user using a mobile application which shows the real-time updates of the parking slots. The user can also reserve or book slots priorly. Whereas in [6], we can see the use of WSN (Wireless Sensors Network) this model consists of four different layers to detect and determine parking lot status. The different layers in [6] consists of network layer which collects all the data, the middleware layer and application layer which gives the user the real-time status of the parking lots.

A similar division can be seen in [3] where the Smart Parking System concept has been divided into three parts namely parking element which includes sensor nodes in indoor and on-street parking, as well as microcontroller devices. The cloud functions as a go-between for the automobile parking and the user application and the user application is a mobile application. The system uses sensors to collect data on indoor and on-street parking, which is then analysed and processed by IoT devices. To analyse and assess the data, machine learning techniques are applied. This technique aids in the alleviation of traffic congestion. With the aid of the Google API, the application uses a map to display the user the number of parking spaces that are available as well as the routes that are closest to and least trafficked from their current position. The use of RFID and Arduino technology is seen in [2]. Here the RFID is being used as a tag-based wireless sensor network to keep an eye on parking lots. Parking places are counted using RFID tags. The Arduino module authenticates as a car draws near, sending user data to the cloud server where it is kept in a database. This system links various parking lots; each lot is referred to as a node, and when one lot is full, the user is alerted to the neighbouring lot. The use of moving and fixed Arduino can be seen in [8] where, the moving Arduino analyses the signal which is further converted into a code which is sent to the fixed Arduino. But unlike other research papers [8] does not consists a real time website or mobile application rather it makes use of a Nextion display touch screen which shows the results of the parking lot. In [7] we can see the use of IoT sensors and

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surveillance cameras to count vehicles in the parking. All this is connected to a website which provides real-time parking space availability, floor-level capacity estimation and parking occupancy prediction. The proposed model in [9] also makes use of CCTV or surveillance cameras which situated 2.5 meters above the ground near the parking area. This system makes use of Haar Cascade Classifier and YOLOv3 Detection which is used to detect object in real-time. Research paper [4] makes use of automatic number-plate recognition to identify the vehicle's number plates. The system assigns the best and closest available slot, ensures that another vehicle does not receive that slot, and directs the car to the slot using LED boards, which are turned off as the system passes the node.

In [5], we can see raspberry pi-based parking sensor equipped with a pi-camera, and the data is delivered to a server where it is stored and accessible to users. The availability of parking and the number of slots filled are updated on a regular basis in the servers and can be accessed by users over the internet. A single user can obtain information about multiple car parking places and select the best one for them. The proposed model in [10] is an application based which makes use of Mobius server for the driver's information. The Arduino receives the information, which acts as a display. The RFID and the three beacons at the bottom of every corner is recognised by the application which then calculates the current driver's position. The Mobius Server then receives the current driver's position via the Raspberry pi, which acts as a gateway. The number of automobiles has significantly increased over the last couple of decades. Therefore, it is critical to effectively deploy technology to provide convenient parking at both public and private places. The authors of the publication [16] suggest a smart parking system built on IoT and machine learning methods to address real-time parking management and uncertainty, it throws light on a completely autonomous parking system which makes use of various sensors like IR Sensors, Magnetometer Sensor, RFID Sensors [19],[16] , GSM module [19] and IoT based cameras; which will help in detecting the empty slots in a parking bay and directing the user to the specific parking. To predict the best and most suitable parking slot for a vehicles various methods and algorithms are being discussed; which includes object detection [17] using AI cameras and Open ALPR technology [20] to detect the number plates and size of various vehicles and using image processing methods [16],[17] to convert the image into binary format by implementing pixel image to binary conversions [11] for the machine learning system to process the received data and predict the parking slot.

In order to increase the efficiency and the speed of prediction of the suitable slot, various algorithms have been touched upon like YOLO [17], Haar Cascade [13], KNN [14]; which allows detection of slots based of the visibility of the reference lines drawn for each parking slot, and updates the same to the back-end storage of the application which is either a cloud-based storage [19] or a local storage. Interconnection methods of all the hardware components and the sensors are also achieved using techniques like ZigBee [12], Artificial Bee Colony & Artificial Neural Network [15] which acts as a platform for interconnections of various components and can be integrated onto an Arduino board. Integration of IoT and cloud [18] is also being discussed which will allow the developers the feasibility to present the data regarding the empty, non-empty slots of a parking using services like Fire based cloud applications [14]; this will also add an extra feature allowing the users to pre-book an empty slot in a parking bay, all this put together as an application or a website will allow for a completely autonomous parking experience serving as a mean of saving money, saving time, reducing pollution and allowing for a completely organised parking bay using classifiers algorithm which classifies the vehicles in a certain parkin bay and organising them in such way that there are no disturbances between two or more parking slots.

Implementation Approach
Our idea is to make an IoT (Internet of Things) based system for smooth car parking. The model will be in such a way that when a car enters the parking lot there will be an automatic toll collecting system which will keep the count of cars present in the lot. Fig. 4 represents the workflow of Smart Parking System. Fig 2 represents the System Architecture of the Smart Parking System, the Stage 1 represents the entry of the vehicle at the toll gate where the gates are automatically opened after detecting the vehicle, Stage 2 involves the detection of vehicle's number plate, Stage 3 involves uploading of various data from the hardware components to the cloud and Blynk IoT, Stage 4 involves analysing the number plate data and sorting the vehicle's based on its size which is retrieved from the RTO database, Stage 5 involves pushing the sensor data into the app database to provide info about the number of empty

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parking slot, Stage 6 in this stage the allotted parking slot details are updated to the user through the application, Stage 7 involves updating the number of empty slots to the Arduino, Stage 8 it involves pushing the empty slot data to the led display, Stage 9 the number of available empty slots are displayed in the led at the entrance, Stage 10 in this stage the user parks the vehicle at the allotted slot, Stage 11 represents the final stage of exiting from the parking slot where RFID readers are used to accept payment for the parking hours and gates will automatically open after payment when it detects the vehicle. For example, if the parking lot can accommodate "n" number of cars, then the toll collecting booth will keep a count of the cars entering so that if the lot is full the car can be sent to a different place. If the parking space is not occupied the rays emitted will not bounce back which leads to the conclusion that no object was detected. This indicates green LED colour which shows the availability of a parking lot. As long as the vehicle height is within the threshold distance, the IR rays that are emitted by the emitter are reflected back when the parking space is occupied. When they strike the receiver, the waves are transformed into an electrical signal that results in a potential difference. The Red LED turns on as a result of this feedback, signalling to the motorist that the parking space is occupied. The feedback is instantaneous since IR rays are continuously emitted. The Yellow LED turns back on as soon as the car leaves the parking area since the light rays do not come back. Moreover, this whole system will be connected to either an app or a website which will help the user to locate the free parking space easily. The App will contain the map of the parking lot it will indicate with either yellow or red colour whether the parking space is occupied or not. Fig 3, Fig 4 represents Circuit design, Schematic representation respectively.

Classification of Vehicles using Edge AI
Edge AI enables to react quickly to incoming inputs as compared to the cloud. The processing time is reduced by using edge device closer to the Smart Parking System. We propose to use the Edge AI for classification of vehicles/cars according to their size and model. The Incoming cars are directed to different sections of policy according to their size and models. The model is trained using convolution neural networks at the edge device.

CONCLUSION

A reduction in parking spaces and an increase in traffic congestion are both results of urban population growth and unplanned urbanisation. Because of this, experts and urban planners are interested in smart parking. The smart parking technologies deployed by several researchers are described in this study in general terms. The article contrasts cutting-edge platforms or methods used in different smart parking systems. It also describes the various sensors and microcontrollers that may be employed in an IoT-based system. In addition, the research gives an overview of cloud computing and the connectivity of cloud computing and other wireless networks with IoT in order to store the various kinds of parking system data. There has also been a user interface classification of the Smart Parking System. computing, networking, and service technologies. These categories offer a comprehensive overview of the Smart Parking System from a variety of angles and methodologies. Furthermore, the paper provides a thorough assessment of the benefits and drawbacks of various types of Smart Parking Systems in addressing a variety of difficulties placed upon the systems. The conclusion drawn from the thorough evaluation and analysis conducted in this study is that future smart cities built on the Internet of Things would mostly use multi-approach based Smart Parking Systems. Common features of the Smart Parking System's user interface, which will be based on either a smart phone app or a web-based application, include parking supervision, online payment, parking reservation, and vehicle direction. Depending on the conditions inside and outside, the Smart Parking System uses different sensors. The ease of installation, privacy, sensing technique, and sensor coverage area will, however, be the most crucial factors to take into account when choosing a sensor. In upcoming SPS, data transmission protocol security will likewise be a major source of worry.

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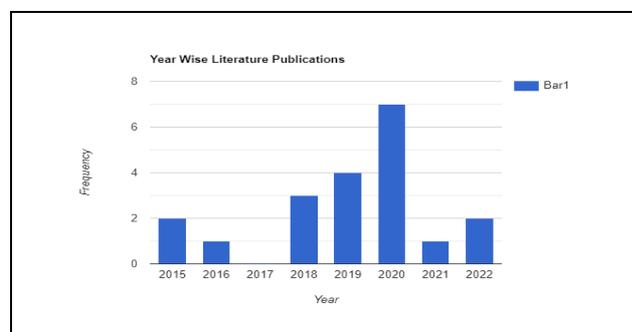
| **Fig 1: Graphical representation of year wise Literature Publications** | **Fig 2: System Architecture** |
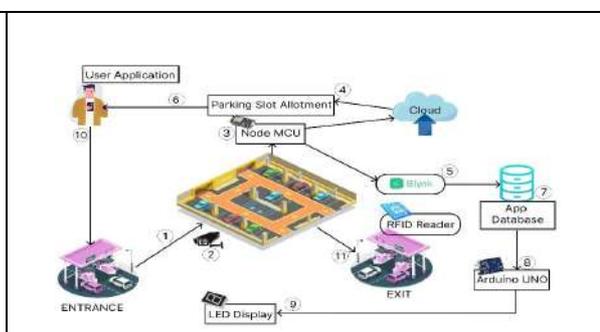
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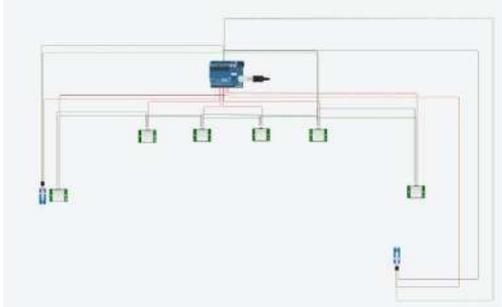
| **Fig 3: Circuit design of Smart Parking System** | **Fig 4: Schematic representation of Smart Parking System** |
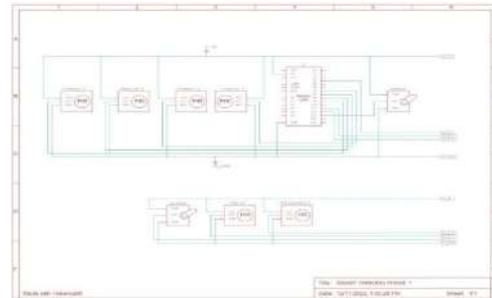
RESEARCH ARTICLE

Wheelchair Stimulated by Tongue using Arduino and Hall Effect Sensors

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ABSTRACT

A severe impact to the vertebrate can cause a majority of spinal cord injuries. The people with spinal cord injuries are a burden on the society and families as they are unable to lead their daily chores regularly. Assistive technology has been developed to aid paralysed people. This technology will help in assisting them in finding work, improve their ability to govern their environment, minimise the work of the family members, and also decrease their hospital expenses. The proposed wheelchair stimulated by tongue system is one of the aiding technologies that allows severely impaired persons due to spinal cord injuries to control their lives by being a less burdened to the society or family members.

Keywords: Hall Effect Sensor, Tongue drive system, wheelchair controlled, Arduino

INTRODUCTION

The human body serves as a living machine. It is considered as the primary body system that allows humans to move, work and recreate, as well as perform all other functions. Spinal cord injury will make a human being paralysed that is the disability in functioning of the muscle in a part of the body. People who have had a paralytic stroke as a result of a spinal injury can benefit greatly from the tongue drive system. Except for the tongue muscles and the brain, the rest of the spinal cord is damaged when a person is severely injured because it is not connected to the cranial nerves. When necessary, this technology allows disabled people to move around in a wheelchair using their tongue movement. The tongue is an appropriate organ for mastering the aiding technology. A tiny permanent magnet placed on the patient's tongue will produce a magnetic field that will be picked up by sensors mounted to the headset outside of the mouth. To operate the wheelchair's motors, the sensors wirelessly broadcast the signals they produce. Proximity sensors are introduced with the intention to avoid obstruction. To prevent interfering with users' regular activities like talking, eating, working and body movement, an additional feature called activation mode has been included.

Components Used

- Arduino Uno: For implementation in a variety of electronic applications, the programmable microcontroller board known as Arduino UNO is affordable, versatile, and simple to use. This board's output device comprises relays, LEDs, servos, and motors, and it can interconnect with other Arduino boards, Arduino shields, and Raspberry Pi boards.
- Arduino Mega 2560: The Arduino MEGA 2560 is intended for projects that require for additional RAM, I/O lines, and designs. It is the ideal board for 3D printing and robotics applications as it has 54 digital I/O pins, 16 analogue inputs, and more capacity for your design.
- Wheelchair
- 12v Battery
- 433 MHz Transmitter and Receiver Modules: These modules are very compact, allowing us to add a wireless interface to nearly any system.

o DATA pin accepts digital data to be transmitted and outputs the data to be received.
o VCC supplies power for the transmitter and the receiver.
o GND is a ground pin.
o Antenna is a pin for external antenna.
o VCC supplies power for the receiver.

- Magnetic Hall Effect Sensor: To find a magnetic field, a hall effect sensor module is used to find the magnetic field. In the presence of a magnetic field, the module's output increases, whereas in the absence of the magnetic field, it decreases.

Some reasons for choosing Hall effect sensors include the following:
o Smaller Size: Hall effect sensors are so lightweight that they can fit nearly everywhere that other magnetic transducers couldn't because of their size.
o Affordable: Hall effect sensors are some of the most affordable magnetic field sensors now on the market.
o Convenience: Almost all magnetic fields are compatible with Hall effect sensors, but other transducers are not very accurate for measuring magnetic fields.

- Ferromagnetic material: Ferromagnetic materials are the most important magnetic components being used electricity and electronics. In the very same direction as the magnetic field, they are instantly and strongly magnetised. The most often utilised ferromagnetic materials include commercial alloys, iron, steel, nickel, cobalt, and nickel.
- DC Motors: DC motors are increasingly being used for electric vehicle engines, elevator and hoist electric motors, and steel rolling mill drives.
- The H-Bridge Motor Driver: An electronic circuit with an H-shaped appearance is called an H-bridge. A load, such as a brushed DC motor, can be driven in both directions using an H-bridge. Additionally, it manages the current that goes to a load.

Working of the system: (Block Diagram)
The implementation of this proposed system involves two steps. Firstly, finding out which is the hall effect sensor that is activated. Secondly, transmitting a wireless command to the wheelchair. When the tongue-controlled wheelchair receives commands, these commands are evaluated relying at the predetermined conditions, and the wheelchair is operated as necessary. A Hall Effect sensor (transducer), is a kind of device which transfers power through one system to another by altering its voltage output in response to variations in the magnetic field. Several functions, including as geolocation, speed detection, proximity switching, and current sensing applications, make use of these sensors. Hall Effect sensors may measure their distance from the Hall plates and operate as transducers,

delivering a voltage with a known magnetic field. The Hall Effect sensors in the wheelchair stimulated by tongue system will be capable to detect the magnetic field produced by the permanent magnet that will be placed on the tongue. The headset will include the sensor mounted. The movement can be done in four different directions: left, right, backward, and forward. The generated signals will be transmitted from the transmitting side to the receiver side in order to command the wheelchair. Both Hall Effect magnetic sensors and push buttons can be used to control this wheelchair. There are four buttons on it, and each of them has one side attached to the ground while the remaining end to the respective Arduino pins described in the code. The Arduino board is connected to a 433 MHz radio transmitter (5V, GND, Data pin). It consists of four hall effect sensors, each of which requires five volts to operate. The desired analogue pins of the Arduino or Mega are connected with the signal wires of the magnetic hall effect sensors in accordance with the programming specifications. The Arduino's 5V and GND pins are wired to the transmitter's 5V and GND pins. While the Arduino's Pin 12 is connected to the transmitter's data pin via a cable. The signal is received, enters the receiver module, is processed by the microcontroller, which then sends the command to the H-drive. The motor will be moved in the desired direction by the H-drive. The H-bridge controls the motor in a middle-man capacity after receiving the necessary signals from the Arduino.

Advantages

- For individuals who have severe spinal cord injuries and disorders, the proposed technique is more likely to be effective even after serious incidents since it makes use of the strong correlation between both the tongue and the brain via cranial nerves.
- Patients who are partially or fully paralyzed can utilize this because it doesn't need a lot of thought, focus, or effort.
- People using it don't have to depend on anyone.
- It is simple and easy to use.
- It is a one-time investment.
- It is economical.

Limitations

- Patients who are suffering from tongue paralysis will not be able to use this device effectively.
- If there are any physical disturbances in the mobility area, the wheelchair can be damaged.

RESULT

When the tongue is moved the magnetic field comes in contact with the hall effect sensor. The sensor senses the voltage difference and the signals are sent to the respective motors and the wheel chair is moved in that direction.

CONCLUSION

This proposed system design is considered as effective since it helps impaired persons, particularly those who are paralyzed, to manage their environments and operate powered wheelchairs with the movements of their tongue. This significantly reduces their dependency on family and caregivers. Moreover, the wheelchair offers effective risk management through obstacle recognition and avoidance. In terms of system security, Wi-Fi and cell phone transmissions are not hampered by it. The system may experience effects from a variety of situations, including power plants, rain, and locations with strong magnetic fields. The wheelchair may be GSM-based, allowing the patient using it to access additional functionalities. The patient in the wheelchair can send a message to his or her family asking for assistance if they feel uncomfortable or predict having health problems. These modifications might be included to enhance user experience and boost system dependability.

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Figure:1 Carnial Nerves	**Figure:2 Arduino Uno**
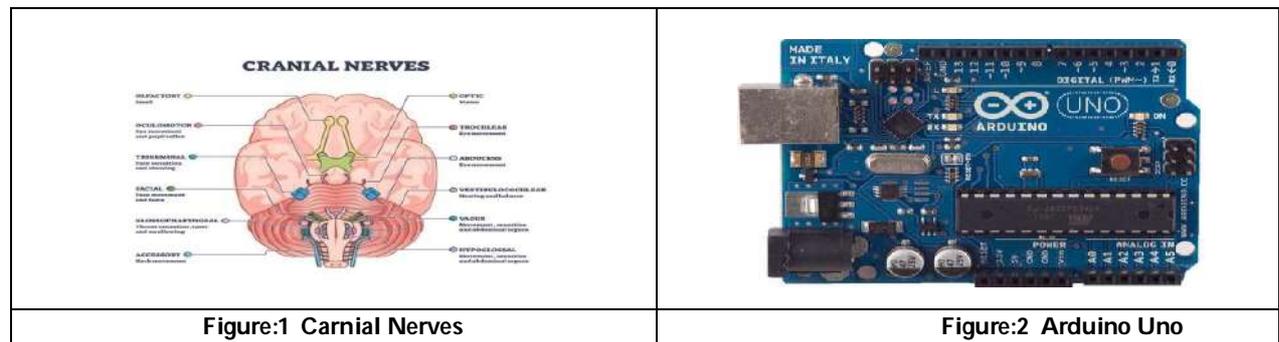
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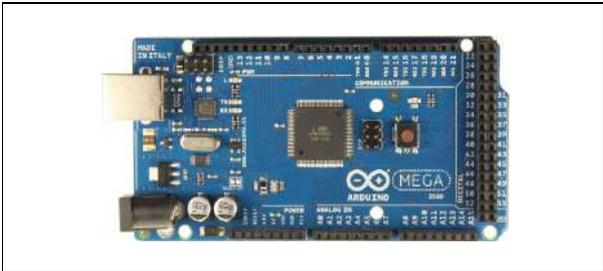
Figure:3 Arduino Mega2560	**Figure:4 Transmitter and receiver modules**
Figure 5: Circuit of Hall Effect sensors	**Figure: 6 Gear DC Motor**
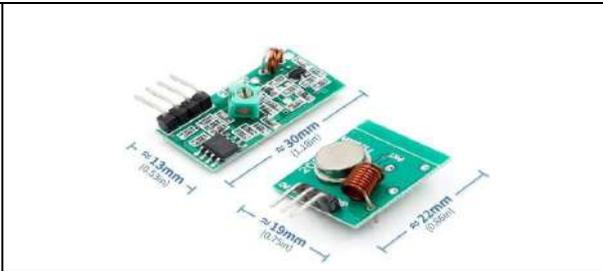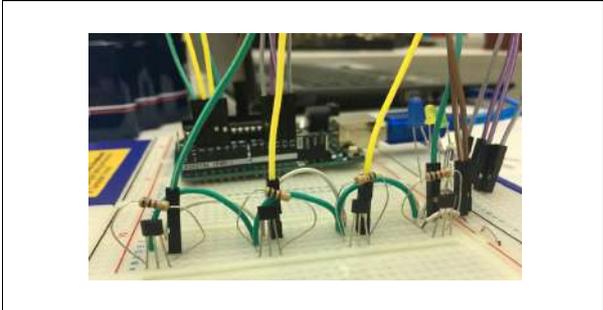
Figure 7: Working of the system: (Block Diagram)
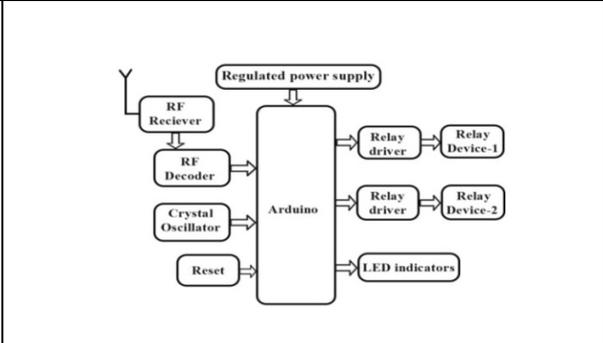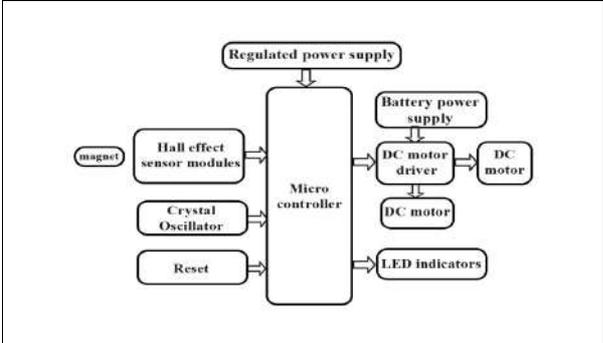
Figure:8 Microcontroller unit of TDS powered wheel chair

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Figure:9 Result of the system

RESEARCH ARTICLE

Intelligent Video Monitorinig and Analysis

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ABSTRACT

In recent years, many cameras have been installed in public spaces and everywhere where security is more important. Every surveillance should be monitored by knowledgeable persons. It is not an easy task to track each object and find Abnormalities. Here we are introducing Intelligent video monitoring systems. Such systems are constantly being developed, observed, and understanding keeps track of objects and classifies the data. find out Abnormalities in real-timesystems able to warn against, alarming situations and information to first responders. Simply It observes, Inspects the data, and makes conclusions Finally inform to appropriate people. In this paper, we are providing a detailed view of implementation. With respective requirements. The following categories were considered: Object detection, tracking, and movement analysis systems, systems capable of alerting against, detecting, and identifying anomalous and alarming circumstances, vehicle detection and accident detection systems, crowds detection systems, systems basis of various linked camera views, and technologies that utilize the cloud environment. Each category is described in great detail in the paper.

Keywords: Accident Detection, Crowd Detection, CNN, YOLO, AI, ML, Python

INTRODUCTION

In our daily lives, we have been noticed many Abnormal activities which are happening around us, they are accidents, crimes, thefts, and some dangerous incidents like bomb blasts which are probably happens more in crowded places. Detecting of this Activities is not that simple, it takes time to detect and respond accordingly. In recent years, an Artificial Intelligence (AI) technology has made a human perform more consistently and effectively by streamlining their work with more accuracy and precision [1]. AI is emerging in many industries for providing better results to develop their productivity and performance, The technology of CCTV (Closed Circuit Television) cameras are also raised, where surveillance cameras are detecting automatically without Human interruption using

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Deep Learning techniques especially conventional neural networks. It will detect the incidents and activates the alarm systems, by using this Advanced technology we can detect the incidents quickly, It helps in reducing Human power, In the event of accidents, it assists in saving several lives and saves times while detecting any incident. By using this advanced technology, we can achieve high accuracy in detecting such cases. So the technologies which are widely used are deep learning i.e., Back subtraction, Convolutional Neural networks it will detect the pixels in image and collects the object pixels, mainly used for detecting and tracking objects. Intelligent video monitoring system makes a CCTV camera more than just video recorder.

Technical Review

Surveillance are used in many places it is to find activities, but in recent days it is not a well Organized manner, because in recent years technology is developed rapidly to improve our way of lives, so many technologies are emerging in today's world. By using AI, ML and Deep Learning we are developing Intelligent video monitoring systems, which observes the incident, inspects the data and inform to the first responders. Here in this our idea of implementation is we are adding High level complex module to NVR/DVR as shown in below figure 1. AI Module acts as brain which automatically detects and analyses the incident and make conclusions from it. Module works by extracting frames from the live footage and it considers as input to the module, which is trained by using deep learning techniques that are background subtraction and convolutional neural networks, with the help of statistics and test data which are feed already. Convolutional neural networks are composed of several layers, including convolutional, max - pooling, and fully linked layers. They are designed to learn particular feature hierarchies automatically and adaptively using a back propagation mechanism. Here software platform has developed i.e., Web Application We can see the warnings by using this application. We can access the footage everywhere through any Device, which consists of internet [13]. Every CCTV camera has specific IP (Internet Protocol) Address, which is unique to every device. By using this IP Address we can access footage of specific camera.

METHODOLOGY

Accident Detection

In today's world, accidents are quite normal, it is typical for folks. It's the worst thing that could happen. Human mistake is the leading cause of automobile accidents and collisions. Over speeding, intoxicated driving, diversions to drivers, red light jumping, and disregarding safety equipment such as seat belts and helmets are some of the primary reasons., some technical malfunctions in vehicles, and so on. Accidents cause severe damage. Everything is a disadvantage associated with accidents; due to accidents, injuries happen, there are higher chances of loss of life, and there is so much property damage to the government or owner as a result, when an accident happens. Let's take the example of colliding two cars were happen in the centre of the city, which people are passing more frequently, if any Abnormality happens (Any accident), they notice and inform first responders. Some places were not frequently busy places or at night times any incidents happen nobody notice such incidents, most of the Because so many people are killed in car accidents, people do not always seek medical attention as soon as feasible or as thoroughly as they should. In recent years most of the places are covered by surveillance/CCTV (Closed Circuit Television). By using this technology and developing it into an intelligent machine, we can detect such incidents, and it will inform the respective officers. Who takes responsibility and control for such causes. Here we are mainly focusing on accident detection. We can detect accidents through surveillance by using Artificial Intelligence and some Advanced technology techniques. Machine learning Algorithms/methods showed accurate results in anomaly detection. We are considered incidents in normal traffic as an anomaly. When an accident or any colliding of vehicles happens, following vehicles The accident will cause several vehicles to slow down or stop abruptly. When vehicle location data is analysed, through Intelligent Surveillance, Many automobiles may be observed clustered near accident spots. Clustering algorithms are used to group automobiles based on their speed and location on a certain route or scene. In an accident case, algorithms will put vehicles that are affected grouped into one, other vehicles are other groups or groups. In this simulation, if groups are more than one at the time of the incident and the number of vehicles is increased in the following seconds. It can be concluded as an accident/incident happens and the following vehicles

around the accident are affected by the accident [2]. In this activity, they determined the incident, and accident detection by using the YOLO algorithm and conventional neural networks technology. Accomplished the task in three stages, In the first stage, They used a conventional neural network algorithm, which simply detects the image by processing pixel data. In the second stage, they focused on tracking the cars for better accuracy. At the final stage, they focus on flow-vector magnitude change over time by using statistics that are violent flow descriptor (VIF). This approach gives approx 89% [3]. In This is project they find accident detection using conventional neural network (CNN) which belongs to deep learning technology, Once the accident detects, [12] The system will look for nearby facilities such as police stations and hospitals. It alerts them of the situation and shares geolocation and accident photographs with them.Once the information shares successfully the Rescue team can rush the spot instantly, it is possible because the right location is communicated through Application.[4] In this review approach, They discover an accident while watching CCTV camera footage in real time. The idea is to run each frame of video via the traditional neural network approach. which has trained extensively with sometest data and it classifies video frames and decides whether the accident happens or not. It provides approximationof 92.3% [5].

Crowd Detection

In urban culture, gathering a big number of individuals in a single physical place is highly prevalent. Due to the crowd so many problems are occurring and many kidnaps and crime incidents are happening through is crowd. Crowds may be seen in a variety of settings, including airports and sports stadiums, various, educational, and entertainment events etc. More Over it can be very useful in the covid -19 pandemic situations to avoid people gatherings at a place. with the expanding population and several problems arising due to crowded situations. Miscreants frequently exploit crowds to commit inhumane acts such as pestering women. Crowd counting is critical for maintaining safety. Human safety in crowed situations. due to the large crowd many accidents are occuring and the murders are happening in the public area. Due to lower prices, the availability of monitoring devices has expanded several times in order to avert such acts. Surveillance films have shown to be quite useful in criminal investigations and in locating thieves and offenders. It is critical to recognise the existence of a crowdand the amount of persons in the gathering. Video monitoring in such busy areas may be quite beneficial in crowdmanagement. Now a days increasing the technology and we can reduce these Type of abnormal activities and incidents .by usingthe latest technologies like artificial intelligence, machine learning and deep learning. The goal of these study is to provide a unique simulation method that in cooperates the deep learning algorithms for managing huge, complicated crowds in real-world situations. Additionally to prevent the crowd from getting too large, the proposed approach measures the crowd level and issues an alert. In addition, the mode calculates the density of people in the photos, This enables the study to examine the deep learning algorithm approach to Congestion in the crowds. In addition, the suggested model comprises two major components. The first makes use of moving crowd images to categorise them into five classifications: "heavily crowded, crowded, semi-packed, lightcongested, and normal," while the second makes use of visual alerts (five) [6].

Background Subtraction

Background subtraction is a popular approach for segregating a screen's moving portions by splitting it into background and foreground [14]. For motion monitoring, background subtraction algorithm is used, the genuine differences in intensity with regard to displacement can be seen by comparing the pixel positions of two picturesand videos. In order to remove the backdrop from an image, use background subtraction. In order to accomplish this, the moving foreground is separated from the static background. In daily life, background subtraction is utilised for a variety of purposes, including object segmentation, security enhancement, tracking of pedestrians, tally of visits, traffic flow, and other traffic-related statistics. The foreground mask can be learned and recognised by it. The Mixture of Gaussians (MOG) technique, introduced in 2001, was an early form of a BGS-based objectidentification framework, employing a Gaussian mixture background and foreground segmentation algorithm [7]. These BGS techniques, however, has certain basic constraints since they rely on Based on human perception (i.e.,visible light), RGB, HSV, and YUV colour spaces, where Y and UV represent brightness and chrominance, respectively. In essence, those strategies are ineffective in colour camouflage circumstances and are extremely aware of changes in illumination. To address the issues, different BGS techniques that do not rely on colour information have been developed. Depth data from the

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stereo cameras, Microsoft Kinect, and also time-of-flight (ToF) sensors, in particular, have been coupled with colour data. Presented the foreground segmentation technique with extra depth information utilising the YUV colour space. Using the covariance matrix, the approach attempted to determine the connection between YUV and depth. There are apparent restrictions, however, because the approach employs a 4-channel feature vector produced by adding the depth value to a 3-channel colour vector, and colors and depth are two separate forms of information [8].

Convolutional neutral network

Neural networks are networks built by the connectivity of multiple nodes with varying values and weights, and they play an important part in decision making. A single node may be ineffective on its own. However, if a sufficient number of nodes are linked with appropriate weights and values, each node contributes to the decision-making process. Neural Networks are created by simulating a genuine human brain, with nodes corresponding to neurons in our brain. In the subject of Artificial Intelligence, Neural Networks are critical. At a higher level, neural networks are developed using a large amount of training data. Training data is any data that has had categorization choices made for it. Every training instance or example has already been labelled with the right outcomes and is sent to the neural network to train it. The network then connects the nodes and modifies their weights based on the patterns in the training data. After adequate training, test data is input into the neural network, which uses its learning to execute its learning and predicts the output. CNNs are fully linked feed forward neural networks. They are well renowned for their ability to minimise the amount of parameters while maintaining model quality. CNNs have been shown to be extremely efficient with picture data [15]. A convolutional neural network (CNN or convnet) is a machine learning subset. It is one of numerous different kinds of artificial neural networks utilised for diverse applications and data sources. A CNN is a type of network design for deep learning algorithms that is primarily utilised for image recognition as well as pixel data processing applications. There are different forms of neural CNNs are the preferred network design in deep learning for identifying and recognising items. As a result, they are ideal for computer vision (CV) jobs and applications requiring object recognition, such as self-driving cars and facial recognition.[9].

CNN is composed of three key components

The Convolutional Layer, Pooling Layer, and Fully Connected Layer are the three layers.

1. Convolutional layer: This layer contains filters as well as feature maps. Filters are special-purpose layer processors. These filters differ from each other. They accept pixel data as input and generate a feature map. A single filter layer creates a feature map. The filter is moved over The picture is being built up one pixel at a time. A feature map is formed as a result of the activation of a few neurons.
2. To minimise dimensionality, the pooling layer is used. After one or two convolutional layers, pooling layers are added to generalise characteristics learned from prior feature maps. This reduces the chance of overfitting during the training stage.
3. Fully connected layer: Following the collection and consolidation Contains characteristics from the Convolutional Layer and subsequent pooling, the At the conclusion, a fully connected layer is utilised to assign the feature to class likelihood. Linear activation functions or soft max activation functions are used in these layers.

CONCLUSION

We explored a set of deep learning techniques in this theory algorithms to achieve maximum accuracy in detecting events, and developed a software platform which is web application, where it will show all the triggered events which came from CCTV cameras and it is connected to alarm systems, GUI is developed in such a way it is easy to use and understand. By using web application we can access our CCTV footage from everywhere and though any Device.

Future Enhancements

Developing our system to provide maximum Accuracy in detecting activities/incidents, and adding new features/Systems i.e., theft detection, Human fall detection, mask detection and making use of our systems effectively and efficiently with smooth GUI.

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| Fig.1: Adding AI Module to DVR | Fig.2:[10]Accident Detected Making it as one group. |
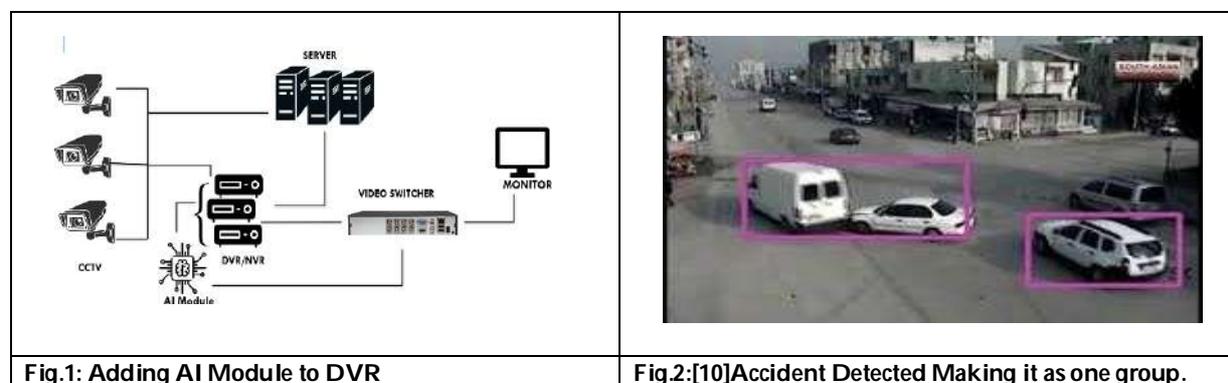
Fig.3:[11]Crowd counting and Abnormal behaviour detection

RESEARCH ARTICLE

Cybernetic companion using Machine learning implemented through Python

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ABSTRACT

In this tech era, our everyday lives are becoming more stressful. Human beings being a social animal, it is very important for us to have a support system at our disposal. In our virtual companion, we make sure we achieve the same thing, without even having someone with us in person. The method of recognising human speech by computer and creating an event in a well written sequence structure is known as speech recognition. As Natural Language Processing (NLP) techniques are used, operations based on voice recognition are currently entering a hugely popular phase. This paper proposes a virtual companion, which communicates with us, be with us to give us counsel, and make necessary actions (inform the concerned) during an emergency. We have focused on the students of age group 18-24, that is the college students who undergo a lot of stress and loneliness. The proposed system communicates with the user, stores the data that we speak to for future reference, and analyses the frequency range of the user, along with the word meaning to produce a suitable reply. We utilize the SVM (Support Vector Machine) classification Technique for the machine learning, and Mel-Frequency Cepstral Coefficients (MFCC) for calculating the MFCCs of a signal and implemented using Python libraries. Our service will be linked to the World Wide Web for to provide more accurate and timely replies. Rather than being a mere assistant, the main objective of our virtual companion will be to be there for the individuals in time of need.

Keywords: Natural Language Processing, Support Vector Machine, MFCC, virtual companion, Python

INTRODUCTION

To meet the laborious needs of the modern world, we often overwork and drain ourselves of the energy to hold any type of conversation. The cybernetic companion is the virtual peer that gives the individual, using it, a supportive presence. A cybernetic companion acts as an interaction medium for an individual, who can make a conversation with him/her and occasionally provides moral support as well. From a technological point of view, a cybernetic

companion is an ingenious application of Information Technology as the barriers between machine and human both come closer to a point where they can understand each other through direct communication. These are implemented in the modern world under the names like chatbots, virtual assistant, etc., and are really helpful and user-friendly for those individuals who find themselves battling with the machinery that are currently relevant. These companions, when compared to their human counterpart, provide much higher accuracy and have a wide range of information and are available at any given time of the day. The justification for the need of a cybernetic companion is that it allows us to be more productive about our daily errands and endeavours, receiving a compliment can increase productivity by a substantial amount. It also minimizes the stress on the individual by providing words of encouragement and relief. Keeping in mind with the fast-moving world, not everyone has the time to be at one's side at any given time, a cybernetic companion is, however, at one's disposal round the clock. One of the components on the basis of which the companion works is Support Vector Machine (SVM). It is a machine learning algorithm which is used to classify the input from the individual and match it with the respective and desired output. SVM is flexible and efficient as it can work with huge amounts of data. The other component used is Mel-Frequency Cepstral Coefficients (MFCC). It is an extraction technique that is used for speech recognition. A phrase has different meaning depending upon its frequency, MFCC enables to respond with the appropriate response. MFCC is preferred as it is relatively good in error reduction consequently giving suitable responses.

Literature Survey

Pansy Nandwani *et al.* [1]has proposed a research that discusses the challenges faced during sentimentand emotion through analysis. For this to happen in particular, the data must be processed as rapidly as generated to comprehend human psychology, and it can be accomplished using sentiment analysis, which recognizes polarity in texts. Through this it determines whether the attitude towards an item, individual or organization is negative, positive, or neutral. Sudarsana Reddy Kadiri *et al.* [2] has presented a research that examines detection due to emotion from speech in a speaker-specific scenario. The proposed method sautomatically detects if an utterance a speaker has spoken is non-emotional. In order to evaluate the excitation, features like instantaneous fundamental frequency, the excitation strength and the excitation energy are assessed. The KullbackLeibler (KL) distance is evaluated to understand the correlation between feature distributions of emotional as well as neutral speech, Andbased on this KL distance co-efficient between the test utterances and utterances produced in a neutral state by the same speaker, a decision based on the detection is made by the system. Udit Jain *et al.* [3] has proposed a study that involves identifying emotions in Hindi speech spoken in a noisy environment, and grouping them into four categories: happiness, sadness, anger, and neutral. A cubic support vector machine classifier model is used to analyze the pitch, energy, formant, Mel-frequency cepstrum coefficients, and linear prediction cepstral coefficients of the acoustic signal. The analysis yielded an accuracy of 98.75% for male speech and 95% for female speech. Samira Zad *et al* [4] has proposed a research that reviews the current literature of Text Based Emotion Detection (TBED), one of the fastest growing branches of Natural Language Processing (NLP) and the psychological models associated with them. TBED classifies syntactic or semantic units of a corpus that are sorted into a given set of emotion classes. Jose Maria Garcia-Garcia *et al.* [5] has submitted a review of current technologies to detect human emotions is presented. A survey has been conducted to identify the strengths and shortcomings of the present-day technologies for emotion detection. C. Sunitha *et al.* [6] has presented a paper that explores on how speaker recognition is accomplished using Mel-frequency Cepstral Coefficient (MFCC) with Weighted Vector Quantization algorithm. The feature extraction process is carried out using MFCC. Then the pattern matching is accomplished by estimating the similarity of the unknown speaker and the trained models from the database. Weighted vector quantization is then proposed that takes into account the correlations between the known models in the database for the pattern matching.

Proposed System

The following section explains the proposed system using auditory methodologies. Frequency in the voice plays a significant role and by the use of a trained dataset appropriate result is validated and is propounded. Mel-Frequency Cepstrum Coefficient (MFCC) technique is used for speech recognition. Support Vector Machine (SVM) is also used for classifying the input of the user and link it to the appropriate response. As we know, speech recognition is a

supervised learning task. The text is predicted from the audio signal. We cannot take the raw audio signal as an input due to the presence of external factors that could potentially impact the overall meaning of the audio signal. Hence, we extract the features in the signal through MFCC. It is a widely used technique for extracting the features from an audio signal. MFCC extracts notable features from the speech and used for recognition, they understand the frequency response of the vocal tract. MFCC is preferred to minimize the error as much as possible and it produces a robust feature when a noise affects the signal. The implementation of SVM is done as it is a popular supervised learning algorithm, it can solve both linear and non-linear problems and produce effective results for many practical problems. The underlying working of an SVM is that it creates a hyperplane where the distinction of data is done. After the data is segregated, the expected result is then affixed. SVM yields good results in terms of accuracy when the data is linearly or non-linearly separable. The four phases for the working are:

Phase 1: Recognizing speech by determining frequency of the voice. The input is given by the user via the audio signal. This audio signal's frequency is the core factor around which the corresponding result can be determined. MFCC converts the speech to text and the SVM, depending upon the frequency classifies the signal and joins it to the desired output.

Phase 2: MFCC determines frequency of the input speech and identifies spoken words. MFCC, after converting the speech to text, stores it until the SVM categories the input signal from the user and matches it with the trained dataset to obtain the resultant output. SVM gets this output from the dataset after matching it with the frequency.

Phase 3: A SVM that has been implemented with a trained dataset categorizes the words/audio. The SVM is administered with a trained dataset (such as Kaggle, etc,.) which enables us to process the precise output with minimum failure. The dataset can be enhanced with each interaction to provide maximum precision.

Phase 4: Based on category, resultant output is produced via the virtual companion. The frequency is matched with the allotted dataset and the accurate answer to the user's query is then put together and is given by the cybernetic companion. The workflow diagram of the proposed system is shown in Figure 1.

Proposed Algorithm

Experimental analysis on cybernetic companions using MFCC (Mel-Frequency Cepstral Coefficients) and SVM (Support Vector Machine) can be used to improve the performance of speech recognition systems. MFCC is a technique used to extract features from audio signals that are important for speech recognition, while an SVM is a machine learning algorithm that can be used to classify data based on its features. Another key prerequisite needed is a platform that provides access to a wide variety of datasets and tools for data analysis and modelling; therefore, Kaggle is used. By implementing MFCC and SVM on a cybernetic companion with a dataset on Kaggle, researchers can improve the performance of the speech recognition system and make the companion more responsive to user commands. The screenshot of the proposed system is shown figure 1. Steps Involved in the analysis include:

STEP 1

Data collection

Collect a dataset of audio samples that includes speech commands, emotional expressions, and sound events relevant to the cybernetic companion from Kaggle. The model was trained and tested using a dataset sourced from Kaggle, a provider of open datasets. Kaggle is a platform for data science and machine learning competitions where practically anybody can find and use open datasets for a wide range of purposes, including research, teaching, personal projects, etc. The datasets available on Kaggle is used for a variety of different use cases, including computer vision, natural language processing, etc. Some examples of the datasets available on Kaggle are:

a) The Iris dataset, which is a classic dataset used for classification and consists of 150 samples of iris flowers, each with four features (sepal length, sepal width, petal length, and petal width).

b) The MNIST dataset, which is a dataset of handwritten digits and is often used as a benchmark for image classification algorithms.

c) The IMDB Reviews dataset, which is a collection of movie reviews and is commonly used for sentiment analysis. Kaggle is also a way to find and collaborate with other data scientists, and can be a great way to learn new skills and improve your own work. For the cybernetic companion we use a trained dataset named "RAVDESS dataset" containing 24 actors, reading two statements in eight different emotional states (neutral, calm, happy, sad, angry, fearful, disgust, and surprised). This portion of the RAVDESS contains 1440 files: 60 trials per actor x 24 actors = 1440. Speech emotions includes calm, happy, sad, angry, fearful, surprise, and disgust expressions. Each expression is produced at two levels of emotional intensity (normal, strong), with an additional neutral expression.

STEP 2
Feature extraction
Use MFCC to extract relevant features from the audio samples in the dataset. These features will be used as input for the SVM model. Mel-Frequency Cepstral Coefficients (MFCCs) is extracted from the audio input using the following steps

(a) **Pre-processing**
In this part, the audio input is devoid of any noise and made into a clean data. This can be done using techniques such as noise reduction, filtering, and normalization.

(b) **Framing**
The pre-processed voice recording is then divided into small frames of fixed length, which can range from 20-40 milliseconds. It is done in order to reduce spectral leakage and improve the frequency resolution of the resulting spectrum. Spectral leakage occurs when the energy from one frequency component spills over into other frequency bins due to the finite length of the frame. Window functions such as the Hamming window are typically used to minimize spectral leakage and improve the frequency resolution of the resulting spectrum. In summary, windowing is a technique used to reduce the impact of spectral leakage, improve the frequency resolution, and reduce the distortion in the resulting spectrum which would make it easier to extract the relevant information in the audio input.

(c) **Fourier Transform**
It is a mathematical technique used to transform a time-domain signal into a frequency-domain representation. In the context of MFCC feature extraction, the Fourier Transform is applied to each windowed frame of the speech signal to convert it from the time-domain to the frequency-domain. The resulting signal is then passed through a discrete Fourier transform (DFT) algorithm to obtain the complex frequency spectrum. The DFT algorithm calculates the contribution of different frequency components to the signal in each frame. The magnitude of the DFT coefficients represents the power at each frequency and is used to calculate the Mel-scale filter bank energies in the next step of the MFCC extraction process.

(d) **Mel-scale Filter bank**
It is a set of triangular filters used in MFCC feature extraction process to map the power spectrum of a speech signal from the linear frequency scale to a non-linear Mel-scale. The Mel-scale is defined as a function of frequency that compresses the higher frequencies while expanding the lower frequencies. This compression makes it possible to better distinguish between different vowel sounds, while making it less sensitive to the higher frequencies. The Mel-scale filter bank is typically implemented as a bank of triangular filters, where each filter covers a specific range of frequencies on the Mel-scale. In summary, the Mel-scale filter bank is a technique used to convert the power spectrum of a speech signal from the linear frequency scale to a non-linear Mel-scale, which is more closely aligned with the way the human auditory system perceives sound, and it's useful for speech recognition tasks.

(e) Cepstral Coefficients

These are a set of coefficients obtained in the final step of the MFCC feature extraction process. They are obtained by applying the Discrete Cosine Transform (DCT) to the logarithm of the filter bank energies, which are obtained in the previous step of the MFCC extraction process.

The DCT is a mathematical technique that allows for a representation of a signal in terms of a linear combination of cosine functions. The DCT is applied to the logarithm of the filter bank energies to decorrelate the coefficients and reduce the dimensionality of the feature set. The resulting coefficients, also called the cepstral coefficients, represent the spectral envelope of the speech signal, and they are less sensitive to the variations in the overall level of the speech signal than the filter bank energies. They are also less sensitive to the variations in the spectral tilt of the speech signal, which is caused by changes in the vocal tract size, and other factors. In summary, the Cepstral Coefficients in MFCC feature extraction process, are obtained by applying the DCT to the logarithm of the filter bank energies, which are obtained in the previous step, and they represent the spectral envelope of the speech signal, and contain the most relevant information about the spectral envelope of the speech signal. They are less sensitive to the variations in the overall level of the speech signal, and to the variations in the spectral tilt of the speech signal, making them useful for speech recognition tasks.

STEP 3
Model training
Use SVM to train a model using the extracted features and corresponding labels (speech commands, emotions, sound events). The model will be able to recognize speech commands, emotions, and sound events based on the features it has learned from the dataset.

STEP 4
Model evaluation
Evaluate the performance of the trained model by testing it on a separate dataset. This can be done by comparing the model's predictions to the actual labels and measuring the accuracy, precision and response.

STEP 5
Model deployment
Once the model is trained and evaluated, it can be deployed on the cybernetic companion. The companion can then use the model to recognize speech commands, emotions, and sound events from its owner.

STEP 6
User study
Conduct a user study with the cybernetic companion to evaluate the user experience, including satisfaction with the companion's speech recognition, emotion recognition, and sound event recognition abilities. This experimental analysis could provide valuable insights into the capabilities of using SVM and MFCC for speech, emotion, and sound event recognition on a cybernetic companion. The user study could also provide feedback on the overall user experience and satisfaction with the companion's capabilities.

CONCLUSION AND FUTURE ENCHANCMENTS

In conclusion, the use of Support Vector Machines (SVM) and Mel-Frequency Cepstral Coefficients (MFCC) in a cybernetic companion system has been shown to be a promising approach for speech recognition and natural language processing tasks. The combination of these techniques allows for accurate and efficient analysis of speech input, resulting in improved performance and user satisfaction. The proposed Cybernetic companion can be enhanced to capture real-time visual images of guest speaker with the help of OpenCV (Open-Source Computer Vision) libraries. Machine learning techniques that include the Haar cascade method and ConvNet are trained to

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detect the emotions on the face. These detections can be used to trigger an option that directly calls for emergency if required. A wide variety of automated response data can be fed onto the cybernetic companion as well as having it connected live to the internet will make it more versatile to content different user specific needs.

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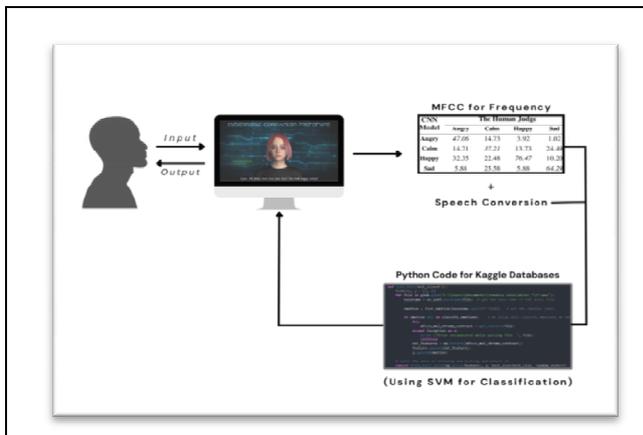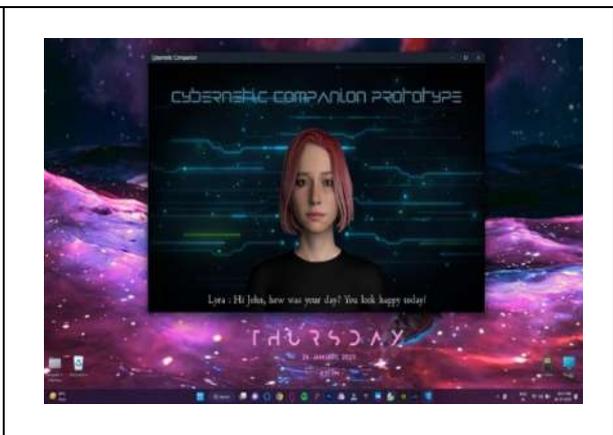
Figure 1: Workflow Diagram	**Figure: 2 Screenshot of the working prototype**

RESEARCH ARTICLE

A Hand-Gesture Recognition System Using Image Processing to Translate Indian Sign Language Alphabets to Text

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ABSTRACT

Most interpersonal communication takes place through the use of languages. Specially gifted people are compelled to employ unconventional forms of communication, such as sign language. Communication amongst people with special needs is made possible by this, but communication with the general public is restricted. This gap in communication may lead to misinterpretation of information or tone. In order to address the aforementioned issues, a method of translating Indian sign language to text and speech is implemented in this work. It method records the input as serially rendered Indian Sign Language alphabets using a webcam or video file. Then, using the machine learning model, the data is processed to find distinct alphabets. Then, this can be translated into other languages, such as regional Indian languages. The entire workflow is enabled using technologies like opencv2 for image recognition and Keras for the AI/ML model.

Keywords: Image Processing, OpenCV, Tensorflow2, Keras, Machine Learning, Computer Intelligence, Transfer Learning

INTRODUCTION

According to the Census of India 2011, there are approximately 2.68 million deaf people in India. It is worth noting that this number may not include individuals with mild or moderate hearing loss, or those who do not self-identify as deaf. The Census of India does not provide separate data on the number of people who are dumb. A sizable section of the deaf and hard of hearing population in India uses Indian Sign Language (ISL), a natural language, as a form of communication. ISL users frequently experience communication issues and social isolation as a result of the hearing population's limited familiarity with the language. Growing efforts have been made in recent years to close this communication gap by creating technology that instantly translates ISL into text and speech. One such technology is a hand-gesture recognition system that translates and interprets ISL using image processing. The

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capacity of people who use ISL to interact with the hearing population and fully participate in society might be significantly improved by this kind of technology. We describe a hand-gesture recognition system in this study that is intended exclusively for the conversion of ISL into text and voice. The system's conception and execution, as well as the findings of the analyses is outlined. This technology has the potential to significantly enhance the lives of people who use ISL as their primary form of communication and marks an important development in the field of ISL translation.

Literature Review

There have been multiple previous approaches to this domain. Most of the approaches can be broadly categorised by the way of detecting the gestures by the system-

1. Systems that use a video-based input device like a camera to capture the user's hand gestures utilising computer vision.
2. Systems that read information from the user's arm and upper torso using physical sensors.

Sensor-based systems are constrained in how the user may move, but optical systems demand more processing power and are more frequently plagued by noise. Despite achieving more accuracy, optical systems are less expensive to create and employ since they may be used with any general-purpose computer with a respectable processing power. Due to the ubiquitous availability of laptops and desktop computers with built-in webcams, this endeavour is practically free. There are numerous such systems that use skeletal sensors, lidar, infrared, ultrasonic, magnetic imaging, and cameras to recognise sign language. Most systems just employ hand alphabets, not complete signals, which combine facial gestures, motion, and body language to create a full context. Numerous commercial solutions that use a glove of some kind to recognise sign language and translate it into English have also been granted patents. With millions of people experiencing communication challenges as a result of their handicap, work in this sector has generally been stagnant, but particularly so for Indian Sign Language. Additionally, sensor-based solutions lose their utility in low-income areas where it is more difficult to buy specialised equipment. The most advantageous solution for this would be one that runs on a general-purpose computer and operating system.

METHODOLOGY

Hardware and Software Tools

In this paper, A hand-gesture recognition system specifically designed for the translation of ISL to text is presented. The hardware components of the system include a camera for capturing images of hand gestures live and sending it to the model for prediction, a processor for analysing the images and performing the required probability calculations, and a display for outputting the translated text and speech. The software components consist of image processing software OpenCV for interpreting the hand gestures and identifying the position, angle, and orientation of the hands and sending it to the model, and an operating system to manage the hardware and software and provide a user interface.

Data Collection and Annotation

In order to develop and evaluate the hand-gesture recognition system, A dataset of hand gestures annotated with their corresponding ISL translations was required. For this, we obtained a dataset from Kaggle, a popular online platform for data science and machine learning. The Kaggle dataset consisted of a large number of images of hand gestures made by native ISL users, along with their corresponding ISL translations. The Kaggle dataset was carefully curated to ensure that it contained a diverse range of hand gestures and covered a wide range of ISL translations. The data was pre-annotated to label the hand gestures in the dataset with their corresponding ISL translations. This process of data collection and annotation was essential for training and evaluating the performance of the hand-gesture recognition system. Overall, the Kaggle dataset proved to be an invaluable resource for the research and allowed to develop and evaluate a high-quality hand-gesture recognition system for the translation of ISL to text and speech.

Details on the Dataset Used

In the dataset, there exists 1200 samples of each letter and number of the English Alphabet (A-Z & 1-9). Additionally, we have also split the dataset into Training, Testing and Validations Sets. The Testing Set consists of 90% of all images, while the Testing and Validation sets have 5% each dedicated for them. It should be noted that all the Test, Validation and Training sets contain mutually exclusive images.

Model, Training and Evaluation

In this paper, A transfer learning approach is presented using a pre-trained 'InceptionResnetV2' Machine Learning Model. Transfer Learning is a methodology used in Machine Learning to retrain an existing model to better suit a given specific use case. InceptionResnetV2 is a Convolutional Neural Network that is pre-trained on more than a million images. It is 164 layers deep and has the ability to classify upto1000 types of categories. We will be passing a small subset of the training set for the model to adapt and specifically learn to recognise the dataset at hand. A supervised learning method was used in the already pre-trained model, and a sizable number of hand gesture examples and their accompanying ISL translations were fed into the system. These examples were used by the system to train it to identify and categorise various hand gestures and to produce the correct ISL translation for each gesture. A number of tests were employed to assess the system's performance. First, we tested the system's ability to generalise from training data to cases it had never seen before without losing accuracy or confidence. High accuracy on the test set demonstrated that the system had successfully learned from the training data. A thorough investigation of the system's performance on several subsets of the data in addition to the train-test evaluation was also done. This allowed us to spot any gaps in the system's capacity to interpret particular ISL translations or recognise particular hand motions. Having a solid pre-trained model like the InceptionResnetV2 made things simpler here, as the model learns and adapts quickly to the dataset at hand.

Re-training the model to suit our dataset

Since we have a pretrained InceptionResnetV2 model, The python library called Keras will be used, which is built on top of Tensorflow2 to do the retraining. In this case, instead of the 1200 images for each of the 35 categories, we will only be using 400 images instead. It was found that 5 epocs (rounds) of training for the model, with the given dataset, reached a satisfactory level of minimising loss and maximising accuracy. Further increasing the number of epochs did not really help with loss and accuracy, and the model stagnated beyond 5 epocs. We used a few parameters, such as Training Loss, Validation Loss, and the results for the same will be discussed further below.

Limitations and Challenges

Although the methodology is quite good at predicting from the given dataset, the dataset itself is very close to ideal, with decent lighting and accurate labelling for each image. How this model performs for images that have particularly bad lighting conditions is yet to be evaluated. Our Model is not fast enough to do real-time translation, at least for now. This requires further optimisation in our model and perhaps even a total rehauling of the model to make it more lighter and have less parameters. InceptionResnetV2 is a very heavy model and is not fast enough to be used in real-time translation applications with today's hardware. Although it should be noted, that with handheld devices getting more and more powerful with every generation, and some even getting a dedicated neural processing hardware, it likely won't be an issue in the future. There are also some disadvantages with transfer learning, one of the main issues with transfer learning is "Negative Learning", where, due to the differences of the data between the pre-trained model and the new data that will be fed into it, the weights in the model might go rogue and result in a bad model, which might not produce good results. Something like this is especially important to keep in mind for critical applications like predicting Sign Language to text. As mistranslations can be fatal in certain situations.

RESULTS

After training the model in the above-mentioned methodology, we have obtained the following results:

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Loss and Accuracy
In the above image, the Loss and Accuracy of our pre-trained model is illustrated. As expected, the accuracy on the training set was very high (Close to 100%) even on the first epoch. While on the validation set, we see a steady increase in the accuracy, which is higher than 99.1% as we approach the 5th epoch. A similar trend can be seen in loss as well, where the loss decreases with every epoch. Loss is the measure of how well the model fits a never-before-seen data, and it is safe to say that we have loss numbers as low as 0.3 as we approach the 5th epoch.

Confusion Matrix, and Most Mis-predicted Classes
In the current Model, the letters V, O and C were the most mis-predicted. Here is a confusion matrix for all the classes. As seen from Figs 4 and 5, almost all the mis-predictions are of the letter I, which is either mis-predicted as V, O, or C. Upon further inspection, we think that this might be because of how the model interprets these images on a fundamental level. The errors are more prevalent in the signs for the letters O and C, both of whose signs can be shown with a single 'stroke', talking from a purely mathematical and 2-d image interpretational standpoint.

CONCLUSION

In this study, a method to predict the alphabet signs from the Indian Sign Language using Keras, a machine learning package built on top of Tensorflow2, was explored. As an outcome, a practical application that can be deployed for testing purposes in the creation of technology that benefits differently abled individuals in India and throughout the world has been produced. A Transfer Learning approach was used to achieve the same. Other similar works which aim to do the same, have taken a hardware approach, while some others will have the need for expensive camera equipment to do the prediction. While our method works well with even something like a phone camera, and webcam of a laptop, it still uses quite a heavy machine learning model to do the prediction which makes it highly accurate and suitable for testing more of such technology for the differently abled.

Future Prospects
The future prospects for such a solution are endless. With a lighter and more specialised model, it is possible to make this application run in real time, which will prove to be very helpful for the differently abled among us. Depending on the model and implementation, the application can either take the form of a mobile or desktop application that can be used to communicate better with everybody. It is also possible to use this model to adapt to other sign languages from around the world to help the world. As we grow in population with time, there is always a need for such a technology in all corners of the world, for people from all walks of life. With Technology becoming cheaper by the day, a solution like this will aid in making the world become a more accessible place.

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Fig 1: Overview of the methodology

Fig 2: Loss& Fig 2.2: Accuracy

Fig 3: Accuracy

Fig 4: Most mis-predicted classes

Fig 5: Confusion Matrix with all the classes (A-Z & 1-9)

RESEARCH ARTICLE

On the M Modulo *N* Graceful Game of Cayley Graph

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ABSTRACT

In this paper, we establish that Cayley graph $G(Z_6, \{1, 3, 5\})$ is M modulo N Graceful Labeling. Describe the M modulo N Graceful Labeling game on Cayley graph $G(Z_6, \{1, 3, 5\})$ and study the winning strategies for Players.

Keywords: Graceful Labeling, M modulo N Graceful Labeling, Cayley graph, Game on Graceful Labeling

INTRODUCTION AND MOTIVATION

Cayley graphs, named after mathematician Arthur Cayley(1878), are an important concept relating group theory and graph theory [2]. Graceful labeling was introduced by Rosa [5]. Odd gracefulness was launched by Gnanajothi[6]. Sekar[7] developed one modulo three graceful labeling. Ramachandran[8] build up the concept of One modulo N graceful labeling and proved various graph are belongs to this family. Tamizhchelvam *et al.,* [9] proved for any finite group Γ and a generating subset S of Γ, that $Cay_D(\Gamma, S)$ admits a super vertex (a, d)-antimagic labeling depending on d and $|S|$. The Graceful game was established by Tuza (2017) as a two-player game on a connected graph [3]. Luiz presented the first results in this area by showing winning strategies for Alice and Bob in complete graphs, paths, cycles, complete bipartite graphs, caterpillars, prisms, wheels, helms, webs, gear graphs, hypercubes and some powers of paths [1].

Definition 1.1A graph G is said to be M modulo N graceful labeling (where N is positive integer and M = 1 to N) if there is a function f from the vertex set of G to {0, M, N, N + M, 2N, …, N(q-1), N(q-1) + M} in such a way that f is 1-1 and f induces a bijection f^* from edge set of G to {M, N + M, 2N + M, ..., N(q-1) + M} where f^*(u, v) = $|f(u) - f(v)|$ for all u, v in V(G). A graph G satisfied M modulo N graceful labeling is known as M modulo N graceful graph [4].

Definition 1.2 For a given finite group Γ and a unit free, inverse closed generating set X of Γ, the Cayley graph G = Cay(Γ, X) is a graph with vertex set V(G) = Γ and with edge set E(G) = {(g, h)| g ∈ Γ, $g^{-1}h$ ∈ X}. Since X is inverse closed (that is X = X^{-1}), for every $g^{-1}h$ ∈ X we have $h^{-1}g$ ∈ X. Therefore the Cayley graphs are undirected [2].[See Fig.1]

THE M MODULO N GRACEFUL GAME OF CAYLEY GRAPH
Theorem 2.1. A Cayley graph G(Z_6, {1, 3, 5}) is M modulo N Graceful Labeling for all Positive integers N and M = 1 to N. [See Fig.2]

Proof. A Cayley graph G(Z_6, {1, 3, 5}) has 6 vertices and 9 edges.

Define M modulo N graceful labeling on Vertices of G(Z_6, {1, 3, 5})
f[v(2(i - 1)] = 3(i - 1)N, i = 1 to 3.   --- (1)
f[v(2i - 1)] = (9 - i)N + M, i = 1 to 3.   --- (2)

The vertices{ f[v(2(i-1))], i = 1 to 3 } ∪ { f[v(2i-1)] , i = 1 to 3 }= { 0, 3N, 6N } ∪ { 8N + M, 7N + M, 6N + M } = { 0, 8N + M, 3N, 7N + M 6N, 6N + M } has distinct labels.

Define M modulo N graceful labeling on edges of G(Z_6, {1, 3, 5})
f^*[v(2j-1), v(2(i-1))] = (12-j-3i)N + M, j= 1 to 3, i = 1 to 3. ---- (3)
The edges{ f^*[v(2j-1), v(2(i-1))] , j = 1 to 3, i = 1 to 3 } = { 8N + M, 7N + M, 6N + M , 5N + M, 4N + M, 3N + M, 2N + M, N + M, M }has distinct labels.
Hence Cayley graph G(Z_6, {1, 3, 5}) is M modulo N Graceful Labeling for all Positive integers N and M = 1 to N.

Example 1.2 modulo 5 graceful labelingon Cayley graph G(Z_6, {1, 3, 5}) [See Fig.3]

2.2Procedure for Construction of Game
- In this game, consider two players A and B.
- The vertex label of the given graph as {0, M, N, N +M, 2N, …, N(q-1), N(q-1) + M} where (q be number of edges).
- Player A goal is to M modulo N graceful labeling of the given graph by usinglabels {0, N, 2N, …, N(q-1)}.
- Player B goal is to M modulo N graceful labeling of the given graph by using labels {M, N + M, 2N + M, …, N(q-1) + M}
- Players A and B are alternatively choose and assign the label for a vertex on thegiven graph.
- Suppose uv in E(G), then either u is labeled by A and v is labeled by B or v is labeled by A and u is labeled by B. ie. Two adjacent vertices do not labeled bysame person.
- If they win the game, then they obtain M modulo N graceful labeling otherwisethey lose the game.
- Study the winning and loss strategies for Players.

Theorem 2.3 Winning and loss strategies of players on the M modulo N Graceful Labeling game of Cayley graph G(Z_6, {1, 3, 5}) for all positive integer N and M = 1 to N.

Proof.
Suppose Player A starts first, then he labels the vertex have a value **0** as 0. Now the turn goes to Player B, suppose if B is not choose labeling 8N + M on any one neighbourhood vertices of the vertex having value **0**, say {1 or 3 or 5}. Then they lose the game. Since they doesn't have an edge label as 8N + M. Hence B must be choosing the label as 8N + M on any one neighbourhood vertex {1 or 3 or 5} of the vertex having value **0**.Let B assign label 8N + M on the

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vertex has value **1**. Then the resultant edge labeling set contains {$8N + M$}.Now the turn goes A, A label the vertex which are not adjacent to the vertex has value **0** ie. **2** or **4**. Suppose A choose label as N and assign it on vertex having value **2**. Then the resultant edge labeling set contains {$8N + M$, $7N + M$}.Nowsuppose B chooses $7N$ + M for the vertices which are not adjacent to vertex have value **1**. ie. **3** or **5**. Then the edge labeling $7N$ + M repeated. Hence they lose the game.Therefore B decide to label $6N$ + M for the vertices which are not adjacent to vertex have value **1**ie, **3** or **5**. Then the resultant edge labeling set contains {$8N$ + M, $7N$ + M, $6N$ + M, $5N$ + M }.Now A has a last change choose label for the vertex have value as **4**. A cannot select the label $2N$ since the edge labeling $6N$ + M repeated. Hence they lose the game. Assume A prefers to label $3N$ then they get an edge labeling as $5N$ + M which is already available. Hence they lose the game.Therefore A must choose $4N$ then they get an edge labeling as $4N$ + M and $2N$ + M. Then the resultant edge labeling set contains {$8N$ + M, $7N$ + M, $6N$ + M, $5N$ + M, $4N$ + M and $2N$ + M}.

Finally B choose any one labeling from {M, N + M, $2N$ + M, $3N$ + M, $4N$ + M, $5N$ + M} and assign it on a vertex have a value as **3**, then the resultant edge label as duplicate or they doesn't get any one of the following edge labeling {M, N + M, $3N$ + M}. Hence they lose the game.Repeat the above process until to obtain an M modulo N graceful labeling to win the game.If A and B wishes to labeling as follows then they get M modulo N graceful labeling.ie .**0** to 0, **1** to $8N$ + M, **2** to $3N$, **3** to $7N$ + M, **4** to $6N$, **5** to $6N$ + M. Then the resultant edge labeling set contains {$8N$ + M, $7N$ + M, $6N$ + M, $5N$ + M, $4N$ + M, $3N$ + M, $2N$ + M, N + M, M } are distinct. Which is the one of the Winning strategy of players on the M modulo N graceful game of G(Z₆, {1, 3, 5})[Refer Fig.2]. Other winning Strategies are presented in table 1.

CONCLUSION

In this paper, established that Cayley graph G(Z₆, {1, 3, 5}) is M modulo N Graceful Labeling. The winning and loss strategies were studied for Players on M modulo N Graceful game of Cayley graph G(Z₆,{1, 3, 5}). In future we plan to generalize it and develop game software.

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Table 1. Other winning Strategies

Vertices	Strategies							
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**
0	0	$8N+M$	$7N+M$	N	0	$8N+M$	$7N+M$	N
1	$8N+M$	0	$3N$	$5N+M$	$6N+M$	$2N$	$6N$	$2N+M$
2	$3N$	$5N+M$	$8N+M$	0	$6N$	$2N+M$	$6N+M$	$2N$
3	$7N+M$	N	0	$8N+M$	$7N+M$	N	0	$8N+M$
4	$6N$	$2N+M$	$6N+M$	$2N$	$3N$	$5N+M$	$8N+M$	0
5	$6N+M$	$2N$	$6N$	$2N+M$	$8N+M$	0	$3N$	$5N+M$

Fig 1. Cayley graph $G(Z_6, \{1, 3, 5\})$

Fig 2. M modulo N graceful labeling on Cayley graph $G(Z_6, \{1, 3, 5\})$

Fig 3: 2 modulo 5 graceful labelingon Cayley graph $G(Z_6, \{1, 3, 5\})$

RESEARCH ARTICLE
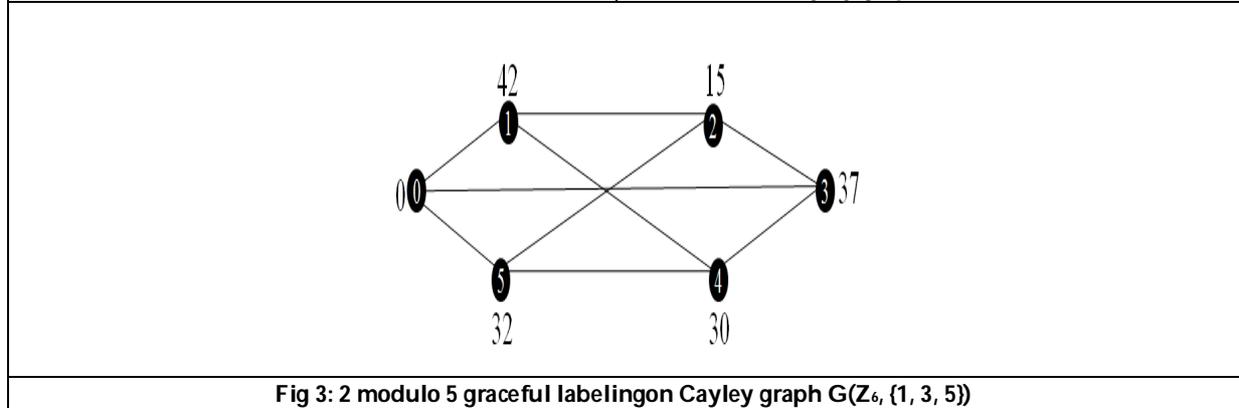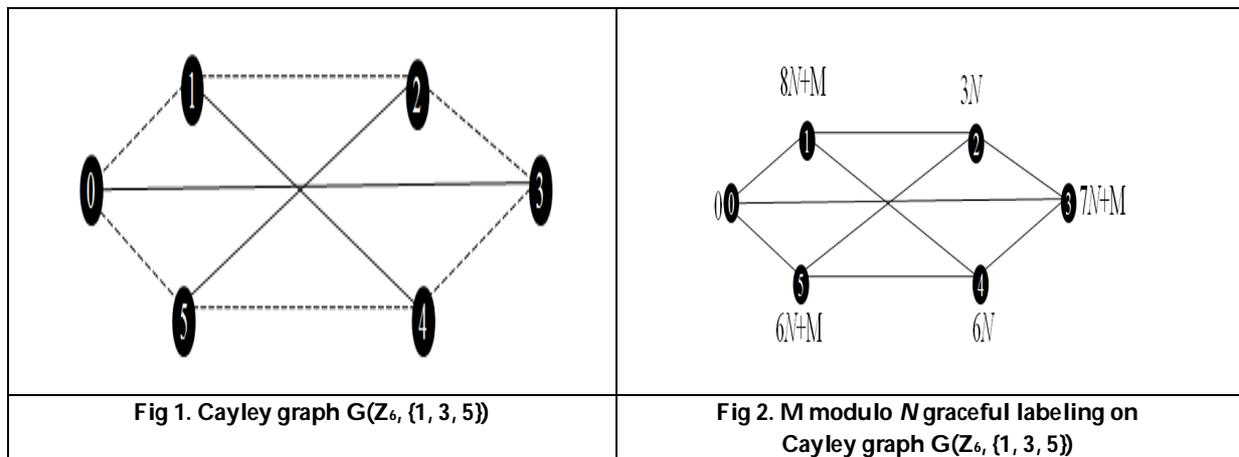
A study on Intelligent Social Recommendation System based on user's Influence

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ABSTRACT

During the last few decades, with the advancement of technology where everything is available at one single click, recommendation systems have taken more and more place in our lives. Recommendation systems are the building blocks of modern technology, that provide different suggestions to users on the items related to them. These suggestions are provided based on user's previous activity. Social media recommendation model is a type of adaptive and intelligent recommendation system that will suggest the user various things based on the influence of the activity of those people that he reacts to or is connected with in social media. We have surveyed 21 different research papers in recommendation systems and social media recommendation domain, and through our survey we found different algorithms that have been used to build the recommendation systems. Most of the papers mentioned about using collaborative-Filtering for building their recommendation models. On further surveying it has been found that collaborative-Filtering is alone not much practical as it doesn't consider various other cases and has several drawbacks. It has been mentioned in some papers drawbacks. Further experimental analysis showed that indirect interactions between the users is much better than direct interactions. Few papers mentioned about integrating collaborative-Filtering with various other algorithms for increased efficiency. But even they lack in giving expert suggestion after a certain extent. Hence we propose to build a smart and adaptive social media recommendation model that gives correct and accurate suggestions to the user with high efficiency, based on the influence of activities of his indirect user interactions.

Keywords: Adaptive Pattern, Social Network, Recommendation System, User Influence, Collaborative-Filtering

INTRODUCTION

In this era, where the world is expanding at a rapid rate, every human remains occupied in fulfilling his goals and objectives. This need for attaining goals made people stay in different places far from their friends and families; which in turn gave rise to the need of a platform where people can communicate with each other from any place and any time. This began the rise of Social media. Social media enables online communication. But now, it has become something more than online communication. It enables the users to perform various activities, open businesses, post their activities, the places they visit, etc. One such thing that is trending in this time is social media recommendations. Social media recommendations suggest the users various places or items or websites based on their activity. Different users usually share their most of their activities in social media which directly or indirectly influences the other users, which makes them react on it. We have studied about different algorithms and models that will help us to create a recommendation system which gives accurate suggestions based on the influence of user's activity in social media. Implementation of such a system, helps in marketing, and expansion of many businesses and also helps the user to choose from the suggestions given. There are different types of methods and algorithms used in recommendation systems are:

Collaborative-Filtering
A most commonly used recommendation algorithm is Collaborative-Filtering. This algorithm finds   people with similar interests and analyzes their behavior, and gives suggestions to the users the same items.

Matrix decomposition
 It is an elegant recommendation algorithm.
 u -vector of interests of n-th user, and v - a vector of parameters for m-th film.

$$x_{nm} \approx \langle u_n, v_m \rangle$$
$$\sum_{n,m} \left(\langle u_n, v_m \rangle - x_{nm} \right)^2 \to \min$$

So we can approximate x (grade from n-th user to m-th film) with dot product of u and v. We create these vectors based on the predetermined scores and use them to forecast grades.

Clustering
It is an unsupervised method of recommendation. The user groups are identified and each and every user in this group is recommended similar items.

Hybrid approach
 It combines collaborative and content - based recommendations. Practical studies show that this algorithm has provided better and accurate recommendations.

Related work
This section discusses past research on the subject of recommendation systems, especially works that employ techniques based on social recommendation systems. The section that follows provides descriptions of the several studies. There exists a large pool of data, and in this data there is a lot of relevant information. Due to several reasons, current recommendation systems still faces the disadvantage of inaccurate and incorrect predictions for users. This results in providing wrong suggestions. In this paper Francisco et al.[1], Proposed a strategy to recommendations that uses trust data from social networks to encourage or persuade users to offer their opinions for upcoming recommendations. We'll employ a trust metric based on factors that influence trust, such as familiarity and experience value, to pinpoint prominent users who will direct information flow and inspire their community. There are lots of unvisited places in the world by the users and they constantly look for some suggestions to visit a new

place. Hence, a location recommendation algorithm is required which can be used in rapidly growing location- based social network; which gives suggestions based on his/hers previous visiting histories, and other location related information. In this paper Xin *et al.* [2] had introduced an algorithm called sPCLR that uses category data to suggest destinations to users at specific times of the day. It takes into account the user's location's temporal and spatial components. Similar users' regular check-in behavior at different locations are noticed, and temporal curves are creates using this information. Geographical influence of locations will be used by the spatial component and it will filter out those locations that the user is not interested in. Data sparsity occurs due to large amount of data that is present. It leads to difficulty in finding enough data from a dataset and which in turn leads to inaccurate suggestions. Due to this problem in the data of many electronic-commerce users' behaviors, the traditional method of using only one recommendation algorithm fails to reach the requirement needs of giving correct and proper suggestions. In this study, Chen *et al.*[3] introduced a hybrid recommendation system called KMFSCF that combined Collaborative-Filtering with the Funk-SVD method and K-means clustering. After clustering the users, the scoring matrix of the user-item is divided. In order to forecast score and subsequently provide suggestions based on the ranking of ratings, the user similarity is calculated. Despite the widespread usage of collaborative filtering algorithms, these algorithms do not account for the impact of some anomalous and baleful data in user feedback data on how accurate the suggestions can be. Consequently, Weishi *et al* .[4]'s recommendation model was based on USN (User Service Network).

The user's recommendation to the service and the user's trust are calculated by creating a relationship of recommendation between user services and a relationship of trust between users. Additionally, it takes into account how malevolent individuals may affect recommendations and trust, increasing authenticity. Many services employ recommendation systems that operate on learning algorithms that leverage past recommendations and user responses to generate suggestions. These algorithms are predicated on the notion that the interests of the users are fixed and unchanging throughout time. No learning approach is created based on how user interests change. In this paper by Rahul *et al.*[5], influence models were established for learning algorithms that best recommended websites to web users. Users are provided with the best ideas thanks to the development of stochastic and static optimization schemes. Most studies on social recommender systems look at indirect factors like how similar people are, but rarely consider how direct interactions between users can influence each other [6]. In a new paper, researchers looked at direct connections that lie between users in the social recommendation systems and found that user preferences and item characteristics can be better described this way. Based on the analysis of social influence between users, they proposed a recommendation method that takes into account social influence between users. In order to predict users' unknowable preferences, social recommendation has arisen. This could solve the data sparsity problem in collaborative-Filtering-based suggestion. Early approaches failed to model the social influence diffusion process from the global social network structure and instead depended on each user's first-order social neighbor's preferences for improved user modeling. A neural influence Diffusion Network (also known as DiffNet) for social recommendation is proposed in [7].

In order to represent the influence dissipation disguised in the highest order of the social network, DiffNet models the recursive social diffusion process for each user. Recent research has revealed a rising tendency of examining user influence in social media, which can be attributed to the tremendous proliferation of social network data over the last few decades. To estimate the overall influential user behavior in social networks, it is important to examine the function of users and their collaborative actions with others. To determine how influential a person is to other users so that his or her rating of an item can affect how other users perceive the item, [8] offer an unsupervised measure of Influence Score in this research. Typically, the influence score is calculated taking into account the user's trustworthiness and dependability when evaluating the things under each particular category. Later a suggestion based on graph embedding that takes social impact into account was made [8].The fundamental unit of collaborative-Filtering is that people with matching and resembling interests will continue to be biased by those same preferences. However, the following issues with the conventional collaborative-Filtering algorithm exist in the E-commerce sector: Lacking truston the basis of user's interest bias similarity; disregard for the time factor; and absence of any association between behavior. In order to look after the precedent flaws, the collaborative-Filtering model based on

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user interest probability (PUCF) presented in [9] article was developed. First, Wilson confidence interval is utilized to solve the confidence issue, and then normalized time is used to produce the behavior time decay factor. Then taking into account the issue of behavior conversion. Recommendation system, which falls under the category of content-based filtering approach, is explained in the research performed by Kosuku Takano *et al.*[10].The recommendation model that is proposed was based on the sentiment analysis model. The analysis methods based on sentiments which have been implemented will look over text and the pictures which are been posted by the user .But sometimes its been difficult for these methods to analyze it properly due to the fake pictures or text that are posted by the user. In this case study, with respect to the context of user sentiment recommendation we calculate the users score of the sentiment based on the text and pictures which have been posted by them it sees the relation between them and calculates the score. In this modern era, we encounter a lot of malicious attacks on our system hence proving no security. To avoid this and also to incline the accuracy of the recommendation Dong Liu *et al.*[11] proposed a suggestion system which is based on the methodology of collaborative-Filtering which is solely based on fuzzy subjective trust . In this, by making use of the trust degree, a trust matrix is been constructed. Later on, by using the trust matrix and the similarity matrix of the user a hybrid recommendation system is been built. This way suggestion can be made for the targeted population. It is common for most cases, that these systems give more importance to individuals rather than making it for a group of users. Here Junpeng Guo *et.al* [12] mainly focused recommendations for a group of people, social events usually involve groups of users. Social factors of group users are the most remarkable difference between individual and group recommender systems. It has been found that the gap between group recommendations and individual recommendations is widened by social factors such as identity, expertise, relationship between the folks, and similarities. Here it makes use of Collaborative-Filtering and focuses on the social factors.

General model
A pictorial representation of main approaches to building recommender systems has been shown in Fig1.
Fig.2 shows how Collaborative-Filtering works

Collaborative-Filtering
In this type it mainly focuses on user similarity rather than the product similarity. Based on the similarity between the users features and their purchase model, it groups the users into clusters and provides them with item hints based on their resemblance with each other. The major focus over here is the customers, their judgment on the items, and the inter linkage with the online platform, as a substitute of items features. It follows that recommender systems in this category will be able to make recommendations ground on the algorithms of machine learning some of the algorithms that work under machine learning algorithms are clustering models, K-nearest neighbors, and many more to count. In order to understand who likes what and make recommendations based on that, we conduct surveys involving taking a note of ratings from the users, understand which items customers value the most, and recommend similar items already purchased by other customers .Its clearly explained by the above given instance, if user X and user Y buys 2 products which are same then the extra product which is brought by user X will be recommended to user Y.
Pros: By using collaborative-Filtering the output can be accurate almost all the time.
It can also depict a product which is not known by the user and displays it.
Cons: Requires huge computational power.

Similar items between the two items are:
• Men collection
• Black in color

Content based filtering
In this type it mainly focuses on product similarity rather than user similarity. This type of method, to a great degree examines the items features such as cost, classification, and other features defined and also the feedback which is been given by them. Same like collaborative-Filtering this also uses machine learning patterns/algorithms to find the

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similarities between the products so that it can suggest the user with the product which is most likely to be liked by the user. This can be understood by the example given above, if a user X buys a product, then it suggests a list of products which have similar features associated with the product that he had already purchased.

Pros: Works with lesser data.

Cons: Difficult to note down multiple items features.

Hybrid filtering

It is a compound of non-hybrid filtering. In this non-hybrid filtering, collaborative-Filtering and content based filtering comes into account. Many of the applications use this hybrid filtering. This approach is introduced so that there will be an incline in pros and decline in cons. The below bar graph shows us the year wise, which recommendation approach is more used.

Comparisons

Here we mentioned few of the authors from our research along with the methodology that they used and the final output they received. Five most relevant research papers have been analyzed and the comparison has been made based on the methodology implemented in each and its result. This is been represented in the given below tabular form where we compare and contrast between the author's mentioned.

DISCUSSION

We have reviewed several papers from different journals, which have left a remarkable impact on our project and on us. We have reviewed 21 papers in social media recommendation domain. All the papers reflected different ideas and paths on building recommendation systems that use data from social media. The study has classified few things to move forward with.

Recommendation Approaches

The most popular recommendation filtering techniques are Hybrid Based, Collaborative-Filtering, and Content Based [5]. Different suggestion filtering techniques have specific benefits and drawbacks. Content-Based filtering suggests products that are similar to those that a particular user has previously preferred. Items that tend to have a very high similarity constant, to the user profile will be suggested after comparing each item with the profile [8].Collaborative-Filtering is used to make decisions based on the opinions of other individuals with comparable interests. The two types of CF techniques are user-based and item-based CF approaches. In a user-based CF approach, a user will be given a suggestion for an item that comparable currently active users have enjoyed. In the item based Collaborative-Filtering approach, get suggestions for products from people who have previously enjoyed the item [3], [9]. A calculated average of the chosen user's ratings is used to predict the active user. The main problem with CF is sparsity; having few ratings is a very serious issue [9]. HB outperforms CB and CF while overcoming their weaknesses. Commonly utilized in practice to avert cold start, slenderness, and scalability concerns [14] and achieve higher perform ance is the HB technique to address the current CB and CF challenges.

Data Mining (DM) Techniques

In recommendation system domain the technique which is used most frequently, according to a review of several data mining techniques, are k NN, clustering, and matrix factorization. In RSs, a popular CF-based method known as k NN is employed for a number of tasks, including the creation of user profiles with ratings [2]. Social data extractors are used to gather textual data on user's activities, notably on social networks (like Facebook and Twitter) (such as heading, description of liked groups, events attended, liked pages, and articles). The information from tweets and direct communications can be used to develop user profiles. Using these techniques, user profiles that are beneficial for product and expert recommendations can be developed. By combining several approaches, the recommendations' accuracy can be improved.

Type of Recommendation

The most commonly used type of recommendation in the papers that we studied was user-items, while type which was notably used the feeblest was Item-Tags[15]. Mostly the recommender systems suggest and show items which are a result of the user's activity and their profiles.

CONCLUSION

The research done by our team has included 15 papers on social media recommendation systems were analyzed to understand how they are used and how they are changing over time. There will be a significant increase in social media research interest in Recommendation System's domain. According to the domain classification, the majority are associated with movies, while others are associated with entertainment. In many other areas, social media RSs require significant enhancement. The data mining-based classification demonstrates that clustering is the most commonly employed method. Bayesian text classification and link analysis are the methods that are used the least. This study has some limitations, including that it only includes articles from computer science and information technology journals. The limitation on keywords is that it only includes terms related to computer science and information technology.

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Table 1: A comparison based on their methodologies and output

Author	Methodology	Result
Jing Wang	Content based filtering	A Content-Based Music Recommendation System is been developed, It is 80% efficient than collaborative filtering.
Beibei Jin**a**	Collaborative based filtering	A collaborative based group recommendation system is built .It is 90% efficient than content filtering.
Angira Amit Patel	Hybrid based filtering	Restaurant recommendation system is been made. The efficiency of this is much greater than the basic recommendation systems.
Sonia Souabi	Co-occurrence	Recommender software where activities of learners are listed out. Efficiency of this is less than that of hybrid.
Wingyan Chung, Hsiu chin Chen	Graph based filtering	A digital library is been achieved. In this no significant advancement is seen .It is almost similar to hybrid as it makes use of hybrid filtering as well.

Fig.1: General Model	**Fig.2: Collaborative-Filtering model**
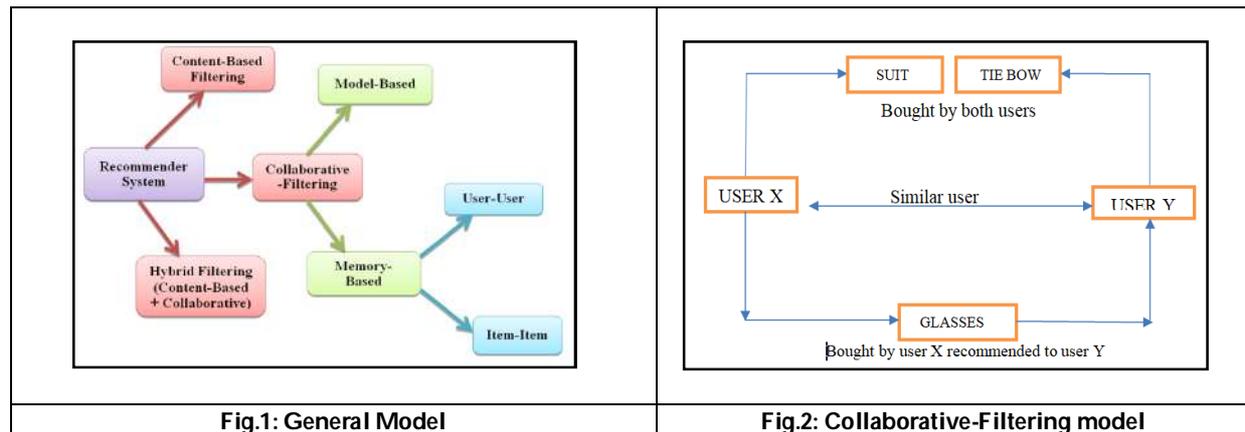
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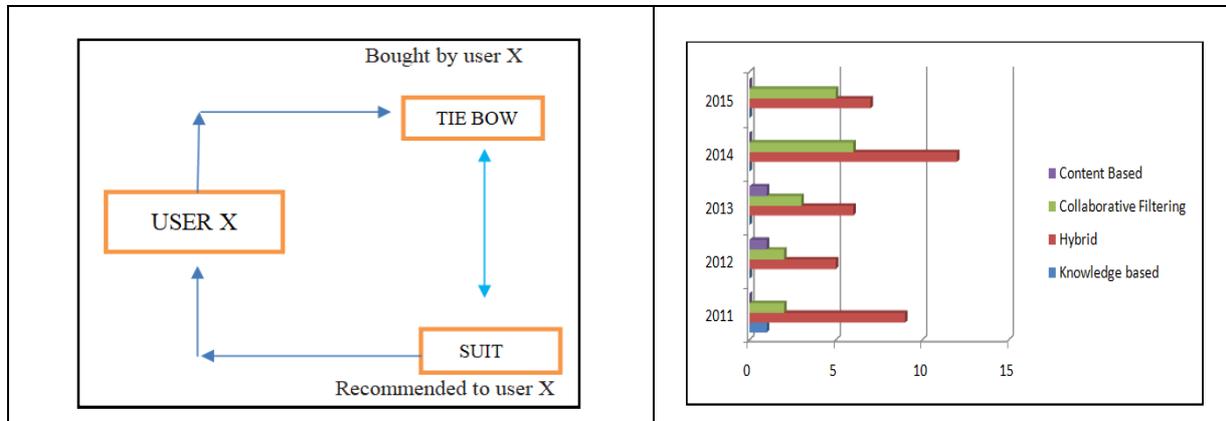
Fig.3: Content based filtering model

Fig.4: Recommendation Approach
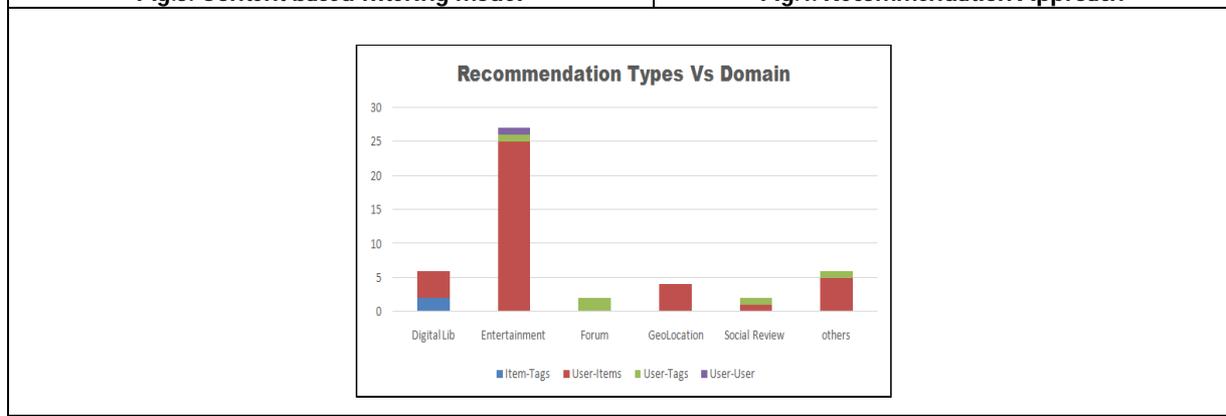
Fig.5: Recommendation Types Vs Domain

RESEARCH ARTICLE

Frequency Implications in Energy Healing

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ABSTRACT

The subtle energetic anatomy of each one of us is made up of tiers of vibrational structure known as koshas, or sheaths, according to yoga. Each and every item in the cosmos has a default rate of vibration, which is known as its resonance. When we examine the human body, we notice that every organ and even tissue is constantly vibrating. A good healthy body is one in which the organs and tissues are in vibrational harmony. When there is a state of discord, it is referred to as sickness. Vibrational therapies send energy frequencies into the body, changing its frequencies and resetting the body's energy fields. This can be truly attributed to the principle of entrainment. Tibetan singing bowls, which have been used for centuries, are one of the therapies for resonating the frequency levels in the human body. We have the ability to regulate our vibration rather than our vibration dominating us, according to one of the hermetic principles. The frequency domain and its implications in energy healing with factual secondary data is narrated in this study.

Keywords: Resonance, Bioresonance, Vibrational Medication Therapies, Entrainment, Hermetic Principles, Energy Healing, Schumann Resonance, Coronavirus, Acoustic Frequency, Solfeggio Frequency, Ho'oponopono, Law of Vibration, Law of Attraction

INTRODUCTION

The vibrational structure levels or sheaths available in our body are the physical body or food sheath, the energy of breath sheath called pranamaya kosha, the emotional layer or astral body, the layer of thoughts or mental body, and

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the highest frequency layer referred to as the casual body or the soul[1].Heartbeats, movements of the respiratory tract, the flow of blood through the blood vessels and through other mechanical processes the human body can produce very low frequency vibrations. It is observed that specific resonance frequencies are produced by the different organs of the human body. The resonance frequency of the heart is approximated to one hertz, the brain to ten hertz and that of blood circulation between 0.05 to 0.3 hertz. Among the infrasonic waves generated in the human body the first two types were associated with heartbeat and the respiratory system while the third, Traube-Hering waves were associated with the states of emotional tension. In 1917, Franz Morrell introduced to the world the Bioresonance therapy which involves measurement of frequencies emitted from the human body with the help of specific devices which in turn helps in diagnosis of diseases and further as part of the treatment process, corrects the frequencies back to the normal frequency. Some of the instruments used for this therapy include Mora and Bicom. This therapy is a treatment methodology for treating areas such as smoking cessation, stomach pain, allergies, rheumatoid arthritis, cancer, fibromyalgia, overtraining syndrome and so on[3].One of the predictions of the great scientist Albert Einstein states that human beings exhibit waves which are hyper in nature in six dimensions of space.Hence in addition to the physical plane six other planes are said to exist. One of the therapies which is based on working in the biological plane or M-field is the MORA therapy.

A rigid body may oscillate in such a way that all its component parts undergo the same motion during a translational or linear motion. But if it is an angular motion then all the component part does not undergo the same motion. Both these types of vibrations can influence human responses. The after effects of the whole body vibration may be protruded as degraded comfort, interference, or motion sickness. It is observed that if frequencies higher than 2 Hz are applied on the human body the resonance effects can occur which in turn tends to amplify the motion and overall discomfort which is revealed in terms of discomforts felt at the abdomen, thorax, shoulder, face, and other parts or organs of the body[3]. The various toxins including DDT present in the body is broken apart by the fields of energy generated using crystals in the vibrational therapy called "Molecular surgery"[4].It is observed that the resonance vibrations occurring among the molecules pave way for the Spectroscopy phenomenon. The electromagnetic fields are generated whenever an electric field created by the movement or rotation of a charged particle moves or rotates. In an atom the electrons available in the innermost shell have highest level of energy motions and they are the ones which resonate in the X-ray region of the electromagnetic spectrum. The electrons farther away from the nucleus of the atom or present at the outermost shells resonates in the ultraviolet band of the electromagnetic spectrum and are the reason for exhibiting unique physical and chemical properties of an atom. Infrared light is usually involved in the bond bending and stretching procedures. The different types of spectrometers are used for the measurement of emission level and absorption level of molecules. The molecules present in the human body vibrates in specific frequencies and emits a unique energy spectrum. This spectrum reveals precise information about motion of particles within it[5].

The crystalline nature of living tissues are taken into account by light and sound therapists who apply energies of particular frequencies to appropriate points on the body. The credibility of Magnetic Resonance Imaging can be closely attributed with the fact that tumors contain abnormal quantity of water[6]. Nothing in this universe can be attributed to solidity. If an object is appearing as solid to us then the actual reason for the same is that it is actually created by an underlying vibration. These vibrations produce geometrical figures and in turn builds up crystalline structures. The vibrations within each individual varies in intensity owing to the experiences manifested in oneself. Every individual is attuned to his/her own vibrations and this attunement is influenced by the various forces outside or within oneself. Any organism or parasite such as virus or bacteria is sensitive to specific frequency and can be disintegrated by intensifying that frequency as per the discovery of Rife. For this he invented a Beam Ray machine (Rife machine). According to Dr. Horowitz there is a specific sound frequency and color for exciting love. Broadcasting of the right frequency can even propagate peace and healing. The love frequency of 528 Hertz is one among the six core creative frequencies of the universe.

The 7.83 Hz Schumann Resonance frequency can be considered as an addition to these core frequencies of the Universe and was discovered in 1952 by the German scientist Winifried Otto Schumann. This frequency travels

around the Earth at a distance of around 60 miles in the cavity formed between the Earth's surface and ionosphere. The collision of the negatively charged Earth's surface and positively charged ionosphere, caused by solar winds, fills this area with an electrical tension. Our planet's electromagnetic aura and pulse are determined by the Schumann Resonance. Researchers have proven that electro-magnetic pollution, especially from mobile phones can bring out hindrance in the body's ability to harmonize with the mother Earth's natural frequency. This in turn causes reduced production of melatonin by the brain. Melatonin is a hormone made in the brain that plays a significant role in cell rejuvenation and cancer prevention. Our planet's and ourselves' resonant frequencies are both represented by the Schumann Resonance. The relationship between the Schumann resonance and the alpha frequency of brainwaves was discovered by physician Dr. Ankermueller. Herbert Konig, a doctoral candidate under Professor Schumann, used a comparison of human EEG readings with the Earth's natural electromagnetic fields to show that there is a connection between the Schumann Resonances and brain rhythms. He discovered that the alpha and theta rhythms in the brain have a frequency range that includes the fundamental frequency of 7.83 Hz produced by Schumann resonances. Alpha waves are said to be the prominent among the five main types of brain waves which induces relaxation and takes us towards the wealth of creativity that lies just below our conscious awareness .

The heart is one of the body's various organs that may be viewed as a network of nerves that uses human energy to function as a whole. The human body receives the energy produced by magnetic field radiations via the nerves. The energy current in the body is taken up by the brain which in turn sends it to all the control centres and then receives the impulses back through the returning nerve channels. Most of the energy we require is acquired through the air we inhale and in adolescence greater supply of human energy force is required for the smoother functioning of the nervous system, which is provided by energy of oneself and that evolving from the mating energy. Fueling of the nerve takes place to a great extent through normal sex life which in turn helps for maintaining good health. The clitoris nerve is the dominant nerve that powers women and plays a vital role for the magnetic field's rehabilitation and vitalization through natural sex as it enables the magnetic field to gather enough energy from the atmosphere through the lungs so that the heart and other organs will receive their fair share of energy. The fuel is not properly relayed to the magnetic field when the clitoris nerve is inactive. As a result of the magnetic field's partial dormancy, there is an insufficient distribution of energy, which raises neurological tension leading to appearance of various symptoms such as heart strain, shortness of breath symptoms, sinus, bronchial trouble, and so on. This in turn effects on nervous system of the husband[7]. For individuals utilizing the hand healing technique "Therapeutic Touch," Dr. John Zimerman determined the frequency of the pulsating biomagnetic field emitted by SQUID to be between 0.3 and 30 Hz. He noticed that the electromagnetic emission of healers' hands has the same pulsation frequency as the right and left hemispheres of the brain become balanced and show an alpha rhythm with a frequency of 7.8- 8 Hz[8, 9]. During hands-on healing, distance healing, and Healing Touch, low-frequency (0–40 Hz) magnetic field (MF) oscillations are seen, which are more frequent and of greater amplitude during the energy healing session and immediately after the session, as compared to non-healing time periods[10, 11].

The Law of Vibration
Ho'oponoponois said to be working in association with the twelve universal laws. Everything is constantly in motion and vibrating at a particular frequency as per the second universal law. According to the law by Shannon Kaiser each of us vibrates at a particular frequency and that, if we find ourselves in an experience or situation that is low vibratory, we may learn to raise it. In the end, everything is composed of energy that vibrates at a specific frequency [12]. The Law of Vibration can be used for manifestation, navigating situations and managing emotions. In order to raise your vibration you can practice self-care, nourish your body with a diet which can produce high vibration, movement routines, focus on daily activities that makes us feel good, meditate, and avoid the company of low-vibrational people or situations.

Law of vibration vs. law of attraction
As per Kaiser, The law of vibration is considered as the predecessor for the law of attraction. The law of attraction says that at first the vibration or frequency within oneself has to be created or invoked through meditation, visualization and affirmations. The prime area of focus in the law of vibration is in making a match of the specific

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frequency which is sought out. The saying by Richardson substantiates this theory as it says once you properly align vibrationally through frequency match on something then it becomes easier to attract the same .

TREATMENTS AND RESULTS

The coronavirus envelope is predominantly made up of three proteins that include the membrane protein (M), the envelope protein (E), and the spike protein (S). The spike proteins of a realistic 2019-nCoV often differ from one another in shape and have varying frequencies with slight variations. Every spike protein of 2019-nCoV must be excited to resonate using an ultrasonic vibration exciter with a 360 degree sweep whose frequency range is tuned to the first-order bending vibration frequencies of 1.9×10^8 Hz to 2.0×10^8 Hz. The vibration concentration and 360-degree rotating sweep stimulation could induce spike protein resonance. With the right excitation amplitude, it could break down the spike protein structures and stop 2019-nCoV from becoming contagious[13]. It was discovered that while treating diabetic and venous stasis ulcers with a battery-operated wearable Pulsed Radio Frequency Energy (PRFE) device, nearly complete healing could be attained in as little as six weeks. The PRFE device used in this case study has a carrier frequency of 27.12 MHz and a pulse rate of 1000 Hz. In cell tests, it was discovered that PRFE exposure enhanced fibroblast growth factor-2 (FGF-2), an important molecule in wound healing that promotes endothelial cell proliferation, angiogenesis, and the development of granulation tissue[14]. The main element for blood circulation and oxygen delivery in the human body is thought to be acoustic resonance. The energy to vibrate is provided by oxygen, which also controls the different organs and tissues to produce varied functioning frequencies. This frequency is a characteristic of an acoustic wave, which the body's other cells are constantly exposed to. As a result, sound transmission is how the body's organs and tissues talk to one another. The lung and heart are the most crucial organs for controlling and filtering acoustic frequency in the entire resonating system of the body. To create the heartbeat, which is the functioning rhythm of all organs, the heart particularly contracts and relaxes. Additionally, as a carrier for all resonant frequencies in the human body, the heartbeat is the most important frequency. Organs and tissues are able to work harmoniously together based on the heartbeat frequency.

To receive the blood perfusion and subsequently the delivery of oxygen, all organs must maintain a tuning with the heartbeat frequency. When tissues and organs lose the heartbeat's carrier frequency, they are unable to adjust to its resonant frequency and finally stop working in concert. Severe hypoxia in the body inevitably results in major side effects such tissue necrosis at the ends of limbs, kidney failure, stroke, epilepsy, brain injury, and other conditions. The goal of exercise is to cause the muscles to vibrate and improve the acoustic resonance, which improves the flow of blood and oxygen throughout the body. However, vigorous exercise will raise the resonance frequency too much, causing blood to flow to the skin and limbs rather than the brain and other internal organs. It goes without saying that vigorous exercise generates an oxygen deficit in the brain and other organs, damaging the organs and brain tissue. In excess of 90% of people will stop smoking after one session of Bioresonance therapy whereas success rate with nicotine patches and gum is 7%, acupuncture and hypnosis is 30%, smoking cessation clinics is 30% and cold turkey is 3%[15].Studies have shown that the detection of human gender can also be done by analyzing the characteristics of radiations from the human body[16]. Energy and electromagnetic waves that vibrate at specific frequencies are present in our bodies and cells. When specific musical or acoustic vibrations are introduced to the vibrational frequency of our bodies, they resonate together and cause a new vibration in our cells. The most important purpose of music, according to Pythagoras, is to unite a person's soul with their Divine Nature. Because of this, music can promote healing, joy, and a sensation of being loved when it is created with a certain goal and uses a particular frequency. A useful resource are the Solfeggio frequencies. It is said that Guido of Arezzo, an Italian Benedictine monk, invented the tones in the 11th century. He used the "Guidonian Hand," a mnemonic device, to teach melodies and harmonies to monastery choirs by assigning notes to specific locations on the fingers and palm. The choirmaster would indicate the next note by pointing to various portions of his hand. Brother Guido, however, desired to discover a means of expressing a musical scale. The health implications of the solfeggio frequencies can be understood from the above depiction .

CONCLUSION

Having a basic understanding of the resonance frequency of different body organs is very essential for the physical and mental wellbeing of a person. Starting from the Bioresonance therapy, knowledge and understanding of the core frequencies of the Universe, Schumann frequency, solfeggio frequency and the laws of Universe including the law of vibration with its associated counterpart the law of attraction all throws light into the world of possibilities. More and more Bioresonance therapy devices should invade the market and wider areas of research should be explored in this unique area. These treatment techniques should be widely explored even for the covid-19 treatment and for deaddiction treatments.

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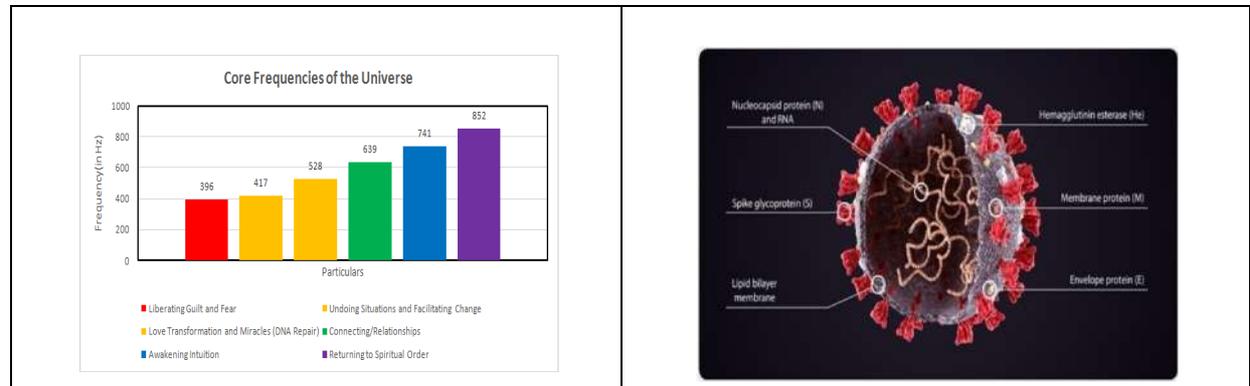
Fig 1: Core Frequencies of the Universe

Fig 2: spike proteins of a realistic 2019-nCoV
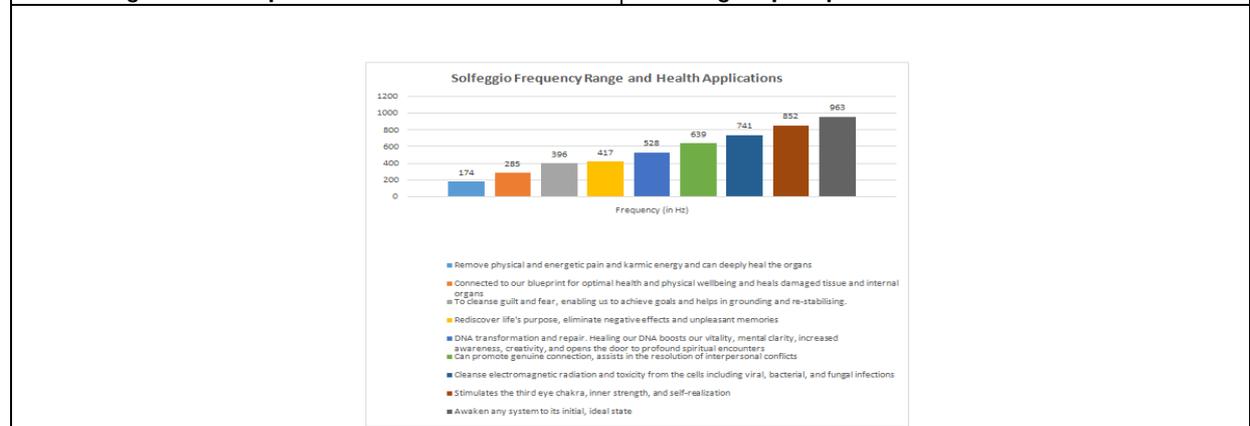
Fig 3: Solfeggio Frequency Range and Health Applications

REVIEW ARTICLE

A Review on Federated Learning Techniques

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ABSTRACT

This paper focuses on Federated learning technique on Machine Learning and deep learning models for attaining finer models which are trained using multiple data sources providing a better exposure to various realms of data. Review on this topic tries to establish the importance of learning with various datasets available, both public and private, to improvise the models collaboratively. Though, publicly available datasets provides a platform on which models could be trained, their number is often limited. The main reason why business firms don't share their customer details, hospitals don't share their patient details and other data sources are reluctant to share their private data is the concern for data protection. Sharing of data outside the organization may cause the violation of Data protection Act and causes breach in Data security. Federated learning, comes as a solution to this problem. In this technique, data is not shared or transferred outside the organization, but are used to train the models, for the enhancement of its performance. Global Model is updated after training with each private dataset locally, and thus collaborative learning is made possible, which eventually increases the performance of the model. Various federated learning algorithms such as Federated Learning Aggregate Methods which includes Federated Stochastic Gradient Descent and Federated Averaging, and their performance, comparison are also done in this paper which can give more insights to this technique.

Keywords: FedAvg, FedSGD

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INTRODUCTION

Machine Learning and Deep Learning models have to be trained using massive datasets to obtain better accuracy. Though there are some publicly available datasets to train these models, their efficiency is often limited when applied to a newly generated data. For example, datasets available with various hospitals or government entities are not shared publicly due to security reasons and privacy concerns. Despite of the enormous amount of data generated every moment, due to the organizations' reluctance to provide their data, academics and data scientists are unable to use this data. This issue can be addressed using Federated Learning. Federated Learning(FL) is introduced by Google in 2016, as a type of collaborative learning in one of its paper [1]. They have coined the term Federated Learning by considering the entire process as the operation of a loose confederation of devices in the system controlled by a centralized device. Participating devices are termed as clients and the central controlling device as server. Each client's training dataset is unique. An update ,computed by the client for the current global model and sent to the server, is then used for the global model updation. This update is further sent to each client so that their local models can be subsequently updated. There is no need to store these updates once they are updated because they are particular to enhancing the present model. The White House study on consumer data privacy of 2012 which employs the concept of data minimization is used here. [4]. Federated Learning can be used along with ML and DL to solve many real world problems. The concern for the data sharing can be solved by using this method. In this method, dataset associated with an organization is not shared, but used to train the model locally and result obtained is sent to the global model managed by a centralised server. Global model performs certain operations and send parameters to update the local models. Thus it solves the bottleneck with traditional machine learning models which requires access to entire dataset to train the model. Federated learning provides a decentralized training mechanism.

Federated Learning (FL) ,since it was initially launched by Google, has been a key component in enhancing the performance of a variety of applications. Google Assistant and the predictive text feature-rich Gboard app for Android are two of the most well-known and frequently used FL-powered products. FL can be characterized as an environment that allows for collaborative on-device machine learning. FL applications include AI, IoT, blockchain [20], natural language processing(NLP), driverless vehicles, resource allocation, and healthcare use cases in data science, education, and business. Recommendation systems, self-driving cars, the Internet of Things, battery management, privacy, fairness, and personalization are some areas where FL can be used. Governments and the public sector can also benefit from FL [2]. The following aspects characterize ideal federated learning problems: 1) Mobile device training on real-world data has a clear benefit over training with publicly accessible proxy data from the data centre. 2) Because the data is sensitive to privacy or is huge in comparison to the models' size, storing it in the datacenter for the purpose of training is not preferred. 3) For supervised tasks, user interaction can naturally identify labels for the data. Federated Averaging (FedAvg) , Federated Stochastic Gradient Descent (FedSGD) are some of the most common algorithms used in Federated Learning Techniques. Federated learning thus enable us to overcome various issues associated with typical machine and deep learning models where data privacy is a major concern. The main idea behind federated learning is decentralized data. The interesting fact is that the data that is used to train the model in one client, never leaves that client or organization. The weights, biases and other parameters learned by that individual model leaves that client. The technical issues, frameworks, and constraints of FL have been extensively examined in the literature, and summaries of the key FL studies are provided here in this paper. Prior surveys focused on FL's technical concerns and challenges. In this survey, we explain FL principles by identifying its techniques, implementations, use cases, and privacy preserving techniques. Here focus is given on the applications of FL to healthcare field, as human lives are more important than anything else.

METHODS

The hardware element that performs model training utilising locally accessible datasets is the client devices. In the beginning, each client device gathers and prepares the data locally (feature Extraction, cleaning, transform, load). The operations are started by all client devices after they have received the inital agreed upon global model. The

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client devices encrypt and extract the parameters for the global model. They then practise local model training. The devices that are clients, then use the acquired updated global model for their data assessment and prediction tasks.

The performance each of the local model is optimised while the loss function is minimised by the local model training. This model is typically trained for a number of epochs for a certain number of specified rounds [1] before uploaded back to the main server for further model aggregation. Neel et.al [6] suggested performing training on numerous mini-batch of client local data to reduce the total number of communication rounds. Only after the model's convergence does the method connect with the main server. The training results including model parameters or gradients are then sent back to the server by the clients. Clients assess the performance of the local model beforehand, and they upload results only after a certain level of performance is reached [7]. To maintain data security and stop information leaking, the findings are encrypted using various encryption processes before uploading [8]. To further cut down on transmission costs, the model compression is done before being sent to the main server [9]–[11]. Not all devices must upload their results in certain circumstances. This is done based on the availability of the data and devices. Depending on the criteria established by server, only the chosen client devices are required to upload the findings. After the completion of one round of model training, result is transmitted to the server for global aggregation. There are various methods used for aggregation in federated learning .Some of them are Federated Stochasic Gradient Descent and Federated Averaging. These methods are described below:

FEDERATED SGD(FedSGD)
Large-batch synchronous SGD in the federated environment [1] are employed as adding more clients has low impact on wall-clock time; It has been showing this strategy is cutting-edge in the data centre , where it outperforms various asynchronous approaches [17]. In order to use this strategy in a federated environment,a K-percentage of clients is chosen in every round and the gradient loss across all the data these clients hold, was computed. As a result, K determines the size of the overall batch, with K = 1 denoting full-batch (nonstochastic) gradient descent. This is Federated SGD's baseline algorithm (FedSGD). Each client c computes

$$g_c = \nabla F_c(w_r) \qquad (1)$$

the average of the gradient on its local data at the current model, w t, in a typical FedSGD implementation with K = 1 and a fixed learning rate η. The central server then aggregates these gradients and updates the global model.

$$w_{r+1} = w_r - \eta \sum_{c=1}^{C} \frac{n_c}{n} g_c$$

$$(2)$$

Since

$$\sum_{c=1}^{C} \frac{n_c}{n} g_c = \nabla F_c(w_t) \qquad (3)$$

An update is made by $\forall c$,

$$w_{r+1} = w_r - \eta g_c \qquad (4)$$

Followed by

$$w_{t+1} = \sum_{c=1}^{C} \frac{n_c}{n} g_c w_{t+1} \qquad (5)$$

That's each client locally perform a gradient descent operation on the current model using its own data, and the central server computes the weighted average of the same.

FEDERATED AVERAGING(FedAvg)
The local updateiteration

$$w_c = w_c - \eta \nabla F_c(w_r) \qquad (6)$$

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can be repeated several times before the average step after the algorithm has been defined in this fashion. This strategy is known as Federated Averaging or FedAvg. How much computation is done depends on three crucial factors: E,Each client's local dataset is subjected to a certain number of training cycles throughout each round; K, the proportion of clients that conduct computation; and B, the local minibatch size used for the client updates. To denote that, the entire local dataset is handled as one minibatch, it is chosen as B =∞. As a result, we can take B =∞ and E = 1 at one endpoint of this algorithm family, which exactly matches FedSGD. The number of local updates each round for a client with $n_c$local examples is given by

$$u_c = E \frac{n_c}{B} \qquad\qquad (7)$$

complete pseudo-code is provided in Algorithm 1.

Algorithm [1]

Input: The K clients are indexed by C. The number of local epochs is E.B is the minibatch size used locally and η is the learning rate.

Server side

initialisew_0;

for*each r=1,2,3...* do

$m \leftarrow$ *maximum(K.C,1)*;

$P_r \leftarrow$ *nclients set*;

for *each client c∈P_r in parallel* do

$w_{r+1}^c \leftarrow UpdateClient(c, c_r)$

$w_{r+1} \leftarrow \sum_{c-1}^{C} \frac{n_c}{n} g_c w_{r+1}$

end

end

UpdateClient(c,w)://client side ;

$B \leftarrow$ *splitDintosizeBbatches*;

for*each local epochs i from 1 to E* do

$w \leftarrow w - \eta \nabla l(w;b)$;

end

return w to the Server;

Algorithm [1]: Federated Averaging

Privacy

When compared to data centre training on persistent data, federated learning provides clear privacy advantages. Even holding a dataset that has been "anonymized" can compromise user privacy if it is joined with other data [3]. Contrarily, the data sent for federated learning(FL) is the bare minimum update required to enhance a certain model .Naturally, the privacy potency is dependant on the nature of the updates. These updates generally contain less amount of information about the training data. And further more, sources of updates are immaterial for the aggregation algorithms used. Henceforth, updates can be transmited via a trusted third party network without much complications. There is also scope for using FL with multiparty computation with sufficient amount of security and differential privacy.

Federated Optimisation

As a comparison to distributed optimization, we use the term "federated optimization" to describe the optimization issue inherent in federated learning. [1] Optimization in Federated environment differs from distributed one in a number of ways, including the following:

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- Non-IID: Any specific user's local dataset can't be considered as representative of the population distribution because the data on a particular client often depends on how that user uses the mobile device.
- Inequitable: Similar to how some consumers would use a service or app far more than others, this will result in variable amounts of local training data.
- Widespread distribution: The number of client devices taking part in an optimization is anticipated to be substantially higher compared to the typical number of instances per client.
- Insufficient communication: Mobile devices frequently have slow or expensive connections, or they are offline.

In data centers, communication costs are smaller compared to Federated environment. There computational costs are higher, which is recently tackled by making use of GPUs. Federated environment makes use of additional computational units(on-deviceGPUs) to reduce communications required and hence by their costs. There are primarily two methods for adding computation: 1) more parallelism, where we use multiple clients operating independently between each round of communication; and 2) more computation per client, where each client does a more sophisticated calculation between each communication round rather than a simple calculation like a gradient.

Evaluation Metrics
- Data Nodes: In federated learning, in order to create a global model, numerous nodes must take part in the learning process.
- Communication Rounds: There is no doubt that the node communication rounds have a greater significance on the model's performance.
- Data Nodes weights: It is crucial to indicate how accuracy is distributed among nodes, including whether each node is equally significant or whether each data node is absolutely vital.
- The Node Quality: In this section, we investigate the effects of the same distributed data or the same data percentage in the total data and the incorrect data percentage in the total data proportion on the model's performance. We think of the aforementioned characteristics as data quality.

Comparison Between Two Methods
Brendan McMahan et.al [1]presented a workable approach to the federated learning(FL) of deep neural networks focused on iterative model averaging, and carried out a thorough empirical analysis taking into account five distinct model architectural designs, including a multilayer perceptron ,a two layer character LSTM, word –level LSTM of large scale and two different Convolutional Neural Networks ,and four datasets namely MNIST , CIFAR-10 ,dataset from Complete Works of William Shakespeare and dataset made from 10 million public posts from a large social network .The investigations are carried out on image classification and language modelling tasks. These tests show that the method is resistant to the imbalanced and non-IID data sets that characterize this situation. The main restriction is communication costs, demonstrated a 10-100times reduction in the number of communication cycles necessary compared to synchronized stochastic gradient descent .It has been found that Federated Averaging (FedAvg) outperforms Federated SGD in almost all the cases of study. Federated Averaging (FedAvg) model trained models with relatively less rounds of communications .Results depicted that FedAvg algorithm is the winner.

Advantages Of FI
In comparison to centralized, traditional machine learning methods, federated learning is still in its infancy but already offers substantial advantages. The advantages of federated learning methods include the following:
- Data privacy: Maintaining the training dataset locally on devices/organizations ensures data security and eliminates the need for a data pool for the model and data is secured with the organization itself.
- Data diversity: Organizations and institutions may be prevented from combining datasets from many sources by issues other than data security, such as network unavailability in edge devices. Federated learning makes it easier to access diverse data, even when particular data sources can only interact at specific periods.
- Real-time continuous learning: Without the need to aggregate data, models are continuously upgraded using client data.

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- Hardware effectiveness: Because federated learning models do not require a single complex central server to evaluate data, this method employs less complex hardware with minimum storage requirements.

Disadvantages Of FI
- Noise vs. accuracy trade-off: Leveraging Differential Privacy (DP), we could introduce noise into the data for the purpose of improving privacy protection. However, by using Differential Privacy, we forfeited the model's performance. Therefore, a trade-off is necessary to add the proper amount of noise without affecting the model's performance.
- System and statistical heterogeneity: Federated learning must scale successfully across all devices, independent of the devices' kind, as training on heterogeneous platforms is difficult. The term "dissimilarity of statistical information" refers to a device's inability to determine the overall statistical pattern in a way that the samples, population or findings differ from one device to others.
- Communication Limitations: Since it may affect the Federated environment, where any device may become disabled because of communication bottleneck, which in turn stalls the Federated (FL) training process, the cost for transporting the models to the device should be comparatively small. [19] There have been numerous efforts to alleviate communication constraints, including discarding stragglers (devices that did not complete training computation inside the allotted time-window) and model compaction to save bandwidth costs.
- Data Poisoning Attacks: In a federated learning environments training process, several clients can contribute their on-device training sets. Data Poisoning [18]: Attacks, wherein the multiple attackers collaborate and insert malicious training samples into their own local models, may sabotage purpose of the entire FL system. 2) Model poisoning: As opposed to the previous type, malevolent clients alter the gradient or parameters of the received model before sending it back to server for aggregation. Due to this, the global model may get seriously contaminated by incorrect gradients during the process of aggregation.
- Trade-off between privacy and efficiency: Differential Privacy (DP) and Secure Multi-Computation (SMPC) can be used to boost the data privacy protection capabilities in FL environment. However such protection arrives with cost versus effectiveness trade-off. Clients who use SMPC has to encrypt model parameters before transmitting them back to the main server; this requires more computational resources, which reduces the effectiveness of training the model. With DP, model and data gets the noise, which results in a slight decrease in accuracy. Therefore, current difficulty in federated learning is determining a fair trade-off between SMPC and DP.

Applications Of FI In Healthcare
Large volumes of data are ideally needed to train deep learning models for segmentation and classification of images. Getting enough data is a big problem in the field of medical imaging. Data labels for medical images must be knowledgeable. Collaboration across institutions might be able to resolve this problem, however sending medical information to a single site presents a number of legal, privacy, technical, and data ownership issues, particularly among multinational organizations. Federated Learning comes as a good solution for this data issue. Federated learning enables deep learning modelling across multiple institutions without transferring patient data. Here are some applications of federated learning in medical field.

Covid 19 Detection
A COVID-19 detection is proposed by Mustafa *et.al.* [12] using federated machine learning using Keras API and Tensor flow in federated environment. During the training stage model loss & prediction accuracy are calculated for each round. For training, COVID 19 datasets are used. Activation function, Sigmoid produced more precise results than Relu, and the SGD optimiser outperformed the ADAM optimiser in terms of model accuracy loss. Federated model with SGD optimiser gave an accuracy of 95.96% with a loss of 11.24 % and training time was 9 minutes.

Invasive Carcinoma Detection
In order to create a global model, this researcher Agbley *et.al* [13] suggests a method that uses FL to safely train models across different clients using local Invasive Carcinoma(IC) of No Special Type(NST) pictures divided from

histopathology imaging of the breast ,BHI dataset. First, for automatic feature extraction, residual neural networks are employed. Then, in order to extract yet another set of features from the IC-NST dataset, a second model which uses Gabor kernels are implemented. After that, the two sets of features obtained from two networks are combined at a later time and processed the results through a unique classifier. The outcomes of tests were analysed for the federated learning (FL) & centralised learning (CL) environments. Competitive outcomes were attained, pointing to the advantages of using Federated Learning for IC-NST detection. Additionally, accuracy, F1- score, and area under the ROC curve (AUC) were all improved by combining the Gabor network features with the remaining network features (AUC). The models performed well on a different domain dataset (BreakHis), demonstrating good generalisation. The BHI dataset gave the highest accuracy of 86.57 percent with the suggested Federated Learning+ResNet50+GaborNet architecture.

Brain Tumor Segmentation

According to M.Scheller *et.al* [14] quantitative findings, models are trained via sharing data perform similarly to federated feature extraction models on multimodal brain images(Dice=0.852) .This paper has contrasted federated learning (FL) with two other distinct collaborative learning strategies and showed that neither is at par with federated learning's effectiveness. A U-Net framework of a deep CNN network was used to input the BraTS 2018 training dataset. This dataset contains multi-institutional multi-modal magnetic resonance imaging brain (MRI) scans from patients with gliomas was employed in this paper. Even with imbalance in the datasets, like the actual BraTS institutional distribution, or with relatively few samples per participant, this model constituted 32 institutions with 6 participants per institution. Using Federated Learning, experimentation achieved 99% of the model performance of a data-sharing model.

Classification Of Heterogenous Chest XRAYs

Zeigler *et.al* [15] assesses the viability of differentially private technique applied to federated learning (FL) for classifying chest X-rays, in order to defend against data privacy assaults. This research studied effects of DP learning on DenseNet121 & ResNet50, two neural network designs. By uneven distribution of images from CheXpert & Mendeley chest X-ray(CXR) datasets across 36 number of clients, this study assessed the viability of DP in diverse and imbalanced federated settings. On the task of binary classification of identifying the presence of a medical condition, both baseline non-private models attained an AUC score of 0.94. Later training phases were when the image reconstruction attack was most successful,DenseNet121 & ResNet50, architectures, were contrasted. It was found, therobust model to differentially private(DP) training is the DenseNet121 one. It is proved by utilising the Deep Leakage from Gradients(DLG) attacks approach, where shared model updates from those networks within the federated learning context ,are used to reconstruct individual X-rays. Rényi divergence based differential privacy (RDP) is used with a mechanism of Gaussian noise, into locally training the model to reduce the chance of a privacy violation.

Micro vascular Segmentation & Diabetic Retinopathy Classification

A system for numerous clients to undertake federated learning(FL) on a decentralised data corpus was proposed and developed by Lo *et al.* [16]. Although the system is currently implemented over an ownCloud instance, adding support for additional APIs is easy. To assess the effectiveness of a FL framework for Referable Diabetic Retinopathy (RDR) classification and retinal microvasculature segmentation utilizing deep neural networks using Optical Coherence Tomography(OCT) &OCT Angiography (OCTA).Diabetes patients and control participants' clinical OCTA and OCT scans were used for retrospective study. The Federated Learning configuration was tested against other collaborative training techniques using a simulation with four clients to segment the microvasculature. Then, Federated Learning was used to classify RDR across numerous institutions, and it was compared to models that were trained and evaluated using data from both the same institutions (internal models) and separate universities (external models). In order to segment the microvasculature, precision and Dice Similarity Coefficient (DSC) were evaluated. Accuracy, AUC, Precision-Recall curve (AUC-PR), Balanced Accuracy (BA), F1- score, Sensitivity (TPR) &Specificity are all tested for severity classification. FL produced similar performance in both applications as internal models. In particular, the FL model performed well for microvasculature segmentation (mean DSC computed from

all test sets was 0.793) and as models trained on a completely centralised dataset (0.807 was the mean DSC).The local models achieved a mean AUC of 0.956 and 0.973 for RDR classification, while FL attained a mean AUC of 0.954 and 0.960. The other derived assessment indicators also showed similar results. The study of various applications of federated Learning with deep NN in the health care field are shown in Table 1.

CONCLUSION AND FUTURE SCOPE

Federated Learning allows models to be trained with decentralised data. FL model enables organisations to train their system without sharing their private data to the server. This decentralised training method allows to solve the concerns for data sensitivity and security. A wide spectrum of interests from academia and business have been attracted to federated learning. A systematic literature is performed review on federated learning techniques .The findings indicate that the majority of the known reasons for using federated learning appear to also be the most investigated federated learning research challenges. The results of the study offer greater insights on development of federated learning systems. The main potential of collaborative learning is the evident increase domain variety and the generalizability of models. This report also encourages experts to expand on and progress their existing work by providing some insight on the federated learning research topics that may emerge in the future. Methods has to be devised to address privacy issues and to reduce the communication time required for training. Data heterogeneity and imbalance limit how well models can be aggregated. Because updates are collected in small batches rather than the entire dataset of the client, sharing intermediate models quite often makes them more vulnerable to reconstruction attacks. Future research will focus on optimising the aggregation process while taking privacy costs into account.

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Table 1: Comparison Of Traditional Methods With Federated Learning

Research Paper	Learning rate	Loss function	Models Used	Model Accuracy (FL)	Model Accuracy (without FL)
Mustafa *et.al* [12]	.0001	Sparse Categorical Cross Entropy	-	95.96%	92.34 %
Agbley *et.al* [13]	.0001	Weighted Cross Entropy	Resnet 18 Resnet 50 + Gabornet	Resnet50+GaborNet 86.57 % Resnet18+GaborNet - 86.13 %	85.90 % 86.33 %
M.Scheller *et.al* [14]	0.0005	-	U-Net-	-	-
Ziegler *et.al* [15]	0.01	Binary Cross Entropy	DenseNet 121 ResNet 50	AUC-0.937 Densenet 121	-
Lo *et.al* [16]	0.1 to 0.001	-	Residual U - Net	87.5	86.9 %

Suni Jose *et al.*,
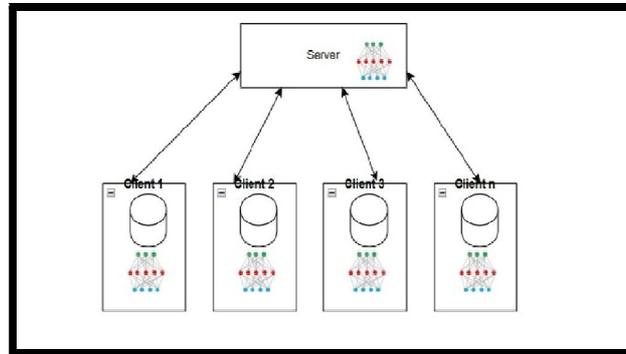
Fig. 1. Architecture of Federated Learning Environment.

RESEARCH ARTICLE

A Study on Intelligent Trustworthy System for Crowd-Funding

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ABSTRACT

Crowd funding is a practice of supporting various government and NGOs fundraising campaigns, business ventures and startups by receiving funds from investors. The traditional methods of centralized crowd funding platforms have a lot of shortcomings like lack of transparency, fraud campaigns, delay in raising funds and investments in projects with low success rate. Blockchain technology can overcome the shortcomings of traditional crowd funding methods by creating a decentralized network. Blockchain is a distributed unchangeable ledger which is completely transparent and decentralized. Machine learning concepts can be employed in determining the success rate of a crowdfunding campaign. This paper presents a study on blockchain technology and the related cryptocurrencies like Ethereum and Bitcoin. The paper also covers study on Ethereum based smart contracts which enables the transactions to be executed automatically thus ensuring trust between investors and vendors. At the end we surveyed the role of blockchain technology in crowdfunding campaigns which helps to understand the practical implementation of the technologies covered.

Keywords: Crowdfunding, Blockchain, Bitcoin, Ethereum, Smart Contracts.

INTRODUCTION

The blockchain is a decentralized, transparent ledger that stores transaction histories and is open to public scrutiny. It is not owned or controlled by any one party and is maintained by miners. The completed transactions are recorded in a chain of different blocks. It expands as additional blocks are consistently added to it [1]. Zheng et al. [2] in his study stated that decentralization, privacy, and auditability are essential properties of blockchain technology thus allowing blockchain to reduce the expenses significantly and increase the efficiency. Blockchain technology, particularly central banking platforms, has the potential to favorably disrupt a wide range of business models and application cases, including commerce, financial services, supply chains, business process optimization, sharing of

health information, and logistics management. [3]. One of the most significant applications of Blockchain is building decentralized platforms for crowdfunding campaigns. Crowdfunding, to put it simply, is the practice raising money for a project or campaign without the help of a third party or a centralized institution [4]. The crowdfunding platforms have many benefits as it creates traction, social proof, and validation and provides a forum for crowdsourcing concept refinement. It also helps us find early adopters and devoted champions and serves as a marketing and publicity tool. Choudary et al. [5] analyzed that although they have many advantages, traditional crowdfunding platforms have a lot of faults that need to be corrected. Fraud cases are one of the primary problems with traditional crowdfunding platforms, which claim that online crowdfunding exposes donors to fraud since conventional legal and reputation protection procedures might not be effective. A different survey conducted in [4] found that more than 75% of crowdfunding initiatives delivered their merchandise later than anticipated. Blockchain can help solve all the problems with the traditional crowdfunding platforms. As by using Blockchain we can build a decentralized application which can be used to make a distributed platform in which the investors will have full control over the money. Ashari et al. [6] surveyed in his research that smart contracts are one of the blockchain's fascinating properties. Smart contracts is a piece of executable program that is executed on a blockchain. It is employed to automatically execute the agreements once the given circumstances are met. Smart contracts can be used on a variety of platforms, including Ethereum, NXT, and Bitcoin. It is made up of programme code, a storage file, and the balance of the account. Making use of smart contracts improves the safety of the crowdfunding platform. They may be delivered automatically without a third party, are kept in public databases, and cannot be altered because the blockchain processes all transactions as they occur. Since there is no involvement of a third party, the trust and security issues are significantly reduced and the transactions only take place when the conditions stipulated in the agreement are met. Blockchain has made smart contracts decentralized, and as a result, the transactions taking place on crowdfunding platforms won't be governed by centralized entities like banks, brokers and other third parties.

Related works

Backmann [7] has highlighted the distinctions and parallels between the peer-to-peer lending and traditional ways of collecting funds. The amount raised, the screening procedure, and the information acquired for risk management are very different between the two fund raising strategies. These kinds of studies could clarify whether or not the outcomes of the novel peer to peer lending method are applicable to the established methods of money raising. This focuses on traditional fund-raising methods as well, where the ventures typically failed and the return on investment was quite low. According to a survey conducted by Prinsha [8] on crowdfunding and its effects in India, there are many benefits to crowdfunding over other options open to start-ups and SMEs. It is very difficult to attract investors to new businesses because crowdfunding is not accessible to the general public, but the younger generation has greater understanding about crowd financing, which is a fantastic beginning point for this crowdfunding platform to develop. This will also enable the new businesses to reach out to a wider range of financiers and investors in order to raise money. Vujičić *et al.* [9] in the research has presented an outline about blockchain technology. A detailed information about bitcoin has been given. Also implementation of blockchain with smart contracts has been put down by using ethereum blockchain. According to Zhu *et al.* [10], blockchain is still a new technology that is currently in the exploration stage. Before it is made available to the general public, various technical and legal difficulties must be taken into account. For market influencers to collaborate and transform the industry, implement blockchain in the marketplace, and propose novel ideas, there is still room for improvement. They must increase their grasp of blockchain innovation, including its value, potential, and risks. They should successfully progress blockchain technologies in the Chinese crowdfunding industry. Blockchain applications and specialized development can lead to financial proficiency and social benefits. There are various applications of Blockchain technology in today's world which includes the financial sector. Benefits of implementing Blockchain technology in modern day finance has been studied by Nandini *et al.* [11].They analyzed that by using smart contracts the execution of an agreement can be automated and payment of low values can be made possible. In their study, Hjálmarsson *et al.* [12] offered a brand-new electronic voting system built on blockchain that addresses some of the issues with existing systems and evaluates some of the well-known blockchain frameworks in order to create a blockchain-based e-voting system. They specifically assessed the potential of distributed ledger technology by

describing a case study, including the conduct of an election and the use of a blockchain-based software that lowers the cost and increases security of holding a national election. There are various protocols of Blockchain technology, the very first protocol was introduced by Nakamoto [13] in which he introduces the world with Bitcoin, a decentralized electronic money transfer solution that would eliminate the banks, brokers and other third parties. Thus, solving the double-spending problem without using digital signatures. One of the most well-known blockchain technologies is Ethereum. In their study, Khan et al. [14] suggested employing the Ethereum blockchain, which uses encryption-algorithms, consensus protocols, and smart contracts to deliver secure and transparent transactions, in the digital sharing economy. Blockchain improves the traceability, security, and transparency of the shared dataacross a company network while also generating cost savings by using Blockchain Databases. One such database is BigchainDB which has both the properties of a blockchain and database. The latest version of BigchainDB is called BigchainDB 2.0 which has come around with a lot of improvements like Byzantine Fault Tolerance [15]. According to research by Alrubei et al. [16] blockchain can also be used in the IOT sector.In a real-world use scenario, this article described a realistic Proof of Authority (PoA) Ethereum blockchain implementation on an IoT system. In order to establish the groundwork for future research and potential solutions to these problems, this implementation was practically completed in order to investigate and highlight some of the potential concerns that could hinder blockchain and Internet of Things integration. In their research, Huang *et al.* [17] have shown how smart contracts compromise security in order to increase decentralization.

The security concerns associated with Ethereum smart contracts fundamentals are then explored. In order to comprehend and use the smart contract, an optimized smart contract application on auction has been put into place. Khan *et al.* [18] in their survey concluded that a shared agreement between two or more parties is known as a smart contract. Thanks to the libraryfunctions, it saves information, handles input, and writes output. For instance, the smart contract can specify the method Object(), which is [native code] and allows for the creation of smart contracts. One can host a new smart contract on the blockchain by invoking the method Object() ([native code]) through a transaction whose sender becomes the smart contract owner. Only the smart contract's owner can typically revoke the contract using this function. A smart contract is often a class that comprises local variables, function modifiers, logs, and struct in order to execute and control relevant actions in line with the contract's rules. Alharby *et al.* [19]conducted a thorough mapping analysis in this publication, in order to compile all technical studies pertinent to smart contracts. By doing this, it will be possible to pinpoint active research areas and unresolved problems for next smart contract research investigations. 24 publications were taken out of various scientific databases by the researchers. The findings reveal that the majority of papers—about two thirds—concentrate on identifying and resolving smart contract challenges. The codifying, security, privacy, and performance difficulties are recognized as the four main issues. The remaining papers concentrated on applications of smart contracts or other relevant subjects. Future studies which would fill in the remaining research gaps, are also presented. We use leave application systems today which are controlled by a centralized authority. By using smart contracts Singla *et al.* [20] have suggested a system based on Solidity and Ethereum, a decentralized app framework based on blockchain technology, and created a smart contract design for the Absence Management System.

The smart contract app is paired with a centralized design, which is a conventional client/server layout with a blockchain - based backend. Untrustworthy parties can conduct business with each other using the emerging smart contract systems over decentralized currency securely without using dependable outsiders. The decentralized blockchain assures that in the event of contractual violations or aborts that just rewards are given to honest parties. Transactional privacy, however, is absent from current systems. On the blockchain, every transaction is visible, including the transaction between aliases and the total money transacted. Kosba *et al.* [21] have introduced Hawk which is a smart contract solution that protects transactional privacy from public view as it does not store financial transactions in the open on the block- chain. Staderini *et al.* [22] based on the Common Weakness Enumeration (CWE), have categorized a number of programming language vulnerabilities found in Solidity. They also provided a fault model for Solidity, and to uncover the flaws leading to the vulnerabilities on a collection of smart contracts, a comparative examination of different static analysis tools was conducted. In order to increase coverage, the study computes the testing effectiveness of static analyzers individually and assesses the covered vulnerabilities. The

analysis of the discovered vulnerabilities has been completed. Thus, it is important to recognize extreme vulnerabilities that static analysis techniques do not cover in order to maximize the tool's impact on the security of smart contracts. This paper describes a decentralized application that makes use of the Ethereum blockchain to lessen the limitations of centralized system. It was created using the solidity language and truffle evolution framework. All of the features of this application are contained in Ethereum smart contracts. A web3.js API was used to construct client-side applications. Utilizing the Kovan test network, analytical assessments of this application reveal the lowest transaction fees to date documented in the literature [23]. Both the academic community and the capital market have given blockchain technology a great deal of attention. However, massive speculation on the tens of thousands of cryptocurrencies that are already in circulation and countless initial coin offering frauds have also sparked infamous discussions about this new technology. In order to highlight the significance of decentralized apps (dApps) and the potential future value of blockchain, this study tracked the evolution of blockchain systems.

They have reviewed the most recent dApps and talk about where blockchain development should go to meet the demands of dApps. The readers will learn about current advancements in the blockchain and receive an outline of dApp research [24]. Blockchain is a fully visible ledger that is immutable and appended only, making it impossible to tamper with. In this article, by utilizing Ethereum's network and E-Wallets, Canessane *et al.* [25] built and put through testing an example smart contract for electronic voting application. After an election, the records of votes and electors will be stored on the Ethereum blockchain, creating a transparent and trustworthy network with little possibility for error. According to research by Hassija *et al.* [26], third parties frequently have a bias in favor of either the investors or the producers, in addition to issues with cost and availability. The conventional technique may appear fair, but it is not truly equitable. Since a smart contract, or self-executing line of code, cannot be biased, the recommended paradigm is shown to be neutral for both developers and investors. They suggested an approach which guarantees that the commitments reached between the parties concerned are followed in addition to offering the greatest bargains to developers and investors. The Ethereum foundation is utilized in their suggested approach to deploy smart contracts between ventures and investors in order to execute smart computing and to avert disagreements. The transactions that take place between the two parties are entirely under the jurisdiction of these contracts, which are self-executing lines of code. Crowdfunding is one of the most recent uses of blockchain. It is a form of online fundraising that was first created as a method for individuals to give a little sum of money to support the financial endeavors of creative people. The issue with the existing system of crowdsourcing funding is that contributors have little control over their funds, and third-party platforms cannot ensure the funds were utilized for the intended cause. This article is a study on smart contracts, which offer contributors power to successfully donate to any project [27].

Hussain *et al.* [28] proposed a decentralized and private blockchain based application in which all the contributors participating in crowdfunding would be having control over the investments being made by the vendors. A lattice-based cryptosystem has been used as extra protection to prevent future quantum computers from being able to decrypt the data. Algorithms and principles from machine learning have been used to make the application intelligent. As a result, the programme can forecast the success of a current live campaign. Dhokley *et al.* [29] proposed a system CrowdSF, in which the success of modern crowdsourcing platform providers will be combined with the benefits of recent advancements in blockchain technology. Their system used Ethereum-based smart contracts between the creator and the workers, to provide a clear and transparent display of the worker's credentials and diligence for a natural differentiation between high-quality workers and low-quality workers based on their Credit or Reputation score, which they will acquire after every task they successfully complete. They have also added Backers to the system, who will support the Creator's concept and finance their endeavor by giving them money. Benila *et al.* [30] studied briefly that the current platforms are problematic as they do not offer any guarantee policy to the donor and the contributors do not have control over the money they donated. The idea of this article is to use blockchain technology for crowdfunding. This paper includes interactive forms for campaign creation, donation, and request approval to make it easier for campaign creators and donors to establish and finance campaigns. The donor can monitor the use of the money they have given.The campaign's founders will put their project ideas there, and anyone who is interested in supporting the idea can donate money. The difference between it

and previous crowdfunding is that all the money is currently in digital currencies like ether. Every single Ether coin will be tracked and stored in the blockchain. In contrast, blockchain is an unchangeable ledger. The funding is under the Donor's control. The donor has complete control over the money they invested thanks to the Request approval module. The vendors can make use of the money only if at least one-half of the investors agree to the proposal.

Comparison

According to Zheng *et al.* [31] Ethereum's native currency is known as ether. Both when smart contracts are being executed and during the transactions that are represented in the block, ether transactions occur. To generate the private Ether transactions dataset, which enables us to examine every Ether transaction, we examine the blocks and trace data. shows the 54,688,782 addresses that are involved in the 330,239,865 Ether transactions. Ether prices range widely. The mean is only 22.26 Ethers, while the maximum are 11,901,464.24 Ether (about 2 billion USD at this time). As shown in table 1 Statistics for all transactions in a block of 10,000. Between 4,000,000 and 4,300,000 blocks, which corresponds to the busiest time for ICOs, the most Ether transactions are seen (ICO). Most ether transactions transfer just extremely little amounts of ether, as shown by the fact that most transactions only move between 0.1 and 1 ether. Yu *et al.* [31] studied that Exploratory Data Analysis (EDA) is a method that uses a variety of strategies to summarize data in both graphical and numerical form. The goal of the data pre-processing task is to identify noisy data and missing values (Kamath, R. S., & Kamat, R. K., 2016)[32]. According to the first observation, 3,801 records could be deleted due to data leaking (Protected data to an untrusted environment). Another discovery is that the "deadline" and "launched" variables have the wrong data type. As a result, the two fields' data type was changed to "datetime". Two additional columns were included as a workaround in order to provide the project duration and length of the project name. Following data cleaning, table 2 displays the number of projects in various statuses. Reading audiences can measure and compare variables by presenting. The distribution of various projects by category is shown in the charts. "Film & Video" is the most well-liked, followed by "Music" and "Publishing" displays the information arranged by the quantity of projects shows the proportion of successful versus unsuccessful projects in each category. "Film & Video" and "Music" are the top two of both when comparing the number of projects and the money committed in each area, whereas the other categories are ranked differently. Despite being few in number, technology-related projects received significant funding. Almost 80% of the programmes were funded in the US, and 9% in the UK.

CONCLUSION

A trustworthy system for modern day crowd funding platforms can be built using Blockchain Technology. New businesses, startups, and NGOs can now raise money without using conventional channels by using the new platform for crowdfunding. By using blockchain protocols/currencies like Bitcoin, Ethereum, BigchainDB transactions among various individuals can be carried out in a decentralized manner. Ethereum blockchain helps to build decentralized applications by smart contracts which are written in Solidity. Thus, crowdfunding can be decentralized by using smart contracts, in which the investor will always be aware of all the investments that are being made by the vendor. Additional security can be provided to the system by maintaining the privacy of each user in which cryptographic algorithms can be applied that would encrypt all of the transactions made by each individual. Apart from this machine learning concepts can be used to predict the campaign completion probability of a particular active campaign. The future of crowdfunding is unquestionably promising. It does, however, encounter certain difficulties. Online crowdfunding is still not widely embraced in India because it is a recent concept. However, the first hesitation should be anticipated and, given enough time, would not prove to be a significant barrier. The majority of the concern against online crowdfunding would fade with time.

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Table 1. Statistic value table

Statistic	Value
No. of Ether Transaction	330,239,865
No. of Addresses	54,688,782
Mean of Amount of Ethers	22.26
Maximum of Amount of Ether	11,901,464.24

Table 2.Total Project by Status

Status	Number of project	Percentage (%)
Suspended	1842	0.49%
Live	2798	0.75%
Canceled	38751	10.34%
Successful	133851	35.71%
Failed	197611	52.72%

Fig.1: Transaction distribution of Ether	**Fig.2: Projects count by category**

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Numbers of projects by Country

Fig.3: No of projects distribution

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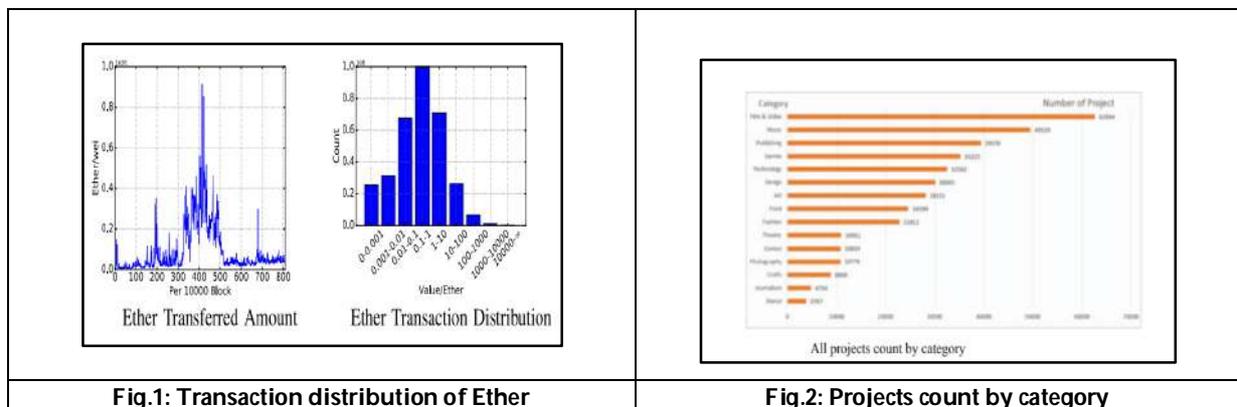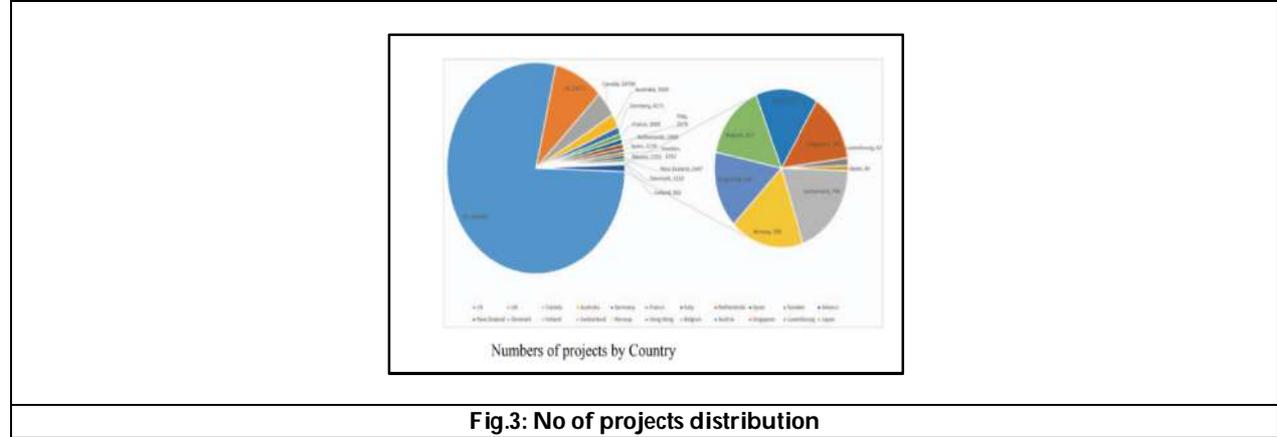
Study on Various Noise Removal Techniques for Malayalam Palm Leaf Character Recognition

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ABSTRACT

In the field of pattern recognition, handwritten character recognition is an emerging area of research. Extraction of Malayalam characters from palm leaf manuscript is very complicated compared to other languages because of its cursive nature. The task of recognition of characters goes through different stages like acquisition of the image, preprocessing the image ,noise removal from the manuscript, segmentation of characters training and testing the model. As a prework of our research in Malayalam palm leaf character recognition, we experimented various noise removal methods in Malayalam palm leaf manuscripts. The main objective of this paper is to present the various existing noise removal methods used for Malayalam palm leaf character recognition and to present the results of various noise removal methods on Malayalam palm leaf images.

Keywords: Character recognition, Pre-processing, Noise removal,

INTRODUCTION

The primary goal of noise reduction is to eliminate any undesired bit-patterns that don't contribute anything to the output. Noise reduction can provide a substantial improvement in the accuracy and reliability of feature extraction and in the recognition stages of OCR systems. Filtering, morphological processes, and noise modelling are methods for noise reduction. Filters can be made to smoothen, sharpen, threshold, eliminate background, connect strokes, decompose connected strokes, clip unnecessary parts, thin letters and remove borders. Noise removal method is important in character recognition systems to correctly recognize the characters. It is necessary to apply good noise removal techniques to images since the final result depends on the accuracy of the image.[5]. While handwritten character recognition systems have become commonplace, extracting textual content from palm leaf manuscripts is

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still an evolving domain, owing to the regionally limited relevance of these manuscript documents. Among India's 22 official languages, Malayalam is considered a classic Dravidian Language and is spoken by around 36 million individuals. It is spoken predominantly in Kerala. This paper explores the various noise removal algorithms and their applicability in palm leaf manuscripts written in Malayalam. Figure 1 shows the image of a Malayalam palm leaf.

Literature Review

D. Sudarshan *et.al,* in [6] advocated the use of a contrast-based adaptive method for binarization during pre-processing. Applying a contrast adaptive thresholding method can extract useful visual information from even low-quality palm leaf manuscripts. A CNN was trained to classify Malayalam character images The network will predict the class of the character which corresponds to a character in the Malayalam script. The system produces a file as output, containing the text found in the palm leaf manuscript. During testing, an accuracy level of 96.7% was obtained for the model. One of the earlier works on Malayalam palm leaf manuscripts by Geena K P and G Raju, [7] details the various methods used in image segmentation of characters. The authors suggested a comprehensive algorithm for segmentation of Malayalam characters. As part of the experimental setup, 7000 Malayalam handwritten palm leaf document images were collected from the manuscript library of the Malayalam department at Calicut University. From the dataset, characters were properly segmented after pre-processing and stored as 120 separate classes. In [8], the authors proposed a novel algorithm that used local Otsu thresholding and image gradient approximations (Sobel operator based) for denoising. In existing algorithms, the performance is heavily dependent on the threshold value used in the filter and the computational complexity increases proportional to the increase in threshold value. This novel algorithm produced the PSNR, SSIM and MSE values of 14.69, 0.003 and 0.02 respectively, which can be considered a significant improvement over existing methods.

Implementation

A typical optical character recognition system follows the sequence of steps as visualized in figure 2.The scope of this paper is limited to the pre-processing stage of the optical character recognition workflow, where noise removal algorithms are applied to images. The experiments involved applying various noise removal algorithms on the same dataset and comparing their results. The experiments were programmed in Python and were executed on a Linux machine having 13 gigabytes of RAM and a 2.20 GHz Intel Xeon CPU.

Noise Removal Techniques

Gaussian blur

Gaussian blurring is a low-pass filter (LP filter) that is used as a non-uniform, noise reduction technique. The Gaussian filter is identified as a spatial filter wherein it utilizes the kernel to convolve the input image[2]. In order to give distant pixels less weight than those in the centre, this procedure calculates a weighted average of the neighbourhood around the current pixel. A hazy image with better edges is produced by using a low-pass filter instead of a uniform smoothing technique. When an image size is to be reduced, the Gaussian blurring is a commonly approached method. A popular technique is to use a low-pass filter that is applied on an image before down sampling it. This prevents erroneous high-frequency information from showing up in the down sampled image (aliasing). Using the Gaussian function, which describes the normal distribution in statistics, the Gaussian blur is a picture-blurring filter type that ascertains the change to be applied to each pixel in the image. In the proposed noise removal method, we tested for PSNR and MSE values for all the noise removal methods. The PSNR values and MSE values are 30.90 and 52.80 respectively using this method[1].

Median Blur method

The median filter is an example for non-linear digital filtering. Typically, its performance is not on par comparatively to that of a Gaussian blur for high noise levels. In contrast, it is effective for removing for speckle noise and salt-and-pepper noise (impulsive noise). Due to this, the digital processing domain commonly applies the median filtering technique [3]. The median filter examines each pixel iteratively and looks at its immediate neighbours to ensure that

if a pixel is indicative of its surroundings. Rather than replacing only the mean of the neighbouring pixel values (mean filter), it exchanges the pixel value with the median of those values instead.

Wiener filter
Wiener filter is one of the key techniques for elimination of image(s) blur due to either unfocused topics or linear motion. The Weiner filter design requires the knowledge of the original signal's spectral properties. A noisy signal is provided as the input to the wiener filter [4].Wiener filters are one of the most common deblurring techniques which returns mathematically best results. It is possible to restore a picture that has been blurred by a known lowpass filter using generalized inverse filtering or inverse filtering, which is a restoration approach for deconvolution. However, additive noise is a common prone by-product (susceptible) when inverse filtering technique is used when it comes to noise removal. A restoration algorithm can be created for each form of deterioration and then effortlessly combine them due to the method of lowering one degradation aspect at a time. Wiener filter optimally balances the noise smoothening and inverse filtering. Both the blurring and the additional noise are simultaneously reversed.

Bilateral filter
Bilateral filtering, which was developed by the research duoTomasi and Manduchi, is a nonlinear filtering method. This filter is based on the concept of Gaussian averaging and prohibits blurring across future boundaries by decreasing the filter weight, which in turn reduces the future boundaries when the difference in intensity is vast. In Gaussian smoothing, we take the pixel values' weighted average within the neighbourhood. The weights share an inversely proportional relationship to the distance from the centre of the neighbourhood. Apart from these spatial weights, the bilateral filter includes a tonal weight such that pixel values that are in near proximity to the centre's pixel value outweigh more than the pixel values that are further away. The bilateral filter can preserve edges (high tonal differences) while smoothing down more flat regions (small tonal differences) because to this tonal weighting.

Non-Local Means Denoising
Noise is usually defined as a random variable with zero mean. Let's consider a noisy pixel, $p=p^0+n$,where p^0 is the true value of the pixel and n is the amount of noise present in that pixel. It is possible to select a reasonably large number of the same pixels (say N) from multiple images and calculate their average. Ultimately, $p=p^0$should be obtained since the mean of noise is zero. Figure 3 shows an image which contains small window of size 5x5 window. Patches of equal identities canlocate somewhere else in the image. It can even be situated in a minor neighbourhood surrounding it. The similar patches can be found and their average can be calculated. It is generally accepted for that particular window.

Consider the following image
As observed in Fig 3, the blue and green patches look approximately identical. Therefore, a pixel is selected with a small window around it, and compute search for similar windows within the image. Afterwards, the average of all the windows would be calculated and eventually switch the pixel with the result produced. This method is termed as 'non-local means denoising'. Although it is time-consuming when compared to blurring techniques (as seen earlier), the results are promising.

Guided Filter
A Guided filter is a smoothening light filter that allows edge preservation. Similar to a bilateral filter, it not only preserve sharp edges but filter out texture or noise.
When compared to the bilateral filter, the guided image filter provides benefits as follows:
- Simple calculations with linear computational complexity as compared to Bilateral filters that have high computational complexity.
- Bilateral filters cause image distortion by allowing unwanted gradient reversal artifacts.
- The guided image filter is built on top of linear combination thus ensuring that the output image stays consistent with the guidance image's gradient direction hence prohibiting gradient reversal.

To influence the filtering, the guided filter carries out edge-preserving smoothening on an image by using a guidance image i.e. the content of a second image. In addition, the guidance image can either be the image itself, a completely different image or a different version of it. Like other operations, the guided image filtering (within a guidance image) is a neighbourhood operational procedure, but considers the region's statistics that corresponds to the spatial neighbourhood when computing the output pixel value.

RESULTS AND DISCUSSIONS

The output images after applying different noise removal methods are given below. Peak Signal to Noise Ratio is the ratio between the maximum power of a signal and the power of the noise that could be included in the signal. In image processing, it is used as a quality metric. The higher the PSNR, the higher is the quality of the image. Mean Squared Error, abbreviated as MSE, is the measure of cumulative squared error between two images. These two images are generally the noisy image sample and the image output after applying the filter. Based on PSNR and MSE, guided filter emerged as the best denoising algorithm in the experiments carried out.

CONCLUSION

A very simplistic definition of noise removal would be applying filters on images to remove unnecessary details. It is impossible to eliminate noise completely, even if we adopt the highest standards in image capturing and processing. Apart from the digital noise, physical artifacts like palm leaf manuscripts are prone to deterioration due to natural forces and this could in turn affect the quality of the images, which in turn affects the accuracy of the character recognition model. The experimental results indicate that the use of guided filter is suitable for palm leaf manuscripts can be used in denoising, right after the image is captured by a camera or scanner. Ideally, all forms of noise should be identified in the pre-processing phase and eliminated, before the image data is passed on to the next stage. The choice and fine-tuning of a noise reduction method can be a major factor that determines the overall efficiency of an optical character recognition model, including handwritten character recognition models.

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Table 1. Comparison of different denoising algorithms

Method used	PSNR	MSE
Gaussian Blur	30.90	52.80
Median Blur and Wiener Filter	28.09	100.83
Bilateral Filter, Median Blur and Fast Non-Local Means Denoising	23.52	288.93
Fast Non-Local Means Denoising	23.78	272.19
Gaussian Blur and Median Blur	29.16	78.94
Median Blur and Fast Non-Local Means Denoising	23.66	279.69
Guided Filter	51.88	0.42
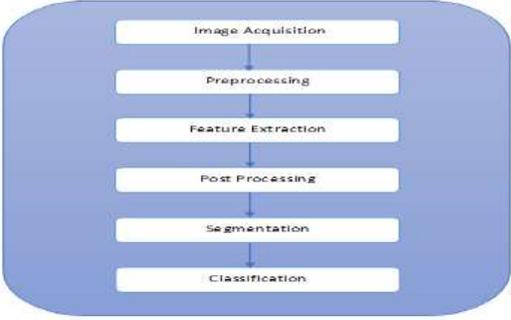
Fig1. Image of Malayalam palm leaf from an Ayurveda Grandha

Fig 2. Optical character recognition system flowchart
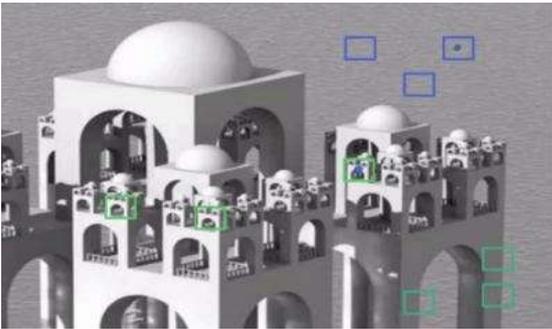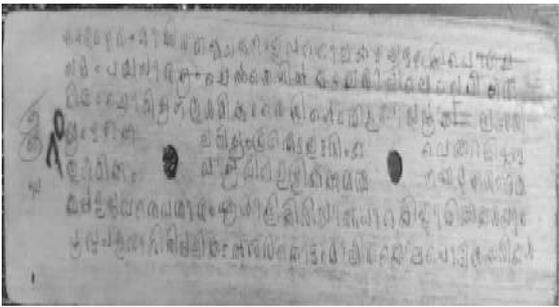
Fig 3. Non-local means denoising

Fig 4. Result of applying Gaussian Blur

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Fig 5. Result of applying Median Blur and Wiener Filter	**Fig 6. Result of applying Bilateral Filter, Median Blur and Fast Non-Local Means**
Fig 7. Result of applying Fast Non-Local Means	**Fig 8. Result of applying Gaussian Blur and Median Blur**
Fig 9. Result of applying Median Blur and Fast Non-Local Means Denoising	**Fig 10. Result of applying Guided Filter**
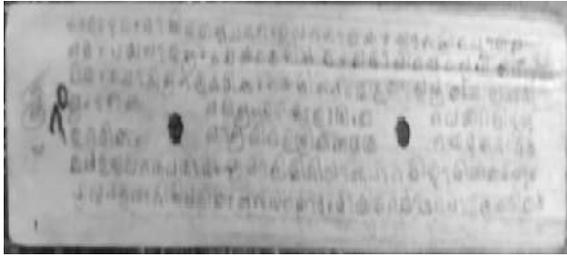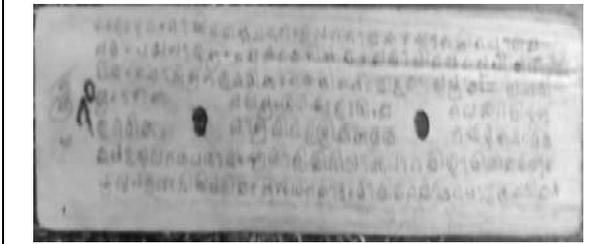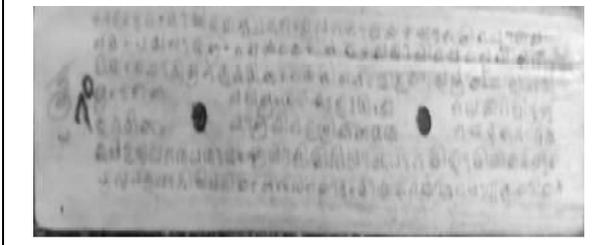
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RESEARCH ARTICLE

A Comparative Study on Medical Image Denoising Methods

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ABSTRACT

The increase in the number of digital images taken each day is leading to a greater need for images that are more accurate and aesthetically beautiful. However, noise always reduces the visual image quality of photographs shot with current cameras. Therefore, efforts are required to reduce noise without compromising image quality (edges, corners, and other sharp structures). Researchers have so far proposed a wide range of noise reduction techniques. Each technique has pros and cons of its own. The method of image denoising involves removing noise from a picture so that the original picture can be viewed. Since noise, edge, and texture are high frequency components that are challenging to distinguish during the denoising process, denoised photos may eventually lose some detail. In order to create high-quality images nowadays, recovering important information from noisy images during the noise removal process is generally a substantial problem. Image denoising is a well-known issue that has been researched for a very long time. It is still a difficult and open task. This is mostly due to the fact that image denoising is an inverse problem with several solutions from a mathematical point of view. We review some significant studies in the area of image denoising in this paper. We first describe the formulation of the image denoising problem before introducing various image denoising methods. We also talk about the features of these methods. As a part of the study, we analyze the methods which can be adopted for medical image denoising.

Keywords: - Wavelet transform, Curve let transform, Fast Non Local Mean Filter (FNLM), Convolution Auto Encoder (CAE) and Convolution Neural Network (CNN) techniques

Siji jose pulluparambil and Netravathi

INTRODUCTION

Due to the influence of the environment, transmission channel, and other variables, images are typically contaminated by noise during collection, compression, and transmission. As a result, the image information is lost and distorted. Potential post-image processing operations like video processing, image analysis, and tracking are negatively impacted by noise. Image denoising is therefore essential in contemporary image processing systems. [1] Image denoising is the process of taking out noise from a picture so that the original image can be seen. Denoised photos may inevitably lose some information since noise, edge, and texture are high frequency components that are challenging to detect during the denoising process. Therefore, today's most concerning problem is how to extract important information from noisy photos during the noise removal process. In fact, image denoising is a well-known issue that has been researched for a very long time. It is still a difficult and open task. This is mostly due to the fact that image denoising is a problem with several solutions from a mathematical point of view.In order to improve the signal-to-noise ratio(SNR) and reduce the loss of original information, noise reduction method tries to reduce noise in natural photographs [2] . The following are the main obstacles for image denoising: Flat surfaces must be smooth. Edges must be preserved without becoming blurred. Textures must be maintained, and it is not recommended to create new objects.

OBJECTIVES
i.   To study the types of various medical images
ii. Review the denoising techniques for gray scale medical images
iii. To find the challenges in processing medical images for analysis using machine learning algorithms.

TYPES OF MEDICAL IMAGES
The field of medicine known as radiology—medical imaging—involves the creation of various images of bodily components for diagnostic or therapeutic purposes. The field of medicine known as radiology—medical imaging—involves the creation of various images of bodily components for diagnostic or therapeutic purposes.[3].Medical imaging procedures come in a variety of forms, including:

X-rays
● Magnetic resonance imaging (MRI)
● Ultrasounds
● Endoscopy
● Tactile imaging
● Computerized tomography (CT scan)
● Positron emission tomography (PET) scans.

Ultrasound, employing ultrasonic vibrations to create images, is one of the safest techniques of medical imaging. Electroencephalography (EEG) and electrocardiography (ECG) are two safe medical imaging procedures that use surface-mounted sensors to record electrical activity. However, these procedures provide a change over time graph rather of a graphical image [4]. Most of the medical images are produced as grayscale images. It imposes stricter constraints on the optimization and adjusting of parameters [5].

Challenges In Processing Medical Images
The branch of machine learning known as "image processing" ensures the processing of any converted or digitized images. Grayscale images has a pixel, which is an integer with a value between 0 and 255.In a nutshell, it's similar to data processing. Multidimensional systems may be used as a paradigm for these algorithms. A variety of algorithms are used to remove the noise and irregularities [7]. The main steps in image processing are image segmentation, image classification, removing prints and image enhancement. For human brain, to extract information from an image is not a big task. But to train a machine is a big challenge. The machines must be able to view and comprehend images just like we can. Digital photos are divided up into objects for this use. The major challenge in image

segmentation is to segment these images into the desired type of objects. There are a few techniques to make this process easy such as

• Watershed Segmentation
• Edge-Based Segmentation
• Region-Based Segmentation
• Neural Networks for Segmentation
• Clustering-Based Segmentation Algorithm
• Thresholding Segmentation

During image classification, assigning a label to the image is a crucial task. A few issues are related to scale variation, illumination and object detection. Image enhancement requires more focus on the important features of the image. The images like x-ray images require more clear and bright pictures. By selecting an apt denoise algorithm is the best solution for all the mentioned issues.

Types Of Noises In Medical Images

A random signal is called noise. Noise may appear in a digital image during picture collecting, coding, transmission, and processing. [9]. Gaussian noise, speckle noise, salt and pepper noise, Poisson noise, impulse noise, and quantization noise are some of the different types of noise that can damage different kinds of images [11]. Low light levels and restricted exposure options in medical imaging cause specimens to degrade by increasing the influence of noise. Extraction of precise and reliable information from medical scans is crucial for the diagnosis, staging, and therapy of diseases. Noise frequently causes artifacts in the photographs, which can lead to incorrect diagnoses [8]. Image quality is impacted by image noise. The poor image quality makes it difficult to extract useful features, analysis, recognition and perform quantitative measurements. Additive White Gaussian Noise is the most common type of noise in images. This happens during capture and transmission through analogue circuitry, which is essentially the fundamental activity required for computerized operation. Gaussian noise actually affects the entire pixels of the image. Contrarily, a small percentage of pixels are affected by the impulse noise in a dark and white manner. In a gray-scale image, speckle noise is a multiplicative noise that affects the pixels. [9]. It is commonly found in low level luminance images like Synthetic Aperture Radar (SAR) images and Magnetic Resonance Image (MRI) images.

Gaussian noise

Gaussian noise mainly occurs when the light is low while capturing the images. There are many filtering techniques to remove Gaussian noise [14]. The bivariate circular Gaussian function is Where x and y are the means and σx and σy are standard deviations. The difference from the mean is represented by the standard deviation.

Speckle noise

Speckle noise is a multiplicative noise, not the same as Gaussian or Salt & Pepper noise. During the diagnosis, the backward wave reduces the image quality due to reflections. The observer finds it more challenging to detect minute features in the images as a result. It is a most common noise found in ultrasound images.

Salt and Pepper noise

A type of noise that is frequently seen in images is salt and pepper noise. It looks as pixels of black and white that are irregularly spaced apart. This kind of noise results due to errors during data transfer. In salt pepper noise, a and b have distinct values. Each has an average probability of less than 0.1. The image has a "salt and pepper" appearance because the corrupted pixels alternatively set to the lowest and highest value [16]. An efficient noise-eradication method for this kind of noise is the employment of a median filter, morphological filter, or contra harmonic mean filter.

Impulse noise

Impulse noise that occurs when the pixel values are modified randomly. Impulse noise can be categorized between two types - static and dynamic (random). Static noise is commonly found in digital images that are affected by either

two intensity values - 0 (weak) or 255 (strong). In dynamic type, the pixel values get adjusted randomly as well as independently which is why it's identified as Random Value Impulse Noise (RVIN) [17].

Quantization noise
Quantization noise is produced when a continuous random variable is transformed to a discrete one or when a discrete random variable is modified to one with fewer levels. This noise occurs during the acquisition process. At the start, the image may have continuous variables defined but ultimately needs to have a digital representation for it to be processed.

Noise Cancellation Algorithms
Watershed Segmentation
Watershed algorithm is applied in cases where contour detection and simple thresholding will not yield accurate results. This algorithm is used primarily for segmentation found in complex images.

Algorithm
Use morphological procedures such as opening and dilation for seeking a sure background.
Use distance transform to identify sure foreground
Finally, the area found neither in foreground and background is observed and used as an element the algorithm [18]

Edge-based-segmentation
Edge-based segmentation algorithm depends on edges seen in an image via numerous edge detection operators. With the help of these edges, image locations of discontinuity are marked in color, gray levels, texture, and more. As there is progression from one region to another, the gray level varies. Therefore, if discontinuity is sought after, it will lead to that edge [19].

Thresholding Segmentation
Thresholding Segmentation algorithm changes the pixels for an image to be analyzed effortlessly. The image is transformed from grayscale or color to a binary image type, i.e., a simple black and white picture. The threshold value is the basis of pixel intensity of the sample image selected. There are multiple ways to perform the thresholding technique such as: Global thresholding, Manual thresholding, Adaptive thresholding, Optimal thresholding, and Local adaptive thresholding [20].

Region-Based-Segmentation
Region-Based Segmentation is a pixel-based image segmentation method due to its involvement in picking initial seed points. With the help of the algorithm, the region can be determined close to accuracy. In addition, it uses region growing - a process that clumps pixels or sub-regions into sizable regions. A set of seed points are introduced and then aggregated into regions by fixing each of the seed points to neighboring pixels that have common properties such as color, texture, gray level, and shape. This type of segmentation is preferred over edge-based algorithms in 'noisy images' where the edges are laborious to detect [21].

Neural Networks for Segmentation
Neural Networks are introduced into the image segmentation especially within the medicinal diagnosis context since automatic segmentation of such medical images are challenging tasks due to different artifacts, inconsistency in intensity, etc being present. Since different body parts and ailments have distinct needs, choosing the best deep learning model depends on factors including the imaging modality used, the body part to be segmented, and the type of condition. Moreover, data is crucial in deep learning models. Furthermore, it is strenuous to collect medical image data due to governance over collection and data labeling under privacy rules. With this, it demands prolonged explanations that need to be performed by specialists [22].

Clustering-Based Segmentation Algorithm

Clustering-based segmentation is similar to clustering algorithms wherein such algorithms are used to categorize data points that are common with each other from other such data points. Likewise, this algorithm embarks on collecting a group of articles that share common traits with each other in contrast to those with dissimilar groups. There are a variety of methods available to conduct this sort of segmentation such as: Hierarchical clustering, Fuzzy-C means, K-Means, ANN Clustering, and more [23].

Findings And Scope

As a result of this study, we found that the analysis of a specific medical image with few denoising algorithms can be further taken into consideration.

CONCLUSION

This study found that analysis of each medical images highly depends on the various internal and external noises. The findings based on these medical images is related to the perfection of each images. For various images, the type of noise adversely affecting the quality of the image varies. Different denoising algorithms with their performance were studied as part of our research. Various medical images with the different factors that may affect the implementation of diagnosis methodology were also reviewed.

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Table 1: Comparison on various medical images

	X-RAY	CT	PET	SPECT	MRI	ULTRASOUND
Basic principle	X-RAY radiations/ projections	X-RAY projections of cross section of body	nuclear substance imaging/radioactive tracing	nuclear substance imaging/radioactive tracing	Energy transition of protons	Reflection of high frequency temporal waves
Cost	Intermediate	intermediate	High	very high	high	Low
Radiation source	X-rays	X-rays (Ionizing)	Positron	Photons	magnetic field	sound waves
Type of noise distribution	Gaussian, Poisson	Gaussian, quantum noise	Gaussian	Gaussian,	Gaussian, Rician, Rayleigh	Speckle, Gaussian

Table 2: Comparison of noise cancellation algorithms [24]

	Watershed Segmentation	Edge-based segmentation	Thresholding Segmentation	Region-Based Segmentation	Neural Networks for Segmentation	Clustering-Based Segmentation Algorithm
Accuracy	Approximate 99% detection accuracy	Reliable algorithm however accuracy is based on number of edges available in images since	Varies since the algorithm is affected by noise sensitivity and unevenness of gray scale images	90% accuracy in average cases	Neural network shows a 99% classification accuracy (based on the quality of data set provided)	Accuracy is defined using formula: TP+TN/TP+TN+FP+FN

		it can slow down the performance and sensitive to noise				
Expectation of results	Impactful in medical image segmentation.	Detects edges first, then removes the unnecessary edges and then creates a group. The discontinuity is recognized using derivatives which are approximated by differential operators	Simple to calculate, and quick enough within the case of the threshold method.	Uses investigative attributes of each block and merges them with neighbor blocks after meeting certain conditions	The accuracy and speed is comparatively higher against other methods. These networks need to be trained for every image provided.	These are unsupervised algorithms therefore do not include labeled data. It is used to recognize clusters or classes for a given dataset based on homogenous data

REVIEW ARTICLE

AI Chatbot for Mental Health Status Detection – A Literature Review

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ABSTRACT

The suicide rates in the world have increased drastically from the past four years. And the first precursor to suicide is depression. This review's goal is to study the ways to create an intelligent solution which detects the symptoms of depression early on and alert the user, through a chat bot interface. The most accessible way to diagnose depression in the present day is to consult a psychotherapist. It is counter productive as a person in depression will be hesitant to ask for help in most cases. Also, there is a negligence towards the severity of a bad mental health as the general public will not be made aware of it. These factors make it extremely difficult for a depressed person to find preventive measures. (IDPT)is a method of treatment that can be provided through inter- net. There are 9 main criteria of CGI that can predict the severity of depression. (TEA) Textual Emotion Analysis is a method of extracting emotions in text. It finds meaning in words at a very deep level using mul- ti layer word-representation. CRF algorithm accuracy greater than SVM for classification of words into emotions. RNN will yield a better result if mode is trained separately for depressed and non-depressed. DAIC- WOZ Depression Speech Data Set provides textual records of clinical interviews. It is self-administered so no party other than the user them- selves will be directly involved. The analysis of text is very similar to interpretation of speech. So, determination of the users feeling will be highly accurate.

Keywords: Chatbot, Suicide, Depression, Self-administered, Treatment

INTRODUCTION

Mental health is important at every stage of life, from childhood and adoles- cence through adulthood it includes our emotional, psychological, and social well-being. if you experience mental health problems, your thinking, mood, and behaviour could be affected.A2020 national survey of14-to22-year-olds found that 90 percent of teens and young adults experiencing symptoms of depression are researching mental health issues online. Mental Health is the most overlooked and under-addressed health condition. It is almost seen as a weakness in present-day society to have any

mental illness. The symptoms themselves are invisible in most cases. People do always have a tendency to say that they are well and not have any mental health issue due to social stigma. This is an extremely dangerous issue especially in the younger generation. A survey was conducted in 2020 on teenagers, where it was observed that 90%of the teens and young adults had some symptom of depression or other mental health issue. The mental healthcare is a field which has very less practitioners. There exists about one psychiatrist for over 2 lakh people. A chat bot delivered through online means for therapy helps resolve the issue as it is easily accessible to all andavailable24/7 as well as the no one other than the user gets to know about the results. People of a country being the most important resource of a nation, their men- tal health becomes equally important as mental health of a person determines many things in a person such as how he deals with stress, his mood, his thinking ability and his ability to do work. So keeping this in mind many countries passes legislations and changed laws of basic care giving in the country so the issue could be tackled. Depression is one of the most prominent mental health issues that people face today especially among the youngsters has resulted in increase in the cases of suicide and self-harm. One-in-five or nearly 2.4 Million teen in US alone have experienced at lea stone episode of depression. It does not just contain it self to brain but has effects on other parts of the body as well causing problems such as insomnia, fatigue, increased heart rate, inflammation to name a few. To fix this problem, it is very much necessary for the people to be able to get a basic diagnosis done through the means of a chatbot that can report about the severity of the depression they are experiencing or if they are experiencing one at all. This would not only reduce the burden over the medical system but also help in spreading awareness and remove the stigmas around mental health. Main significance of this paper is to map the level of depression a person experiences by mimicking the procedure and guidelines practiced by psychiatrist in order suggest him to correct treatment, medication or need of any further diagnosis.

Conceptualizing Mental Health
Depression is a mental health disorder that results in sadness, hopelessness and worthlessness as its main symptoms. It majorly affects the person's thought process. If a person is depressed, it means his daily routine will be affected, along with his social life like friendships etc. It is in most cases tool ate when a person identifies that he has Depression or some Depressive disorder. It becomes extremely important to address any mental health issue like de-pression, anxiety etc. because the worst consequence of major depressive disorder is suicide[13]. A person ending his life of his own accord is a dangerous things as it affects only the people around him, and that can lead to more trauma. During the pandemic, there was a rise in hopelessness, boredom and depression especially in the younger generations of the population. This behaviour is illustrated in Fig. 1. It is extremely important to detect the symptoms of Depressive disorders early on to avoid the worst case effect which is Suicide. This is generally done by clinical Psychotherapists when a patient gets himself checked. So the first phase of diagnosis is actually initiated by the patient. This is counter-productive as the patient if has severe Depression will be in a delusion and think that he is all right, so would refuse therapy at all costs. This will leave the disorder untreated which can be lethal. Clinically the detection of severity is done using the Beck's Depression In- ventory[2].This is a self-answer questionnaire with MCQ like questions. The problem with this method is that the patient may be in capable of accurate self- analysis and hence the true result of his illness may be different from the one obtained through the questionnaire. Therefore a better approach is needed to do the same. This survey is aimed at finding methods that can perform diagnosis without the help of Therapists using an Internet based Treatment system That makes use of a chatbot to analyze symptoms in Users and give appropriate diagnosis.

Literature review
From a WHO Survey [15], we observed global data of depression, anxiety and suicide prevalence in different geographical areas of the Earth. It is observed that generally females across the globe have higher risk of depression prevalence, but males tend to perform the act of suicide more with a peak of 80 thousand suicides in the age group of 20 across the globe in an year. Depression in Primary care[13], provides information on the factors which are symptoms of initial phases of depression. It provides a comprehensive under- standing of assessing the degree of depression based on the subject's behaviour patterns. It is meant to be used by Doctors to classify the patients into the 3 types of Depressive disorder classes.

These are namely:
1. Major Depressive Disorder
2. Bipolar Disorder
3. Major Depressive Disorder in partial remission

Beck's Depression Inventory[2] (BDI) is a standardized questionnaire which is given as a preliminary treatment to any Mental Health Patient (MHP). It consists of 21 self reporting questions using a four-point scale ranging which ranges from 0 (Symptom not Present) to 3 (Symptom very Intense). The test takes approximately 5 to 10 minutes to complete. Based on the total score of the patient he is classified in to five different categories of Depression each with increasing levels of severity. The Discriminate analysis is shown in Table 1. Depression is a common mental disorder which is treated at healthcare fa- cilities. To determine mental the existence of mental health issue is a challenge. Hence Nurses in the mental health domain are mostly reported to carry out this procedure using the standard PHQ-9 questionnaire[9]. In DSM-5, all symptoms of depression are considered equal representations of severity. But It was found that Suicidal Ideation[17] was the factor which was the most strongest indicator of depression among all the other symptoms for major depressive disorder (MDD). Natural Language Processing[6] is one technology which has been found to be a very effective method for analysis of text and make the computer understand the meaning, implications of a block of text. Language is basically defined as a set of rules or symbols, when the symbols are combined together they form a meaning and they are used to broadcast information.
NLP is classified in to two categoriesi.e.

Natural Language Understanding
Table1. Discriminant Analysis of Items From the Beck Depression Inventory (BDI)

Natural Language Generation
While Natural Language Understanding mainly focuses on generation of text while NLU(Natural Language Understanding) gives a detailed understanding of text recognition and interpretation. The use of lexical analysis method to identify and analyze structure of words and phrases, also called parsing or tokenization is understood. By the year 2003, an important area under NLP came into the picture called sentiment analysis. Sentiment analysis deals with analysing the sentiment from a particular topic which could be a word, a text block, a sentence or a paragraph. Some of the datasets used for sentiment analysis are Stanford Sentiment Treebank(SST), Sentiment140, and Paper Reviews etc. The main challenges concerning NLP are dealing with" synonyms" where many words are used to express order fine the same meaning and "homonyms" where similar sounding words convey differ- ent meaning, informal phrases, culture-specific linguistic challenges, misspelled words or misused words also causes a major challenge to the user. Textual Emotion Analysis (TEA) is the process of extracting emotions of statements from textual data. With the help of this research[10] we find numerous DL methods that are effective for extracting emotions out of text. A few of these are:
1. DAN
2. DAE(Autoencoder)
3. CNN
4. RNN
5. LTSM
6. Bi-LTSM
7. GRU
8. Attention
9. MHA

Also, the research expands on the numerous pre-training methods which are word-representation methods and sentence-representation methods. A few of them are Word2Vec, Bandwidth Expansions, GloVe, BiDRL, Emoji2Vec, Sentiment-specific Word Embedding (SSWE), Context 2Vec. Out of all the tested methods, The one with the best accuracy was CNN with LTSMusingWord2VecPre-training method for monolingual emotion analysis Keyword

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extraction is a process which when fed the contents of a document will be able to provide an overview of the document. This article[4] evaluates and compares several methods used for keyword extraction, such as support vector machine (SVM),NP-chunk, conditional random fields(CRF),N-grams, multiple linear regression. It is found that SVM provides an overall better result compared to the other methods. But in terms of accuracy it is found that the CRM accuracy is greater than that of SVM as determined by the F1Score.The results are illustrated in Table2 Internet-Delivered Psychological Treatment (IDPT) is a method which is used to provide treatment through the means of internet rather than a physical ap- proach. This research[8] approaches to extract depression symptoms based on standard questionnaire PHQ9, using patient authored text data. The concept used here is text embedding. The keywords were extracted from PHQ-9 Questionnaire. For each symptom in the PHQ-9 most relevent keywords were handpicked. Then WordNet was used to find synonyms of all the keywords. For each synonym , the related hypernym, hyponym and antonyms were found. The proposed method in this article was Depression2Vec which took first five words which occurred, and they were found to be highly related to the actual symptom. Deep Learning[14] is a technology which has widespread application in mim-icking human understanding using a computer. Hence many of it's technologies can be used to make the computer understand and add meaning to human- wirtten text. DL consists of 2 key factors supervised or unsupervised learning and non linear processing in multiple stages. Non linear processing in the multiple layers involves an algorithm where a current layer takes the previous layer as an input. Data is thus arranged in hierarchical order. Meanwhile supervised or unsuper- vised learning is related with class target label. Non availability of target label makes it an unsupervised system.

Applications of Deep Learning(DL) include Digital Image Processing(DIP),Medicine, Biometrics etc. Sentiment Analysis[16] is a tool which is used to obtain Opinions and Emo- tions from text. A large text dataset can be used to identify symptoms of depression in the users. This can be done by using RNN and LTSM [12] to classify the words. This research was conducted on Norwegian text data from public Norwegian online information channel: ung.no. This data was then passed to experts in the field of medical Healthcare to extract the features for processing the data. The emotional state is determined by using Recurrent Neural Network (RNN) and LTSM. The words are classified into categories Depressed and Non-depressed. Each word is assigned an intensity from −1 to +1 based on the given features. A model is then generated using RNN and LTSM that can take a text extract from a user and determine if the user has symptoms of depression. Henry Hellyer was a 42 year old Australian who committed suicide[1]. His past 7 years of text records were analysed to find out the changes in pattern of suicide victims prior to suicide. It was found that Hellyer showed increases in first-person singular pronoun use in his texts which are words like I, Me etc. decreases in first-person plural pronoun use. This indicates a person becomes more self-conscious and talks in a pessimistic way when depressed. A study was conducted on Czech Republic citizens where this formal texts were analysed for the risk of depression.[5] A Model was created to classify text and determine depressive symptoms based on the DASS-21. Certain patterns in grammar were found which were more significant factors of depression. A Model using Deep Integrated Support Vector Machine (DISVM) was cre- ated using text data from Chinese social media texting platforms such as Weibo, WeChat, QQ[3].It was used to determine depression levels in the college going students by analysing their text data. DISVM is used to classify input data and to recognize depression. The data set that was used here was DAIC- WOZ dataset which includes a interview type data collected for the diagnosis of anxi- ety, depression and other psychological diseases. A high accuracy was obtained for ESVM since Deep learning methods were used. The results obtained are illustrated in the Fig. 2

METHODOLOGY

The methodology contains a few basic processes which are performed with cer- tain goals in mind It starts with data collection, then creation of the model which involves the main computation part of the solution, finally comes to determina- tion of results.

Data Collection from the user

The data is collected in the form of Text from the user. It will be through a Chatbot interface. The questions / Queries will be given by a bot, to which the user shall provide descriptive answers. The questions will be based on the User's day-to-day activities. The chatbot will be built using React JS for front-end.

Dataset containing Depression related terms

The next main step is to find a dataset which can be used to classify words into depression Indicators. For this task, the DAIC-WOZ dataset can be used. It is a series of recorded speech of clinical interviews of professional psychotherapists in the form of audio and text. This dataset can be used to extract only the text transcripts of the interviews.

Creation of Model

This process involves the classification of words in the training data-set. For this, we can use multiple algorithms which determines what words carry what meaning in a sentence. We prefer using Conditional Random Fields (CRF) as its F1-score was found to be most optimal. Given here is the formula for Conditional Radom fields. The Y term is the non-determined state (parts of speech) and the X term is the observed parameter. Task is to identify the relation of the words based on the words around them. For entity recognition from the raw data input we receive from the user, we use Conditional Random Fields as the sequence of wording matter more than the presence of few specific words. There are 2 main components for the CRF
1. Normalization
2. Weights and Features

Normalization is done as the output is predicted as a probability. We first annotate the training data or the words that we know might come together and then train the model for the given data.

Fit user data into Model

This process is to make the computer understand the text given by the user. This task is challenging as the computer cannot understand words explicitly. It has to be fed to the computer in some other form such as numbers or vectors. There is a process in Natural Language Processing (NLP) which does exactly this. This process is termed vectorization. One such method is the Word2Vec embedding which was discovered in 2013. What word2vec does is, it takes words and assigns weights to each word in an iterative manner. The weights are in float format and easily understandable by a computer. All similar words are grouped together. An illustration of this is shown in Fig. 3

Classify the Severity

For classification on the severity for the user's condition we get the score of the user from the model based on the inputs that he gave. Higher the score of the user more critical / more severe the condition might he be facing. The score classification will be based the clinical scales used by psychiatrist such as PHQ-9, BDA etc.

Provide preventive methods

Finally, after the user is diagnosed, we must be able to help him/her to get through the rehabilitation, based on the severity of the depression. We will be providing a list of Recovery methods such as:
1. Self paced recovery Videos
2. Daily schedule to get more involved in other activities
3. Diet plans to get enough energy
4. Assessment questionnaire to solve the problem
5. Set goals to make small steps toward activeness
6. Recommendation to professional therapist in severe cases

DISCUSSION

The methods discussed above generalizes the different approaches to solve the problem of analysis of depression using text. This process can be classified into the steps mentioned below:

i) Understanding symptoms: The first step is to understand how depression occurs, and how people with depression think and behave. This is done by studying medical research on the treatment of depression [13,2,9,17]. It will provide us with enough knowledge to take appropriate decisions during provision of treatment.

ii) Obtaining Text: To make a solution that is self administered, we need to avoid all contact/external conversation. Taking input as Text through the means of a ChatBot is best suited for this. A chatbot will accumulate paragraphs of text which will be given by the user as answers to a few questions that will be asked. This can be made using a web Interface.

iii) Analysis of Text: After obtaining text as input, analysis is to be performed so that the state of mind of the user can be evaluated using some stan- dard known methods. This can be Emotion extraction, Sentiment Analy- sis, Classification of words into depressed symptoms[10,4,16,12,18,7,11]. On classification, determination of the severity of depression will be most use- ful. Technologies like Deep Learning and SVM are proven to be effective for these tasks[5,3]

iv) Administering Treatment: Finally the patient is to be treated based on the severity levels of his depression. Online treatment can be given in the form of text. Advice to perform that can alleviate hopelessness to be delivered[5,8]. Customized schedules and tasks can be assigned as a form of rehabilitation for different severities.

CONCLUSIONS

In this paper we aimed to find a method to provide online assessment and treat- ment method for Depressive Disorders through the means of a chatbot. Various methods were studied on analysis of text and determination of severity of de- pression. The portions of the text that reflect the depressive behaviour of the person can be extracted using sentiment analysis and the severity can be determined us- ing neural network algorithms and mapping the result against clinical depression scale. These methods are the most feasible approach to create an AI based chatbot to detect and treat depression. The goal is to detect and cure Early signs of depression or Depressive Disorders in order to prevent suicide which is going to be the final stage.

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Table.1:Discriminant Analysis of Items From the Beck Depression Inventory (BDI)

Item from BDI(N=834)	Correlation Coefficient
Feel Sad	0.834
Discouraged about the future	0.653
Satisfaction from life	0.640
Disappointed in self	0.589
Feel like a failure	0.540
Loss of interest	0.531
Feel guilty	0.523
Hard to make decisions	0.517
Worried about health	0.506
Feel like killing themselves	0.489
Feel they are to blame	0.481
Feel more tired	0.464
Feel they are being punished	0.461
Have to push oneself to do things	0.428
Worried about looking unattractive	0.420
Early morning awakening	0.401
More tearful	0.395
More irritable	0.321

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Loss of appetite	0.319
Loss of libido	0.240
Loss of weight	0.194

Table.2: Comparison Of Results

Mehtod	Precision	Recall	F-score
Logit	32.48%	53.88%	40.67%
NP-chunks	29.70%	37.20%	33%
Ngrams	25.20%	51.70%	33.90%
SVM	80.17%	33.27%	46.53%
CRF	66.70%	49.96%	51.25%
MLR	31.74%	52.33%	39.51%
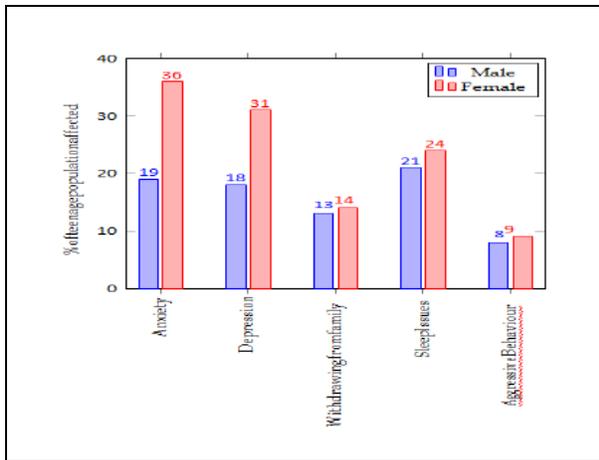
Fig. 1. Effects of Pandemic on Teen Mental Health
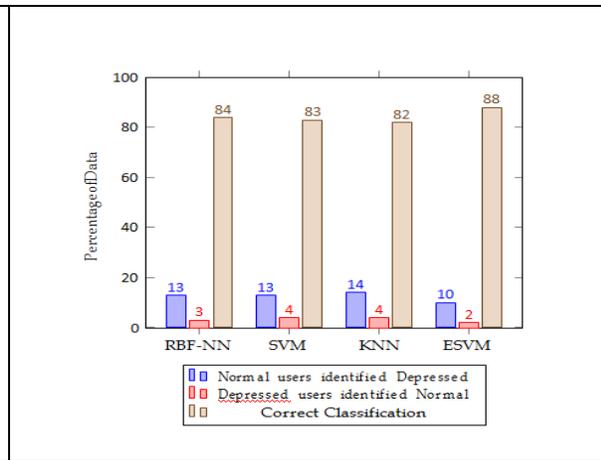
Fig.2.Results of Comparison of accuracy
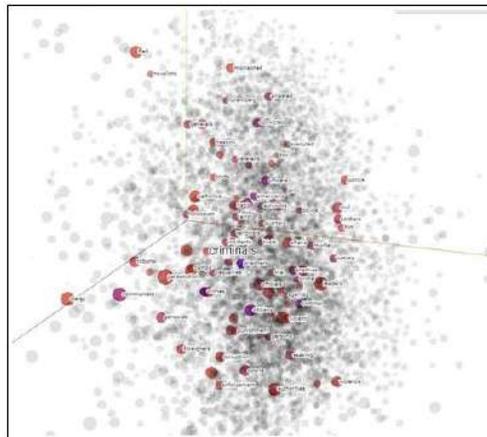
Fig. 3. Visualization of vectorization in 3-D space

RESEARCH ARTICLE

Classification of Raga in Carnatic Music Compositions using Transfer Learning

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ABSTRACT

Audio classification is an essential step in music information retrieval. Machine learning and Deep learning models for raga classification in Carnatic music proposed by researchers are really incredible but most of the work were restricted to only few ragas. The main issue with deep learning model is that they need lot of data for training. Especially with deep neural network, huge amount of data is essential to feed it in to the network. But sometimes data repositories would not be available for our research problem or data may not be sufficient to train the neural network. We can overcome this problem by implementing transfer learning to our model. Transfer learning is a concept in which a model which have been trained on a massive dataset would transfer the knowledge that it has learnt to solve a completely different task. This paper aims at classifying raga of Carnatic music compositions by taking the advantage of transfer learning with custom input and dense layers fed in to the neural network. The paper also evaluates the performance of VGG 16, DenseNet 169 and InceptionV3 models in classifying various ragas of Carnatic music compositions.

Keywords: Machine Learning, Transfer Learning, Music Information Retrieval

INTRODUCTION

Audio signals are generally considered to be more complex than any other as it is continuous and a combination of many individual sound waves. To process these signals, we need to divide them in to different segments and analyze each segment separately. Machine learning models have shown a great impact in processing audio signals whether it is speech or music. After pre-processing the audio signal, features were extracted and make it ready for machine learning algorithms. But the accuracy of these models needed improvement on many problems related to audio. With the invention of deep learning, the accuracy of models were improved tremendously and the traditional signal processing techniques are no longer needed. The raw waveforms of audio were converted to time frequency domain and used as an input to the model[15].The spectral features of audio are used in majority of music information retrieval tasks and these features have shown great impact in the results[17]. Recent advancements in deep learning have proved that the spectral images of audio works very well with neural network and features of these images could be fed as an input to the layers of Convolutional Neural Network(CNN) [3]. CNN model have shown a major break-through in processing images and the classifier require only minimal data preprocessing tasks. Raga identification in Carnatic music is a challenging task as the singer has the freedom to make improvisations keeping in mind the structure of raga[22]. The same composition could be rendered differently by two different singers with their own singing style. Singers can sing with different gamakas which reflect the main raga bhava. Only a learned musician could identify raga within a few seconds and hence automatic identification of raga is essential for music recommendation and other related tasks in music information retrieval. Many traditional machine learning models were used for classifying raga in Carnatic music but those models needed a lot of data pre-processing steps. Classifying raga using CNN model require only minimal pre-processing steps as it consists of various layers with filters and activation functions. The researchers have proved that the Mel Frequency Cepstral Coefficient(MFCC) feature of audio works the same way as the human ears perceive sound[8,26]. The MFCC have thirtynine features and twelve parameters are related to amplitude of frequencies. These parameters are sufficient to analyze the frequencies of an audio signal. An audio signal is continuous and MFCC divide the signal in to shorter frames assuming the fact that audio signal would not change in shorter time scale. The cochlea, an organ in the ear vibrates at various places according to the frequency of sound. To calculate the frequencies of incoming sound, MFCC calculate the frequencies at each frame. Mel Filter Bank is implemented to discover the significance of closely spaced frequencies. This is implemented by taking the sum of the frequency bins to understand the energy concentrated on each frequency region. As the human ear hear the loudness on a logarithmic scale, MFCC takes the log of the filter bank energies as a normalization technique. As the filter bank energies are overlapping, a Discrete Cosine Transform function is performed as a compression technique Since a trained ear could spot the raga within a few seconds, the MFCC representation of audio images would be sufficient to capture the significant features of an audio signal.

Convolutional Neural Network And Transfer Learning

CNN networks have been successful in classifying images mainly because of the massive data available for training, correlation among the data points, weights sharing and a large number of filters and activation function used in the layers[3]. It has been observed that CNN is also useful for object detection, event detection from video, image segmentation and many more[4,7,9,10,13].A CNN comprises with an input layer, output layer and multiple hidden layers as well[11]. The hidden layers have kernels, filters, pooling layers and activation functions. The image classification competition organized by ILSVRC(ImageNet Large Scale Visual Recognition Challenge) was a benchmark in classifying millions of images in to thousands of categories[24].The Super Vision team, winners of the competition implemented many layers for the neural network and could achieve amazing results in classifying images. From then, researchers have been using CNN for computer vision applications and image processing tasks [20]. The lack of the dataset remains as a challenge in getting good accuracy for deep learning models though deep learning models always outperform traditional machine learning models[4]. We could overcome this problem by implementing transfer learning. The main goal of transfer learning is that a model already trained on a huge dataset would be used to develop another model for a similar but for a different task. The features learnt by CNN model

which have been trained on millions of data could be used to learn the features of the current problem Fig 1.The models developed as part of ILSVRC are best suited for computer vision applications and are capable of detecting generic features from images [23]. And also, these models are easily downloadable and libraries including keras allow the application to use the model directly. As mentioned above, the objective of transfer learning is to make use of the features that may be useful for learning and apply the same for the new model and hence reduce the training time for learning. Though there exists many high performance models, mostly the models used for transfer learning are VGG(VGG16, VGG19), GoogLeNet(Inception V3) and Residual Network(ResNet)[16].

Related Work

Keunwoo Choi *et.al* proposes a model for music classification by taking the benefit of transfer learning[14].The spectrogram images of audio signal were used as the input to the convolutional neural network. The VGG model was used to learn the hierarchical time frequency patterns. The pre-trained convolutional neural network model was able to predict the music tags and features learnt from different layers were aggregated to solve six music information retrieval tasks such as genre classification, vocal and non-vocal classification, emotion, speech-music and acoustic event classification problems. For genre classification, they used Ballroom dataset and Gitzan dataset and could achieve an accuracy of 86.7% and 89.8% respectively using convolutional neural network model. They have observed that combining the features from all layers is a good approach and found that combination of four or five layers were the best configurations of the model. For speech-music classification, Gitzan dataset was used and could achieve 100% accuracy with convolutional neural network model. The Jamendo dataset was used for vocal-non vocal classification and found that the fourth layer of the network played an important role in achieving good accuracy. The Urbansound8K dataset was used for acoustic event detection task, a good accuracy is achieved by combining different combinations of three, four and five layers of convolutional neural network model.

Kafeng Wang *et.al* proposes Attentive feature distillation and Selection method(AFDS) which would dynamically decide the important features that need to be transferred to the new model rather than blindly transferring all learnt features from source dataset [4]. They claim that implementing AFDS on ResNet 101 outperform all existing transfer learning models and avoid unnecessary computation task. The AFDS learn the significance of each channel in the output of Batch Normalized Convolutional Layer and eliminate unnecessary channels thereby reducing the expense of convolution operation. The transfer learning combined with channel pruning was experimented on six datasets such as Caltech-256, Stanford Dogs 120, MIT Indoors 67, Caltech –UCSD and Food-101. The pre-trained model ResNet 101 trained on ImageNet dataset was used for transfer learning by replacing batch normalization with AFDS.The resulting model was fine-tuned on ImageNet for 90 epochs and could achieve good accuracy. The research paper published by Shahbaz Rezaei & Xin Liu discusses the security issues in transfer learning as the pre-trained model is publicly available[5]. To overcome this issue, they developed an Extreme Value Machine model which aims to fit a distribution with the activation vector rather than softmax which produce a linear combination. The model gave an accuracy 95.6% but still a more robust model was needed as there was a 7.38% chance that the model classifies the input as one of the target class. They also discuss another alternative, to check all elements in the activation vector and avoid classification of malicious images. To detect suspicious images, a threshold could be set for the activation element and hence reduce the severity of the attack. The evaluation of robustness of the model produced by transfer learning was discussed in [6].They experimented on CIFAR domain which contains using the knowledge transferred by robust ImageNet dataset and found that a good accuracy and robustness could be achieved even without any adversarial training.

Earlier work in transfer learning establishes that the data should be transferred between the same layers of source and target domains. But this cannot be always possible when the data from source and target domains are heterogeneous with different specifications. In such a case the most important layers of source and target domain may differ and the knowledge would be transferred to the wrong layer. A novel method developed byJianzhe Lin et.al, identify which layer of the source domain should transfer the knowledge to which layer of the target domain[25].Theyhave developed a mathematical model DT-LET to understand the best matching layers of source and target domain and have defined a loss function to understand the features and the respective relationship in

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both the domains. The have concluded by proving that finding the best match layers in source and target domain is an essential step while transferring knowledge between the layers. A detailed study of Inception V3 CNN architecture model was evaluated for its efficiency and accuracy on a different dataset through transfer learning in [11]. They have experimented transfer learning on two different datasets such as CIFAR-10 and Caltech Faces and observed that the size of the training data and the number of epochs affects the accuracy of the model. The results showed that the Inception V3 model gave a good accuracy on CIFAR dataset compared to previous state-of-the-art works where the authors directly used CNN model without making use of the advantage of transfer learning. Though the model gave good accuracy with more number of epochs, took more time for training. They have also discovered that access to GPU instead of CPU would improve the accuracy and time efficiency. Their test results showed that transfer learning could be experimented with other deep neural network models in order to achieve good accuracy. In [2], authors have proved that transfer learning and spectrogram augmentation have really shown an impact on detecting emotions in speech. The ResNet model was used to extract the features from spectrograms and they have also used augmentation technique on spectrograms to generate additional samples for training. This is done by applying random time frequency masks to the spectrograms to avoid overfitting and also to improve the results. The spectrogram feature is very effective and well suited for applications such as speech emotion recognition. The accuracy was improved by incorporating a statistics pooling layer to the network

Pre-Trained Models
VGG 16
The VGG 16 model, Visual Geometry Group trained on ImageNet dataset has sixteen layers with convolutional block 1 and block 2 are having 2 layers each. The convolutional block 3, block 4 and block 5 are having 3 layers with a total of thirteen layers and three fully connected layers or dense layers would sum up to sixteen layers Fig 2. The convolutional block 1,block 2 and block 3 consists of 64 ,128 and 256 filters respectively with same padding and relu activation function is used in every block except the fully connected dense layer. The block 4 and block 5 consists of 512 filters with a kernel size 3 X 3.The final dense layer consists of output classes and activation function used is softmax. A maxpooling function is used to reduce the size of the image and it is included in every block of convolutional layer.

DenseNet 169
DenseNet 169, Densely Connected Convolutional Network from the family DenseNet architecture, trained on ImageNet have fewer layers and less trainable parameters compared to other DenseNet models. What makes DenseNet one of the reliable deep learning model is its capability to get rid of vanishing gradient problem, strong feature propogation strategy, minimize the number of trainable parameters and also reuse of features[1,13,10]. The architecture of DenseNet model is shown in Fig 3. The architecture includes convolutional layers, maxpooling layers, transition layers and dense layers. The convolutional layers having kernel size 7 X 7 applies filter to discover the feature map from the input images and are passed to relu activation function. A dropout of 0.2 has been applied to every layer except the first convolutional layer. In DenseNet model, every layer plays an important role in deciding the information to be passed to the next layer. It works on the principle of feed-forward connection wherein the feature maps of each layer would be concatenated and are passed to the next layer in the network. That way it overcome the vanishing gradient problem which was the drawback of CNN classifier. In DenseNet, the first dense block contains 6 convolutional layers, second dense block contains 12 convolutional layers, third and fourth dense block contains 32 layers each. Each dense block extract the feature maps from the input image and concatenate it with the feature maps discovered from the previous layer provided the size of feature maps are same. These are passed to the transition layer which would perform the down sampling operation and are passed to the next dense block, followed by Global Average Pooling layer and fully connected layers. The function used for activation in the final output layer is soft max which would finally classify the problem.

InceptionV3
As compared to VGG model, Inception model and its successors have showed greater performance in terms of computational cost as well as constraints on memory [18,24,25]. InceptionV3 model, consists of 42 layers is a

modified version of Inception V1 and V2 models [8,12]. It has been observed that convolutions with more number of filters would be expensive than convolutions with smaller number of filters as the number of parameters used would be lesser in the latter case. For example, as we have a 5X5 convolution layer in Inception V1, it has been replaced with 2 layers of 3X3 convolutions in Inception V3. This would reduce the cost and also allow us to use the computational resources effectively. Hence to reduce the number of parameters, larger convolutions are factorized in to smaller convolutions in InceptionV3 model. Rather using a 3X3 convolution, it is divided in to 1X3 and 3X1 convolutions i.e, factorization in to asymmetric convolutions has been implemented in order to reduce the number of parameters. Similarly, a 7X7 convolution is replaced with 7X1 and 1X7 convolutions. The auxiliary classifiers inserted in between the layers of Inception block would eliminate the vanishing gradient problem of deepneural networks. The detailed architecture of Inception V3 model and Inception block is given in Fig 4, Fig 5,Fig 6 and Fig 7[21].

About The Dataset

The dataset used for this research have been taken from open source repositories such as CompMusic, Raaga and also from youtube videos. The duration of songs varies and were sung by both male and female, professional as well as amateur singers. The dataset contains a mixture of vocals accompanied with instruments such as thambura, mridangam, violin and ghatam and also few compositions were only with instruments. The compositions considered were geetham, varnam, keerthana and also raga alaap of different ragas in Carnatic music. There were 200 compositions of 22 different ragas in Carnatic music, with every raga having a minimum of 10 compositions. A combination of melakartha ragas such as Mayamalava Gowla, Kalyani, Shankarabharanam, Shanmughapriya, Harikamboji, Kharaharapriya and janya ragas such as Kaapi, Nattai, Khamas, Begada, Kanada, Saveri, Mohanam, Kedara Gowla, Mukhari,Hamsadhwani, Chenjurutti, Ananda Bhairavi, Reeti Gowla, Ranjani, Hamsanandi, and Athana were included for this research.

Flow Of The Work

As the number of ragas in Carnatic music taken for this research were more in number, the basic machine learning models couldn't perform well. So deep learning models were implemented .in order to achieve good accuracy. The reason for choosing transfer learning model is mainly because of the lack of data and GPU. The implementation of the model is shown in Fig 8.Allaudio files were converted in to .wav format. The Python library Librosa was used to load the audio input and extract the MFCC images of each audio track. The MFCC images were finally classified according to the raga and were saved in a directory with the directory name as the name of the raga. The data is divided in to training, validation and test data. The flow_from_directory()methodof ImageData Generator class of keras were used to iterate through the images from each raga directory. The advantage of using Image Data Generator class is that it would recognize the labels or classes from the name of its directory. Since the images are already classified and saved in the respective directory of raga, it could easily identify the labels or classes. The models such as VGG16, DenseNet169 and Inception V3 trained on ImageNet dataset were used for extracting the features and the pre trained weights were passed to the neural network. The fully connected layers of these models were frozen in order to implement the final classification for our problem.

RESULTS AND DISCUSSION

The models implemented for this research were VGG16, DenseNet 169 and Inception V3 trained on ImageNet dataset. These models were retrained on the audio images by freezing the output layer and added a dense layer with 22 neurons as there are 22 different classification of ragas and activation function used was softmax The model was compiled with loss as categorical_ cross entropy and optimizer as adam. The VGG 16 model couldn't perform well with lesser number of epochs. But when trained with more number of epochs, the model gave better accuracy results. The VGG 16 model gave an accuracy of 72% with 50 epochs and 87% with 100 epochs. With DenseNet 169, accuracy was 83% with20 epochs and 90% with 50 epochs. Compared toVGG 16 and DenseNet 169, Inception V3 model gave a good accuracy in classifying ragas of Carnatic music. The accuracy was 85% with 10 epochs and 92%

with 20 epochs with Inception V3 model. The test accuracy results of DenseNet 169 and Inception V3 models are shown in the Fig 9, Fig 10 and Table 1.

CONCLUSIONS

The lack of data and better utilization of computational resources has been a challenge with the implementation of deep learning models. The research problem of classifying different varieties of ragas has shown better results by adopting transfer learning without training the deep neural networks from scratch. It has been observed that the trained models such as VGG 16, DenseNet 169 and Inception V3 trained on ImageNet dataset is useful in classifying audio images as well. Though all the three models gave good accuracy in classifying 22 different categories of ragas in Carnatic music, Inception V3 model outperformed with lesser number of epochs.

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Table 1: Accuracy of Transfer Learning Models in Classifying Raga of Carnatic Music

Model	Epoch	Accuracy
Inception V3	20	92%
Inception V3	10	85%
DenseNet 169	20	83%
DenseNet 169	50	90%
VGG16	50	72%
VGG 16	100	87%
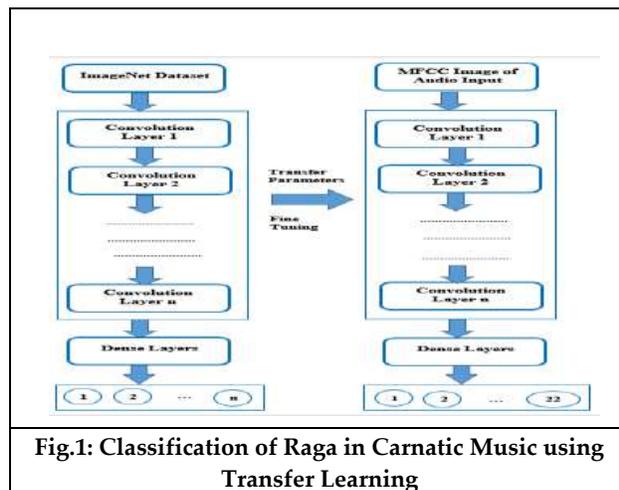
Fig.1: Classification of Raga in Carnatic Music using Transfer Learning
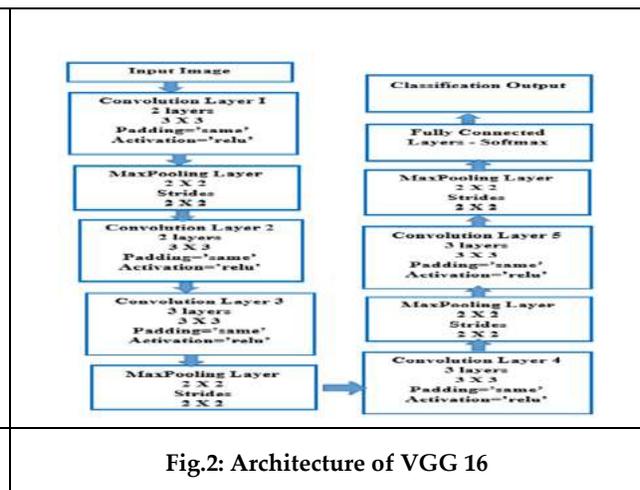
Fig.2: Architecture of VGG 16

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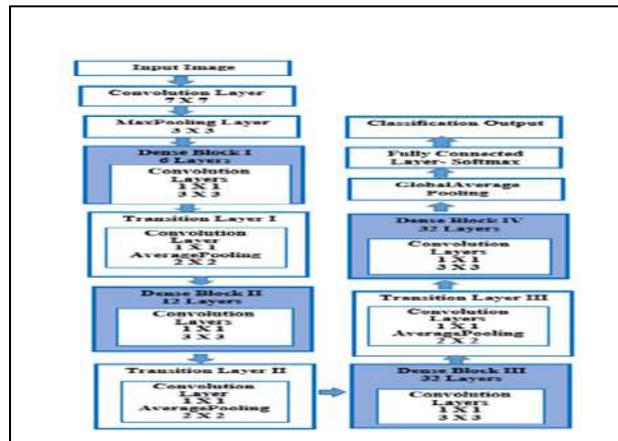
Fig.3: Architecture of DenseNet 169	**Fig.4: Architecture of Inception V3**
Fig.5: Inception Block A	**Fig.6: Inception Block B**
Fig.7: Inception Block C	**Fig.8: Classifying Raga in Carnatic Music Using VGG 16**
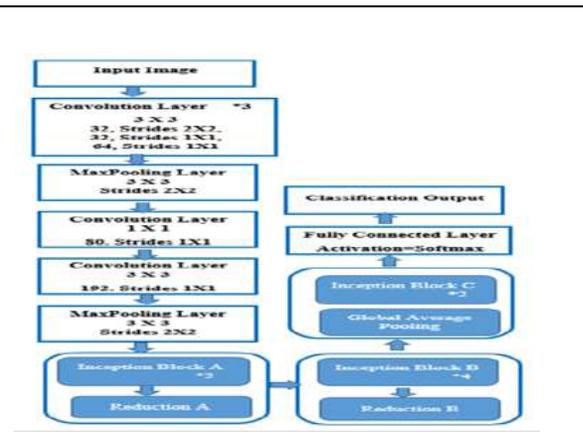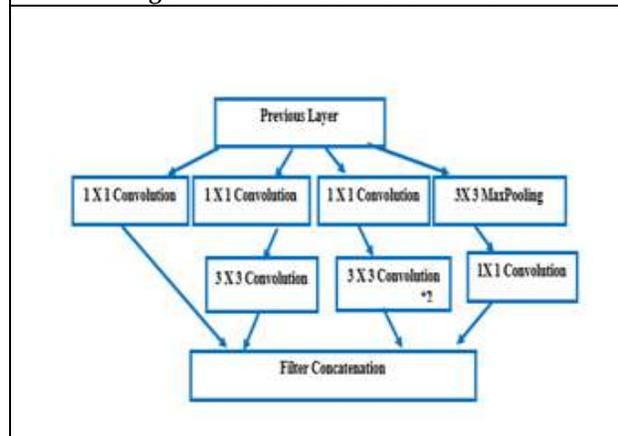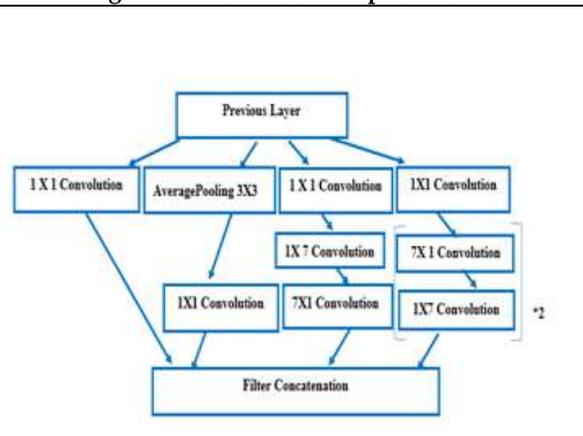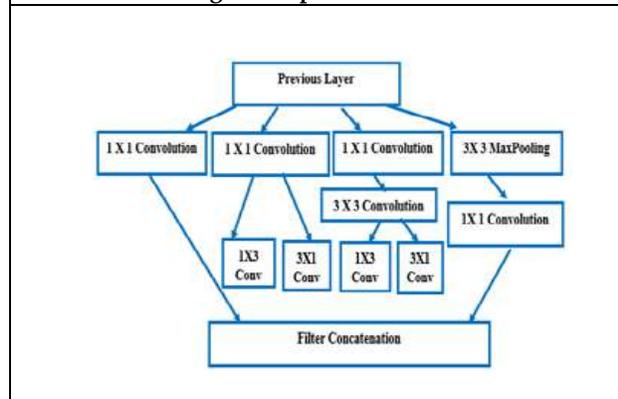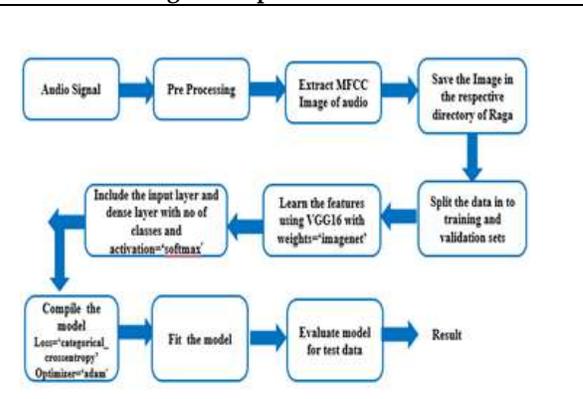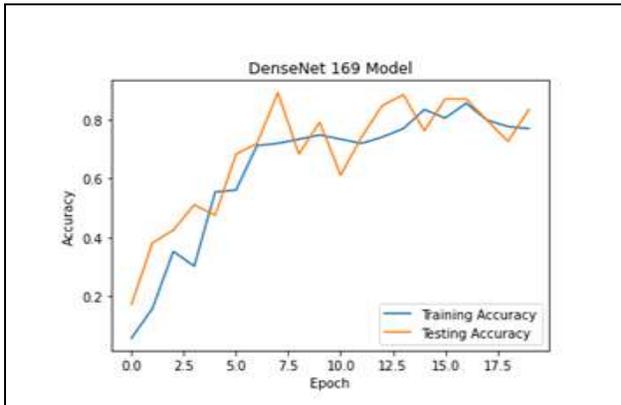
Fig. 9: Accuracy of DenseNet 169 Model with epochs=20	Fig.10: Accuracy of Inception V3 Model with epochs=20
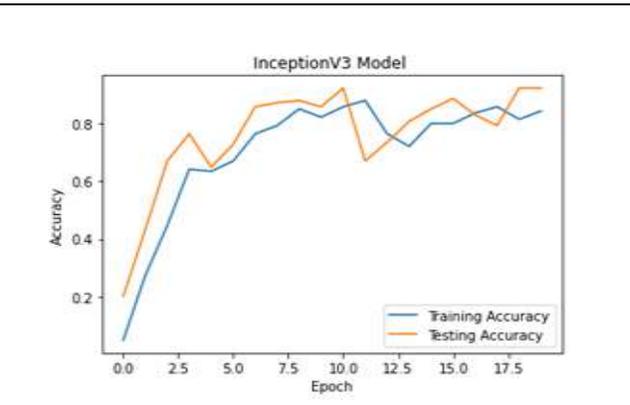
RESEARCH ARTICLE

Technical Survey on an Iot Based Vehicle for Farming Assistance

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ABSTRACT

Agriculture is considered the sustenance of mankind as it is the primary source of agricultural raw materials and plays a chief role in the development of the national economy as it provides great job opportunities for people. Unfortunately, traditional farming methods are still used by many farmers, resulting in low crop and fruit yields. However, productivity has improved as automation has been introduced and people have been replaced by automated machines. Smart agriculture is an emerging concept in IoT as it provides information about farmland and can take necessary actions on the user input. As a result, robots are increasing productivity and appearing in large numbers on the job site. Therefore, it is necessary to utilize modern science and technology to increase productivity in the agricultural sector. Hence, this paper proposes a system that helps in tracking field data and field operation management and provides flexibility. This paper was assembled after researching various papers. The proposed system focuses on performing functions such as tillage and seeding using Raspberry Pi microcontroller that acts as the brain of the IoT-controlled robots which are connected to control devices via Wi-Fi. The proposed system is an asset to the farmers as it helps automate physically demanding processes by using robotic systems to cultivate farmland with minimal human assistance.

Keywords: Agriculture, Farming, Internet of Things (IoT), Wi-fi, Raspberry Pi, Plowing, Seeding

INTRODUCTION

Agriculture is essential for human survival and farmers spend most of their time plowing and irrigating fields. Majority of the population in India is dependent on agriculture. The country's broadest economic sector is the agriculture industry, which plays a crucial role in the economic progress of the country. Compared to other fields, agricultural land development is low and hence some improvement is needed in this area. A major goal of agricultural technology development is the minimization of labor, which is a common phenomenon worldwide.

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Today, agricultural tasks such as plowing and harvesting can be automated and farmers can have access to automated equipment such as robots. The use of robotics in various agricultural activities, such as plowing, seed distribution and harvesting, allows farmers to achieve better results by increasing productivity. The traditional method requires manpower for weed control, lifting, dragging and picking fruits by hand. The conventional methods also pose a threat to the farmers health as they tend to work in toxic environments while spraying chemicals and pesticides. Since the tractors are heavy and large, they compact the muddy ground but cannot move in off-road conditions. Issues in the traditional methods can be overcome by the use of robots as they are light-weighted. Hence we surveyed a range of research papers from previous years through which we were able to provide a solution. We have browsed through and structured a literature survey that discusses methodologies used in the past. Under all conditions, the robot can restlessly follow the displayed program and perform the required exercises with the help of computer assistance. The main advantage of a lightweight robot is that it does not compress the muddy ground and can move about easily.

LITERATURE SURVEY

A review of various papers related to agriculture activities using IoT, agricultural robots and research related to machinery used has been completed. Papers that were found to be correlated with smart agriculture are discussed and tabulated below. An increase in the competence of some activities of agricultural enterprises was detected by Technological progress. New strategy introduced by authors of paper[1] included combining irrigation and sensing for smart agriculture wirelessly. New approaches for digital agriculture , sensor data collection, irrigation control were studied. A case study was presented that suggested an experiment that was conducted on a farm which utilizes various technologies to monitor the livestock using environmental sensors[1]. From the paper[2] we found a report, which predicted that to balance the world population, which was an estimate of 9.6 billion people, we must increase production of food till the rate of 70 percent in the year 2050. The Authors [2] proposed a system that remotely monitors parameters such as moisture, temperature, water content and fertility of the plant. An algorithm was created to code the microcontroller. After energy and water wastage was tested the generated data was stored using cloud technology. Findings from the authors of [4] revealed that there was a strategy developed which monitors criterias such as moisture, temperature, humidity or animal movements with the use of Arduino board. If there was a case where any discrepancy was detected the model alerts the farmer via the smartphone which has the application installed via an SMS as well as a notification. It was proposed in [3] ,that a robot that was proficient enough of conducting operations such as motorized plowing, sowing , delivery, fruit picking and pesticide spraying was developed. The model can cater to manual control whenever necessary and is able to maintain an overview of humidity with the use of humidity sensors. The main hardware requirements include a jumbo microcontroller which will oversee the consolidated mechanism. Authors also mention using GSM modules to alert the farmers via SMS.

From the authors of [5] it was noticed that the model used for plowing and dropping seeds into the plowed land was using an IoT controlled robot. It could perform various agricultural tasks, such as plowing, seeding, spreading fertilizers and reaping without the need for human intervention. It can perform all the mentioned tasks using only the field length and width as input. The architecture and performance of activities like plowing and seeding done by robots that use IOT was also studied from [6]. The developed robot focuses on agricultural purposes like plowing, sowing and mud leveling. The robot is also battery operated and can operate in any weather conditions. The suggested structure of [6], states that it makes use of a mechanical device that supervises the field. The device consists of two motors and a power source that provides the robot with movement in forward and backward directions, and also makes use of sensors of four types. These are sensors that sense temperature, ultrasonic waves, pH and a level sensor which senses the required parameters. It also makes use of a microcontroller that connects to Wi-Fi which not only monitors but also provides the results of the sensors used. The robot does the activities of plowing, sowing and sprinkling water automatically. The idea for our project was taken from [7] . It discusses that the most advantageous feature of indoor farming is that it can mass-produce nourishing food utilizing less agricultural land and manpower. This smart farming management system uses readily available sensors and hence makes indoor farming easier and cheaper. The entire farm could be easily monitored with the help of a line-

following robot. Primary farm tasks such as supplying water, providing acceptable lighting, fertilizing trees, etc. can be done either automatically or manually [7]. This model uses transmitters that send the system's data to the robot and the gas sensors to monitor the amount of carbon and detect the amount of smoke in the room. From [8] it was observed that as the community grows, it leads to an increased demand for healthy foods. As a result, indoor farming is gaining popularity.. This paper introduces a system through which an indoor farm can be managed at a very low cost. Due to this, it is possible to provide each plant with specific light for photosynthesis, limit the concentration of CO2 and water the plants when necessary. You can also control the entire configuration from anywhere via the mobile application. The system includes an assistant robot that fertilizes the plants on the farm and monitors the entire farm in real time. Robots allow users to predefined tasks or use the app to give instructions anytime, anywhere. The author of this paper [9] aims to take advantage of emerging technologies such as IoT and smart agriculture. Monitoring ecological factors is crucial for improving the yield of crops. This article includes keeping track of the temperature and humidity in an agricultural area using a single CC3200 chip and various sensors. A camera is linked to the chip and it sends the pictures to mobile farmers via MMS using Wi-Fi. Microcontrollers, Wi-Fi modules and network processors are on the same chip which makes it portable.

Changes in environmental conditions will have an impact on the total crop yield. Plants require precise conditions for their optimal growth and health and hence monitoring these conditions is very crucial. TMP007, a Temperature Infrared thermopile sensor is used. The HDC1010 sensor monitors the humidity of the air within the agricultural sector. The camera interacts with the Camera Amplifier of CC3200 via PCB Camera sensor MT9D111 and is used to capture the live images of the field and is posted to the farmer via GPRS. The proposed system in [10] uses the NodeMCU microcontroller where the ESP8266 Wi-Fi module is installed. Smartphones with the Blynk app are used as the user interface. Sensors such as rain sensors, soil moisture sensors and temperature sensors are used with DC motors and deek robots. At the humidity level, NodeMCU decides whether the crops are watered or not using the appropriate functions. The user gets the notifications of each sensor readings on the Blynk app. In this application, the farmer controls the DC motor by using the user interface. In paper [11] we are using a NodeMCU ESP8266 microcontroller. Running natively at 80 MHz, this low-cost device can go up to 160 MHz. We can connect additional modules to expand its functionality. The MCU is programmed with the Arduino IDE including libraries. The proposed model uses a humidity and temperature sensor, a soil moisture sensor, servo motor and gyro sensor. To store the data, ThinkSpeak cloud is used. All the sensor datasets are sent to the cloud for analysis and use machine learning techniques for crop prediction. This device [12] monitors the greenhouse or the farm and according to the readings of various kinds of sensors such as the UV, IR, soil nutrient, temperature, humidity and soil moisture sensor.

It provides the farmers with different types of reports about the current conditions so that the farmer can act quickly. Prompt measures taken by the farmer will benefit in increasing agricultural productivity. The appropriate use of natural resources will also ensure that the product is environmentally friendly. The proposed system will increase the quality and quantity of crops by properly monitoring different current conditions. Current data of the various sensors can be seen on laptops and smartphones. According to the authors of [13], farmers spend most of their time comprehending and keeping track of the crop conditions compared to actual field work. As a result, the use of wireless sensing can be facilitated to provide accurate monitoring of crops along with using smart tools for crop harvesting in order to save both their time and efforts. Thus, the manuscript proposes the viability of using Cloud technology and IoT to process, store, and analyze field data in order to produce better and faster outcomes while reducing the burden of manual agriculture. In paper [14], we learn and understand how traditional agricultural products cannot guarantee the quality of agricultural products and require higher time, efforts, manpower along with high material resources. The paper explores how IoT technology can be used over the old traditional methods to ensure fine management of agricultural production and its environmental monitoring by proposing a 4 layer architectural application of IoT technology for intelligent agriculture. Exploring modernization of agricultural farms with minimum human involvement, the authors of [15] exhibit the major segments of smart farming based on IoT. The article uses IoT, computer networking and its various protocols along with other technologies such as big data analytics and cloud computing which proposes the development of different aspects of farm management. Thus the

paper explores the feasibility of different technologies with IoT to further accommodate the sending and receiving of agriculture data which can overall reduce the overhead which comes with traditional farming methods.

CONCLUSION

In conclusion, the agricultural industry will be largely benefitted by investing in the development of more IoT-based vehicles for farming assistance. By leveraging the power of technology such as the Internet of Things, allows features like real-time monitoring and control of farming activities, leading to increased efficiency and productivity. Additionally, the use of this technology can help to reduce the workload of farmers and improve the overall sustainability of farming operations. While there may be some concerns about the cost and complexity of implementing this type of system, the long-term benefits are likely to outweigh the initial investment. Overall, the IoT-based vehicle for farming assistance represents a significant step forward in the evolution of modern agriculture.

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RESEARCH ARTICLE

Removal of Fraudulent activities in Electronic Health Records using Blockchain Security Framework

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ABSTRACT

Existing Electronic Health Records (EHR-Systems) are no longer in use since they were never meant to work with multi-institutional data storage. Traditional EHRs are currently vulnerable to Internet transaction assaults and other threats. Several fraud schemes are attempted to change the information internally all around the world to make profit from it. This usually involves changing or hacking the records in order to make forged reports. This also provides interoperability and makes it convenient to transfer and store information and medical data. This is a requirement for a new and efficient system for storage and retrieval of Health Records. The system is to establish the benefits of Blockchain Technology in the Medical Sector. The most prominent things to be kept in mind while designing and developing new technologies to carry out the same task is evidently, transparency and accessibility of medical history data to the patients while keeping the economic feasibility in mind. Moreover, patients will have to be convinced about the confidentiality of their information which is mandatory for them. Also, the new technology should definitely consider adding exceptions cases while providing information to the patients as not every data can be transferred to patients, for example psychotherapy notes or therapist's personal information. The main goal of the Blockchain in EHRs is to provide a secure, temper-proof and a transparent system that will not permit downloading of the files and any alteration.

Keywords: Blockchain, decentralization, consensus, scalability, smart contract, Firebase, ReactJS, Solidity and Ethereum.

INTRODUCTION

It is frequently seen that the actual workload placed on humans declines dramatically as a result of the expanding revolution and automation, or the use of technology in every field of labor. Innovation has woven its web over nearly all of them, whether it be in the business and technological sectors, production facilities, the automobile industry, or

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elsewhere. The information and data of the patients, their appointments, diagnoses, medications, and prescriptions are contained in electronic health records (EHR). Particularly in the department of healthcare, the information recorded typically includes patient histories, operations, treatments, and other procedures that the patient has undergone [1]. Lamentably, as innovation has gone inseparably, so too have the methods used to disregard protection and online security. The medical care industry, specifically, frequently has been a significant objective for data robbery as prosperity records consistently contain private information like the names, government upheld retirement numbers, and addresses of patients [2]. With a decentralized blockchain system, they have control over their patients' credentials and can simply check their histories. Each entity in the system has specific roles and abilities that are established by the architecture, which is then used to construct the relationships between the entities. As can be seen in Fig. 1, blockchain is thus employed to implement efficiency as well as security. Transactions between what is referred to as the singleton state machine are protected by cryptography. The concept of blockchain can be represented as a chain of three-component blocks. The block can be thought of as being encoded by the hash. The prior block's hash value is the previous hash on the blockchain [3].

Blockchain technology was basically tailor-made for keeping a distributive financial ledger but the Blockchain paradigm can be generalized to make a decentralized ledger to store information of any specific domain. The transactions between what is referred as the singleton state-machine are secured by cryptography. Whenever a new data entry is made the node encodes the logic thus, validating it before uploading it to the Blockchain. The Blockchain technology-based ledgers used for storing data is primarily based on the use of Contract which allows automation and tracking of data related characteristics such as, Viewership Records new data entries [4]. The viewership and ownership permissions are shared through the peer-to-peer network, accessible to the private members. The smart contracts available on the Ethereum framework for Blockchain, we define the relationships between two entities and also formulate the viewing instructions and data retrieval permissions for them to be available for external databases. Through this system patients can choose and allow the sharing of their medical data among trusted providers, whereas providers are capable of adding new entries related to patient. Thus, validating and keeping the users indulged in the evolution of the data making it more secure [5].

Related Work
To simplify the foundation of EHR frameworks, many areas where blockchain technology is used have undergone a systematic literature review.

A. Blockchain Approach
The key of the record is encrypted by applying the ABE algorithm. The record is then encrypted with other records using the ABE algorithm as presented by the researcher [6]. The data buyers are authenticated, and the data may be decrypted remotely as presented by researchers [7]. A system that leverages remote storage to overcome blockchain storage limitations and offer exact rollbacks as the frequency of false alarms increases [8].

B. Healthcare Approach
The EHR framework for medical records includes a variety of file kinds, including text and image records, and because blockchain block sizes are constrained, it is challenging to store high-speed data storage. It has also been suggested that they build an electronic health record framework for a healthcare system to store vast amounts of data [9]. For secure remote storage of health information, it employs CP-based Access Control. To verify the authenticity and integrity of the records holding that linked signature on the remote side, data is required [10]. With a gatekeeper database, an offline database can be used as a cache for health records. If authorization has been given and a researcher's suggestion has been made, the gatekeeper may roll back the results of the inquiry [11]. Researchers have proposed a framework that combines a smart contract and an interplanetary file system to enhance decentralized remote side storage and data sharing for better utilization [12].

SYSTEM METHODOLOGY

The most prominent things to be kept in mind while designing and developing new technologies to carry out the same task is evidently, transparency and accessibility of medical history data to the patients while keeping the economic feasibility in mind. Moreover, patients will have to be convinced about the confidentiality of their information which is mandatory for them to indulge in the process with full disclosure. Also, the new technology should definitely consider adding exceptions cases while providing information to the patients as not every data can be transferred to patients, for example psychotherapy notes or therapist's personal information. Not only will maintenance of these records be time consuming, the patients involved hardly care enough to take out their time to indulge in the process [13]. The updating and removal of erroneously added data hence becomes impossible. This causes both patients and medical institutions to deal with compromised data and in a fractured manner. The health records need to be cohesive, whereas this method of data storing results in a fragmented manner. One major cause can be the strategic barriers between the various medical institutions and Healthcare centers. Thus, a patient trying to retrieve his/her past medical treatment data is often hurdled by the economic incentive involved. Recent investigation shows that IT developers providing information exchanging interfaces charge exorbitant prices making it even more impractical [14]. After the system has been planned in detail, the next stage is to move the system into a functioning one. For this, various interfaces can be created which will then be linked with the backend. System design acts as a backbone for any framework because We use it for the development of our system. Implementation of the proposed system requires various tools and technologies. An Ethereum testnet is Rinkeby (or test organization) Architects frequently utilize testnets to run "tests" for their programming or application. In contrast to Ethereum mainnet, which is a proof-of-work network, Rinkeby testnet is a proof-of-authority organization. A local server was utilized to construct the frontend. The cornerstone for all patient and doctor interactions with the dental care system was this frontend. The data became extremely safe and untouchable—that is, it cannot be deleted—after the Smart contracts supporting the ReactJS frontend were deployed. Here, we use modules and components that we combine to make the whole thing. The goal of this blockchain framework is to create a decentralized electronic health records system that is secure, confidential, and tamper-proof. The given EHR blockchain framework consists of the following major components shown in Fig. 2.

Using this interface, for doctors can search
Using the ReactJs framework, they categorize their patients. It includes all of the patient's information, previous consultations with the same doctor, or even consultations with different doctors. The doctor can also keep track of their professional accomplishments. The doctor may at any time include a new patient and their diagnosis. A connection is made to the Serving System, which is in charge of a number of significant duties, including obtaining and processing patient requests and authenticating and registering all patient transactions. Once a connection has been made, the user interface enables updating of the patient's personal information as well as several forms of authentication such as private key and certification information. The doctor creates a request to acquire a patient's health record, in which the doctor's request information about the patient's medical record from the database. Acquiring the patient record according to the doctor's request is the phase during which the patient's record is retrieved from the database. The next step is to generate new diagnosis data to be shown to the doctor. Encryption of the medical-health-record is the final phase where the EHR which will be sent is encrypted as shown in Fig. 3. The patient then verifies the credibility of the Doctor and also gets access to the previous feedback from other patients for the same doctor to make an informed decision. The recently made client can likewise make a secret word to unapproved admittance to his information as well as the Blockchain in general through his/her user interface as shown in Fig. 4. The encryption for the newly created record is carried out [15].

Firebase
Any user-centered program must be able to confirm and authenticate the user's identity and the type of access to which he has been granted. This enables the application to safely store user- related data in the cloud or on distant servers and to give each user a customized experience regardless of the device they are using. It supports all forms of

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validation including contact information, passwords, widely used online media records, and more. It is simple to combine Firebase Authentication with user-specific backend because it integrates with other Firebase administrations and uses industry standards like OAuth 2.0 andOpenID Connect, as seen in Fig.5.

Ethereum Virtual Machine (EVM)

It cannot be defined as a single entity but as amalgamation of thousands of connected systems which behave as Ethereum Client. The whole system remained immutable, continuous, uninterrupted, and this comprised a special state machine. At any instance and at any given block in the chain, Ethereum is the sole obligation to choose a new substantial state. It is the environmentalluded to as the Ethereum where every one of the brilliant agreements and the Ethereum accounts live as shown Fig. 6.

RESULTS

User Interface - Doctor Side

This interface, which was created using the ReactJS framework, gives clinicians a way to search for patients theyhave treated in a classified way. This provides information about every patient, including past interactions with the same doctor or even different doctors. The doctor can also keep track of their professional accomplishments, as seen in Fig. 7.

User Interface - Patient Side

This is the patient-side interface, and it includes all the data, including information about prior visits, given medications, performed tests, etc. As seen in Fig. 8, the patient is free to review any of this information whenever and whenever they like.

Backend-Solidity Compiler

The entire system's backend is written in Solidity and is being assembled using the online IDE remix. The compiler enables all CRUD operations, including

1. Making a New Patient
2) Finding/reading the necessary patient data
3) Updating Patient Data in accordance with the Need
4) Eradicating patient data

The blockchain is reset and updated with the most recentdata throughout compilation.

The entire system's backend is written in Solidity andis being assembled using the online IDE remix. [16]. A patient's record is retrieved from the database according to the doctor's request. After that Generating new diagnosis data which is to be shown to the doctor is generated where the medical- health-record which is to be sent is encrypted for the security purposes [17].

Technologies Used Over The Year

EHRs are no longer useful since they were never designed to work with multi-institutional control or data storage. Fig9. This proposed article integrates Blockchain Technology with EHR for storing patients' medical records. Fig. 10 illustrates several technologies utilized to store medical records. It makes thedata and records stored secure but also scalable. Another major advantage of this technology is that the patient will always have an updated track of his/her medical data at their disposal. This even helps in identifying cons and good doctors through Feedback data for each patient visit to any doctor. Feedback in the health industry is very important but it's often tainted, but with this implementation, once the data is updated it cannot be deleted.

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CONCLUSION

The traditional method of a centralized system of storing and aggregating data involves problems related to transparency and security concerns. Whereas the system provides for total transparency in the process the users' data is also protected by the means of carefully drafted authorization depending upon the type of the user as well as by the implementation of encryption through SHA 256 algorithm. Blockchain being a futuristic approach contains a very bright future during this technological world in terms of safety, security, complexity, and sustainability. Blockchain technology helps to make smartcontracts easily and efficiently without any fraud happeningor data getting leaked or copied. Plenty of challenges are happening in the healthcare system such as copying of information, loss of information, wrong data interpretation, etc. In this paper we picked up a subset of those healthcare-specific challenges, we tried to demonstrate and develop a contemporary, futuristic yet technologically advanced methodology to deal with the priority.

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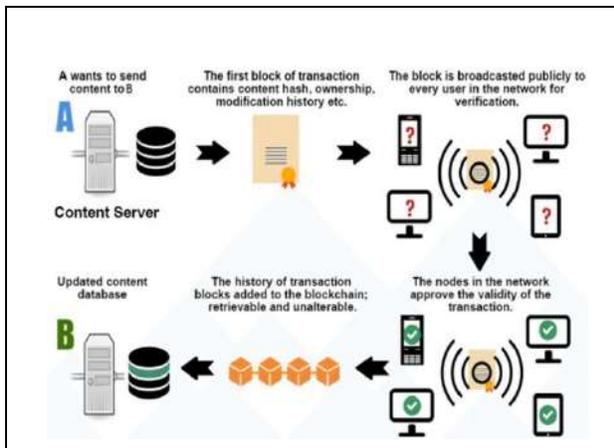
Fig. 1: Flow Diagram of Blockchain Technology
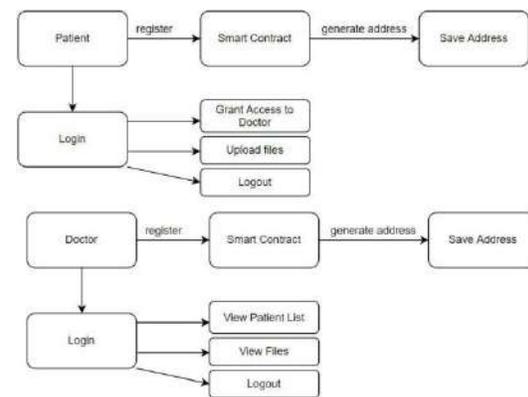
Fig. 2: EHR Framework
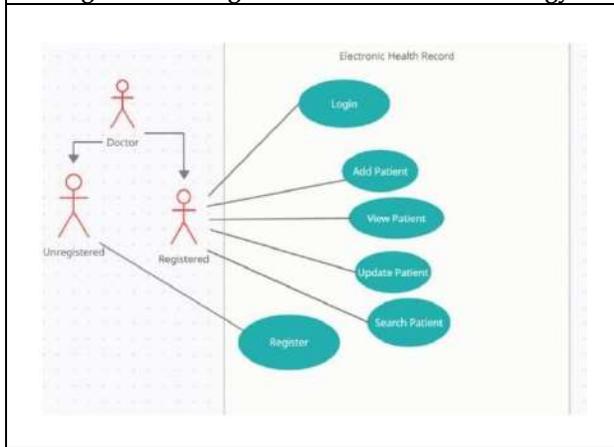
Fig. 3: System Interface for doctor
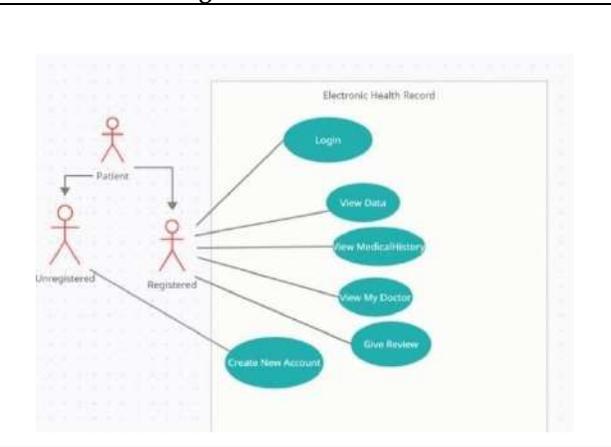
Fig. 4: System Interface for Patient
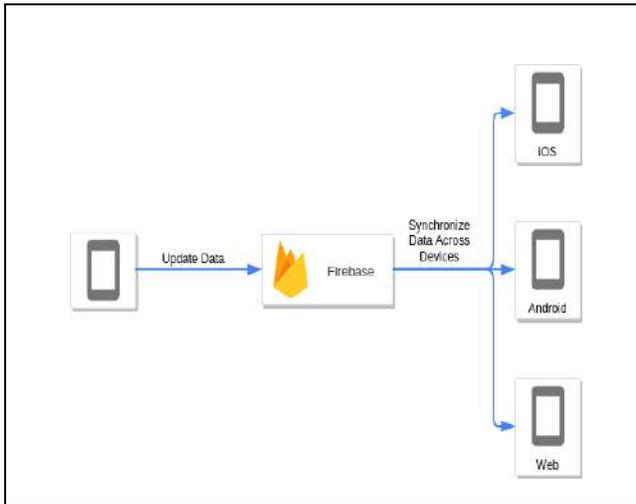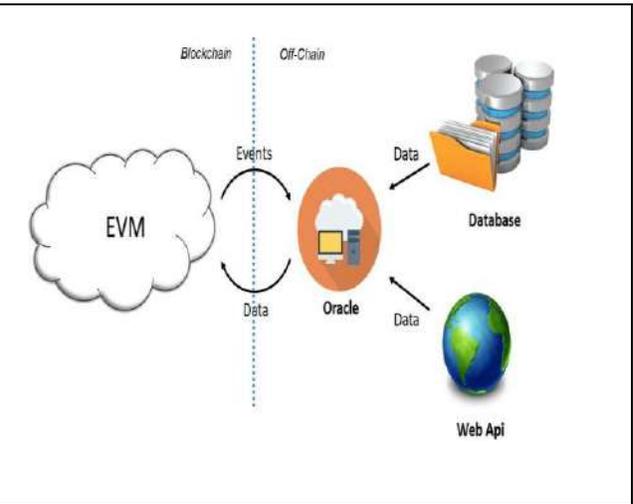
Fig.5: Firebase	**Fig.6: Ethereum Virtual Machine (EVM)**
Fig. 7: Doctor's User Interface	**Fig. 8: Patient's User Interface**
Fig. 9: Solidity Compiler	**Fig 10. Technologies used over the year**
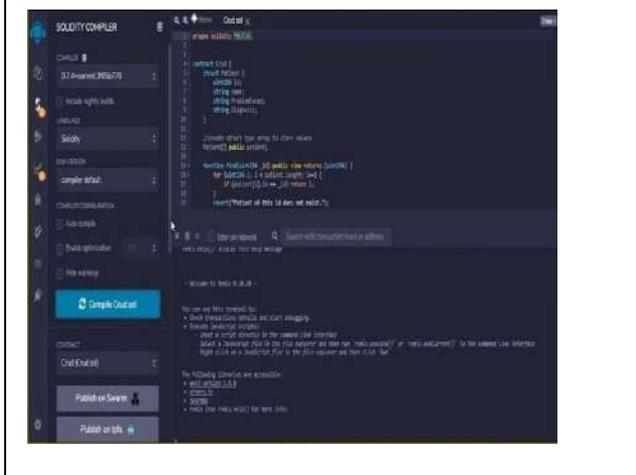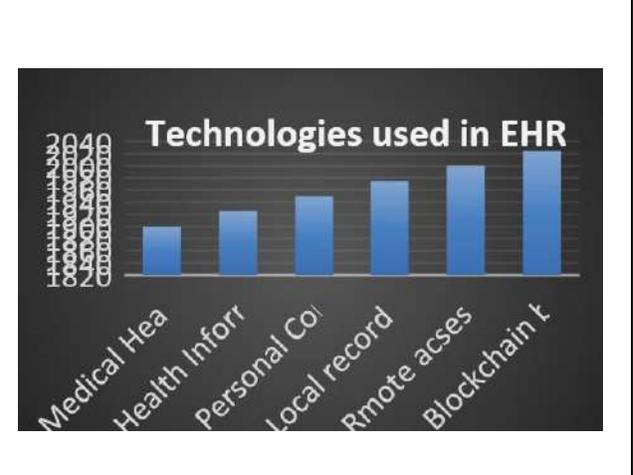
RESEARCH ARTICLE

Face Detection and Recognition-Based Automated Criminal Identification

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ABSTRACT

A majority of individuals are worried about security difficulties as a result of the world's exponential expansion over the past ten years, which has resulted in an exceptional rise in crime rates and an alarming number of criminals. Due to a lack of police services, a variety of theft-related issues, theft crimes, burglaries, kidnappings, human trafficking, etc., go unsolved. Frequently, the person who was involved in illegal activities is never recognized. An automated facial recognition system using a Haar feature-based cascade classifier is urged   to avoid this circumstance. This article offers a demonstration using meaningful facial recognition by the autonomous spy sensor. This technology will be expected to swiftly and automatics find and identify faces. Face identification acts as biometry firm technology which depict a specific facial attribute and data is stored as face copy. It operates Machine Learning on the depiction then give raise to attribute vector and plot an item with bunch of numbers. That is projected to utilize this technology to spot out criminals who are on the confront of their past records. Around 75% of the crimes are often confide by the same criminals according to the NCRB (National crime Records Bureau) report. These criminals Can be recognized and inspect its accuracy level with numerous images including function of the human face, terrible lightning, negative environmental conditions, pose version, Aadhar card images, blurred, childhood images. flask application it extracts the input image and execute contrast the resemblance from web scraping and exhibit the outcome. We present an attribute aging module which can age progression extent face character results with an identity verification to make better   precision of age segregation children face likeness. This desired outcome for rapidly finding suspected person which identifies multiple face estimation time is less. This outcome recommend that adult face character increase the potential that recognize youngster who are viable sufferer from youngster abduction and child trafficking.

Keywords: These criminals, vector and plot, recognised and inspect

INTRODUCTION

Human identity has been mostly defined by the face. The attribute that most obviously characterizes a person is this one. In order to appreciate a person in a video or image, face detection and recognition technology is utilized With the assist of the Python and OpenCV frameworks, we recommend a face identification and detection system for criminal identification. Target matching, geometric feature recognition, principal component analysis, and other approaches comprise the vast majority of the widely used facial recognition methods. In our society, the vast majority of criminals camouflage in with us, making it difficult to spot them. Biometrics like thumbprints   have historically been used to identify repeat offenders. However, criminals are resourceful enough to avoid leaving their biometrics at the crime scene. In industrialized economies, the government develops datasets that are useful in identifying human faces and compares suspicious acts with training datasets and database data. Principal Component Analysis (PCA) it is used to build the face identification system. high computational cost and the fact that it can only interpret faces exhibiting comparable facial expressions are the two key drawbacks of employing the PCA method The technology is going to discover and recognize faces easily and automatically. Facial recognition software utilizes biometrics, applying principal component Face recognition and instant detection will be achieved by technology. Software for face recognition uses biometrics, around 75% of crimes are often confide by the same criminals according to the NCRB (National crime Records Bureau) report. These criminals Can be recognized and inspect its accuracy level with numerous images including function of the human face, terrible lightning, negative environmental conditions, pose version, Aadhar card images, blurred, childhood images. flask application it extracts the input image and execute contrast the resemblance from web scraping and exhibit the outcome. We present an attribute aging module which can age progression extent face character results with an identity verification to make better   precision of age segregation children face likeness. This desired outcome for rapidly finding suspected person which identifies multiple face estimation time is less. This outcome recommend that adult face character increase the potential that recognize youngster who are viable sufferer from youngster abduction and child trafficking. It generates distinctive template from each face also contrast them with depiction accessible in the dataset. In case the input face contest with accessible in dataset, then feature associated image would be presented. The present method would reduce the illegal act and make sure the reliability within the public.

Literature Survey

In paper 1, two steps are required for recognition the method of evaluation and the process in training. A distinctive model is constructed for each image during the training phase of the algorithm when it is fed samples of the photos to learn from. A duplicate of a subsequently acquired test is generated throughout evaluation process. And picture is compared to all of the versions that are presently in the database. Then it is determined whether the recognition is activated by acquiring the near-corresponding model. Here, there a set of basic feature known to be a sample of eigenfaces— on a sample of facial images, are developed using the quantitative approach Principal Component Analysis (PCA). Any human face can be regarded of as a synthesis of a range of typical facial aspects. In paper 2, Face and object detection are both possible with Python-open-CV. Rotational images, however, are inaccessible to them in order to distinguish faces in rotating and blurred frames. Python's Facepplib is used to extract faces, and it provides a variety of features that assist you compare the attributes of two photographs..It is a face recognition and comparison API. It processes two photos via several steps after receiving them as input. Facepplib's ability to recognize faces in fuzzy or distant photos is one of its benefits. They do not need to utilize the haar classifier since the photographs of the prior criminal and the missing children only need a little bit of preparation. In paper 3, Python's opencv code frequently uses the principal component analysis (PCA) [4] or (CNN) convolution neural network [3] approaches which detect faces. These strategies categorise visuals into face and non-facial areas based on traits that can be gleaned from a picture. In order for the classifier to recognise the faces in the provided image, it should be traits with both negative and positive facial photos. In paper 4, This article recommends a face recognition system based on intelligent imagery that can extract the distinctive character of a face and sample material from the features and emotions of the face, in addition to the physical characteristics and features and emotions of the face, such as the pupil and eyelids. Using an adaptive template matching technique, a face image is segmented, eyelid and pupil

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features are gathered using a 3D dynamic scanning technique, and the target face image's best pixel features are determined using a matching filter detector. In paper 5, For robust and accurate face identification we provide a novel learning-based face picture quality evaluation in this study. The paper's two primary contributions are as follows:

1) To assess a face image's feasibility for recognition, two categories of FIQ—objective facial picture calibre (are suggested by (OFIQ), along with comparative facial picture quality (RFIQ). The word "OFIQ" in this context refers to the objective visual quality in terms of brightness, blurriness, facial alignments, as well the posture. To distinguish between useful and undesirable face shots, a learning system is integrated into suggested face picture evaluation approach.FR system output is used to carry out the instruction, and our FIQ modelling approach is versatile and adaptable to FR system and also the circumstances of a trail face picture. In paper 6, In the Manual Identification System (MIS), police officers check people in public locations to identify them. It takes a long time to provide the necessary care, and there is a danger that it will miss criminals since they will be alerted by seeing police leave the area quickly. Since the MIS is taking longer than expected, we won't be able to adequately concentrate on everyone. However, there is no requirement for surveillance when using an automatic identification system (AIS). In paper 7, Fully linked feed forward neural networks will aid in feature learning and data classification. For huge inputs like high-resolution photos, this design will thereafter become unusable. A hidden layer, an output layer, and an input layer make up CNN. As the activation function and final convolution identify the inputs and outputs, the intermediary layer is referred to as concealed. The system will display a dialogue box indica ting a match has been made and showing the information if the photo is present in the database.

In paper 8, Researchers proposed creating an automatic facial recognition system that makes use of the wellknown Principal Component Analysis technique. That technique allows for automatic facial detection and identification. This technology will aid law enforcement in tracing the criminal in the event that a fingerprint is not found at the crime site. A dialogue window indicating a match has been found and providing details will be shown by the database's software. In paper 9, A method for identifying faces using the haar classifier was explored by Apoorva and Impana. This method uses a single classifier to identify many types of images with variable quality and rotations. Instead of a sophisticated classifier, it employs a number of poor ones. Convolution Neural Network (CNN) technique-based deep learning strategy for face identification and recognition is described by Kavushica Rasanayagam. Data is classified using the IMDb dataset and the cloud AWS. In paper 10, The function of the human face, as well as position variation, unfavourable environmental factors, dreadful lightning, and image tilt, are explained by Arulananth T.S., Baskar M., and Sateesh R. Therefore, we need to come up with some workable methods to resolve such problems by enforcing a new system. Our proposed project could help with problems with face detection, monitoring of human faces, and face identification.

In paper 11, Importantly, CNN has translation invariance, rotation invariance, and visual distortion. CNN is utilized generally in deep learning research for computer vision applications requiring object and popular feature. Prior to CNN's widespread use, manual feature extraction and classifiers were used to manually accomplish the majority of pattern recognition jobs. But the development of CNN drastically transformed pattern recognition. Instead of using a traditional the conditions of a sample face image along with the FR method picture's the parameters of a reference picture and the FR approach frequently perform well when processing two-dimensional input, such as audio and images. During a public event. In paper 12, The classifier starts off by extracting Haar features from each image after being fed a massive amount of training data (in the form of photos) into the system. A variety of convolution kernel known Haar features might establish if a relevant feature is present on an image or not. On visuals, these windows-like Haar Features are deployed to compute a single feature. The feature has mostly been made up of a single valued that is resulted simply taking the total of the pixels in the black and white sectors out.

METHODOLOGY

Acquisition Of Image
In this scenario, the suspicious photo will be entered by the user and taken image , and then web is crawled for prior crime and kidnapping young children. This is able to access webpages. dynamically to make sure that the most up-to-date information is always provided. CCTV or video evidence may also be used. Due to the 29FPS frame rate of videos, information is scanned in seconds rather than frames to prevent duplication images.

Face Detection
This Haar Cascade Classification is utilized to detect and recognize.

Haar Cascade Classifier
It is a machine training method that makes use of a cascade function that was trained using such a vast collection both of negative and positive images. Additionally, it can be used to find objects in other photos.

$F(Haar) = FWhite - FBlack$ where
$FWhite$ = sum of pixel of the dark area
$FBlack$ = sum of pixel of bright area

Scraping Web
For scraping pictures from the web, Beautiful Soup and also the Python requests library are both utilised. The websites that include illegal and kidnapped person information are mentioned, and Beautiful Soup is employed to retrieve the site's source code. To generate an HTML document from unformatted text, use the Htlm5lib parser. By supplying the tag and class name that each of the required elements is composed of and parsing them according to the type of information, the elements are produced. This material is dynamically updated, so small adjustments don't necessitate additional training.

Featur Extraction
Using opencv with detect multiscale, the elements from such an image are extracted, and the parameters must be specified with the proper values. On collected profile pictures, more than one classifier is used. With the use of modified XML of cascade classifiers, the picture changed Grayscale and HSV colour were substituted for RGB. A list of integers with a variety of values was created from the extracted features. The input is mapped using deep learning methods.

Comparing Templates
The similarity here between face vectors are compared. The matching attributes of the two pictures are used to calculate the level of similarity. The Python facepplib API package is used to compare the template files. It retrieves the face print from both the original criminal image and the suspect input image. Then, it generates criminal face prints and contrasts

Facepplib for python
Python is just a strong, well-documented language that can be used for a variety of purposes. Python is commonly utilized in computer vision technology due to its ease of usage. The Facepplib API makes template matching straightforward to do. The api key and secret key arguments are used to configure it. It provides a compare method that generates a list of every similarity between two templates. the level of certainty that is defined by how two features are separated. If the value of confidence exceeds the value of threshold, two images are deemed to be identical, and it is determined if the suspect is a missing or criminal. The relevant data relating to facial picture that can be located online is displayed.

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CONCLUSION AND FUTURE WORK

Given that this system was created with a very constrained amount of time and resources, much more testing and debugging will be required in the future. However, because it is open-source software, developers can simply improve the built-in functionality and add new features. In order to detect faces on lower quality photos, the system can also include picture processing that makes the input picture fewer fuzzy. In addition, system is capable to access to a database that stores the individual's personal information, enabling it to show that information whenever FRCI recognises a face. In these study, We analyse several picture formats, as well as the results' level of precision is quite satisfying It functions perfectly with both videos and images. 90% of the results was displayed As well as accurate. It works flawlessly both with clips and photos. 90% of the outcomes are visible. Using this, it is simple to identify offenders and locate missing children or other individuals, and it is dynamically updated. This analytics method makes use of criminal images that were discovered online and yields useful results. We believe that this technology will reduce crime in our neighbourhood. As part of this study, we are able to instantly identify and detect offenders' faces in a video stream received from a camera. A system of three databases makes The citizen database comes first, and it will include all of the residents' photos and unique identifiers. The second is the local watch list database, which includes at least ten pictures of each criminal residing in their country. The third will be an international watch lists databases, which are contain a minimum of ten photos and information about criminals who are not nationals of that country, comprising their name, gender, religion, and crimes undertaken. There are numerous face detection and identification functions in the open CV module. The technique for feature extraction that follows incorporates the Haar cascade. The characteristics of the real-time processed image are contrasted against those of processed imagery that have already been stored in Google Firebase. If a match is found, the features of pictures taken that are preserved in a local watch list of Amazon Fire Base are compared to it in order to determine if the individual is a criminal or not. To receive alerts and information, utilize an Android app f a match is discovered, the characteristics of photos collected and stored in a local watch list of Amazon Fire Base are compared to it to determine if the person is or is not a criminal Utilize an Android app to get notifications and information.

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RESEARCH ARTICLE

Traffic Crash Detection and Prediction in Intelligent Transport system using optimal hybrid deep learning Algorithms

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ABSTRACT

As motor vehicles are increasing in numbers of manufacturing due to the random increase of population the congestion of traffic is considered as a major issue faced in 21st century in many countries. Accidents are considered as a major issue for traffic congestion which cannot be solved casually, but it leads to waste of time by stucking behind the wheels. To overcome such issues, earlier detection of accidents is the only way to protect the lives by clearing the roads with less time and resources with higher efficiency. The proposed research paper is about traffic crash detection and prediction in intelligent transport system (ITS-TCDP) using optimal hybrid deep learning algorithms. In ITS-TCDP model, hybrid recurrent-deep neural network (RDNN) is combined with the swarm intelligent based optimization (SIO) algorithm for detect and prediction of traffic crashes. Here, we consider a fully connected RDNN and E-layers which helps to connect the local inputs with feed forward process by reducing the local short problems. The proposed research with hybrid model is the simple and enhanced fastest method to learn and measure the networks between the layers of output and hidden with one iteration. The different control metrics are used for this detection process are traffic factors, geometric designs, pavement factors, weather condition and accident data. The main objective of proposed ITS-TCDP model can significantly improve driver safety and driving experiences so that the driver can receive assistance or be warned of potential hazards. The proposed ITS-TCDP model implement in weka tool with the collective data which

is collected from the Knox County for validation of performance by accuracy detection and error rates of the models.

INTRODUCTION

According to the study of researchers, due to collisions in countries like India exceeds the individual accidents around 1,50,000 every year which is around 400 fatalities in a day that is comparatively higher by comparing with US, where the census taken in the year 2016. More than a million of vehicles is the reason for heavy traffic and the fundamental purposes behind fatalities from these mishaps is a deferral in announcing the mishaps to approach by crisis wellbeing focuses and delay in an emergency vehicle arriving at the mishap area. Such a deferral can be decreased if there is programmed identification and revealing of the mishaps to crisis help focuses [3].The expense of street mishaps can be exceptionally overwhelming weight to the legislature[4]. Street mishaps are a genuine danger to open transportation. Transport framework directors additionally need to take the requirements for street security measures and crusade to the individuals and furthermore take important activities to improve the street conditions decrease of street mishaps is just conceivable by instructing the drivers with viable traffic designing needs [5][6]. A programmed street sign location and acknowledgment framework depends on support vector machines (SVMs) for design acknowledgment and shape characterization [7]. A dream-based car crash recognition calculation is built up a framework for naturally identifying, recording, and announcing auto collisions at crossing points [8]. The proposed model will focused on the vehicles to capture the video in picture using high definition camera, tracks the motion of the vehicles and also concentrates highlights, for example, the variety pace of the speed, position, territory, and course of MVs. The dynamic visual model (DVM) is utilized to recognize basic movements of close by vehicles while driving on an expressway [9]. Two distinct plans utilized illuminate the deficiencies of every single past framework dependent on novel radar, the relationship of each reverberation to each target [10].

A dream-based vehicle discovery framework [11] is made out using the method called hypothesis generation (HG) and hypothesis verification (HV) to deal with vision-based vehicle recognition frameworks. A nitty gritty depiction of the best explores ever performed with a mishap notice framework explicitly contrived for parkway situations [12]. The nonintrusive and constant recognition of visual interruption depends on the vehicle elements information and without utilizing the eye-tracker information as contributions to classifiers [13]. A few profound learning or machine inclining systems [14]-[18] are utilized to show car crash information records can comprehend the qualities of drivers' conduct, roadway condition and climate condition that were causally associated with various damage seriousness. Hearty on-board vehicle acknowledgment [14] depends on monocular vision innovation utilizing layered AI and molecule channel to fabricate a multi-vehicle recognition and following framework. A nonintrusive looking at changed technique (for example ML calculations) [15] is utilized for a continuous framework to identify and order driver interruption utilizing just vehicle dynamic information as contributions to the model. The portion elements of SVM use the truth of vehicle information's to acquire the vehicle condition design [16]. Extraordinary learning machine (ELM) [17] is utilized to recognize the virtual streets and vehicles dependent on the inside parameters of dim worth and HOG feature. A semi-regulated learning model [18] depends on chart regularization is manufactured, and enhancement capacity of curved writing computer programs is developed by obliging the diagram consistency and the wellness of expectation name.

Related Works
Pashaei *et al.* [19] have proposed on-line sequential ELM (OSELM) and Kernel ELM (KELM). This outfit classifier joins the benefits of various ELMs utilizing a gating system and its precision is high while the preparing time is near constant. The various mixes of the conventional element extraction and highlight choice strategies and the different classifiers are inspected on two sorts of benchmarks including mishap pictures' informational index and some broad

informational indexes. This framework recognizes the mishaps with 99.31% accuracy, review and F-measure. Zhang *et al.* [20]designed DNN and LSTM to prepare and arranging the mishap related tweets. Not at all like classifiers, for example, strategic relapse, artificial neural network (ANN) with a solitary concealed layer, doesn't profound learning look for direct practical connections between the info highlights and the yield arrangement results. It is a lot of AI calculations that endeavor to learn in numerous levels, relating to various degrees of reflection. The preparation procedure of DNN is partitioned into different layers, and the yield result is communicated as a creation of layers, where the more elevated level highlights the piece of lower-level highlights. Xiao *et al.,* [21] have proposed a group learning strategy in rush hour gridlock episode recognition. It utilizes the individual SVM and KNN models initially, and afterward it takes one gathering learning technique to join them for better last yield. This technique is applied on another informational index once more, its exhibition isn't in every case great and got great execution on one informational index once. The exploratory outcomes show this strategy has accomplished the best execution among all the thought about techniques. Singh *et al.* [22] have proposed a system for programmed recognition of street mishaps in observation recordings. This structure consequently takes in highlight portrayal from the spatiotemporal volumes of crude pixel power rather than customary hand-made highlights. The structure extricates profound portrayal utilizing de-noising auto-encoders prepared over the ordinary traffic recordings. The plausibility of a mishap is resolved dependent on the remaking mistake and the probability of the profound portrayal. The profound portrayal with a solo model is prepared utilizing one class bolster vector machine. The convergence purposes of the vehicle's directions are utilized to lessen the bogus caution rate and increment the dependability of the general framework.

Aloqaily *et al.* [23] have introduced a computerized the securing of data for administering the data with vehicles of associated recognition system for security and gives administrations which meet clients QoS and QoE prerequisites. A Hybrid Intrusion Detection System dependent on observing utilizing the Deep Belief Network (DBN), in particular, D2H-IDS, to identify interruptions while checking frameworks is proposed and assessed. The D2H–IDS, utilizes the profound conviction organize (DBN) for dimensionality decrease and the ID3 based choice tree (DT) for assault arrangement. Dairi *et al.* [24] proposeda stereo vision based on the technique using distinguishing deterrents in urban condition. A deep stacked auto-encoders (DSA) techniques are joined with the covetous learning highlights with the dimensionality decrease limit with an unaided k-nearest neighbors (KNN) calculation to identify the nearness of hindrances. Abdi *et al.* [25] have proposed a framework for in-vehicle helpful driver to improve the driving security by joining the new worldview of committed remote correspondences. AR advancements and found learning-based machine vision for distinguishing and perceiving street hindrances types. The field of man-made brainpower and specifically profound learning has had the option to perceive items significantly quicker and with more exactness than people. This technique is utilized for confining articles in a picture; a solitary neural system predicts the locale of intrigue and class probabilities legitimately from full picture in one assessment. A solitary completely convolutional neural system used to distinguish protests under various scales with overwhelming impediment very precisely and effectively.

Jahangiri *et al.* [26] have developed an AI way to deal with recognize movement-based factors that can anticipate forceful driving for flat bend arrangement. The model is prepared utilizing the fundamental wellbeing message information from a genuine field associated vehicle study. The driver conducts in a sensible way utilizing the rising innovation of CV is an essential advance towards the improvement of countermeasures to build security on stunning streets. The main endeavors are utilized true CV information concentrating on driver conduct displaying on level bends. Jin *et al.* [27] have proposed eight worldwide fundamental visual highlights are extricated and five managed learning calculations are utilized to see multi-traffic street scene. This strategy concentrates shading highlights; surface highlights and limit include which are utilized to assess the picture quality. The removed highlights are increasingly thorough and ten classifications traffic scene picture is set apart as marks 1-10. The class name speaks to the entire picture, there is no compelling reason to stamp the particular region or key purpose of picture. Kim *et al.* [28] proposed a learning system which consolidates the CNN along with ELM models. The layers are embedded between the convolutional and layers of sub- sampling. The recently included layer in the last completely associated hubs of the CNN is streamlined by customary ELM calculations and other extra layers are refreshed by an adjusted

back engendering taking in rule got from the first ELM learning calculation. To distinguish paths proficiently while disregarding clamor and different hindrances dependent on the RANSAC calculation for straightforward street scenes and utilized an AI based strategy to progressively complex street scenes. The incredibly quick learning rate of ELM is decreasing the calculation time drastically and acquires execution.

Proposed Methodology And Model

Proposed methodology

Dong *et.al.,* [29] has proposed a model using deep learning for improving the complex interactions of roadways traffic and crashes. The proposed model includes two different modules as supervised and unsupervised which is used for feature learning method to identify the network functions of variables and representing the features called unsupervised module. The supervised learning model will tune the module for performing the prediction process of traffic crash with MVNB model with embedding by supervised learning method using regression layers. The execution results will help to identify the relative data about the variables and features of the data which will reduce the dimensions of input layer and preserves the host information using the proposed MVNB regression model. Detection of crashes in traffic is the challenging issues due to the intra class by truncation and viewpoints with various dimension and the major focus to the issue is causality and loss of participants. The proposed model will be executed with accurate prediction faster to support the real time road conditions with deep learning techniques using object detection techniques which is categorized as single and double stages. Detection of accidents in earlier will helps to save the lives and opens the road closures with less time. The research in existence as discussed in [15-20,29], will be more helpful to improve thetraffic crash detection and prevention using hybrid recurrent deep neural network (RDNN) and swarm intelligent based optimization (SIO) algorithm. The proposed hybrid model will work faster with great efficiency which will calculate the weights of output and hidden layers with one iteration. The different control metrics are used for this detection process are traffic factors, geometric designs, pavement factors, weather condition and accident data. The main objective of proposed ITS-TCDP model can significantly improve driver safety and driving experiences so that the driver can receive assistance or be warned of potential hazards.

System model

Based on real time crash data the framework has designed for prediction with two different parts as RDNN technique and optimization techniques. The classifiers are used to detect the conditions of normal traffic environment by increasing the sample of data to classify the design to improve the accuracy of identifying the prediction. The proposed work has some weights on network layer using RDNN and optimization techniques for better prediction.

IV. TRAFFIC CRASH PREDICTION AND DETECTION USING ITS-TCDP

E-Learner's classification Models using RDNN algorithm

The model which is unidirectional layer is known as recurrent deep neural network (RDNN) with some idle factors and interfaces which is subjective. The major issues are adaptability for different connections with layers and it will be tested randomly for better and fast connectivity. The model RDNN has the layers to choose the positions and when to insert the non- linearity layers by exchanging the centers around LSTM models with some additional non-linearity components. It helps to utilize the various layers and the model LSTM was not altered rather than it will be increased. This proposed model will have the straight forward layers where the information is significant with some different stacks.

Mathematical Dependencies

The mathematical dependencies are having some equations as $X_t \in R^{nxd}$ with n as total number of inputs with some hidden layer **1 (1 = 1,…..T) is** H_t $R^{n \times d}$ with its respective outputs and hidden layers for activation functions f_1 for first layer. We enhance the hidden layer 1 before using X_t as input data and remaining subsequent layers with hidden layers are used by its own place where it is located.

$H_t^1 = f_1$ (Xt, H_t^1)   (1)

Finally, execution of the output layer with hidden layer of L with the functions of g address as mentioned below,

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$O_t = g(H_t^1)$ (2)

Similarly, observations of multilayer quantity with layers L and hyper parameters of H. Model has actualized by the LSTM layer using DRNN with standard class with neural network system which has best feed forward network system. The feed forward neural system is the process of RNN for contributing the intermittent progress in advance. The information is calculated as X = (X_1, X_2,….., X_T) and concealed by formula mentioned below,

$$ht = \begin{cases} 0, & if\ t = 0 \\ \varphi(ht-1, x1), & otherwise \end{cases}$$ (3)

where φ is a nonlinear capacity. Alternatively, recurrent neural network may have a yield for updating the standards of model with some mathematical model as below,

$h_1 = \phi\ (Wx_1 + Uh_{t-1})$ (4)

Were,

W and U denoted as coefficient of grids.

Also, let we consider the values of $P(X_1, X_2, X_3, ……, X_t)$ be the grouping likelihood, which can be calculated as,

$P\ (x1, x2,……,xt) = P(x_1)….P(x_T, x_1,…..x_{t-1})$ (5)

$P(x_T, x_1,…..x_{t-1}) = \phi(h_1)$ (6)

Where h_t is acquired from (5) and (6). Our inspiration in this paper is clear here: the pixel which goes beyond the consecutive information was created with a vector of elements and the system is embraced to display the group of layers as family. The deep recurrent neural network has executed the results using artificial intelligence and computer vision assignments. It has prepared by DRNN model to handle all the data with different angles to point out the issue with normal methodology in refined unit. The layers are appeared by computing with weighted sources of nonlinear capacities with LSTM layers makes the cells for storing memory by the equation as below,

$$h_t = o_t \tanh(c_t)$$ (7)

where tanh(·) is the hyperbolic tangent function and O_t is the output gate that determines the part of the memory content that will be exposed.

Network weight calculation from RDNN using SIO

Minimization problems in global with the constrains of bound are considered as follows,

$$\min_{x \in \prod_{a=1}^{i}[x_a, y_a]} f(x)$$ (13)

These issues are solved by enhanced intelligence algorithm with framework as follows,

Algorithms

Step 1: Model initialized
Random population with S is generated automatically. Minimum and maximum function values are expressed as f_{max} and $f_{min.}$
Step 2: Bound mutation is formed
Integers are generated randomly using values [1, n]
For….. end
Step 3: Cross- over of three points
Compute the values,
For I = 1 along with N parameters.
End
Step 4: Selection of data
Step 5: Terminate the conditions. Best results are executed as optimization results. Orelse repeat from step 1.

The mutation of bound helps to increase the global search capacity and selection of data about the parameters are used for solving the certain issues.

RESULT AND DISCUSSION

As discussed in the methodology, analyses were made of the crash and speed data to include model evaluations of case vs. control hour speed metrics as well as sensitivity analyses of the resulting models, correlations between explanatory variables, and speed variations by time-of-day and day-of-year vs. crash count. The results of these analyses are presented in the following sections.

Experimental design of proposed method and preparation of data
The data about the traffic was collected for each and every 20 seconds and the size of data may be reached 1287mb and it will be utilized for performing various experiments. The sample data are considered as source data which includes null string and outliers on 20 second datasets which need no cleaning process. The unknown detectors are deleted and the data which is not reasonable and thresholded was deleted. The average speed of vehicle and total speed of the vehicle with volume and standard deviations are calculated at 6min interval with variables to analyse the risk model with 90 different total variables.

Control Metrics
The dataset collected from the real crash data which is separated and tested with values of 4:1 and the models are trained based on the training data by applying different samples for training and testing. It helps to reduce the bias weight which is associated with separation of datasets randomly with five different classification tasks by displaying the accuracy of prediction through the model performance. The accuracy of classification was calculated into 10 estimates along with standard deviation for better analysis. The hybrid learning algorithms are used through the data mining tool known as WEKA for executing the better prediction which is calculated by the following formula,

$$Accuracy_j = \frac{CP_j}{N_j}$$

Where CPj denoted as prediction of injured severely,

J & N_j denoted as observation of injured from the datasets, where the overall accuracy of prediction is calculated by the below mentioned formula,

$$Accuracy_{overall} = \sum_{j=1}^{J} Accuracy_j . \frac{N_j}{N}$$

Where,
J denoted as severe injured category
N denoted as number of observations.
The machine learning models helps to determine the parameters to achieve the prediction using ITC and TCDP models for hybrid recurrent deep neural network model using parameters (C, γ). By implementing the algorithms with values C as 1000 and γ as 0.9 using RDNN to predict the K values with good execution results are predicted. There are 20 samples were trained and tested to predict the better accuracy for severe crash injured data by assuming the values for K as 13 finally as proposed research. The proposed model will need to predict the total number of trees which grow along with variables and it will be splitted between the accuracy of prediction and time taken for computation. The proposed research was set to be 500 as dependent variable and 5 as independent variables which is usually considered for reducing the type of risk with some extract process by fixing the minimum value to predict the injury severity in tested data. The variables are kept in the form of layered model with some estimated coefficient and it will analyse the best statistical fits for predicted one model.

Mean Absolute Error
Mean Absolute Error (MAE) will measure the error magnitude from collected data and the accuracies are measured for variable continuous. The verification of data values is different between the observation of data and the linear score are individual with weight which is average in value equally.

RMSE deviations

Root Mean Square Error (RMSE) is a rule to measure the values of magnitude about the errors and the observed values are squared with sample data. The value finally executed is taken as RMSE value with it weight for larger errors, also the combination of MAE and RMSE are joined together to diagnose the error variations from the data values which is larger to MAE always with greater variance difference from the sample data. If the RMSE is equal to MAE then the errors magnitude is same and it will be range from 0 to infinity.

CONCLUSION

The proposed model will be used for detection and prediction of crash using smart and intelligent transport system (ITS-TCDP) using optimal hybrid deep learning algorithms. To identify traffic conditions leading to traffic accidents more likely by using the RDNN and SIO method while controlling the traffic factors, pavement factors, geometry, weather condition and accident data etc. Data used in this research was collected from the knox country. The collected data from freeway areas the proposed model is developed and processed to predict the injury severity of every crash happened. The prediction of each and every model using training data set and testing data set is calculated by comparing the existing research. The proposed research is implemented with optimal hybrid deep learning models to execute the higher prediction model with some statistical calculations using RDNN with SIO for better model prediction with higher accuracy.

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Table 1: Shows about datasets and its accuracy

Right classification of instances	96	98%
Wrong classification of instances	4	4%
MAE	0.072	
RMSE	0.1833	
RAE	-	31.80%
RRSE	-	56.30%
Instances in total	100	100%

Table 2: Comparison of prediction values for proposed and previous traffic crash detection.

	Minor injury	No injury	Major injury	Total
Observed mean value	0.446	1.230	0.098	1.774
Proposed model				
Estimated mean	0.120	1.371	0.120	2.163
RMSD (%)	0.067	0.052	0.021	0.124
MAE	20.106	15.060	10.001	16.102
MVNB model				
Estimated mean	0.573	1.335	0.110	2.019

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RMSD (%)	0.080	0.071	0.030	0.150
MAE	29.961	27.206	17.298	43.652
DL without regression Calculated mean value RMSD (%) MAE	0.556 0.202 51.741	1.332 0.405 65.086	0.101 0.043 20.620	1.989 0.520 82.862
SVM model Estimated mean RMSD (%) MAE	0.513 0.257 61.350	1.329 0.471 72.416	0.101 0.055 26.022	1.943 0.660 96.636

Figure.1:Traffic crash detection and prediction using proposed ITS-TCDP model	Figure.2: RDNN deign formulation

RESEARCH ARTICLE
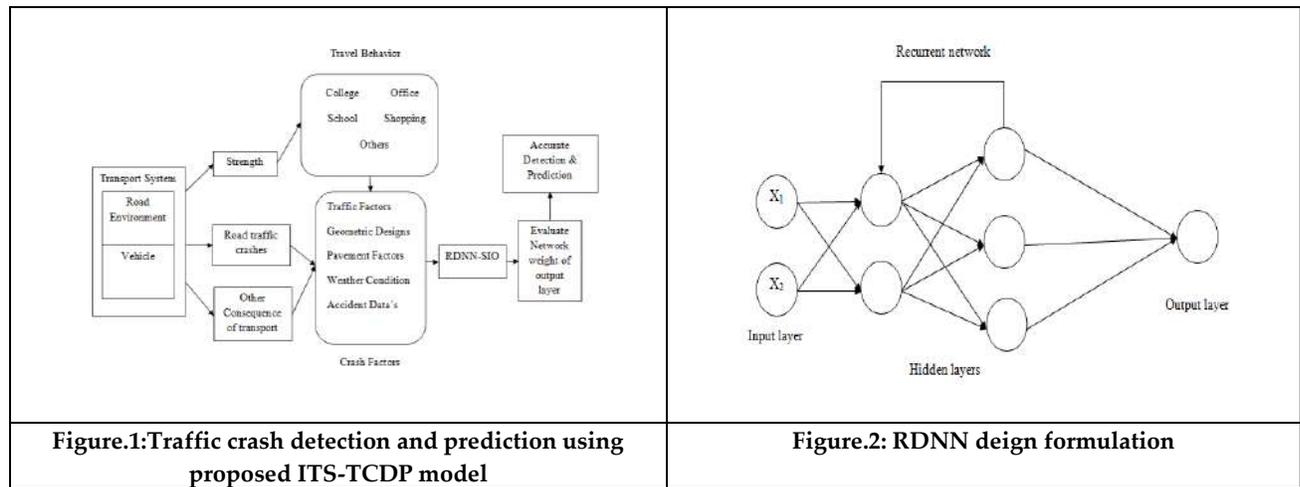
Human Emotion Detection Through Face, Speech and text using Machine Learning Techniques

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ABSTRACT

Emotion is an inherent and natural feeling that is very well differentiated from rational and intelligent. Emotions strongly depends on the circumstances and situations. It can be recognized from the facial features and expressions, words and speech articulated by an individual or through text that a person share via social media, personal messages etc. Emotion detection techniques extracts the captured information and examines the data to recognise the emotions. This research paper proposes a combined system that recognises emotions (i) from facial expression observed from a live video or recorded images, (ii) from speech modulation extraction (iii) from text mining using Natural Language processing classification algorithms. MFCC technique has been applied to extract the signals from the audio signals and Support vector is used as classifier for both image and speech detections. Emotion detection from the combination of image-video, speech and text can be applied in crucial and sensible domains like analysing the psychology of convicts, patients who needs intensive care and persons in stress. This proposed system is implemented using python OpenCV libraries and Text2Emotion package.

Keywords: MFCC, Support Vector Machine, OpenCv, Text2Emotion, Natural Language Processing.

INTRODUCTION

Significance Of Emotion Detection

Human emotions plays a vital role in day-to-day life of an individual that affects every aspects of the normal life. Positive emotions instigate happiness and joy, negative emotions brings adversity. Being it in the family, society or at the work place negative emotions spreads easily that increases the depression. The long-term depression leads to tragedies in society and reduces the productivity in industries. Human nature and the behaviour can be identified from the emotional expressions. The information collected from the emotional expressions helps the appropriate authorities to avert major misadventures like suicide, provides additional care to the chronic illness patients and even thwart major accidents due to depression. All the human expressions can be classified majorly into 6 types

surprise, happiness, sadness, anger, fear, pain and neutral. The emotions can be classified from the recorded information using acquired emotional factors and accurate emotions are extracted for further actions. Emotion detection technology are widely applied in cross multi domains for various aspects of day-to-day life. Emotions recognition system covers areas such as facial recognition, unmanned self-driven vehicles, remote body vital detections, human-machine interactions and intelligent detection as well. Many combinational algorithms that combines predictive and classification algorithms are emerging in this domain of gesture analysis. Emotions are expressed in speech form or through body gestures as a mode of communication. The state of mind is highly subjective depending on the environment and the compelling situation. Emotions can be extracted from the live or recorded images or video stream along with the audio, but it needs a very comprehensive knowledge base. Emotions can also be captured from text like social media tagging, abusive words and depressing statements. Principal component analysis (PCA) is a highly commanding technique used to analyse larger datasets with multidimensional features. Since the proposed system trains images, audio and text datasets, implementation of PCA is inevitable to predict the accurate output. Support vector Machines are used to optimize and classify the captures images/video and text that can capture least possible margin separation between the classes. This paper proposes a comprehensive system that can identify the emotions from images/video, text and audio. The delicate meaning of each word uttered and text written are classified, images captures are preprocessed and filtered to extract the specific emotion. This proposed work uses SVM classification algorithm for image and text processing, MFCC for audio classification to convert and extract the emotions. The model training uses MELD dataset for text classification, MINERVA for image and Kaggle datasets for audio classification.

Literature Study

Chun –Chieh *et al* [1] has proposed a method to find out the number of occurrences of the words that has specific meaning considered as keywords, extracting them as substrings from the text string. The algorithm deals with the context related to the keywords that are predefined as grammar. Sheetal Kusal *et al* [2] has presented as novel method to detect emotions from social media big data application domains that includes reviews, forum discussion and chat communications. The sentimental text classification provided the outcome of the emotions that has been given through the text and emoji messages through deep learning techniques. Shrivastava, K.; Kumar, S [3] has proposed a CNN algorithm that detected emotions through sequence based word embedding method. Feature classification extraction has been proposed to understand the annotations. Udochukwu *et al*. [4] proposed rule-based pipeline method that can assist to recognize the emotions from the text. The authors have implemented OCC hierarchical model to classify the emotions with respect to events. Francisca Adoma [5] has conducted reviews and has shared the highlights of emotion detection from text. The authors have elaborated the recent development in this domain and has thrown light on the available data set for machine learning algorithm training. Canales L *et al* [6] has collected the details about the research work that has been carried out using ontology in machine learning. Anagha Sonawane *et al* [7] has proposed a method to extract the emotions from speech using Mel Frequency cepstrum coefficient for feature extraction and SVM for classification of the features. Zhu Jinnuo *et al* [8] has proposed an experimental analysis of implementing different algorithms with various parameters and samples to observe the emotion detection rate, A comparative study has been done and the results are compared and analysed.

Architectural Diagram

The proposed system is a novel method that detects the emotions from multiple sources likely images or running live videos, recorded audios or live sounds and text. The implementation is done through Python and relevant packages. The basic work flow diagram of the complete implementation is shown in Figure 1. The imported data are classified as image, text or sound. Data cleaning process is followed by the preprocessing and feature extraction methods. According to the type of data that is collected appropriate feature extraction techniques are applied to the data. Mel frequency co-efficient technique is applied for the feature extraction in sound and tokenization is done as a part of feature extraction for text. Support Vector Machine (SVM) classification algorithm is utilized for sound and image extraction. Text Ontology is used for paraphrasing and word meaning match in the proposed system. The combined feature extraction is again treated with K-Nearest Neighbour (K-NN) algorithm to measure the similarities in the data that has been extracted as features. The dominating or the major similarity emotion is recognised and

detected as the overall emotion from image, text and sound data. Figure 2 depicts the overall architecture of Human Detection from different data sets or data sources.

Emotion Detection Through Speech Recognition

Recognizing the emotions from speech depends on the long and short term features like pitch and the rate at which the speech has been delivered. The detection system needs rigorous analysis of databases, classifying the features and extracting the relevant structures from the auditory signals [9] that can be considered as the necessary indications for a specific emotion. This proposed work use MFCC coefficients to extract the features and SVM for classification. The open source python library – pyAudioAnalysis is used to extract the audio parameters. The proposed work proceeds with the following steps to detect the emotions from speech or audio.

Stage 1: convert the obtained raw audio into signal to extract the features

Stage 2: Extracted features are pre-processed that satisfies the constraints, frequency, amplitude, pitch, pulse and harmonics. The relative loudness (decibel) of sound is measured as shown in table 1.1

Stage 3: Training and classifying the selected features by applying the pre-processed data to the statistical feature. MFCC, coefficients are the highly effective to extract the features from audio that uses vocal tract filters. This signal is trained as model that can calculate the spectral from an audio segment. From each frame the pitch and MFCC are extracted that resembles articulated voice from the trained data sets. Figure 3 and Figure 4 illustrates the sound feature extractions.

Stage 4: Detect the precise emotion.

Emotion Detection Through Text Classification

The emotion can be detected, based on the text that is shared as a typed notes or from the social media forum. The Kaggle data set has been taken as the initial dataset for this text summarization phase. The first phase is making the text appropriate for processing by any machine learning or deep learning algorithm is the goal of text pre-processing processes after data production. Tokenization, text cleaning, normalisation, and the creation of feature vectors and embedded features are all components of text preprocessing. Text preprocessing is done by prospering technique followed by augmentation and Tokenization. The feature vectors are given as inputs to the text ontology algorithm to train the system. The trained models classify and predict the emotions of the text labels.

Emotion Detection Through Image Recognition

Before classifying an expression as a particular emotion, every emotion recognition system must go through a few steps. This work consists of four steps for recognizing emotion as Image pre-processing, extracting the feature, selecting the feature and as the final step recognizing the expression.

Process 1: Image/ video stream Pre-processing

By using two techniques—clipping the photos and then performing histogram equalization to remove fluctuations in illumination and skin colors—normalization must be carried out based on the alignment results in order to make the images more compared with reduced size.

Process 2: Extracting the feature

For edge detection in a picture, the Prewitt operator is utilized. Both sorts of edges are picked up by the Prewitt operator: horizontal edges (along the x-axis) and vertical edges (along the y-axis).

Process 3: Selecting the feature

After performing feature selection, we employ the Sequential Forward Selection (SFS) approach to minimise the dimensionality of the features before to classification [10].

Process 4: Recognizing the expression. In order to categorise and test the input facial expressions into one of the six types of expression, SVM was employed as the system's last step [11].

Proposed system

Emotion detection through the combined feature extractions from images/videos, sound and text messages. The following algorithm has been implemented in python using the libraries and packages, openCV , TextToEmotions,

Python Audio Analysis to detect and analyse the emotions from Human Facial Expressions, Contextual Analysis Through Text And Audio as shown in Figure 5.

Step 1: Fetch input from the knowledge base

Step 2: Select the input type to process: Text, image and audio

Step 3: If the selected input is text go to Step 4

Step 4: Text Preprocessing

Step 4.1: Apply propering mechanism to the selected text

Step 4.2: Removal of punctuations, digits and special symbols

Step 4.3: Text Augmentation

Step 4.4: Tokenization

Step 4.5: Text Ontology

Step 4.6: Emotion Detected

Step 4.7: Go to Step 3

Step 5: Image Preprocessing and Filtering

Step 5.1: Detect ROI

Step 5.2: Track ROI

Step 5.3: Digital Signal extraction and Face emotion extraction using SVM

Step 5.4: Go to Step 3

Step 6: Sound Feature extraction

Step 6.1: Noise removal and windowing

Step 6.2: Perform Mel Frequency warping

Step 6.3: MFCC feature extraction

Step 6.4: Sound extracted and emotion detected

Step 7: Extracted outputs from the selected inputs are stored in knowledge base as trained set

Step 8: Reclassification is performed using KNN classifier

Step 9: Appropriate emotion is detected

CONCLUSION AND FUTURE ENHANCEMENT

A combined emotion recognition method based on human facial expression, audio and text using MFCC and SVM as a classifier was approached and implemented using Python. The proposed system is a novel method to have a combined data set for image, text and audio. Optimization algorithm can be applied to this machine learning model to fine-tune the collected data such as sharpness for both image and audio data, clarity in hand written text. This model can be extended as a hand-held device application with more user friendly features that can assist the humans in identifying the thought process of the suspected convicts, palliative care patients and individuals who needs psychiatric care and treatment.

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Table 1: Indicating sounds and predictable emotions

Decibel	Sound	Emotion
10-30	Mostly Inaudible	Pain
60-80	Audible/Irritating/Unpleasant	Fear
80-95	Loud/Extremely Unpleasant/Noisy	Anger
90-100	Extremely Unpleasant	Sad
105-110	Loud/Extremely Loud	Happy/Pain

Figure: 1 Work Flow Diagram	**Figure: 2 Architectural Diagram - Human Emotion Detection through Face**

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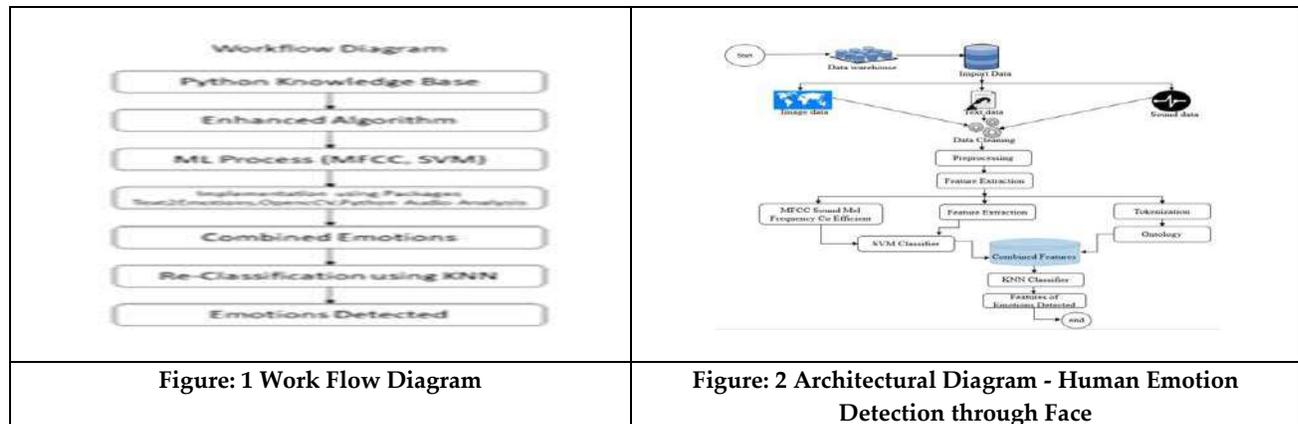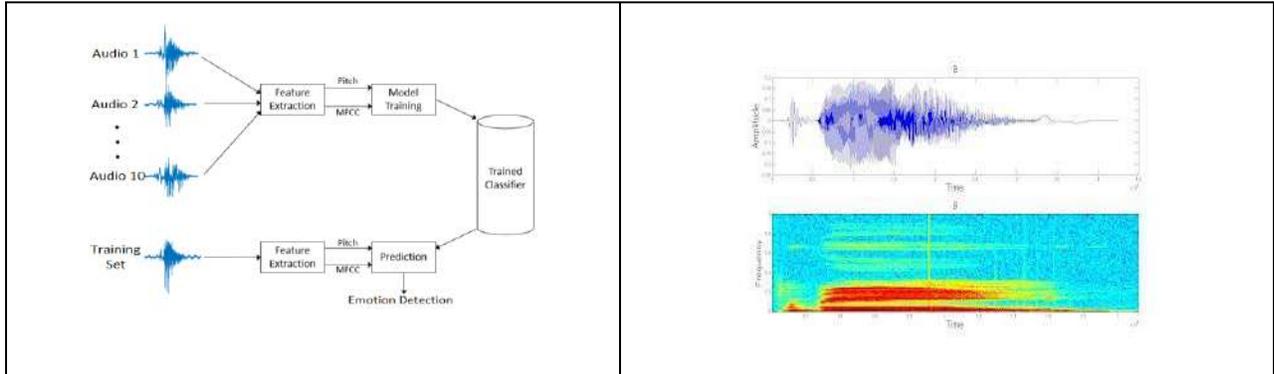
Figure: 3 Feature Extraction-Sound

Figure: 4 Feature Extraction-MFCC graph
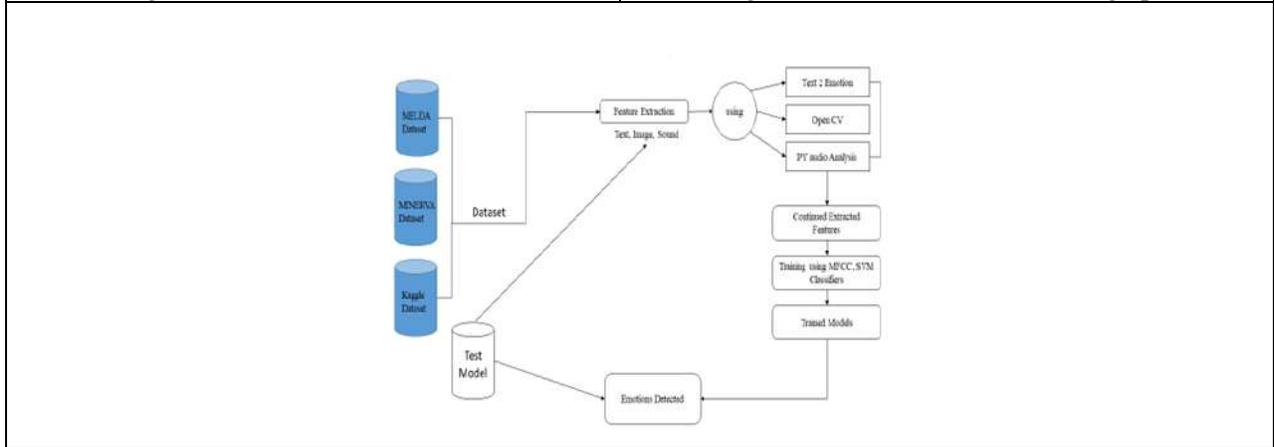
Figure: 5 Emotion Detection Model

RESEARCH ARTICLE

Lulu Smoothened Okamoto–Uchiyama Cryptosystem for Secured Medical Chest Image Transmission

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ABSTRACT

Medical images play an essential part in the medicine field for patient diagnosis at an earlier stage. Hospitals use a large amount of digital medical images for different diagnostic plans. Many researchers introduced different approaches like encryption and visual cryptography to preserve the images against unauthorized access. Image encryption is an efficient technique used for protecting private images during communication. Except, no improvement and no reduced time complexity by existing cryptographic methods on the peak signal-to-noise ratio (PSNR). To address these problems, Lulu Okamoto–Uchiyama Cryptographic Secured Medical Image Transmission (LOUCSMIT) Method is introduced. LOUCSMIT Method comprised three steps, namely pre-processing, encryption, and decryption for performing secured image transmission. Lulu smoothened filter helps medical images denoising. For medical image encryption, Okamoto-Uchiyama Cryptosystem is used. On the sender's side, the encryption process is performed. When the encryption process is performed, input medical images convert the images into unreadable form. The medical image is transmitted to the communication channel. Finally, the decryption is performed to increase the data confidentiality rate. Experimental evaluation is carried out using Chest X-ray medical images considering different factors like PSNR, time to encrypt, and data confidentiality rate (DCR). The discussed results are the evidence for mentioning LOUCSMIT Method high efficiency with respect to attaining the higher PSNR and DCR with lesser encryption time.

Keywords: Encryption, decryption, data confidentiality, Okamoto–Uchiyama Cryptosystem, Lulu smoothened filter

INTRODUCTION

Image encryption is an essential technology for providing image information security. A secure and fast image encryption algorithm was introduced in [1] to preserve image data privacy. But, PSNR was not improved by the designed algorithm. Deep-Network Coding (NC) was designed in [2] for image communication. However, the encryption time was not minimized by the designed protocol. A new image encryption algorithm was designed in [3] depending on the hyper-chaotic systems. However, the data integrity rate was not improved by the image encryption algorithm. An effective chaos-based encryption algorithm was introduced in [4] for efficient image transmission. But, the encryption time was not reduced by the designed algorithm. An enhanced secure image chaotic cryptosystem was introduced in [5] depending on the hybrid CMT-Lanczos algorithm. Though the time complexity was reduced, the data confidentiality was not improved by the designed cryptosystem. A hybrid security model was designed in [6] for securing the diagnostic text data in the medical images. Except, the improvement in the data integrity rate was not acquired inthe designed model. The conceptual scheme introduced in [7] for encryption and decryption of grayscale and color images was entirely new. Except, the encryption time reduction was not acquired by the designed scheme. In [8], for increasing the privacy-preserving process of medical images a new method was introduced. In [9], for image encryption and compression, a technique called Adaptive sigma filterized synorr certificate less signcryptive Levenshtein entropy coding-based deep neural learning (ASFSCSLEC-DNL) was introduced. In [10]a new quantum selective encryption method was introduced for medical images. Region of Interest (ROI) was an essential one with medical images protected during secured transmission. But, the complexity level was not reduced by the designed method.

The issues identified from the above literature are higher complexity, lesser data confidentiality rate, lesser data integrity level, higher encryption time, higher computational cost, lesser peak signal-to-noise ratio, and so on. To address the above-mentioned issues, this paper introduces Lulu Okamoto–Uchiyama Cryptographic Secured Medical Image Transmission (LOUCSMIT) Method. The LOUCSMIT Method will perform secured image transmission with highest peak signal-to-noise ratio with in less encryption time. LOUCSMIT Method performs three processes, namely pre-processing, encryption, and decryption for secured image transmission. Pre-processing is carried out on medical images to remove the noisy pixels from the input medical images. The encryption is carried out on the sender's side. The input medical images are converting the images into unreadable form at encryption. After the medical images are encrypted to unreadable form, the transferring to the communication channel happens. In the end, the decryption happens on the receiver side to raise the data confidentiality rate. There are six different sections available in the rest of the article: Section 2 covers the related work reviews of secured image transmission methods. Section 3 covers a brief description of the LOUCSMIT proposed method in detail. Section 4 covers the experimental setup using the dataset of chest images. Section 5 covers the experiments with the help of tables and graphs. Section 6 concludes the paper.

Related Works

A new enhanced quantum representation (NEQR) model was introduced in [11] with a quantum computers with encryption quantum circuits. A two-way image transmission was carried out in [12] with the Corvus Coron module. Though the computational time was reduced, the data confidentiality rate was not improved. In [13], An Elliptic Curve based key selection along with Hill Cipher based encryption scheme was designed. But, no improvement on the PSNR in the designed scheme. A chaos-based image cryptosystem was introduced in [14] with a spatial domain for secure image transmission in networks. However, the peak signal-to-noise ratio was not improved by the designed cryptosystem. Caesar Cipher Algorithm (CCA) was introduced in [15] with the lightweight encryption algorithm (LEA) and RSSI in an IoT environment. But, the data confidentiality rate was not improved by CCA. An improved seven-dimensional hyperchaotic system (i7DHS) was introduced in [16] to create the secret keys. But, the complexity level was not reduced by the designed system. In [17], A new encryption algorithm depends on the hyperchaotic system was introduced with quadratic non-linearity. A four-dimensional hyperchaotic system was introduced in [18] with dynamic behavior. However, the encryption time was not reduced by the designed system. A

multi-image encryption scheme was designed in [19] depending on a fractional-order hyperchaotic system. In [20], an image encryption scheme that depends on Lorenz hyperchaotic system along with Rivest–Shamir–Adleman (RSA) algorithm was introduced. An initial value of the Lorenz hyperchaotic system was generated by the RSA algorithm.

METHODOLOGY

Image encryption converts the original image to an additional form. Encryption encodes the plain message into a cipher message. Image encryption and decryption is an important research area due to the increasing demand for information security. Many encryptions and decryption methods are introduced for secured and efficient image communication. Except, no improvement in the data confidentiality rate along with the data integrity rate. To address these problems, Lulu Okamoto–Uchiyama Cryptographic Secured Medical Image Transmission (LOUCSMIT) Method is introduced. LOUCTSMIT method performs medical image encryption to develop storage capacity for secured transmission. The main aim of the LOUCSMIT Method is to improve the secured medical image transmission performance with higher data confidentiality and with minimal time consumption. The LOUCSMIT Method structural diagram is described in figure 1.Figure 1 clarifies LOUCSMIT Method structural diagram with two processes, namely pre-processing and encryption before the transmission process. Medical image pre-processing helps to reduce the noisy pixel from the input medical image. The encryption process is carried out on the sender side. During the encryption process, the input medical images are in the form of converting the images into unreadable form. After that, the medical image is sent to the communication channel. Finally, the decryption is performed to increase the data confidentiality rate.

Lulu Okamoto–Uchiyama Cryptographic Secured Medical Image Transmission
Medical data transmission has become a daily practice with the development of remote digital healthcare based IoT technology. Information security is an incomplete one without cryptography. Cryptography is the process of encrypting and decrypting data. The data is converted into unreadable form and then encrypted data is sent for performing secured transmission in cloud. In LOUCSMIT Method, the input medical images '$MI_1, MI_2, MI_3 \ldots . MI_n$' are gathered from the input database. Then, to increase the image contrast and to remove the unwanted pixels, image pre-processing is performed. The medical images are influenced through different redundant noises caused by varying performance of environmental events. Preprocessing is an important task to eliminate the unwanted components for improving the encryption performance. The LOUCTSMIT Method uses the lulu smoothing filter to minimize the noise in the medical image. Lulu smoothing is a nonlinear mathematical technique for removing the noise from the input image. The pixels in an input medical image are denoted as'$v_1, v_2, v_3, \ldots v_m$'. These pixels are arranged like window with different sizes are placed in the adaptive kernel. In figure 2, the lulu-smoothing filter based block diagram of image denoising are shown. The input medical image is initially decomposed in two segments, namely horizontal and vertical. In LOUCSMIT Method, medical image employs Lulu smoother with repeated applications of min and max operators. In lulu smoother, width is to be denoted. Lulu smoothers include the repeated applications of lower (L) and upper (U) operators. The center pixel value is denoted as '$cp_{i,j}$'. The near by pixels are arranged in form of matrix, using 'i^{th} row and 'j^{th}' column. The center value is selected. The deviation 'd_{ij}' is defined as weighted sum between center pixels '$cp_{i,j}$' and neighboring pixels 'cp_n'.

$d_{ij} = \sum |cp_{i,j} - cp_n|$ (1)

The pixels deviate from center value are called as the noisy pixels.

Okamoto–Uchiyama Image Cryptosystem
After performing the image denosing process, to improve the image transmission security the input medical images are encrypted. The LOUCSMIT Method engages the Okamoto–Uchiyama cryptosystem to perform encryption on the medical image. Okamoto–Uchiyama cryptosystem is a public-key cryptography that generates the keys for performing encryption process. In key generation process, the key pairs are generated for the encryption to improve image transmission security over insecure communication channel. The private key and public key are created in the

cryptosystem, public key is referred as the session key which is used in the precise time instance. The security parameter in the setup phase will give back the global system parameters *(GSP)* along with the session key '(SK)', image space '(d)' and cipher image space '(c)'. This is represented as.

$$GSP \rightarrow \langle SK, d, c \rangle \qquad (2)$$

After that certificateless public key is sent by collecting the partial private key. An entity in certificateless environment offers the identity ('id') and secret key ('sk'). After that, the partial private key ('PPK') is attained as,

$$PPK \rightarrow \langle id, d, c \rangle \quad (3)$$

From (3), the user identity used the arbitrary value as '0' and '1'. When user identity is '1', then partial private key is obtained. When user identity is '0', it is considered as the illegal users. The creation of partial private key after getting full private key with created user secret value (usv).

The full private key 'FPK' is given as,

$$FPK \rightarrow \langle usv, PPK \rangle \qquad (4)$$

The encryption process is executed with the public and full private key immediately after the full private key generation process finishes. Encryption process hides the image and it gets accessed by authorized entity. The cipher image '$cipher(MI)$' is denoted as, $cipher(MI) \leftarrow en \langle k_s, MI \rangle$ (5)

From (5), 'en' shows the encryption with receivers public key. Then, encrypted image is sent to the communication channel. The secured transmission is completed after the receiver would not do the decryption. Lastly, the authorized receiver in LOUCSMIT Method decrypts the original image. It is followed as,

$$Plain\ (MI) \leftarrow de \langle FPK, cipher(MI) \rangle \quad (6)$$

From (6), '$Plain\ (MI)$' symbolizes the plain medical image, 'de' denotes the decryption, 'FPK' represents the full private key of receiver. '$cipher(MI)$' symbolizes the cipher image. Finally, the secured data communication is carried out in accurate manner with higher data confidentiality rate. The algorithmic process of Lulu Okamoto–Uchiyama Cryptographic Secured Medical Image Transmission is given as,

Algorithm 1: Lulu Okamoto–Uchiyama Cryptographic Secured Medical Image Transmission
Input: Medical Image Database '$MI_1, MI_2, MI_3 \dots MI_n$'

1.   **Begin**
   2.   Number of medical images is considered as input
 	
// **Lulu Smoothing Filter based Image Denoising**
   3.   **For each** medical image 'MI'
   4.   Decompose the image into horizontal and vertical segments
   5.   Arrange the pixels
   6.   Find center pixels
   7.   Remove noise pixels
   8.   Obtain denoised image
   9.   **end for**
 	
// **Image encryption & decryption**
  10.   **For each** preprocessed image 'MI'
  11. Set global parameters
  12. Generate session key
  13.   Extract partial private key
  14.   Construct full private key
  15.   Encrypt medical image using public key at the sender side
  16.   Perform secured data transmission to the receiver
  17. Decrypt medical image using private key at the receiver side
  18. End for
  19. End

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Algorithm 1 given above shows the algorithmic description of the lulu okamoto–uchiyama cryptographic secured medical image transmission concept with three steps. At first, the input image is considered as input where the preprocessing is performed using the lulu smoothening filter. After that, the encryption is done by the means of the Lulu Okamoto–Uchiyama Cryptosystem. After that, the encrypted image is transmitted to the receiver side. Finally, the decryption process is done at the receiver side. This enhances the secured medical image transmission performance with higher confidentiality rate.

Experimental Evaluation
In the section, experimental evaluation of LOUCSMIT Method and the two existing methods namely secure and fast image encryption algorithm [1] and Deep-Network Coding (NC) [2] are carried out using MATLAB coding with Chest X-Ray Images Database. The Chest X-Ray images are collected from the https://www.kaggle.com/paultimothymooney/chest-xray-pneumonia. The image database comprises the 5863 Chest X-Ray images collected from the patients. For experimental consideration, different sizes of 10 images are used.

RESULT AND DISCUSSION

In this section, the performance of the LOUCSMIT Method and the existing related approaches called secure and fast image encryption algorithm [1] and Deep-Network Coding (NC) [2] are discussed with three metrics, PSNR, encryption time and data confidentiality rate. The description of the metrics is given below,

5.1 Impact on PSNR
PSNR is the first parameter used to determine the denoising capacity. Consequently, the ratio is formulated as,

$$PSNR = 10 \, log10 \left(\frac{L^2}{MSE} \right) \quad (7)$$

From (7), 'L' represents the maximum possible pixel value (255).'MSE'shows the mean square error. The calculation is done as,

$$MSE = [denoised \, MI - \, original \, MI] \quad (8)$$

From (8),'$denoised \, MI$ denotes the denoised image and '$original \, MI$' denotes the original size of input medical images. PSNR is measured in terms of decibel (dB).

Table 1 describes the experimental results of PSNR along with different medical image size in the range 250 to 400KB from the dataset. The obtained results of PSNR using LOUCSMIT Method are compared to the two existing classification techniques namely secure and fast image encryption algorithm [1] and Deep-Network Coding (NC) [2]. According to the attained results, the presented LOUCSMIT Method efficiently achieves higher PSNR than different cryptographic schemes. Let us consider that medical image is 312 KB for conducting the experiments. By applying the LOUCSMIT Method, the observed PSNR is 43.03dB whereas the PSNR of existing [1] and [2] are 36.31dB and 39.19dB respectively. Subsequently, various PSNR results are observed for every cryptographic method. The PSNR performance of proposed LOUCSMIT Method is evaluated with other existing cryptographic methods as described in figure 3.

Figure 3 describes the performance analysis of PSNR for different medical image size. Medical image size is considered in the horizontal direction and the PSNR is observed in the vertical axis. The yellow color bar symbolizes the PSNR of LOUCSMIT Method whereas blue color and red color denotes the PSNR of secure and fast image encryption algorithm [1] and Deep-Network Coding (NC) [2]. As illustrated in the graphical chart, the PSNR of the proposed LOUCSMIT Method is higher than other conventional methods. The reason for this enhancement is to apply the lulu smoothening filter for image denoising. Lulu smoothening filter removes the noisy pixels from input image for future processing. By this way, an efficient PSNR performance gets improved. As a result, proposed

LOUCSMIT Method increases the PSNR by 28% when compared to secure and fast image encryption algorithm [1] and 15% when compared to Deep-Network Coding (NC) [2] respectively.

5.2 Impact on Encryption time
The cryptographic algorithm takes some amount of time to encrypt the inputted medical images is called as Encryption time. The encryption time is expressed as,

$$Encrytion\,Time = N * Time\,consumed\,by\,one\,MI \quad (9)$$

From (9), 'N' symbolizes the number of MI images. The encryption time calculation is expressed in milliseconds (ms). The cryptographic technique is said to be more efficient, when the encryption time is less. Table 2 says the experimental results of encryption time along with the different number medical images ranging from10 to 100from the input dataset. The obtained results of encryption time using LOUCSMIT Method are compared with two existing classification techniques namely secure and fast image encryption algorithm [1] and Deep-Network Coding (NC) [2]. From the attained results, the LOUCSMIT Method consumed lesser encryption time than two different cryptographic schemes. When considering the number of medical images is 50for conducting the experiments. By applying the LOUCSMIT Method, the observed encryption time is 31ms whereas the encryption time of the existing [1] and [2] are 46ms and 37ms respectively. Consequently, various encryption time results are obtained for every cryptographic method. The encryption time performance of proposed LOUCSMIT Method is evaluated with other existing cryptographic methods as illustrated in figure 4. Figure 4illustrates the performance analysis of encryption time for different number of medical images. Number of medical image is considered in horizontal direction and the encryption time is attained in the vertical axis. The yellow color bar symbolizes the encryption time of LOUCSMIT Method whereas blue color and red color denotes the encryption time of secure and fast image encryption algorithm [1] and Deep-Network Coding (NC) [2]. As illustrated in the graphical chart, the encryption time of the proposed LOUCSMIT Method is lesser than other conventional methods. The reason is to apply the lulu okamoto–uchiyama cryptosystem for efficient and secured image transmission. The designed cryptosystem performs three processes, namely key generation, encryption and decryption for image transmission in communication channel. Encryption converts the original medical image into cipher image. The encryption process is doneusing the public and full private key. This in turn helps to reduce the encryption time. As a result, proposed LOUCSMIT Method cuts the encryption time by 33% after comparing with the secure and fast image encryption algorithm [1] and 16% when compared to Deep-Network Coding (NC) [2] respectively.

Impact on Data Confidentiality Rate
Data confidentiality rate is well defined as the ratio of number of medical images delivered correctly to the receiver to the total number of medical images, and it is measured in percentage (%). It is formulated as,

$$DCR = \frac{Number\ of\ medical\ images\ that\ are\ correctly\ delivered}{Total\ number\ of\ medical\ images} * 100 \quad (10)$$

From (10), the data confidentiality rate is calculated. The method is said to be more efficient when the data confidentiality rate is higher. Table 3evidences data confidentiality rate experimental results with the different number of medical images ranging from 10 to 100from the dataset. The results of data confidentiality rate from LOUCSMIT Method are compared to the two existing classification techniques namely secure and fast image encryption algorithm [1] and Deep-Network Coding (NC) [2]. From attained results, the presented LOUCSMIT Method efficiently achieves higher data confidentiality rate than different cryptographic schemes. When considering the number of medical images is 60, for conducting the experiments. By applying the LOUCSMIT Method, the data confidentiality rate is 97% witnessed whereas the existing [1] and [2] data confidentiality rates are 92% and 93% respectively. Afterward, various data confidentiality rate results are observed for each cryptographic method. In figure 5, the data confidentiality rate performance of proposed LOUCSMIT Method is evaluated with additional existing cryptographic methods is described in the following figure. Figure 5 explains the performance analysis on data confidentiality rate for various medical images. Number of medical image is considered in the horizontal direction and the data confidentiality rate is attained in the vertical axis. The yellow color bar symbolizes the data

confidentiality rate of LOUCSMIT Method whereas the blue color and red color denotes the data confidentiality rate of secure and fast image encryption algorithm [1] and Deep-Network Coding (NC) [2]. As illustrated in the graphical chart, the data confidentiality rate of the proposed LOUCSMIT Method is higher than other conventional methods. The reason for this improvement is to apply the Okamoto–Uchiyama cryptosystem for secured image transmission. The designed cryptosystem performs three processes, namely key generation, encryption, and decryption for image transmission in the communication channels. Encryption converts the original medical image into a cipher image. In this way, data confidentiality rate performance gets improved. As a result, the proposed LOUCSMIT Method increase the data confidentiality rate by 10% after comparing with secure and fast image encryption algorithm [1] and 6% comparing with Deep-Network Coding (NC) [2] respectively.

CONCLUSION

A new method termed Lulu Okamoto–Uchiyama Cryptographic Secured Medical Image Transmission (LOUCSMIT) Method is introduced for performing secured image transmission. Lulu smoothened filter in LOUCSMIT Method denoises the medical image to improve the peak signal-to-noise ratio. Okamoto–Uchiyama Cryptosystem is used in LOUCSMIT Method to perform secured medical image transmission through the encryption process. The encryption process is carried out at the sender side. During the encryption process, the input medical images have been converted the images into an unreadable format. After that, the medical image is transmitted to the communication channel. At the end, the decryption is performed at the receiver end for increasing the data confidentiality rate. The proposed methods and existing methods are tested with the metrics such as PSNR, encryption time, and data confidentiality rate using chest X-Ray images, for performance. The results on experiments and evaluations on performance shows evidence saying the proposed LOUCSMIT Method is highly secure with raising data confidentiality performance.

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Table.1:Tabulation of PSNR

Table 1 Tabulation of PSNR

Medical Image Size (KB)	PSNR (dB)		
	Secure and fast image encryption algorithm	Deep-Network Coding	Proposed LOUCSMIT Method
246	34.33	39.50	49.05
329	34.51	40.17	45.21
408	40.17	42.56	46.55
252	39.19	45.85	56.09
401	33.81	39.50	45.85
312	36.31	39.19	43.03
299	35.67	41.28	46.55
446	31.35	33.98	35.88
422	33.81	34.69	40.53
398	35.26	39.19	45.85

Table 1 describes the experimental results of PSNR along with different medical image size in the

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Table.2:Tabulation of Encryption time

Table 2 Tabulation of Encryption Time

Number of Medical Images (Number)	Encryption time (ms)		
	Secure and fast image encryption algorithm	Deep-Network Coding	Proposed LOUCSMIT Method
10	36	28	22
20	39	30	25
30	42	32	27
40	44	34	29
50	46	37	31
60	49	40	33
70	52	42	36
80	55	45	39
90	58	48	41
100	60	50	43

Table.3:Tabulation of data confidentiality

Table 3 Tabulation of Data Confidentiality Rate

Number of Medical Images (Number)	Data Confidentiality Rate (%)		
	Secure and fast image encryption algorithm	Deep-Network Coding	Proposed LOUCSMIT Method
10	70	80	90
20	80	85	90
30	87	90	97
40	88	90	95
50	84	90	94
60	92	93	97
70	91	94	99
80	91	94	98
90	91	94	96
100	92	93	96

Figure 1 Structural Diagram of LOUCSMIT Method

Figure 2 Block Diagram of Lulu Smoothing Filter
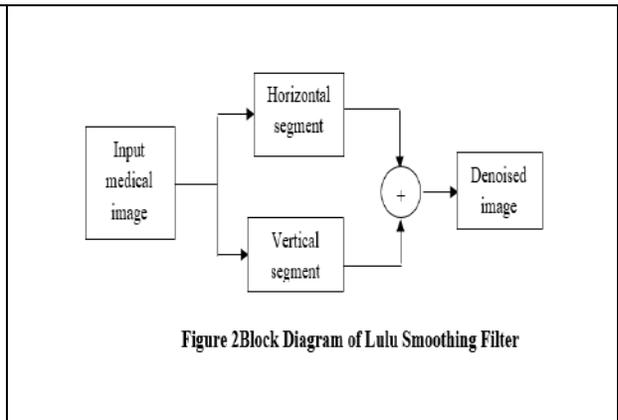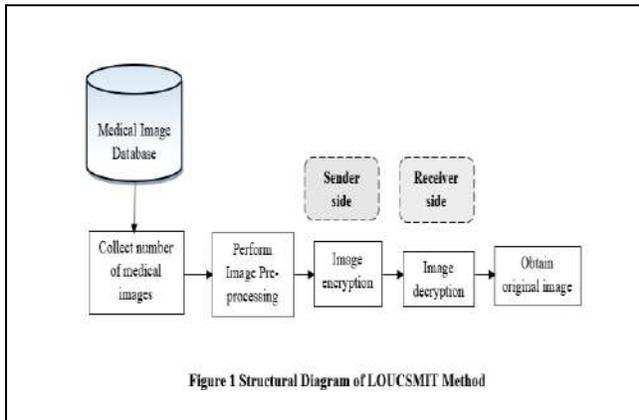
Fig.1: Structural Diagram of LOUCSMIT Methods	**Fig.2: Block Diagram of Lulu Smoothing Filter**
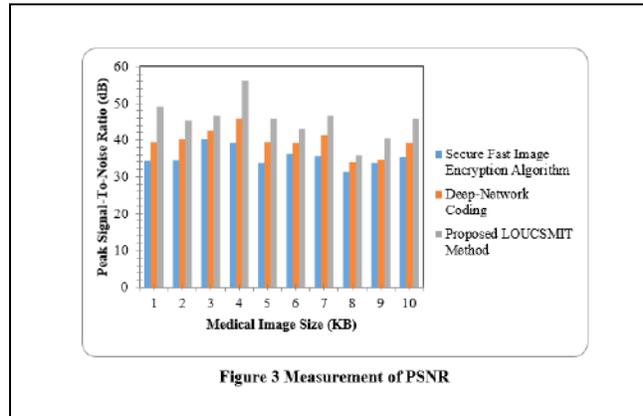
Figure 3 Measurement of PSNR

Fig.3: Measurement of PSNR
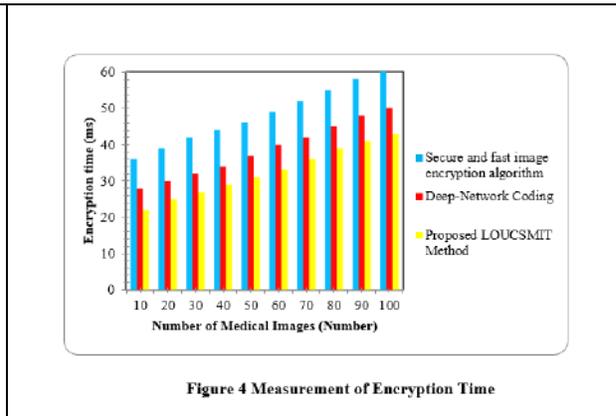
Figure 4 Measurement of Encryption Time

Fig.4: Measurement of Encryption Time
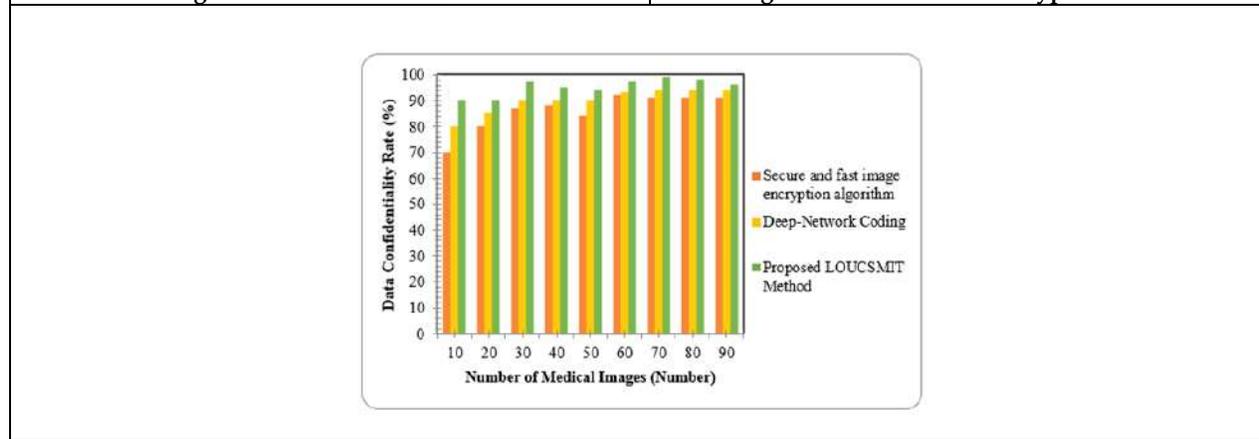
Fig.5: Measurement of Data Confidentiality Rate

RESEARCH ARTICLE

A Study to Assess the Level of Self Esteem and Stress Levels among Students of Higher Education Institutions in Bangalore Urban

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ABSTRACT

A descriptive study was conducted to assess the level of self-esteem and stress levels among students of higher educational institutions in Bangalore urban. The data was collected through demographic variables, strength and difficulty questionnaire, Rosenberg self-esteem scale, perceived stress test and analyzed through descriptive and inferential statistics. The target audience were the undergraduate students and they were interviewed indirectly by collecting information about some common stressors by means of two standardized tests and a self-assessment questionnaire. The results are analyzed to provides inferences about the research study.

Keywords: Self- esteem, Stress levels, Students, Higher education Institutions, young adults.

INTRODUCTION

Higher education Institutions is the turning point in a person's life and plays a vital role in shaping the future of the young adults. The exposure and impact the undergraduate colleges have on these young adult's shape and prepare them for their future endeavors. Managing stress is one of the concerning issues that currently exists among undergraduate students. A plethora of colleges throughout India have adopted various stress coping mechanisms and activities that help in enhancing one's personality and for boosting their self-esteem levels. Academic stress might be one of the most dominant causes of stress among college students. Usually there is an increasing trend of stress over the course of a semester in college and it is noticed that students are stressed the most during the last few weeks of a semester when they are in a hurry to meet deadlines and prepare themselves for the end semester examinations. This study aims at analyzing the stress and self-esteem levels among students post the deadly pandemic. A sudden shift in the mode of teaching unleashed a lot of chaos because most students did not have the

required resources and it took time for the others to understand and adapt to these changes. It is witnessed that the stress levels in the first-year undergraduate students have comparatively decreased with the introduction of the New Education Policy [NEP] as this scheme promotes usage of stress coping mechanisms such as Zumba classes, yoga sessions and so on.

Problem Statement

A Study to Assess the Level of Self Esteem and Stress Levels among students of Higher educational Institutions in Bangalore Urban.

Objectives

- To evaluate the level of self-esteem and stress levels among students of higher educational institutions.
- To find out the association between the level of self-esteem and stress levels among students of higher educational institutions.
- To provide different measures to overcome the problems caused to excessive stress and lack of self-esteem at a very young age

Literature Review

Stress and low self-esteem are two of the main problems affecting young people's mental health nowadays[16]. A person's assessment of their own value is referred to as self-esteem. Self-esteem, according to psychologists, is crucial since it conveys a person's level of social acceptance and cultural value. People are thus driven to pursue and preserve high self-esteem via a variety of tactics. Although levels vary across the life span and depend on experiences of interpersonal acceptance, the majority of people have relatively high levels of self-esteem [14]. The implications of having low self-esteem on the mind, body, and immune system are predictable, whereas having high self-esteem has a protective effect[17]. Results of recent studies showed that students with high self-esteem outperformed students with low self-esteem in terms of professional salience (participation, commitment, and values expectations) and occupational identity, but there was no difference between them in terms of work, community, or leisure roles[15]. Self-esteem is a crucial component for students' positive personalities. Additionally, it has an impact on students' mental health and personalities. Students that have strong self-esteem are aware of their strengths and weaknesses. So they are more self-assured than the kids who have lower self-esteem. Students with high self-esteem are constantly willing to take on obstacles and find solutions to help them reach their life goals. On the other hand, students with low self-esteem lack strong personality traits[18].

Stress also plays a huge role in the performance of the student community[3]. Transitioning from high school to college can be a stressful experience. It can cause psychological, academic and social stressor. [1] While stress can seem unavoidable, it becomes a significant problem if it disrupts their daily activities[6]. Stress is linked to multiple physical and mental disorders including cardiovascular disease, obesity, diabetes, depression, anxiety and sleep issues. Around 80% of doctor's visits are attributed to stress[2]. Personal, familial, and school factors are universal stressors. However, a less researched factor is the academic stress, particularly in the East Asian context. Academic stress is significantly correlated with perfectionism, social-oriented achievement motivation, parent-child relationships, and the emphasis placed on academics in school. Perfectionism and social-oriented achievement motivation, two factors from the personal domain, are the main causes of academic stress[7]. Academic stress affects the academic performance of undergraduate students irrespective of their gender or the schools they studied in before[5]. Not just predicted academic failure or difficulty, merely the knowledge of the potential of academic failure can cause stress in students[9]. Lack of parental support and high academic expectation too can be a stressor in adolescence[4]. Exam stress has been found to be one of the primary stressors among graduate students.[10] There are various factors that further affect exam stress - study pressure, managing time, teacher behaviour, sense of completion, study material [11] not just external factors, even a student's mindset towards stress can affect their response toward exams. Their mindsets need to be changed to protect them from negative consequences of exam stress[12]. Stress due to competition, task requirements, frustrations and expectations can ultimately lead to academic burnout in students[8]. In recent years, students and teachers alike have come to realize the importance of positive coping techniques which are critical to reduce the stress that comes with exams[13]. This study aims to

identify various stressors and issues affecting self-esteem in undergraduate students, particularly in Bengaluru Urban. It uses the following scale for empirical measurement of stress and self-esteem levels in the students

i)Rosenberg self-esteem scale – calculates whether a student has high or low self-esteem based on how they view themselves and how they think others view them

ii)Perceived stress test – calculates whether a person's stress levels are within normal parameters based on various factors

iii)Academic stress test – designed to specifically calculate academic stress of a person. This includes stress due to exams, assignments and course difficulty

RESEARCH METHODOLOGY

Objective Of The Study
The main objective of this empirical study is to evaluate and analyze the stress and self-esteem levels of the undergraduate students in Bengaluru urban and visualize it using R.
The hypothesis has been framed as
H1: The students have high self-esteem and low stress levels
H2: The students have high self-esteem and high stress levels
H3: The students have low self-esteem and low stress levels
H4: The students have low self-esteem and high stress levels.

A survey has been conducted to collect data by sharing structured Google form questionnaire to the respondents of students pursuing Bachelor's degree in Computer Science Major The questionnaire comprises of 3 sections, pertaining to the different tests mentioned above. A range of 5 points grading has been used with 1- Strongly agree, 2 – Agree, 3 – Neutral, 4 – Disagree and 5 – Strongly Disagree. The study focusses on 250 Computer science majors pursuing their undergraduate studies in a college in urban Bengaluru.

Evaluation Approach
The research study was conducted to analyze and evaluate the stress and self-esteem levels of undergraduate students in Bengaluru Urban. A well formulated questionnaire with 30 questions were shared among the group of 250 students pursuing their undergraduate studies is a computer science major. The survey was conducted towards the end of the semester since this is the time of exams and assignment submission. These areas of stress can be accurately assessed only at the end of the semester.
The questions were chosen in such a way that it addresses the following areas
i) General stress
ii) Self esteem
iii) Academic stress
The data collected through the online questionnaire were analyzed with a statistical application software, R and the results were measured. Further tests were not conducted to validate the data collected since the user experience questionnaire follows five-scale Likert scale to collect the responses from both group of respondents.

Description Of The Tool
The visualization tool used while carrying out this research is tableau. Tableau helps to access, visualize, and analyze data. It has an intuitive drag and drop interface which helps to uncover the hidden insights needed to make impactful decisions faster.

Data Collection Procedure
We have conducted this survey among 250 students using google forms. The test consists of three sections where the first section assesses the self-esteem score, the second section assesses the stress score and the final section helps in determining the stressors. The students must choose the correct answer applicable to them and they are graded on a

standard scale. A thorough analysis of the data collected helps in finding the major stressors in the undergraduate students and provide suggestion on how to overcome them.

Data Analysis And Interpretations
self-esteem because the mental health of every student matter and if this small population of students are neglected this might actually increase the number of students with a low level of self-esteem so the mentors must take an initiative to identify major causes that lead to a decrease in self-esteem among such students and help them overcome it.

Stress Score
The third test that we conducted was to identify the common stressors among these students. The following charts represent the percentage of students dealing with some of the most common stressors.

The above questions were the ones that got the greatest number of 'yes' votes:
It is noticed that one of the major reasons that cause stress among the undergraduate students is assignments. Many students fail to meet their deadlines. This might be because of insufficient time to complete their work or any other reason that is blocking them from doing it. This can be because they are too much involved in extracurricular activities that they do not find the time to concentrate on their assignment submissions making it difficult for them to balance their studies and other activities. Some students face issues at their homes where the conditions in their house do not permit them to do their college work. Such students when questioned by their mentors in front of their peers about their deadlines might feel guilty of not doing it on time, this can lead to a decrease in their self-esteem. This point is proved because students have told that there is too much competition among their peers. This can lead to students feeling low about themselves when compared to their other classmates. Students feel anxious when it comes to tests because their concern is not scoring well but to somehow defeat their peers. When this competition becomes unhealthy students might opt unfair means to win over others. Even parents are in favour of competitive education. Instead of asking their children to excel in their academics, they ask them why their peers have secured a better grade than them. Such type of remarks lowers a student's self-esteem and confidence. This in turn can lead to situations where students lose the confidence to speak loudly or face a crowd. The thought that they might be not good enough when compared to their peers always strikes them in such situations when they are among a lot many people. Another major reason can be commuting. Even though certain students want to make it to their institutions on time lack of public transport is always a hindrance. Some students travel long distances to reach their colleges but commuting makes them tired thus reducing their energy which otherwise they could have invested in doing some productive work. Some people make it late even after leaving early. When this happens continuously the student might lose their interest to study itself because for no fault of theirs they lose their attendance and are held responsible for that. Most of their times goes in travelling this provides them with no time to do internship or any other cocurricular activities and this again goes to the point where some of their peers not facing a commuting issue might be more productive than them and the competition increases even more.

CONCLUSION

Stress is unavoidable. At some point or the other in life everyone will be stressed out. In fact sometimes stress and fear motivates students to complete their work on time but it is important for every student to know how to keep their stress under control and few coping mechanisms so that they do not feel overwhelmed at times. Since students spend most of their time with their teachers and peers, they tend to share more with them. From this study we notice that most students feel comfortable among their peers. So student training programs and counselling sessions can help institutions to find out how the students are doing in term of their mental health. This way there will be a drastic improvement in the way students feel about themselves and which in turn increases their self-esteem.

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Figure: 1 Self-esteem Score

Figure: 2 Stress Score:

Figure: 3: Q1. The thought of upcoming tests makes me extremely anxious.

Figure: 4: Q3. Some assignments seem so overwhelming that I just give up on them.

Figure: 5: Q9. Sometimes I have to speak in front of an audience, and that makes me very anxious.

Figure: 6: Q11. There is too much competition among my peers, and I feel lost

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Figure: 7: Q17. Does your schedule get affected by non-availability of public transport (Late to college or late to reach back home?)	**Figure: 8: Q12. Do you travel a long distance to college? Do you think the journey is tiring or difficult?**

RESEARCH ARTICLE

IoT Based Intelligent Parking System using Machine Learning Implemented Python

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ABSTRACT

In the era of this 21st century the idea of smart cities has reverberated and peaked interests of many economists. The advancements in the field of technology mainly in IOT (Internet of Things) has made the idea of a smart city more feasible. Still the field is under constant development and new evolutions are being made consistently. Almost all metropolitan cities face a common issue of congestion, traffic and limited space for parking of vehicles. According to recent analysis the amount of vehicle on the roads of Bangalore have increased from 41.56 lakhs in 2011-12 to 100,44,491 in November 2021 and increasing rapidly, so the amount of congestion and traffic is only going towards an uphill curve. The IOT Based Intelligent Parking System uses the existing CCTV cameras dotted around parking spaces. The proposed system uses them as IOT devices to identify the available parking slots. Python machine learning and Amazon Web Services (AWS) for cloud analytics are used to create the user interface. The proposed system guides the vehicle users towards the appropriate parking spaces according to the type of vehicle (2-wheelers/4-wheelers/differently abled).This system is expected to mitigate the traffic congestion problems in a big metro city like Bangalore.

Keywords: CCTV, machine learning, Amazon Web Services, Internet of Things, Python

INTRODUCTION

Today, the use of Internet of things (IoT) technologies has enhanced a number of applications in scientific fields including medical, agriculture, social sciences, and computer sciences as well as non-scientific fields like government, society, and industry, among others. IoT is present in a variety of fields that are categorized by the issues that can be resolved, including, among others, those in cities, networks, sports, and agriculture. Future large-scale automated systems will include sensing technology, such those present in smart factories, buildings, and cities. Some of the current solutions concentrate on the installation of smart city solutions. The idea of "smart cities" allows

for the integration of technologies into a community with the goal of making life simpler with the least amount of effort. These are the outcomes of the requirement to direct our life in a sustainable direction [1]. Information and communication technologies (ICT) would play an immense role as articulating tools that guarantee a better result and, where appropriately facilitate, social cohesion, security, and sustainable development. The projects of smart and sustainable cities must be considered as a necessary to the present reality in order to meet the difficulties of the contemporary society, not as a model of a far-off and attainable future[2]. Smart cities employ infrastructure, innovation, and technology to adapt to the changes brought on by urban overpopulation. As a result, they support the advancement of economic, social, and environmental growth and reduced carbon dioxide emissions and energy usage. One of the first steps that must be made to change traditional cities into smart ones is smart parking [3]. Smart parking solutions that make life easier have already begun to be implemented in numerous places throughout the world. Through the use of information and communication technology, intelligent parking assists drivers in finding parking places quickly and effectively. Additionally, intelligent parking spaces are solutions that streamline the parking process or decrease the amount of space needed. The goal of this plan is to instill a respect for the environment. This strategy is the focus of numerous proposals. For some of them, utilizing the GPS to determine the closest sites is necessary. Other pieces concentrate on making bookings without verifying the availability of space. An innovative parking mechanism is shown in this book [4]. Three components make up the suggested system. The first is the creation of a parking space-installed Intelligent Vehicular Presence Sensor (MATRIX), which records, analyses, and notifies the parking space's condition. The second is the intelligent parking system, or DOCK, which can be accessed via a mobile application and allows users to reserve any open spot. It oversees and controls parking areas. The third is a monitoring hub that compiles data on users, MATRIX sensors, and the entire system. A case study of the usefulness of a sensor is described, and it is contrasted with others already in use. The most representative proposals in this field are presented in the section that follows [5].

Intelligent Parking System Prototype

DOCK, a smart parking solution for exclusive parking lots, is being recommended. The MATRIX, a smartphone app, and a monitoring station make up its three main parts. A MATRIX is positioned in the centre of the back end of each parking space. The manager of a private parking lot may oversee and regulate the parking spots and reservations through the monitoring centre, while users/drivers can use the mobile application to control and reserve a parking place. The monitoring centre at keeps track of the information shared by the app in a database. The MATRIX transmits all of the data to the cloud. Additionally, WiFi protocol connection allows for the sharing of information [Figure 1]. Using the DOCK as a management and control system for private parking lots, the motorist or user may view the availability of parking spaces in real-time using a mobile app. The user of this app can create a profile, register their vehicle's license plate, keep track of the most recent parking space availability, book a spot, and get various route suggestions to get to the parking lot. The MATRIX, on the other hand, uses a distance sensor to detect a vehicle's entry into the parking space, a camera to capture an image of the licence plate, and an LED indicator and buzzer to signal the parking space's status. Additionally, the monitoring centre receives real-time information about parking space occupancy, ensuring 24-hour operation. The DOCKsmart parking system's proposed network architecture. Additionally, a more thorough explanation of how the entire smart parking system performed is provided below [Figure 2]. When a new automobile approaches and the distance sensor recognizes it, it takes a photo of the license plate and converts the image to text using an image processing algorithm. The licence plate's number is subsequently communicated to the monitoring center's assignation manager. The section gives a description of the procedure and an illustration of an explanation. A parking place may be in one of six states: FREE, OCCUPIED, BOOKED, HOLD, or WAIT. Users may view the status of each parking space inside the garage on the app. Each condition is assigned a certain LED hue. A state diagram and the accompanying transitions are shown in[Figure 3]. The first parking space is provided without charge. If the motorist or user already has the app on their phone or is willing to download it in order to use the DOCK, they will receive the parking availability in real-time. The user or driver may then decide whether to manually seek for a parking space or make a reservation using the app. The specified parking space's state is now BOOKED if a user or motorist books it using an app. To get to the parking spot, he or she must travel. It changes to OCCUPIED as the driver pulls into the parking place, and to FREE when the driver drives away. The MATRIX sensor will take action when a problem arises, as when another car pulls

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into a parking place that has the status BOOKED, in order to always ensure the system's availability. [Figure 4]shows the general process and considerations used while a motorist or other user is looking for a parking place. There are two scenarios that could occur if a person searches for a parking spot. The app is in the user's possession. The user lacks the necessary program. If a user already has the app and searches for a place that's open, they can find one, reserve it, get to the space, and then leave it FREE. Users who don't already have the app can download it or search for a place the old-fashioned way. Figure depicts the entire procedure, excluding any special cases.

Design of the IoT Sensor MATRIX

The MATRIX may be implemented using the Raspberry Pi 3 electrical card, an ECHO ultrasonic sensor, the Pi v2 camera, an LED strip, a buzzer, and a battery [Figure 5].

The descriptions of each component are listed below. [6]

- The Raspberry Pi is a little computer that is built from a motherboard with a CPU, graphics chip, and RAM loaded on it. It is in charge of coordinating communication between the complete system and the cloud services, as well as managing the sensors and led display so that the system can read and write data on them.
- Distance measurements are made possible by the ECHO ultrasonic sensor's two transducers, a piezoelectric emitter and a receiver. The emitter emits ultrasonic pulses at a frequency of 40 KHz, and if an item is found, the sound waves will ricochet off of it. The duration of the wave's return is what establishes the distance. The sensor detects the existence of a car in a parking area.
- The Pi V2 camera, which produces images quickly and sensitively, is used to read licence plates.
- To let the motorist, know how the parking spot is doing, the MATRIX's system uses an LED strip. The battery that powers the Raspberry Pi is located inside the MATRIX components.
- An electroacoustic transducer known as a buzzer is a signalling or warning tool that continuously makes a buzzing sound of a certain tone (often acute).
- The electrochemical cell of a battery powers every component by converting chemical energy into electricity.

The connection diagram of the components of the MATRIX is shown in Figure

CONCLUSION

In order to shorten the time spent looking for outdoor parking during periods of higher traffic congestion, an integral intelligent mobility solution that is built in Python using Machine Learning. The DOCK solution's suggested architecture for the proposed system is made up of three fundamental building blocks: MATRIX, the mobile app, and the monitoring centre, of which the MATRIX IoT sensor is a key component. It is designed to be a compact, adaptable piece of equipment that may be utilised in many different contexts without the need for a costly infrastructure installation. Additionally, it makes non-vision systems more advantageous than visual systems by allowing for individual vehicle management via the reading of the script on the licence plate. Depending on the availability of parking places, this will assist the programme decide whether to assign or place the car in a waiting status. Along with that the proposed system is capable of differentiating between (two wheelers, three wheelers and four wheelers) which further helps to allocate parking spaces in an effective and efficient manner to increase the maximum utilisation of the parking spaces.

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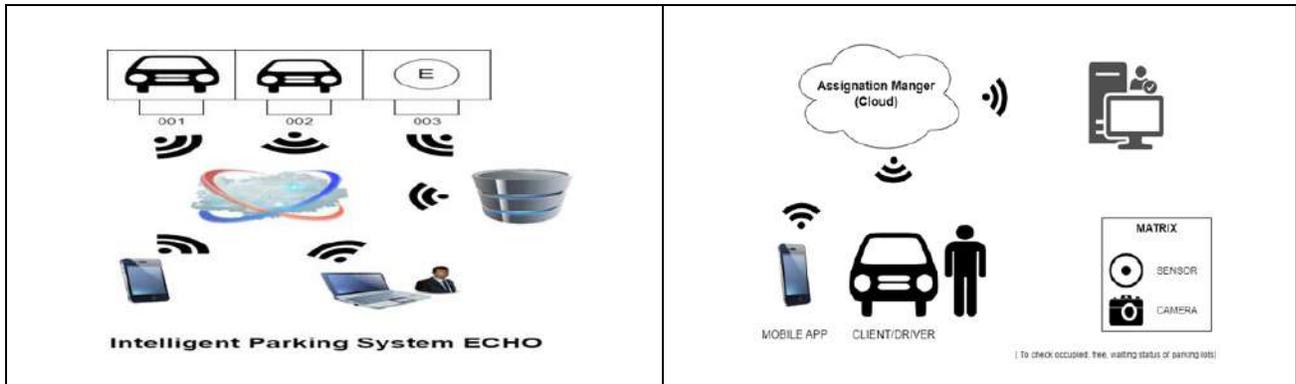
Figure 1 : Concept Diagram

Figure 2 Network Architecture
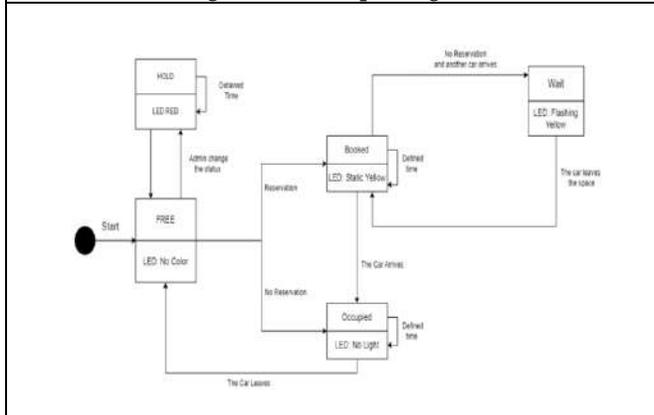
Figure 3 : Block Diagram
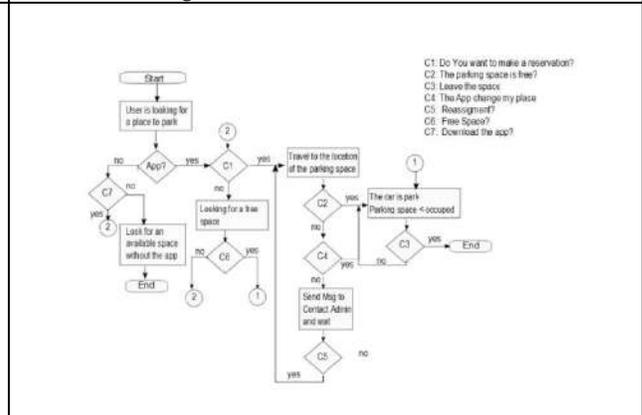
Figure 4: Flow chart

Figure 5: MATRIX

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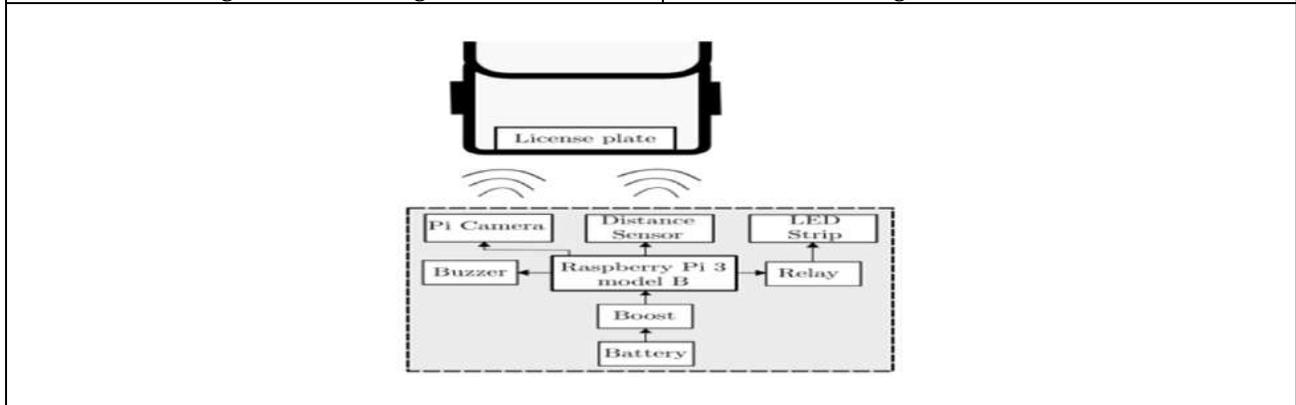
Accessibility and Usability Evaluation of Learning Management System: A case study on Kristu Jayanti Learning Management System

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ABSTRACT

Kristu Jayanti college has adopted and implemented the its own indigenous interactive KJLMS with salient features that facilitates the students, teachers and members of management to access the course materials, upload and download the contents, conduct and attend assessments, evaluate the academic performance and monitor the progress of students. An empirical study has been conducted to evaluate the performance of KJLMS with respect to usability, accessibility, system interface, compatibility and inclusivity. The research study was based on the hypothesis that KJLMS is highly accessible with high performance satisfying the users' need and a negative hypothesis. The respondents are the stake holders of our institution like students, teachers and management members. The result analysis proves that KJLMS has satisfied the positive hypothesis, though few recommendations were provided as future enhancements.

Keywords: Learning Management system, usability, accessibility, Inclusivity

INTRODUCTION

The vivid development in technology has infiltrated the education sector in the past decade. The education and learning have changed or began to change from the usual traditional method and started migrating towards the technology-based education supported by internet milieu. Though the methodology is growing, it's quite challenging to create the proactive and interactive environment which welcomes and satisfies the needs of both the teacher and educator. The buzz word 'E-Learning' is the most interesting topic that has emerged in the past few years. E-Learning spins around implementation and usage of digital tools that influences the teaching- learning activities. The concept of E-Learning has changed the way of traditional teaching -learning pedagogy also. (Abaidoo and Arkoful 2015). A digital platform tool that has been developed to support the E-Learning is 'Learning Management System' provides delivery of E-content material and connects both the teacher and learner in a single platform. But the real time needs of the users increases the complexity of Learning Management System (LMS) with

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respect to information, amount of time spent and the effort taken to accustom to LMS. Kristu Jayanti College (KJC) is one of the pioneering educational institutions with the 10,000 active enrolled students for various discipline and deanery. Since 2019, KJC has implemented web-based LMS for the teachers and students that has created a new learning path. Kristu Jayanti College Learning Management System (KJLMS) is an online system or software that is used to plan, implement, and evaluate a particular learning process. Precisely, it is a software used in eLearning programs that helps with registration, course content delivery management, assessment analysis, tracking and reporting, administration and documentation. The main goal of KJLMS is to improve the teaching-learning process. KJCLMS enables KJC's digital learning methodology to transform innovative teaching and learning resources for stakeholders. In its development phase, KJLMS has undergone version and user interface changes. By witnessing the updates in the KJLMS through increased features, add-ons and plugins, it is inevitable to take account of these features from both the teachers and students' perspectives. The objective of KJLMS is to provide continuous 24/7 learning system, interactive digital media development, prototypical instructional design and the utilization of innovative teaching technologies. KJLMS has gained wide popularity among the users since it has all the components a that are considered as success from student's perspective (Randal ,2010) aspects such as interoperability, ease of use, scalability, flexibility and platform independent. This empirical study was conducted to find and analyze whether the stake holders (teachers, students and management personnel) have positive and adequate user experience at KJLMS from the existing salient features and factors. The result of this study will help the institution evaluate KJLMS with respect to Content creation and accessibility, Usability, Navigation and Functionality. The results are considered as suggestions to improve KJLMS with the above-mentioned aspects.

Literature Review

A Learning Management System (LMS) is a web-based software application that aids in the teaching and learning process, as well as in the delivery of effective teaching, training, and content development. (Malcolm Brown2018). The Learning Management System makes it easier for teachers, students, and administrators to customize and access services even beyond the stipulated time of teaching and learning process. (Takahashi et al., 2014). The detailed introduction and the technical explanation for LMS is "an application software for administration, documentation, tracking, reporting and delivery of educational course or E-Learning training programs". (Ellis, 2009). The basic and most significant attribute of LMS is offer a common platform for both teaching and learning irrespective of the time and distance. Accessibility should be provided to the stakeholders at all the time. (Epping, 2010). The use of electronic media to teach or to deliver a course content has greatly increased in recent years. The popular mode of communication between the tutors and students occurs in a non-continuous manner under this mode of delivery. Information and Communication technologies (ICT) improves the productivity and has reduced the difficulty in learning activity. (Thuseethan, 2014). Users are influenced by two factors in the Learning Management System: 1) The value of a learning management system (LMS) is measured by the needs of individual users or organizations. This means that while LMS can be quite useful and operative for academic usages, it does not necessarily mean that it will be appropriate for industry. 2) Technically well-trained LMS assistants for ongoing support. (Abaidoo and Arkorful, 2015).

LMS has a wider range of functionalities in higher education than usual. LMS is most commonly used for the sharing of course materials, less frequently for communication between instructors and students, and even less frequently for online assessment or collaborative learning, according to a consistent finding. But KJLMS has provides a single platform for all the above-mentioned tasks and also assessment, collaborative and interactive learning. (Garrote and Pettersson, 2016). Its is quite difficult to conduct the human behavior assessments in an objective and systematic manner because of the complexity in the human nature and individual opinions (Bellotti et al., 2013). Though it is difficult to assess, it is mandatory to conduct the usability evaluations in order tounderstand the quality of the LMS. Many evaluation methodologies are developed and in practice. The way user interacts with the computer plays a vital role in improving the usability of LMS by the user. (Sung et al., 2012). Many previous studies in human-computer interaction have provided useful information on how users fit suits to accomplish and think about the LMS so that it can be used easily. This research contributes to the usability of technology and the consideration of the user in the design of human-computer interaction. (De Lera et al., 2010). Hence a very practical design for user

interaction with usability study is one of the vital criteria in the development of LMS. User Experience Evaluation on University's Learning Management System (LMS) has been evaluated and the relationship between hedonic and pragmatic quality has been analyzed. The user's experience with respect to the interoperability, usability, accessibility, efficiency and novelty has been evaluated. (Emil R. Kaburuan et al, 2020).

According to the Shackel's framework, the usability of any application can be evaluated under four major criteria. They are Effectiveness, Learning Ability, flexibility to use and the attitude of the users. This study has been taken to evaluate KJLMS with respect to the above-mention criteria. The context of usability evaluation is

✓ Effectiveness – The user proportionate with respect to the task accomplished through KJLMS
✓ Learning Ability- The degree of learning for a particular task. It can be considered as the time taken to learn multiple times through KJLMS
✓ Flexibility- user's adaptation towards changing environment in the system design.
✓ Attitude of users- user's satisfaction with the system.

RESEARCH METHODOLOGY

Objective Of The Study
The main objective of this empirical study is to evaluate and analyze the salient features of KJLMS such as Usability, Interoperability, Flexibility, Scalability, Technical support and training, cost effectiveness and sustainability. The hypothesis has been framed as

H1: KJLMS is highly accessible and usable among the teachers and faculty of kristu Jayanti college.
H2: KJLMS is not highly usable and accessible by teachers and faculty of Kristu Jayanti   college.

A survey has been conducted to collect data by sharing structured Google form questionnaire to the respondents of students provisionally registered and pursuing Bachelor's degree in Computer Science Major and teachers from Faculty of Computer Science. The questionnaire comprises of 5 sections, pertaining to the features of KJLMS mentioned above. A range of 5 points grading has been used in 2 different formats. First format with 1- Strongly agree, 2 – Agree, 3 – Neutral, 4 – Disagree and 5 – Strongly Disagree has been formalized for Usability, Flexibility and Scalability. Second format with the scale of 1- Excellent, 2 – Very good, 3 – Good, 4 – Average and 5 – Neutral for the questions related to functionality and user interface. The study focusses on 500 learners, major in Computer Science and 100 teachers.

Evaluation Approach
The research study was conducted to analyze and evaluate the accessibility and usability of KJLMS. Well formulated questionnaire with 50 questions were shared among the group of 519 students with computer proficiency. The survey was conducted towards the end of the semester, since the usage of KJLMS is high due to the online assessment conducted, downloading the course content that includes the specific teacher's video lecture, discussions through forum activity and submission of assignments. The questions were chosen in such a way that it addresses the following areas of usability and accessibility such as

• System User Interface design
• KJLMS functionality
• Ease of use and Navigation
• User Satisfaction
• Learning ability
• Usefulness and portability

The study has been conducted among 100 teaching faculty who has very good computer proficiency and has experience in ICT method of teaching. The data collected through the online questionnaire were analyzed with a basic statistical application software, Microsoft Excel and the results were measured. Further tests were not conducted to validate the data collected since the user experience questionnaire follows five-scale Likert scale to collect the responses from both group of respondents.

FINDINGS AND DISCUSSION

This study has been conducted to infer the specific recommendations about KJLMS to help the users understand the educational efficiency of KJLMS and increase its usage. This section explains the findings and the analysis of each question shared among the students and the teacher's community. Certain questions are common to both the users. The result analysis shows that both the stake holders feel the same for those criteria relevant to the usability, functionality and accessibility. The responses are represented in data visualization using Tableau software.

Usability Analysis
This section analyses the user's responses for ease of use of KJLMS and the way it has impact on leaner's ability to create interest in order to accomplish the tasks on-time. Among the respondents 85% of students and 93% of teachers have strongly agree that KJLMS is user-friendly.More than 80% of the students and 99% of teachers appreciated that KJLMS helps them to complete their tasks on time. But ,for the question of instilling interest about the courses among the students , the response is around 65% from students perspective and a very appaulding response of 90% from teachers perspective. For the question, LMS is very simple to understand and interact with and it needs least training for the usage. The results explains that 81% of the students acknowledge the simple usage and around 72% of the students responded that special training is not necessary to work with KJLMS. 70% of the teacher responded that they do not need training to provide content in KJLMS. The results indicates that 74% students feel the time pressure during online assessment and examination conducted through KJLMS. 62% learners have academic pressure while meeting the deadlines during their learning path. The 66% of teachers experience the time management pressure during assessment schedules and 90% feels the academic pressure while delivering contents through KJLMS. The prominent usability analysis questions are shown in Fig:1 and the responses analysis is depicted in the graph shown in Fig:2.

Functionality Analysis
This section analysis the result collected from the respondents pertaining the special features and functionality in KJLMS. The salient features of the LMS accessible by the learners and teachers are reviewed in this section. The functionality features that are studied are
- Compatibility
- Upload/download the learning materials
- Teacher-learner communication
- Course quadrants
- Grade books and Data analysis
- Assessment and score capturing
- Activities in Time frame
- Randomized Question bank and restricted access
- User Interface

The overall analysis states that over 70% of students and 90% of teachers responded that they are agreeing with the current version of KJLMS pertaining to the questions as shown in Fig:3 and Fig:4. There are exclusive questions put forth only to the teachers with respect to the functionalities of KJLMS, that are very specific and plays a vital role in evaluating the performance of LMS. The queries from the teacher's perspective been discussed with their respective responses. Specific queries have been put forth to the teaching fraternity to understand the current version of KJLMS with respect to the functionality and compatibility as in Fig:5 and the results were shown in Fig:6. The overall analysis of functionality of KJLMS has been highly accepted and approved by the teacher's fraternity of KJC. Above 89% of the teachers have agreed with the efficiency and effectiveness of the current version of LMS.

Accessibility Analysis

In this section, the user's accessibility analysis -teachers and learners are discussed. The results shows that KJLMS is readily accessible from college home page and the user interface is compatible with smart phones. The navigation system in LMS is quite easy to access from any intermediate sections. The analysis further clarifies that KJLMS has provided a non-disruptive academic even during the pandemic period. 83% of the respondent confirms that LMS concerns on keeping the track of course event and progress. This will be a concrete input to the management to review the future version of KJLMS. Around 89% of the respondents gave affirmative responses pertaining to the questions listed in Fig: 7 and responses were depicted in Fig:8.

CONCLUSION

KJLMS is an indigenous Learning Management System developed to cater the needs of the students, teachers and the management of Kristu Jayanti College. The result of this study clearly shows the levels of inclusive performance of the effectiveness of LMS from learners and teacher's perspective. The outcome obviously states that above 90% of the learners from the Computer Science major are compatible with the existing functionality, user interface and accessibility. However, from the user's point of view, both the stake holders feel that it is creates more pressure in meeting the deadlines in completing the activities, assessments assignment submission, evaluation and providing content to various courses. Further, compatibility with browsers and smart phones needed to be fine-tuned in next version revision. This study has been conducted among the computer science major students who are very well connected to the usage of computers and digital devices. The complete effectiveness and impact of KJLMS among the learners will be evaluated if the study is conducted among the non-technical students of KJC and compare the result analysis which can be considered as the future work of this empirical study.

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Fig: 1 Usability Analysis

Fig: 2 Responses in Percentage

Fig: 3Functionality Analysis-Learners View

Fig: 4Responses for Functionality Analysis

Fig: 5Functionality Analysis-Teachers view

Fig: 6Responses in % from teachers' perspectives

EJLMS provided non-disruptive academics during the pandemic. EJLMS helps in keeping track of course events and progress. EJLMS is productive even during the Offline classes. I can access the learning activities at times convenient to me. Ease of access, completing course work, Including tests or quizzes, assignments, and discussion forums Compatibility of EJLMS with smart phones and tablets	
Fig: 7 Accessibility Analysis-Students perspective	**Fig: 8 Responses for Accessibility Analysis**
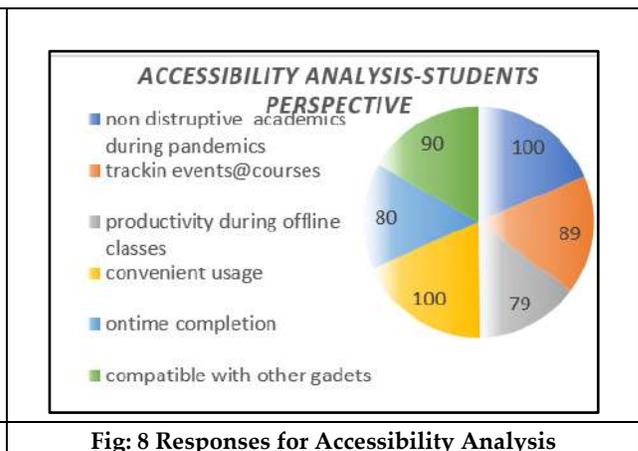
RESEARCH ARTICLE

The Block Chain to Enhance the Privacy and Security in IoT based Traffic Management System

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ABSTRACT

The importance of understanding the disciplines that have been, and will be, fundamentally impacted by blockchain technology is shown by the fact that it continues to grow and expand into new industries with remarkable success. Blockchain technology, in particular, has shown to be more useful in the sector of transportation systems. The Internet of Things (IoT) presents a number of critical issues, including privacy and security in traffic system. The IoT difficulties include improper device upgrades, a lack of efficient and effective security mechanisms, user unawareness, and well-known active device monitoring. In this paper researcher explained about the blockchain which is used to enhance the privacy and security of traffic management with the help of IoT devices. As a result of this paper awareness and debate of blockchain technology's existing and prospective future capabilities, developments may be made to provide answers to challenges that are now present in autonomous car systems. This paper focuses on block chain's possible use in future transportation systems that will be combined with linked and autonomous automobiles.

Keywords: Blockchain, IoT, Privacy, Security, Traffic.

INTRODUCTION

Block chain technology has been the most effective technology available for data security and privacy because of its irreversibility and immutability. The blockchain is not responsible for data change. If a transformation in the directory is made using operations, changes will be transmitted to all modules to check and keep updating their specific directory transcript[1]. Until all network nodes verify the operation, the activity cannot be changed without changing later and earlier blocks. Block chain technology are therefore irreversible, with their data continuously

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being added. The connections are also renowned as a chain for each block. The next block contains the previous block in the sequential able to access the chain[2]. Block chain's smart transportation development system is rather ambiguous. Moreover, the use of blockchain in the intelligent transport sector can hardly be explained at the same level since it interacts concurrently with all subjects involved in intelligence throughout the application process which demands the cooperation and interaction of numerous subjects[3]. A development system coordinated by many disciplines is still unusual for stakeholders. In addition, only a few previous studies have examined the coupling of smart and blockchain transport from a sustainable viewpoint, which demands extensive attention to improved transport needs and problems posed by blockchain in three areas: economic, social and environmental factors. Finally, currently, block chain's applicability in the physical business lacks consortium blockchain investigation as research focuses more on private blockchain[4].

There is a vast spectrum of urban transportation. Taking into account that underground transit has a special operating system, for example the underground. The focus of our study is on the urban transport, involving buses, private automobiles, taxis and Internet. Depending on this, a sustainable block chains application system is developed based on a blockchain consortium in intelligent transport[5]. Internet of Things (IoT) is an Internet power extension that enables various digital gadgets to connect to one other in order to exchange back and forth information. IoT is a linked computer device system in other terms. Each one of these devices has a unique identity and can interact with other devices, which eventually enables individuals and companies to interact and make strategic decisions which are significant. IoT is not only going to bring to revolutionary changes that increase quality of life but also to numerous issues in terms of security in respect to privacy, system setup, information storage/management, and access control. One of IoT's main concerns is addressing security and privacy problems. Another important pillar of IoT, heterogeneity, contributes to safety problems[6].A blockchain is a distributed ledger comprising a list of connected data entries or blocks connected by cryptography hashes that are protected. Each block comprises a collection of fresh datasets or transactions, together with a time-stamp of the preceding block, which checks transactions at the time the block is created, making it impossible to modify the data, because they are dependent on past records. Blockchain is distinguished by the fact that data cannot be updated because it is distributed and kept in a reliable way[7]. Block chain technology is a high transparency solution for access control which enables decentralized security from end to end and lowers the possibility of human mistake. It offers robust hacker security, and access control mechanisms are of utmost importance.

It was launched in 2008 as a key Bitcoin foundation that enables data to be stored, distributed and updated. A decentralized solution which ensures data integrity through a consensus process is Blockchain. There is no requirement for a third-party mediator and trust is created through a decentralized public directory to provide reliable distributed transactions in a distrust less environment. Traditional security methods and access control techniques demand a centralized and reliable body that end-to-end security characteristics are compromised. Applying an increasing number of IoT devices to the centralized access control mechanism might complicate the trust management process and hinder system scalability. Blockchain can assist to establish a fair authorization framework for addressing the IoT access control concerns listed above. Using the challenge response mechanism, the Ethereum blockchain will authenticate your introduced server[8]. This architecture employs a decentralized blockchain technology, but is also dependent on an authentication server from a third party. Another major downsides (one point of failure; single point of faith) to this process is this centralized infrastructure. A secure authentication control and IoT access control for the user to safely connect to IoT devices through the provision of accountability and availability. Although a public blockchain has various benefits, due to its high bandwidth overheads, delays and use of a huge number of computational resources it is not suited for resource restricted IoT devices. Block chain technology is a highly conductive solution for access control which enables decentralized security from end to end and lowers the possibility of human mistake. It offers robust hacker security, and access control mechanisms are of utmost priority. It was launched in 2008 as a key Bitcoin foundation that enables information to be encrypted, distributed and updated. A decentralized solution which ensures data integrity through a consensus process is Blockchain. An intermediary from third parties is not necessary, and trust is created via a decentralized public directory in order to safeguard dispersed transactions in a reliable environment[9]. Traditional

security methods and authentication techniques demand a centralized and reliable body that end-to-end security characteristics are compromised. Applying an increasing number of the IoT devices to the centralized access control mechanisms might complicate the trust management process and hinder system scalability. The purpose of this work is to improve and optimize security of traffic system via a private hierarchical block shaft structure and to make it possible to significantly reduce overhead traffic by adopting a lightweight, IoT-based consensus method. Both the decentralized and distributed structure and the cryptographic features make the Blockchain function in a unique way. Blockchain technology is ideal if security and information secrecy is the network's top goal. In IoT, blockchain implementation can make access control more efficient.

Literature Review

Sultan Algarni et al. in this study provides a new way for managing the delivery of the IoT system, based on a multi-agent system and block chain's safe, lightweight and decentralized access control. The major goal of the solution suggested is to create Blockchain Managers (BCMs) for the regulation of IoT access and safe communication amongst local IoT device. In addition, the system allows safe communication across IoT devices, cloud computing and fog nodes[10]. Pradnya Patil *et al.* explained about the function of a trustworthy third party inside interconnected networks, due to its distribution nature blockchain may be employed as crucial technology. The most significant blockchain systems accessible for deployment include Hyperledger fabric, Ethereum, Ripple, IBM Blockchain, multichain, R3 Corda, The review paper outlines and examines available blockchain based IoT access control, adhoc vehicle networks, healthcare and supply chain security solutions. The extensive study of blockchain applications will provide academics with state-of-the-art research in numerous fields in pursuit of blockchain technology[11]. Xiaomin Du *et al.* the purpose of this work is to examine how to use technology blockchain to smart transport, develop the theoretical hierarchies of intelligent transport and investigate a sustainable smart transport application systems. This theoretical framework should, however, not only take account of unneeded features and the interaction of features and requirements, but also the multi-stakeholder sustainable application systems. The fuzzy theory is therefore utilised to examine the unneeded attributes, to handle the intricate interrelationships between aspects, qualities, and interpretative structural modelling (ISM) is offered to separate the hierarchy and create a hierarchical theoretical frameworks. This approach is utilized for the analysis of the unnecessary attributes. Finally, research builds a sustainable smart transport system under the blockchain. Results show (1) social problem solving is the primary link, (2) economic tasks are mostly focused on smart contracts and social problems; (3) environmental improvements need to be resolved and (4) the intelligent traffic jam application system has to be developed from 3 levels, including governmental level. This theoretical hierarchy is intended to drive smart transport towards blockchain use. In addition, this study suggests stakeholders' participation in the implementation of a sustainable application system[12].

Ali Hassan Sodhro *et al.* explained about the new blockchain-enabled Internet security framework and algorithms for industrial IoTs be developed by implementing a randomly initialized and master keys mechanisms for the creation and transmission of data across long distance wireless networks with low power ratings. There are therefore three outstanding contributions to this study. First, a safe, effective, dependable and sustainable algorithms driven by blockchain is suggested. It may be argued that by placing a chain of blocks with a limited number of cores and a limited number of communicate and computational-bits the system offered administers keys randomly[13]. Navid Khoshavi *et al.* explained about the Blockchain technology, has shown to be more useful in the sector of transportation systems. More research is being done in both disciplines of study as well as their combination. As more study is undertaken and applications are better understood, it is expected that their current connections will considerably improve in the near future. Because blockchain technology is still young in comparison to earlier, more widely utilized systems, many of its future potential remain uncertain. This study focuses on the possible applications of blockchain in future transportation systems that will be linked with connected and autonomous cars (CAVs), as well as a thorough survey of related literature and research works in this topic[2].

Research Question
● How does blockchain help in the traffic management system?

● How Blockchain enhance the privacy and security in IoT based traffic management system?

METHODOLOGY

IoT Privacy and Security Challenges

IoT has provided consumers with great advantages, but with it, it will gives certain drawbacks. The researchers and security professionals mentioned are mostly concerned about cyber safety and privacy hazards. Both of these are a substantial difficulty for many companies and public institutions. The weaknesses of IoT system have been shown by prevalent high-profile cyber security attacks. The fact that the networks connectivity IoT delivers access from the unidentified and untrusted Internet needs new security solutions is simply the reason for this issue[14]. None of the acknowledged obstacles, for example safety and privacy, have a greater effect on IoT adaptation. Unfortunately though, users frequently do not need to recognize the safety consequences until an infringement occurs, resulting in major harm such as the loss of important data. The desire of customer for substandard safety currently declines due to the continuing security breaches that have exposed the privacy of the users. The Internet of Things of the customer did not fare well in a recent study concerning privacy and safety.

Blockchain Security

Blockchain security is a significant concept in that it encompasses information and data protection in bitcoin transactions and block against different malicious and the non-malicious assaults. The safeguarding of threats entails implementing different security policies, technologies, and IT services.

Defense in penetration

Various remedial steps to secure the data are implemented in this method. It operates on the idea that data are protected in several levels rather than using a single security layer.

Minimum privilege

This strategy minimizes data access to the lowest levels feasible to increase and boost the level of security.

Manage vulnerabilities

Vulnerabilities are monitored and managed by the modification, identification, and authentication along with patching of the gap.

Manage risks

Environmental hazards are addressed by risk identification, risk assessment and risk controls.

Manage patches

This technique consists of the patching, testing, and installation of the administered component such as code, application, and operating system.

In order to provide the safety necessary for transaction data or block data, Blockchain technology utilizes numerous strategies, independently of use or block information. For data security, some apps such as Bitcoin employ encryption methods. The other safest assumption about blockchain is that it is valid for the longest chain. This lacks security opportunities due to 51 percent of prevailing attacks or fork problems. Since the longest chains is the most authentic, alternative attacks end up inacceptable and void when they are stranded fork.

Blockchains Privacy

Data protection is the capacity to separate or to send information that contains everything that is to be carefully communicated for the lonely individual or a collection. Blockchain security implies that information may be sent without the spilling of proof. In the meantime, confidentiality allows a client to be pleasant and distinguish himself without showing his behaviors to the entire system. The objective of strengthening blockchain privacy is to make it extremely tough for different customers to identical or to use cryptographic profiles of other customers. Blockchain

allows you to store all data kinds. The privacy standpoint for individual and corporate data changes in blockchain. Although the privacy policies of individual data are relevant, the data sensitive and organizational data are subject to ever increasingly strict privacy regulations. Network nodes are the nodes that store the whole blockchain copy. Full nodes when combined with blockchain system's adhesive-only features frequently result in data redundancy. In blockchain, this redundancy of data adds two additional features: variability and transparency. The compatibility levels of an applications with its data minimization determines transparency and variability levels in the network. The data of preceding blocks in the undiscovered blockchain cannot be changed. In some circumstances, blockchain append-only does not restrict user repair, especially when information is improperly stored. Particular care must be given to spreading data subject rights in blockchain technology. The Private compared to public blockchain. From a privacy point of view, Blockchain accessibility is astonishing. At a higher level, authorized users can encrypt the limited data on a block to ensure conditional access, because each blockchain node contains a copy of the whole blockchain. Non-permitted versus blockchain permitted kinds. All users are permitted to upload data in theory with public or illegal blockchain apps. The network control distribution can be restored with the permission of trustworthy mediators shown in Figure 1.

Blockchain depend on IoT Access Monitoring Method
IoT research has grown enormously with expanding items in communications and networking technologies. Connecting smart devices via the internet offers various benefits such as data sharing, easy access and remote monitoring. The centralized structure the client/server approach is one of the primary problems IoT faces. A lack of confidence between various involved devices might cause the whole network to fail and a credible solution is required in order to avoid this problem. Several techniques were developed throughout these last years when blockchain became popular because of its characteristics such as decentralized structure, security and immutability. Figure 2 shown the above diagram shows the process of traffic management system in which how IoT sensor and blockchain enhance.

The Usage of Blockchains in IoT
A blockchain is a distributed ledger comprising a list of connected data entries or blocks connected by cryptography hashes that are protected. Each block includes a series of new data records or transaction as well as the previous block hash values together with a time stamp that checks transactions at the moment the block was created and makes it impossible to modify the records, as they are reliant on preceding records, as illustrated in Figure 3. Blockchain is distinguished by the facts that data cannot be updated because it is distributed and kept in a reliable way.

The Blockchain Functioning
A network with devices (users) who are interested in communicating through blockchain has to be established in order to use blockchain technology. The node is referred to as each participating device. Each node produces two keys: private and public. As the name indicates, the private key is recognized by all, and the user uses the private key to generate a signature. In summary, asymmetric encryption is employed to satisfy the information security requirements. To avoid any abuse or disturbing data of a blockchain, private keys must be maintained secure. The transaction starts with a node and broadcasts it on the network for peer node verification after signing it with a private key. These techniques of verification are called algorithms of consensus and differ according to design objectives in different blockchain systems. After the pairs have checked, miners gather the transaction to produce a block and add that block with time signature and unique ID (i.e. hash) to the blockchain to avoid future changes. The new block will be connected to the previous block using its Hash, and the next block will connect to this block and so on. The general workflow of the blockchain stand is presented in the Figure 4 below.

Traffic monitoring system
A proactively tracking system that helps manage traffic violations, prevent accidents in traffic, proactively identify potentially harmful drivers and reproduce offline situations of accident traffic is the global vehicle traffic monitoring system (GVTMS). The Internet of Things (IoT) is an interconnectedness of data flowing devices and services. This not

only reduces expenses, but also significantly manages traffic through IoT technology integrations in different road remedying components such as traffic signals and intelligent car parks.

Analysis of the traffic Management systems
Due to their uses, performance and cost, the traffic data may be measured using sensors, detectors and other different ways, which are mostly connected to purchasing, installation and maintenance.

Pneumatic Instruments
The pneumatic road tube was the first invasive traffic detector used today and still used to quantify traffic flows in general, due to its simplicity and low cost. These detectors have to be positioned perpendicular to the flow direction on the road surface see Figure 5. When a vehicle's axles cross a tube a burst of air pressure occurs along it and this air pulse shuts an air switch, which then produces an electrical signal that must be sent on to an analysis system.
When a vehicle's axle passes across the piezoelectric sensor, it causes a voltage to arise in parallel with the piezoelectric crystalline material by producing electric cargoes of opposing polarity. The voltage detected is related to vehicle strength or weight. Since the piezoelectric effect is dynamic, if the force remains constant, the initial charge declines. The adoption of a system of these kinds of detection (WIM Wireless Identity Module; see Figure 6), which, combined with more conventional (traffic streams, occupation rate, headway, distance or distance between speed, vehicles and distance of vehicles, results in acquiring information on vehicle type (charges, overall weight, track) is essential not only for more conventional vehicles.

RESULT AND DISCUSSION

The suggested solution provided is depend on the multi-agent systems and utilizes private blockchain to deliver a lightweight and decentralized IoT system authentication security. Figure 7 shows the suggested design based on a hierarchical blockchain structure including IoT devices, sensors, Local Blockchain, which contains IoT devices at the bottom of our suggested design. Fog Blockchain that incorporates fog/edge nodes, and enhances traffic management and traffic management system privacy. These architectures comply with the security trinity (Privacy, Integrity and Disposability) standards and are well adapted to IoT particular scalability, distribution, limited devices and security challenges, such as single faults. Finally, it is possible to use our suggested architecture for a number of IoT applications. This model help to make the traffic management system which help to operate that system easily, such that mainly the cars themselves are concerned. Certain potential evaluation approaches include a reputational system, as shown in Figure 8 shows the evaluation of each vehicle's weight according to its prior network behaviour. The legitimacy of the transmission establishes the credibility of each transmitting data for vehicles. Three major sorts of messages are included on the network, including: beacon message, which is periodically sent out with simple driving status information, emergency alerting messages and communications on three levels sent by witnesses and those with contradicting information. By this model, the technology behind blockchain is the system's backbone in terms of vehicle safety and stability in this model. It must be ensured that the change of traffic signals in other locations does not result in accidents or jams. The traffic management platform analyses the traffic and determines if traffic signals may be changed in real time. If lights can be changed, control apps transmit a request to the actuators of the traffic lights that implement the control. Figure 9 shows the traffic management system with the IoT devices, Blockchain and control applications.

CONCLUSION

The safety and privacy risks of the IoT system are enormous and need to be carefully addressed. There are both advantages and disadvantages to centralized and decentralized systems. Scalability restricts centralized solutions, whereas decentralized options are restricted to delays, overhead computing and energy limitation. We have presented a multi-agent system for lightweight, decentralized IoT security checks. The researcher recognize that study assessment must be focused on stages of construction and testing that indicate the application and efficiency of

the solution in relation to the associated study. The research is nonetheless ongoing and, because of the anticipated of a large deal of details and further contributions being debated, the outcomes should be presented in this paper.

The dependence on automation and data is rising more quickly in order to overcome restrictions like manual operations, confidence, security and privacy. Although there are numerous traditional state-of-the-art technology, challenges such as single point failure or data manipulation still have to be handled. Together with IoT, cloud, data base and machine learning, blockchain technology is able to give a comprehensive answer to these problems. In future this research help to understand the Block Chain to Enhance the Privacy and Security in IoT based Traffic Management System which is help in traffic management system by providing the privacy and security. It is also help to overcome the problem of jam which is produce by the several vehicles.

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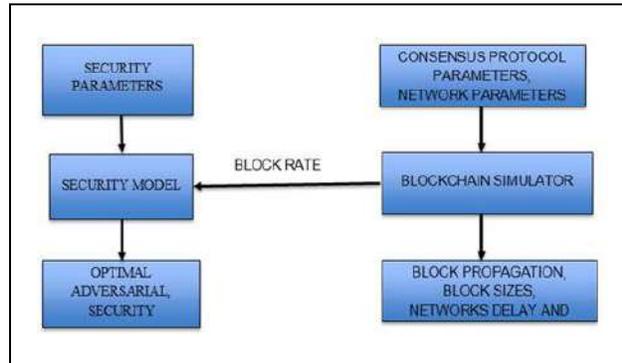
Figure 1: The network control distribution can be restored with the permission of trustworthy mediators in which it will shows the security purpose.
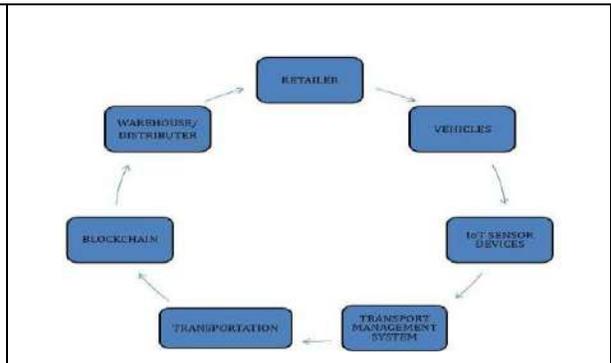
Figure 2: The above diagram shows the process of traffic management system in which how IoT sensor and blockchain enhance.
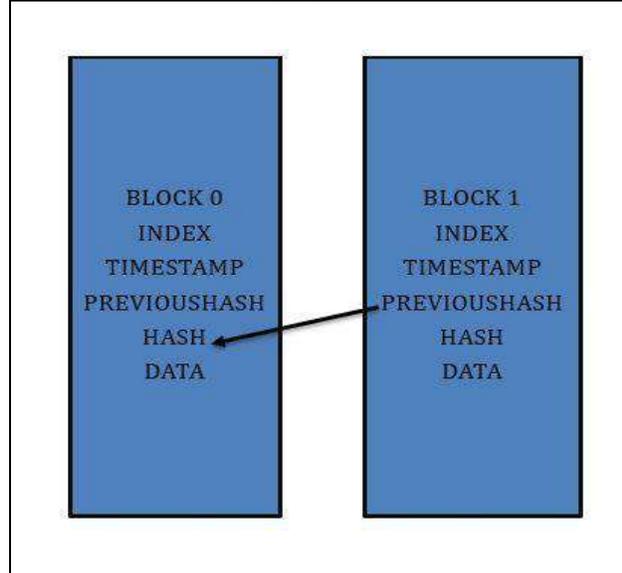
Figure 3: This diagram shows the new data records or transactions as well as the previous block hash value together with a time stamp that checks transactions at the moment the block was created and makes it impossible to modify the records, as they are reliant on preceding records.
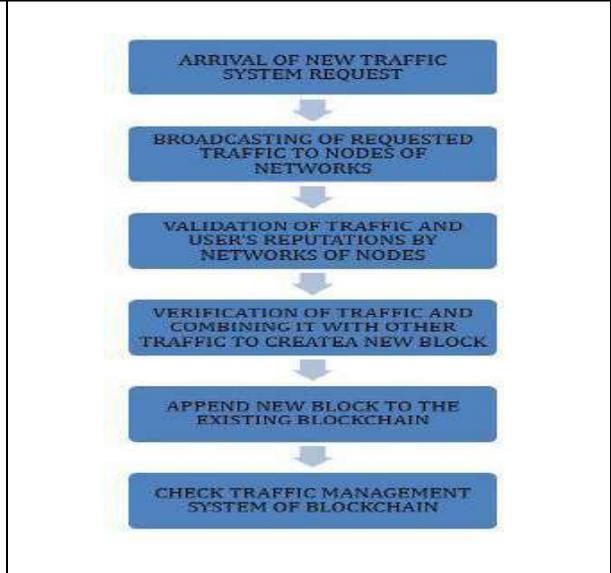
Figure 4: The general workflow of the blockchain stand is presented in which shows the several steps which helps to understand the blockchain concept.
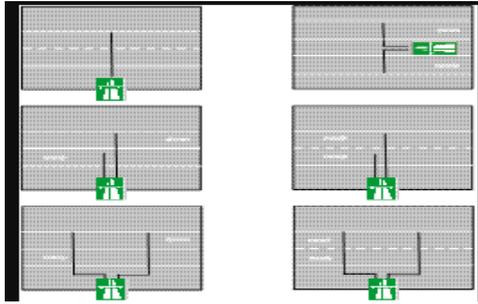
Figure 5: These detectors have to be positioned perpendicular to the flow direction on the road surface [Intelligent Transport].
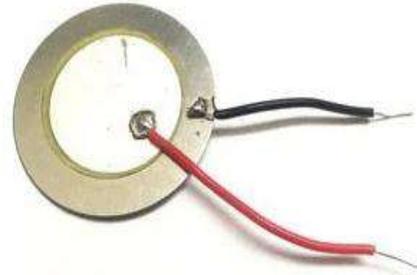
Figure 6: The adoption of a system of piezoelectric sensor for detection which, combined with more conventional (traffic streams, occupation rate, headway, distance or distance between vehicles [robu].
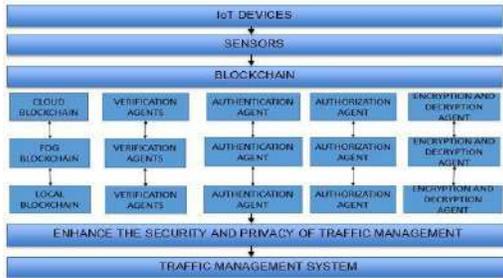
Figure 7: The suggested design based on a hierarchical blockchain structure including IoT devices, sensors, Local Blockchain, which includes IoT devices at the bottom of our proposed architecture. Fog Blockchain that incorporates fog/edge nodes, and enhances traffic management and traffic management system privacy.
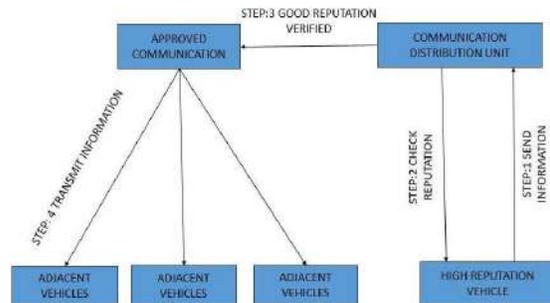
Figure 8: Certain potential evaluation approaches include a reputational system which help to detect the vehicles locations.
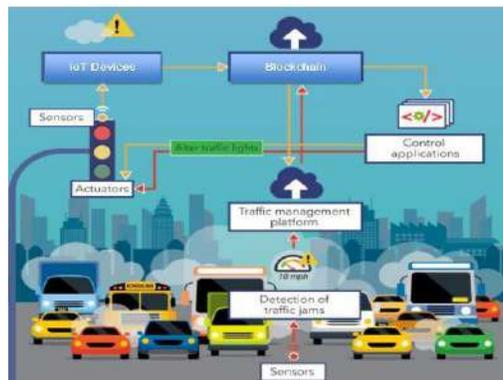
Figure 9: In the above diagram shows the traffic management system with the IoT devices, Blockchain and control applications.

RESEARCH ARTICLE

Web Cypher -A Phishing Classifier

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ABSTRACT

Phishing websites have become a major threat these days. Phishing websites contain spam, malware, ransom ware, drive-by exploits, etc. Phishing websites often resemble highly popular websites to lure unsuspecting users, victims of a trap. Fraud victims suffer financial loss, loss of personal information, and loss of reputation. Therefore, it is essential to find solutions that can neutralize such security threats promptly. Phishing websites have traditionally been detected using blocklists. High-traffic websites that host lists of blacklisted websites like G. Fish tank. No blacklist method is complete in two respects and may fail to detect newly created phishing websites. Modern machine learning various techniques are used to classify and detect phishing websites. This article compared several learning algorithms and found the highest accuracy of 97.8% on the SVM algorithm.

Keywords: Classification, Phishing, Support Vector Machine, XGBOOST, Phishing website detection

INTRODUCTION

Phishing is an illegal tactic that aims to obtain personal and financial data from individuals through deception and manipulation. This is often done by creating fake emails or websites that pose as one by a reputable orga-nization and tricking people into providing their personal information. Hackers also use various tools to intercept login credentials from internet accounts, in order to steal sensitive information. Phishers might use multiple channels to conduct their attacks, such as email, web links, instant messaging, online forums, phone calls, and text messages. The goal of these attacks is to mimic legitimate content for luring people into telling away their personal information. The ultimate objective of phishing is to acquire sensi- tive personal information for financial gain or identity theft. These types of attacks are causing a significant adverse effect on the world economy. In accordance to the latest study on phishing, its attacks are primarily targeting webmail and financial/payment organizations. Criminals create illegal copies of legitimate websites and emails, generally from financial institutions or other organizations that deal with financial data, to get confidential information. The insignias and taglines of an authentic company were used to create this email. Images or a whole website can be copied because of HTML's architecture and structure.

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Additionally, it contributes to the Internet's explosive expansion as a communication tool and makes it possible for consumers to misuse corporate names, insignias, and other identifiers that serve as authentication measures. The user information is sure to be misused. Hence, phishing very pressing matter in our community. Features of a webpage, like its uniform resource locator, its content, its source code, and the website screenshot were subjected to various anti-phishing studies. To save their users, companies require a robust system to detect phishing websites. Hackers steal data and plant ransom ware or malware to extort money or just for the fun of it[2]. Using the ML[3] algorithm, suspicious domains can be found easily. The current method of using a blacklist to detect phishing websites is outdated and relies on someone's maintained list or expert opinion.

Background information and Re- Lated works
It is a strategy employed by cybercriminals to collect confi- dential data from individuals by deceiving them. This can be accomplished through a variety of techniques, including
• Keystroke logging: this technique employs malware to record every keystroke made on a target's device, en- abling the attacker to acquire login credentials, sensitive financial data.
• DNS tampering: this technique redirects targets to a harmful website by corrupting DNS servers.
• Other methods: There are other methods that the at- tacker may use to achieve access to personal data, such
•as creating counterfeit websites or messages, psycho- logical manipulation tactics, and deploying malware.
It is essential to be aware of these tactics to safeguard your- self from phishing attempts.

A. Classification of phishing attack methods
Phishing exists as a tactic used by cybercriminals to obtain sensitive information from individuals and organizations. These attacks might be difficult to detect and come in various forms. The most occurring phishing attack is email phishing. This type of attack involves sending emails that appear to be from legitimate organizations, such as banks or government agencies. These emails typically ask for personal information, such as login credentials or credit card numbers. They may also contain links to fake websites that are designed to steal personal information. Another type of phishing attack is known as spear phishing. These attacks are targeted at specific individuals or organi- zations and are typically more sophisticated than other kinds of attacks. The attacker will often use information that they have gathered about the target to make the phishing attempt more convincing. For example, they may use the target's name, job designation, or company name in the phishing email. Some other categories of attacks might be whaling, and phone/text. Whaling marks entities with administrative access and control. Phone/text phishing involves tricking the target into handing out personal info via the phone or through text messages. Watering hole attacks contaminate a website known to the target with malware, stealing personal information when the target visits the website. To protect from phishing, individuals and organizations should keep software updated, be cautious of unsolicited emails, and be aware of phishing signs.

B. Related Work
Numerous research efforts have been undertaken to safe- guard individuals from fraudulent websites, known as
phishing sites. Various techniques have been employed, such as utilizing ML algorithms, maintaining lists of known malicious sites, analyzing visual similarities, classifying characteristics of URLs, and investigating the DNS of suspi- cious websites. Our study falls under the ML category. To provide essential information for our investigation, we will also provide a brief overview of other approaches to phishing detection. Purkait conducted a thorough examination of phishing identification methods in his extensive analysis of the topic. Showcasing the findings of others that employ several plans to obtain utmost precision and overhaul the mecha- nism. The objective of this comparison is to demonstrate the benefits and drawbacks of ML prediction models and to evaluate their performance in determinating phishing attempts. Our experiments indicate that models specifically designed for catching phishing are more effective. The collected characteristics regarding the URLs of the sites are refactored into a marker matrix. " Phish-Storm"[10], is a phishing categorization program, which can identify a phishing domain in realtime. It is packaged as a real-time tool to save users from potential phishing attacks. It provides an evaluation system that ranks websites based on their phishing capability. Large amounts of elements are textual parts of the domain, with a few 3rd party providers.

C. Machine Learning Algorithms

Several studies have been conducted on the use of ML algorithms for identifying phishing websites. Naive Bayes, Decision Tree, Random Forest, SVM, Logistic Regression, and KNN are a few examples of the algorithms that have been applied to classify phishing and legitimate websites. These algorithms were effective in pinpointing phishing websites with high accuracy. Additionally, some studies have also used ensemble strategies such as Random Forest, AdaBoost, and Bagging to improve the execution of the classifiers. These ensemble techniques have been found to provide better results than the separate classifiers alone. Also, some studies have used "deep-learning" techniques such as "CNN" and "RNN" to improve the performance of the classifiers. These "deep-learning" techniques provided better results than conventional ML techniques. Nonlinear or linear data can be classified using SVM. In summary, when given original training data, the algorithm transforms it into a higher dimension via nonlinear mapping. To keep the data of any two classes distinct, a linear optimum hyperplane is found in this dimension. SVMs can also be used for classification and numerical prediction. The most basic version of SVM is a two-class issue with linearly separable classes. A straight line can be drawn to separate the classes in a 2-D issue; in fact, numerous lines

can be drawn.

Literature Review

Phishing exists as a severe safety concern which exists on Inter-web. Phishing websites steal sensitive financial and personal information from consumers. These websites appear to be authentic and attain private information. As a result, phishing assaults leverage human susceptibilities, which are tricky to mitigate, although being crucial to concentrate on enhancing identification systems. In this area, we show a number of efforts in cyphering phishing domains. Salihovic et al. conducted an experiment on UCI's phishing websites dataset using several machine learn-ing algorithms. In the first trial, they used the original dataset with 31 features. In the following experiment, they applied marker selection techniques, specifically BestFirst+CfsSubsEvaluation and Ranker+Principal Com- ponents, to the dataset. The results expressed RF with the most heightened accuracy of 97.33% in the foremost trial. The first feature selection technique reduced the size of markers to 10, resulting in a slight decrease in an average accuracy of 1.53%. The second feature selection technique only retained one feature in the dataset, which led to an increase in the accuracy of Random Forest and Support Vector Machine, while the accuracy of other algorithms decreased by 0.09%. The same approach was also applied to a spam email dataset and Random Forest performed the best. This demonstrates that the same marker selection technique can be used for both phishing and spam email datasets. In the study, several methodologies were used to com- pare outcomes for phishing domain categorization. The authors employed a dataset of phishing domains using UCI ML Repository. Before feature selection, the Random Forest with REP Tree had the greatest accuracy of 89.1%. After utilizing Correlation Attribute Evaluation to pick features, 12 characteristics were chosen, and all algorithms' tests were repeated. MLP accuracy climbed from 85.5 percent to 89 percent, the highest for a smaller dataset, whereas Rotation Forest accuracy declined to 87.1 percent.

The Proposed Svm Approach For Classification Of Phish- Ing Websites

SVM being a supervised ML method is suitable for classifi- cation regression tasks. It is considered an avant-grade tech- nique that is rapidly gaining popularity due to its success- ful performance in various data mining challenges. SVM is particularly effective in handling large datasets and in solv- ing nonlinear identification problems. It is a statistical-based learning approach. Working with multi-dimensional data is one of the benefits of using the SVM to train the system. An optimum hyper- plane that classifies fresh samples is produced by the SVM classifier using input-labeled training data. Fig. 1 illustrates how SVM creates a hyperplane amongst datasets by balloon- ing the margin. To determine the efficacy of the proposed SVM technique for identifying phishing websites, two performance metrics were considered, namely accuracy and recall. The metric of precision is a widely recognized standard for evaluating clas- sification results. Calculated as the proportion of sites clas- sified correctly in relation to the size of samples. In contrast, the recall metric (true +ve rate) focuses on the frequency of correctly identified phishing websites out of all the actual phishing websites. Being important ensuring that the pro- posed SVM technique is able to detect a maximum number of phishing sites.

Datasets

A phishing website can be detected using PhishTank or Open Phis. APWG, Mozilla, and Kaspersky use data from PhishTank through an API call to categorize a website as a phishing website. Being an appropriate source for uniform resource locator-based[5] analysis because it does not save the content of web pages. Common crawl from high-traffic search engines like Google, and Bing can tell us if the site is legitimate. UCI ML[6] repository's dataset is a public repos- itory to find a phishing website, which has 11,055 records, every single one enclosing 31 markers, utilizing Kaggle data- set.

Attribute Extraction

Let's talk about some of our conclusions and observations. The pointers/features we are planning to use are:

• **Domain name features**

1. Internet Protocol Address - The IP address in the domain name is a big indicator
2. Extremely long URLs - phishing sites use huge text in links to hide their true identity
3. Using bit.ly or tinyURL - used in WWW to com- press long URLs

• **Domain properties**

1. Uptime of Domain - minimum of six months is the indicator of being a legitimate website and this data can be gathered from WHOIS.
2. DNS database - Empty record of DNS is a clear indicator of a phishing website.
3. In Google's Index - Almost every site on the inter- net is indexed by Google Hence if some site is not found in it can be flagged as Phishing.

• **Action supported characteristics**

1. Domain Forwarding [8] - These sites are known to forward to many other sites to mask themselves.
2. Disabling mouse activity - Javascript is used by phishers to disable mouse action on the website. So the user can't see the source code clearly
3. Disabling Backtracking - Phishers disable the back functionality so the user stays on the website. URLs[10] contain distinct traits and patterns that may be categorized as features. In URL-based model training, it is necessary to identify the dominant characteristics, we must extract these characteristics in order to create a dataset for training and testing.

Inquisition Of Research Gaps

Till now, we learned phishing comes under social- engineering assault where attackers leverage fake personified web pages to lure less knowledgeable users to scam them into their false construct. It is necessary to comprehend the psychology of victims in order to determine whether they are concerned about security concerns when they have the capacity to adjust security features. There are various scholarly papers on phishing security[11]. But there still is a wide cavity between the practical use and research papers. There is a significant difference between the results of research and those in the industry when it comes to identify- ing positive outcomes. Academic and literary studies often rely heavily on false positives as indicators, which can result in a disconnect from real-world applications. As a result, these algorithms may only be effective in detecting new, previously unseen phishing sites. In contrast, companies often use lists to categorize phishing websites. However, these lists can be slow to respond to sudden, unexpected attacks and may not be able to adapt to new or unforeseen circumstances.

Observations

Phishing assaults are always developing, and the cyber world[13] is frequently bombarded with new forms of at- tacks. As a result, no one detection strategy[15] or algo- rithm can be labeled as the best at producing precise find- ings. According to the literature review, Random Forest pro- duces superior outcomes in the majority of instances. Algo- rithm's performance differs depending on the data set [16] utilized, the split ratio, the feature selection strategies em- ployed, and so on. Experimenters favor developing machine learning models[10] which identify

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phishing from the great- est value for evaluation parameters and the shortest training time. As a result, future research should concentrate on these features of phishing detection.

CONCLUSIONS

Because of their profound relevance for individuals busi- nesses, phishing websites can cause financial losses. Phishing website detection may be an active subject. artifi- cial intelligence technology has been successfully applied in various fields; Angel websites can be categorized. support vector Mechanical engineering was introduced as a hybrid in this study on a method to identify legitimate, suspicious, or Phishing kind of websites (SVM) [17]. Experiments found the accuracy of the proposed hybrid technique is 90.04 To identify the most crucial pointers, our method uses var- ious property selection [18] filters. The filtrate of these filters is examined, the traits provided by the majority of the filters as the most important are chosen for use in the classification step. Furthermore, we discovered that with shorter property se- lection we can achieve the exact accuracy. Random Forest required consistent 3 seconds before feature selection, and about 20 to 160 milliseconds after it. This is significant be- cause by reducing features, we shaved the time required to develop a model, which further improved the efficiency and is the major outcome of our study.

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Feature Rank	Features from Dataset 1	Features from Dataset 2	Features from Dataset 3
1	RandomString	having_Sub_Domain	Request_URL
2	DomainInPaths	age_of_domain	popUpWidnow
3	NumUnderscore	Page_Rank	URL_of_Anchor
4	RightClickDisabled	Prefix_Suffix	SSLfinal_State
5	ExtFavicon	web_traffic	URL_Length
6	NumPercent	Statistical_report	having_IP_Address
7	NumSensitiveWords	having_At_Symbol	SFH
8	EmbeddedBrandName	SFH	web_traffic
9	TildeSymbol	Redirect	age_of_domain
10	SubmitInfoToEmail	Google_Index	

Fig. 1: SVM for phishing websites classification	**Fig. 2: Datasets**

RESEARCH ARTICLE

Emotion Prediction in Pets by analyzing Body Posture and Acoustic Pattern

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ABSTRACT

Pet ownership contribute positively to human well beings. Compared to the well being of other owners, dog owners have reported higher well being . It is typical for pet owners to be constantly worried about the health and comfort of their animals. This research paper intends to use image processing and machine learning techniques to track changes in behavior and alert pet owners via theirs mobile application. This study primarily looks at the activity patterns of dogs when they are left alone at home or at pet care centre. Sensors and surveillance cameras serve as primary data collection tools. The security camera's audio feature is used to identify the dog's barking behavior. Images captured by the camera provide input to the body posture identification system. Neural Network, Decision Tree Mechanism and Reinforcement learning are used to identify and classify dog's emotional behavior. This research study has successfully achieved the following level of accuracy. Emotion Recognition by dog body posture (89.79%), and emotion recognition according to barking pattern (92.43%) The research was able to recognise the anomalous behaviour of the dogs using the accuracy levels mentioned above.

Keywords: Emotion Identification , Neural Network, Pet Animal, Reinforcement learning

INTRODUCTION

Dogs are highly trained animals that make a variety of sounds according to the circumstances. Sensory abilities, actions such as barking, chasing, and monitoring are their main characteristics. Dog emotional reactions and tones are a means of communicating with other animals and humans. [1, 3]. The dog's facial expressions and noises are often indicative of dog reactions and are related to dog behavior. This research work is focused in identifying dog's emotion based on its communication and its body posture when the owner or caretaker is away from the pet dog. Analysis is done in 2 stages

Based on still body posture

This study proposes a system for emotion recognition for dogs that can automatically identify emotions like rage, panic, cheerfulness, and calmness. The objective of this research work is to convey any kind of casualties or immediate attention required to the owner when the owner is away from the pet dog. It concentrates on a deep learning algorithm that uses automated pose estimation analysis to identify various states of emotions in dogs. In order to accomplish this, we employed a library of 400 full-body dog photos, each of which contained 100 samples for the emotions "angry" ,"fear", "content," and "relaxation"..

Based on acoustic properties

Dogs communicate acoustically at frequencies ranging from 1000 to 2000 Hz. Dog noise has different frequency levels depending on aggression. Dogs make varying noise to communicate with humans. Barking characteristics such as tone, pitch, and interval between barks are used to discriminate dog barking [4]. Dogs barking at a specific pitch can aid in the identification of dog behavioural patterns ie low-pitched barking indicating aggression and high-pitched barking indicating fear [5]. High-pitched, long-spaced dog barking has been proven to be an indication of excitement and play. Visual classification of dog sounds can help in understanding of dog behaviour [6,7] and the frequency spectrum was used to analyse variations in the dog's bark, and the dog produced a different bark for each emotional situation. A variety of techniques were used to analyse the barking pattern, including a machine-learning algorithm for identifying the precise context of dog barking. To classify different barks, an evaluation was conducted depending on the dog's acoustic properties [8.9]. There are acoustic scales for dog barks, such as bark tone, bark length, and bark interval [10].

Most animals seem to use a universal code based on three aspects of their sound pattern :

1. Pitch: Low sounds, like a dog growling, usually indicate threat. Possible anger and aggression. These are interpreted as meaning "Stay away from me." A high note means the opposite. dog is asking them to come closer or suggest that it is safe to approach them.
2. Duration : In general, the longer the tone, the more dog-like make a conscious decision about what is going on and what he is going to do Next. Growls in short bursts and if it last for only a short time, indicate an element of fear. Or Dogs are worried about how well they can handle an attack.
3. frequency: The sound repeats frequently and immediately indicates the grade excitement and urgency
Not repeated at all - usually indicates a low level of arousal. Sometimes A strange chirping at the window is just a small sign of interest.

In our proposed method, we analyse a pet dog based on the captured image and the its barking pattern captured around that time with in an interval of 4 seconds. The two independent modules gives the result of emotional analysis from image and emotional analysis from barking pattern respectively. Finally the results of both are combined together in a objective way to predict the exact behavior of the pet.

State of the Art Literature

Numerous scientific studies on canine emotions have previously been published. The psychological and sociological effects of dogs living with people are frequently studied. The " Dog Facial Action Coding System (DogFACS)", created by a team of academics from around the world, links a few dog facial expressions to its corresponding emotions [5]. Using facial recognition technology with the aforementioned DogFACS, the University of Exeter developed an emotion detecting system. in light of studies pertaining to the automatic recognition of canine emotions [6]. Franzoni *et al*[7] .'s creation of a canine emotion classifier based on face analysis involved using machine learning algorithms to sets of emotion image data. In addition, research has been done to use machine learning to interpret the body language of dogs. A programme for recognising behavioural patterns was created by Brugarolas *et al*. [8] using signals out from dog's wireless system. A sensor-based canine emotion recognizer was created and coded by Aich and colleagues [9]. In this instance, the dog's neck and tail were fitted with sensors, and the information they acquired was used to train an artificial neural network. By developing a cutting-edge system for dog observation, Tsai *et al*. [10] also made a significant scientific contribution. The authors were able to predict a dog's behaviour by separating between the emotions of happiness, rage, and sorrow as well as a neutral state using

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continuous picture and bark analysis in combination with machine learning algorithms for image identification. Maskeliunas *et al*. [11] used cochleagrams to analyse the emotions of dogs based on their vocalisations, categorising canine barking into the categories of angry, crying, pleased, and lonely. Raman et al. automatically identified dog body parts and locations. [12] using DeepLabCut and CNNs. Dog barks' acoustic characteristics have not yet been studied. The signal analysis revealed auditory patterns in the information on dog barking [7-9]. Humans can categorise information about dog barking patterns in relation to the environment in which the noises are produced based on the study. Based on the pattern of sound production, humans can train dogs [10,11]. Machine learning must be used to analyse barking sound patterns because people and dog owners can only now classify dog barks in relation to specific events, such as a stranger entering the house, fear, play, etc. However, additional facets of dog noises have not yet been investigated. The acoustic features of dog barks must be investigated and then trained in order to ascertain the environment in which the sound was created [12,13]. Studies have been done in the past on topics like sound structure, sound-making context, and acoustic pattern analysis. Different contexts have been used as the basis for spectrogram analysis of dog bark acoustics [14]. Through feature extraction from the sounds made in various circumstances, dog sounds can be examined. These characteristics include voice cycles, loudness, intensity, and so on. Age, sex, and the context of the dog's voice are all classified using machine learning techniques like classification trees and k-nearest neighbours [15,16]. Machine learning must be used to categorise canine sounds since dogs make sounds in a variety of circumstances that humans can only recognise to a certain extent [17,18].

Currently, humans are unable to categorise situations like dog noises in crowded places or noisy environments, or canine intraspecific communication. Dogs communicate acoustically between the frequencies of 1000 and 2000 Hz. Dog sounds fluctuate in frequency according to their level of hostility. A dog produces noise in a variety of circumstances and occasionally without meaning to, but simply to communicate with other canines. Humans have traditionally identified dog barks based on their characteristics, such as tone, pitch, and inter-bark intervals [19]. A dog's barking at a certain pitch can assist define the dog's behaviour; for example, low-pitched barks indicate aggression, whereas high-pitched barks indicate fear [20]. Dogs who bark more frequently and at a higher pitch are thought to be playing or being excited. Understanding dog behaviour is aided by the visual categorization and analysis of canine vocalisations [7].. Dogs respond to their owners in accordance with their directions. Dogs' following responses to their owners' commands have been recorded in playback trials to see how they reacted to them [11]. Different methods, such as machine learning algorithms, have been used to evaluate dog barks in order to pinpoint their precise circumstances. For the classification of various barks, analysis based on canine acoustic properties has been done [18]. Acoustic measurements have been used to assess and distinguish between the barks of various breeds of dogs. There are acoustic measurements for dog barks, including the tone, duration, and spacing between barks [11]. The context of canine sounds has been investigated in numerous research projects employing the machine learning method. With practise, machine learning models can acquire new talents [12]. Complex data has been effectively classified and forecasted using machine learning techniques [33]. Deep learning has enhanced the machine learning learning architecture. The area of reinforcement learning in machine learning is used in a variety of contexts to forecast probable behaviour. Reinforcement learning creates a policy for the provided action-value function based on the observed behaviour. In the training process, regularisation alters the hyperparameters, such as environment, for evaluating numerous situations. The environment in the proposed work is straightforward, consisting of a dog and its owner; as a result, there will be less complexity.

Proposed Method for Pet Emotion Prediction

The goal of this study is to use machine learning methods to create a behaviour assessing tool from canine body positions recorded on camera. As a result, landmark points will be identified first and used to train the model. Unlike prior studies in picture canine emotion recognition, this work should be capable of examining the entire picture of the dog and realise tiny variations in the animal's position. This software artifact should perform more consistently in use than previous studies that focused on facial expressions of emotion since the dog's head does not need to be in continuous alignment with camera. This will result in a more useful detector, particularly with moving pets. The literature largely concurs that certain fundamental emotions like Happiness, often known as joy, playfulness, contentment, or excitement, is the most prominent feeling associated with the pet.. It is also common to

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list the opposing emotions of melancholy, anguish, or frustration. Anger, fear, surprise, and disgust have also been noted as basic emotions that apply to dogs [3,13–15]. Here, it's important to note the research of psychologist Stanley Coren [14], who concluded that emotional maturity should be similar to average canine intellect because it is similar to that of a human infant of 2.5 years. As a result, when characterising the emotional responses of dogs, Coren includes affection, love, and suspicion. The majority of dog-related research acknowledges the existence of these canine sentiments, and since posture analysis can identify these sentiments, they are taken into consideration for this work. Although grief, surprise, and disgust are widely discussed emotions, they will not be covered in this article because the primary method for identifying them is facial assessment [13].

The following is the software development structure:
1.Gathering Pet Dog Images;
2. Steps in Preprocessing the image;
(a) Identifying Dog-Contained Areas;
(b) Downsampling Image and Modifying Dog's View Direction;
3. Identifying landmarks;
4. Emotion Recognition Model:
 (a) Apply Learning Process using Neural Network considering all landmark data;
 (b)Decision Tree containing a selected set of measured pose metrics.

Cao *et al.* [20] compiled the Animal Pose Data Set, which includes comments and photographs of cows,sheeps, horses cats, and dogs for a work on animal gesture recognition. The data set includes 1809 examples of dogs in total, with some photos including multiple animals. The Data Set termed as Animal Pose has comments for all of the 20 keypoints, similar to Stanford Extra. The accessible keypoints for both datasets are displayed in Figure 1 identifiable landmark points are produced as a result of this combination, which are then employed for model training. Figure 3 shows the proposed algorithm. Dog Emotion Detector, The following two methods are investigated in this work.
 1. A neural network's training input is a set of coordinate data from landmark detection. The benefit of this strategy is that it gives the model access to all available data. 2. Various pose metrics are calculated by linking several landmarks, such as the weight distribution. By combining this simplified training data along with a fundamental classification method (such a decision tree) and counterfactual explanation techniques, it is reasonable to learn more about how dogs express their emotions. The popular Python module Sklearn is utilised for the model construction.

 Image Analysis
The reference points plotted in the image should be preprocessed because the images can be of varied sizes. To enable image comparison, all parameters are set in respect to the size of the cropped image. To make sure that all dogs look in the same direction, images are also mirrored based on where the landmark points are located. The emotion classes of anger, fear, joy, and relaxing are all simple to encode. As a consequence, a binary field is added to all of the data points for each class. This prohibits the classifier from generating predictions using the natural order of these numbers, in contrast to integer encoding. Prior to the final model training, a grid search strategy employing cross-validation is carried out to find the best model parameters.

Decision Tree Method for assessment
To provide acceptable metrics for forecasting a dog's emotion, various fundamental postures are first broken roughly into the state of certain body parts.. Figure 2 demonstrates the various scenarios of barking Pattern by a pet dog A sample five dog body postures [20] are discussed below
1. A dog in a peaceful stance is unconcerned regarding his environment, which makes him comfortable and friendly.
2. A dog that is startled has seen something in his immediate area and has become excited or alert. A scan of the immediate vicinity for a potential hazard or interesting object frequently follows this attitude.
3. A dog acts aggressively in a dominating manner to signal that it is the dominant member of the pack and that it will attack if challenged.
4. An aggressive dog that attacks in reaction may do so as well, but his motive is fear.
5. A fearful and worried active submissive canine exhibits weak submission signals.

Acoustic approach

In this approach, we record the same pet dog's barking pattern acoustically along with collecting pictures. The differences in dog barking noises are caused by the dog's behavioural responses to various settings. These noises vary in frequency, volume, and rhythm and are connected to the dog's behaviour in various situations, such as when it meets its owner, detects a stranger, engages in combat with another animal, etc. The following scenarios were created by the writers to elicit the dog's behavioural responses. 29 sound metrics are incorporated into the variables for sound. This includes measures for power, intensity, density variation, energy variation, maximum and minimum pitch, number of voice cycles, and tone may be retrieved from a single canine bark. These taken into account characteristics described the generated sound quality, which varied significantly over time. According to the various settings, the dog sounds varied. Using spectrogram analysis, the changes in the noises made by the dogs can be analysed. Other canine noises were taken into consideration for study in a similar way. 1250 specific audio files were examined, as well as the audio were categorised into several contexts. This experimental study makes use of three publicly available datasets for categorization. These are the Urbansound8k (US8K) ESC-50, and ESC-10, [17, 18]. Different environmental sound types are included in these datasets' audio recordingsboth indoors and outdoors. We used a subset of the US8K dataset, which contains 8732 audio files. Air conditioner, children playing, dog barking, car horn, gunfire, motor , street music, dog bark, car horn, siren, jackhammer, and drilling are among its ten categorizations. The technology for analysing sound conditions was developed using the feature extraction of the sound elements. Utilizing the features particular to the dog bark, sound classification was carried out after feature extraction. The provided methodology was utilized to classify dog bark using feature extraction and contextual information. Utilizing the pattern of barking, dog sounds were categorised. The information about the observed dog barking patterns for the various settings was analysed to categorise the various dog sound categories. The reinforcement learning technique for predicting dog sounds is shown in Figure 4. It includes the Environment and the Agent.

Environment : The environment consists of labels, learning layers, input sound, and rewards.
Input *:* input The recorded dog bark or from the dataset can be provided so that its features could be examined serves as the input sound.

Layers of Feature Learning

Sound features were collected from the input sound and then examined to make the prediction. For classification, Reinforcement Learning methodologies are used.

Label the outcomes with a reward

In order to improve training and future predictions, predicted sounds were labeled. Based on accurate and inaccurate predictions, there was a reward for each sound that was learned and forecasted. Using learning layers, the highest-reward was assigned to accurate predictions. The various dog sounds and their related sound movements were taught to the agents. Prediction policy was employed to ascertain the dogs' sound patterns using the sound features that were retrieved. The classification strategy goal is to identify the best scenario from the data that has been collected. It also includes data from the learning layer of the sounds that were trained, as well as previous forecasts. With the use of this method, predictions were made effectively, and more updates to the dog's learning sounds were made for better performance.

Learning Algorithm for SC('Sound Classification')

Based on the labelling data from the input sound, a sequence of dog barking audio recognition was established in the SC process. For the purpose of identifying context-based dog sounds, acoustic characteristics were taken into account. The elements that could be retrieved from the pet dog barking noise were used to create a model that could determine its circumstances. For the purpose of learning,, a classification method was used. Based on the auditory characteristics of the various situations, these models were utilised to predict dog behaviour. The feature vector is denoted by x Rn and its associated sub components, $x1... xn$, are referred to as feature variables in the sound classification problem, and classification variable C holds entries on (0,1). The goal is to construct classification

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model using training data comprised of 'n' observations, Dn = ((x1, C1), (x2, C2),... (xn, Cn)), and with the the probability distribution p. (x, C). The predictor variables describe the sound classification model, x(n + 1), which is utilised to label various instances. The sample data of True Positives (TP), False Positives (FP), False Negatives (FN) and True Negatives (TN) determine the validity of the model for accurate prediction and classification (FN). The accuracy can be expressed as (TP + TN)/N and the error rate as (FN + FP)/N. N represents the number of TP, FP, TN, and FN occurrences. Table 2 shows how accurately they were predicted. 800 cases in all were used to determine the accuracy prediction. The proposed method will reduce the discrepancies in the forecasts and the error rate. The Q-learning algorithm is used to explain algorithms for reinforcement learning. Q-learning can learn an effective method even in the absence of an operational prototype by changing the reward and action of a state known as the Q function. It attempts to choose an action at random, optimises the reward, and determines the next best course of action for the current situation. The sound predictions were made using this technique due to the computational learning efficiency of Q-high learning. A learning algorithm that returns the highest Q value for each state is used to determine the best course of action.

Proposed Learning Method

Initial state (s), Action set (a), Update Sound (k), Learning Rate ($\propto$,), and Discount Factor β are inputs.

Notations: t stands for the period between sounds, yt for actions taken in response to certain noises, st stands for the dog sound's condition of time,

rt for the state's reward,

To assess the update functionality of Q initiate I = 0, t = 0, and Q0 (s0, a0) = 0 for the time interval t between sounds, the following sample set is used:

do the chosen action (y, Qt (st, yt)) rt to receive the reward (st, yt)

$$Q(t+1)(st, yt) \leftarrow Qt(st, yt) + \propto t[rt + 1 + \beta \times \max a \in A\, Qt(s(t+1), y) - Qt(st, yt)]$$

$$Q(t+1)(st, yt) \leftarrow Qt(st, yt) + \propto t[rt + 1 + \beta \times \max a \in A\, Qt(s(t+1), y) - Qt(st, yt)]$$

// Method to update
A← A∪ (st, yt , rt) // Adding a new sample
if i=k then for nK
do (s, y,r) = getsample(A)
end of for loop
initialize i to 0
if loop ends
increment i
for loop ends

The Temporal Difference (TD) change, which was applied each time a voice got sensed in the environment, is represented by the action value of the function Q(t+1). The best possible prediction of the obtained sounds was made using this update. The learning process for the acoustic model approach is broken down into a number of phases and the actions that each one takes in the algorithm. The expected benefit of acting in state s while following the optimum course of action is represented by the symbol Q (s, a). The Q-table is initialised before a specific action is chosen for analysis. A reward is given for each action and returned to identify the action. The learning function for various actions is updated in the Q-table. Based on the provided instance, the k-nearest neighbour classifier predicts the dog's sounds. For the most common sounds included in the " 'k' instances, it fins out the sound named with the letter 'x'. The Euclidean distance technique was used to estimate the neighbours that were the closest to the continuous variable "x". The prediction algorithm employed the labels for the k-nearest neighbours in the sounds. The feature selection process for categorising the sounds was done using the wrapper selection approach for the model design. It is helpful for automatically choosing the data that are most pertinent to the outcomes predicted by

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the model design. Training: Pet dog's barking pattern is the input,during the training process, and its features and labels were extracted and loaded. The K-NN algorithm was used to extract features and forecast behaviour. The learning algorithm was trained on the training dataset to make predictions by the computer. The instruction was then put into practise by showing various dog barking scenarios. For better performance predictions, modifications to the dogs' barking patterns were verified. On the basis of the dog sound attributes, predictions were formed as in figure 5. 3.3. Figure 5 depicts the testing procedure, which includes required input sound, extraction of features, learning model, and the last sound classification model. The barking of a pet dog was given as the input, and characteristics were extracted from it. Predictions were made based on the characteristics of the sounds using the model created using the learning algorithm, which determined the type of sound received as input. As an outcome, dog sounds were classified based on the type of input sound utilised.

RESULTS AND DISCUSSION

Before instructing the decision tree classifier, it was verified that the previously processed photos were suitable for predicting a dog's emotional state. For example, the "defensive aggressive" position is connected to rage. The suggested classifier calculates a positive correlation value for this input image when the animal's distinguishing features—raised ears and tail, lifted head, and widely opened mouth—are recognised. The distinguishing traits of the assigned attitudes do have certain exceptions, though. For instance, raised ears are frequently a sign of the emotion category "glad," which is categorised under the attitude category "playful." Because the results are influenced by the vast range of bodily signals for happiness, this link is not evident from the information since the position "playful" could only be one method that dogs might demonstrate satisfaction. Since this decision tree classifier should not be trained with incomplete data sets, the missing data were filled in by averaging the values of each parameter within its emotion class. During this study process, values for 32 samples (8% of the total data set) were filled with an average of 1.5 empty parameter cells per sample.. As per the studies , we understand that even though image and acoustic analysis gives excellent results , In the collective method, we can give more weightage to acoustic model in formulating an aggregate method in final prediction.

CONCLUSION AND FUTURE SCOPE

The combined method of using audio barking pattern and image analysis of a pet dog's body posture to assess the emotional state of the dog has demonstrated enhanced performance in predicting dog sounds in a variety of scenarios. The properties of dog sounds in a variety of settings were predicted and classified using the reinforcement learning method. Based on the entire training process, an accuracy of prediction of 91.37% was attained. On the basis of the pictures from the Animal Pose dataset and the sounds from the US8Kdataset, categorization and predictions were generated. The suggested prediction method proved effective, and it can be used to specific breeds of dogs to test how well it performs in general dog sound prediction. The Q-learning system with k-nearest neighbour teaches the dogs' every state of action throughout certain scenarios. The suggested approach generates an exact calculation by probabilistically inferring the ideal Q-function from the observed data. Dog sounds therefore contain appropriate information that can be learned from and predicted using machine learning techniques. The s drawbacks of this work include the absence of an investigation of the dogs' behaviour in various circumstances, such as various habitats, climatic factors, etc., which still has to be done. Dogs of various breeds could be studied to determine the type of behaviour that they exhibit.

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Table.1: Accuracy prediction using Image Analyzer

	Count of Images taken for study	**Obtained accuracy rate**
Anger	100	92.43
Fear	100	88.34
Happiness	100	91.6
Relaxation	100	86.8

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Table.2 : Correlation of predicted values with respect to actual

	Anger	Fear	Happiness	Relaxation
Body Weight	-0.15	-0.01	0.23	-0.07
Tail Position	0.3	-0.45	0.34	-0.15
Head Position	0.1	-0.23	0.05	0.08
Ear Position	0.23	-0.05	-0.1	-0.07
Mouth Condition	0.45	-0.34	0.03	-0.13
Front Leg	-0.12	-0.14	-0.13	0.39
Back Leg	-0.1	-0.14	0.14	0.1

Table. 3: Obtained results using acoustic analysis

	count of barking acoustic samples used for study	True positive Predictions as per the proposed method	Obtained accuracy rate
Anger	300	280	93.33
Fear	250	232	92.80
Happiness	400	365	91.25
Relaxation	250	231	92.40

Table.4: Combined approach stating the predicted accuracy %

	Obtained accuracy rate by image analysis	Obtained accuracy rate through acoustic samples	combined prediction rate
Anger	92.43	93.3	92.952
Fear	88.34	92.8	91.016
Happiness	91.6	91.25	91.39
Relaxation	86.8	92.4	90.16
Average Prediction Accuracy	**89.7925**	**92.4375**	**91.3795**
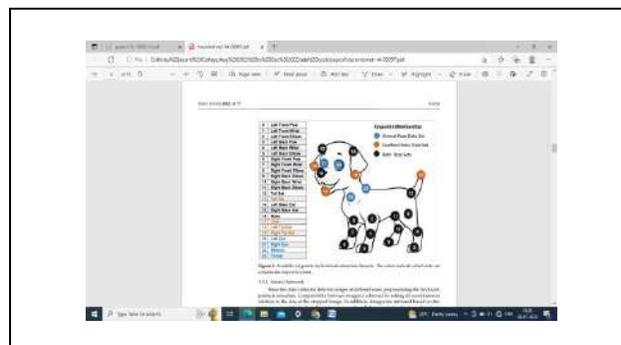
Figure.1: Identifiable landmark points are produced as a result of this combination, which are then employed for model training
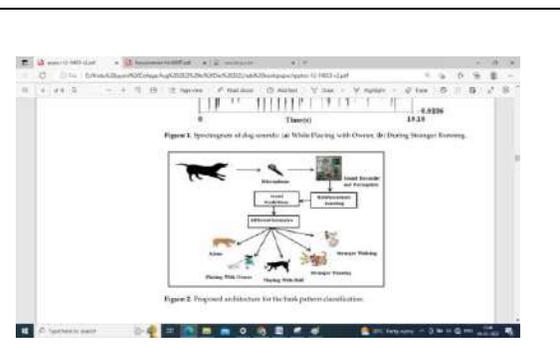
Figure 2: Common scenarios where a pet dog makes different sound (bark) pattern.
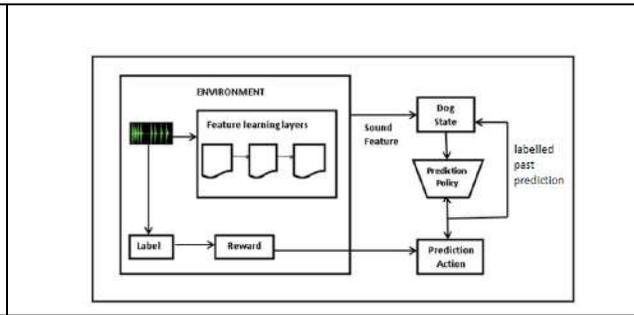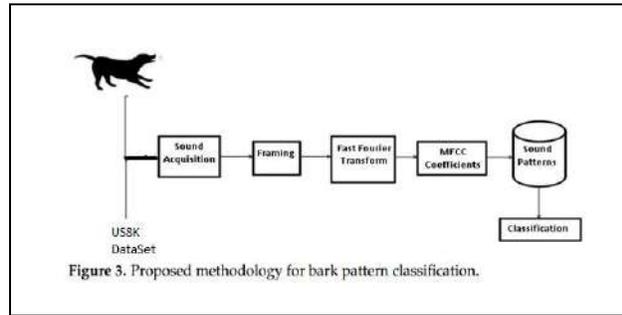
Figure 3 : Proposed Classification method for barking pattern.

Figure 4: Proposed Learning Mechanism for predicting barking pattern.
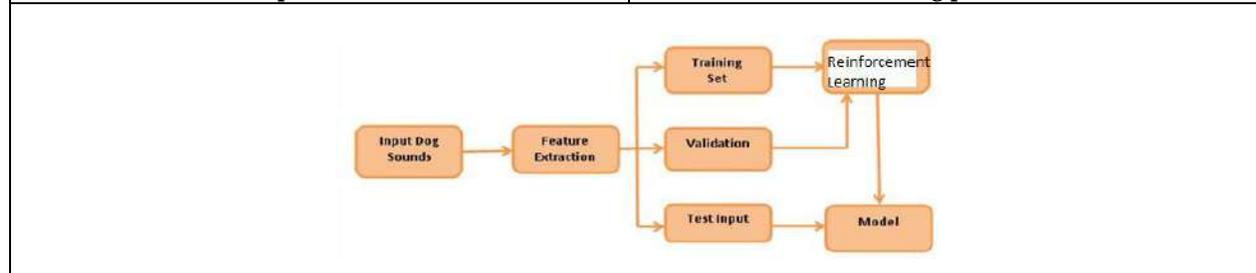
Figure 5 : Training Process of the proposed method
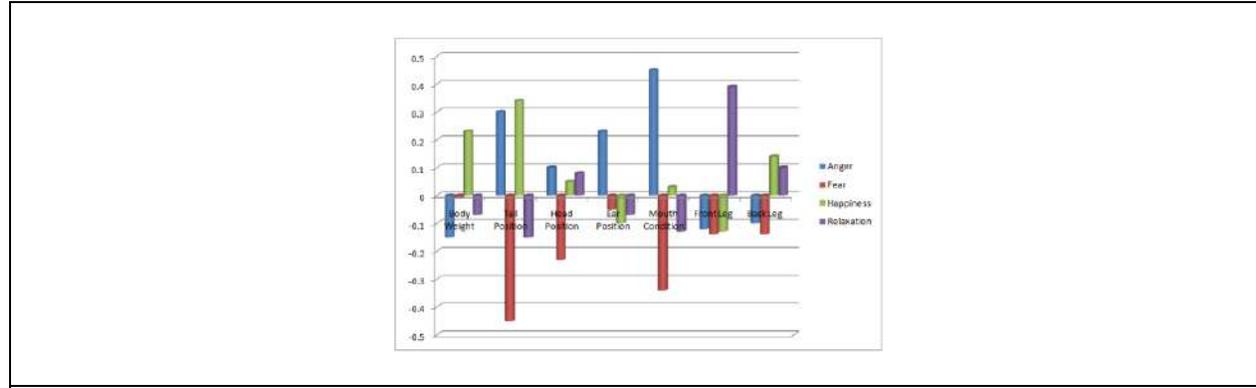
Chart 1 : Demonstration of Actual and predicted correlation values .

IoT Based Intelligent Agriculture Field Monitoring System

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ABSTRACT

Due to the increasing population, agriculture is becoming into a significant worldwide growth industry. The biggest problem facing the agricultural industry is raising agricultural production and quality without constant physical oversight to fulfill the world's expanding need for food. Climate change, in addition to population expansion, is a significant problem in agriculture. To deal with challenging circumstances, this research study will provide smart farming techniques based on the Internet of Things (IoT). Adopt smart farming, which combines automated agricultural technologies, extremely precise crop management, and helpful data collecting. In this study, soil moisture and temperature are monitored as part of an intelligent field monitoring system for agriculture. Without human interaction, it performs the appropriate actions based on these values after analyzing the acquired data. These measurements of the soil's temperature and humidity are stored in the cloud by Thing Speak for use in future data processing.

Keywords: Internet of Things, Smart Farming, Agriculture, ThingSpeak cloud

INTRODUCTION

To feed an expected 9.6 billion people by the year 2050, food output would need to rise by 70%, according to Beecham's paper Towards Smart Farming: Agriculture Embracing the IoT Vision [9].Therefore, increasing agricultural productivity is crucial to ensuring high output and the farm's financial success. Unpredictable weather and environmental factors including precipitation, temperature, and soil moisture provide a significant obstacle to productive agriculture. Additionally, because it influences the indicator plant turgor pressure, moisture is one of the most significant environmental factors in agriculture. the amount of water in plant cells. Low humidity speeds up the rate at which plants transpire. Additionally, plants soon perish due to high transpiration rates and excessive water uptake by plant cells. On the other hand, high air temperatures and moisture content slow down perspiration and restrict evaporative cooling. Continuous physical intervention, which is very impractical and not always achievable, was needed to keep track of these environmental factors and take necessary response. In this regard, the

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notion of "smart agriculture," which automates farm activities, will be realised to a significant extent. The Internet of Things (IoT) is a new paradigm for computing and communication in which common things are outfitted with sensors, microcontrollers, and transceivers to detect their environment. Additionally, the exchange of acquired data between users or among themselves becomes a fundamental aspect of the Internet system. IoT enables data to be exchanged over networks without the need for human involvement because every object used in daily life is attached to a distinct identifier [1, 2].Every day, more connected things across the world contribute to the IoT's growth. Precision agriculture [1, 2], smart grids [3, 4], and environmental monitoring are just a few of the applications for IoT. Due to its highly scalable, interoperable, and pervasive characteristics, IoT technology is becoming more and more popular in the agriculture industry. It is required to identify several environmental elements that have an impact on farm work at various places to automate farm job. Climate factors to consider include the temperature, humidity, and water level. In the field, many sensor types are utilized in conjunction with microcontrollers to track environmental factors that are relevant to agriculture. Depending on the surrounding environment, microcontrollers operate different actuators and agricultural equipment (such as pumps, fans, etc.) without the need for human interaction. In addition, the cloud may be used to store the acquired data. These acquired parameters are sent to the cloud by a microcontroller linked to the Wi-Fi module. Most wireless environmental monitoring systems employ CDMA/GPRS or GSM-based technologies. It does have significant shortcomings, though, such a high cost of network development and a poor access rate. To be a part of the Internet, objects need distinctive IDs. Commonly used as unique identifiers for items are Internet Protocol versions 6 (IPv6) and 4 (IPv4). The rest of the article is organized as follows. Section II covers related work on smart farming. Section III describes the proposed system design for IoT-based smart agriculture. Section IV presents the experimental set-up and results for implementing the proposed system. Finally, Section V completes the work.

Related Work

In [5], M.A. Abdurrahman *et al.* We suggested a reasonably priced product for agriculture in water-scarce areas. The method uses a cheap sensor and a straightforward circuit to automatically regulate the flow of water. Temperature and humidity readings are also captured and shown on the LCD. In accordance with soil moisture levels and plant water requirements, the system provides water to plants. A native, inexpensive, time-dependent microcontroller-based irrigation scheduler made up of multiple sensors for measuring humidity, temperature, and wind was proposed by P.A. Bhosale and V.V. Dixit [6]. The system develops the appropriate actuators based on these data (relays, solenoid valves, motors).The user receives the recorded data through SMS using the GSM module, and it is also stored to the memory card. [7] A network of field irrigation controls and soil sensors makes up the shortfall irrigation management system that J. Barendonck et al. presented. A wireless link is used to connect irrigation controls to the farmer's PC. The device can be employed in locations with scarce water supplies, subpar water quality, or restrictions on flushing. Based on crop choices, water availability, and crop growth, they employed a decision support system (DSS) to assist farmers in managing irrigation and fertiliser use. The DSS may be installed either locally on a computer or remotely on a server, and the user can get in touch with his DSS to adjust the irrigation technique as necessary. F. TongKe suggested IoT-based and cloud-based intelligent agriculture in [8]. To accomplish dynamic resource allocation and load balancing, the agricultural information cloud was constructed using a variety of resources. The agricultural information cloud processes a considerable amount of data that was obtained through RFID and wireless transmission. Ji Chun Zhao and others The author suggested a wireless and internet-based remote monitoring system. Systems for managing information are made to store data as well. Institutes for agricultural research may use the data gathered [10].Contrary to the work introduced in [5, 6], the model proposed in this paper not only provides low-cost smart farming that automates agricultural work, but also provides field temperature and temperature data in a cloud environment via communication technology. Create a humidity chart. regards analytics. The suggested model's implementation details are also included in this study, although they weren't in [8]. The suggested system and other relevant research are compared in Table 1 for your convenience.

Proposed System Design

The fundamental objective of this endeavour is to develop IoT-based smart agriculture systems that can autonomously operate high-voltage electrical equipment like pumps and playhouse shutters in response to environmental factors like soil moisture and temperature for use in analysing data in the future, these parameters are preserved in the cloud. In the playhouse, farming is done in a highly regulated setting. the several strata depicted in the illustration. Sensor layer, middleware, communication layer, cloud, and application layer are the four components.

A. Sensor Layer

The suggested system's top layer is this one. chargeable with gathering and keeping track of numerous environmental indicators. To record or gather parameters, many types of sensors are employed in agriculture. In this study, two different kinds of sensors were employed: a temperature sensor and a soil moisture sensor to track soil moisture and polyhouse temperature, respectively. These sensors are linked to a microcontroller with an Arduino platform. Basic Internet of Things (IoT) gadgets used in agriculture are microcontrollers coupled with sensors.

B. Middleware design

The second layer of the suggested system is this one. To automate farming and manage the actuators, middleware is needed. Designed for a microcontroller is required. The microcontroller receives the detected data and responds in accordance with the thresholds of the different parameters of the monitored field. Temperature and soil moisture are closely monitored by this stratum. Due to the direct impact of these two variables on crop production, the following choices are made:

The microcontroller activates the pump mechanism to water the field if the soil moisture falls below the threshold. Crop yields are lower when soil moisture is insufficient. The soil moisture limit varies depending on the kind of soil [12]. Table 1 lists suggested soil moisture thresholds for various soil types that are being irrigated in accordance with [12]. The suggested approach uses a threshold of 15% soil moisture content. To save excessive power use, the pump will automatically shut down whenever the humidity level reaches the set point. The polyhouse damper is opened by the microcontroller when the temperature reaches the threshold. The threshold temperature used by the proposed system is 40 °C. The crop-pest balance is impacted by shorter growing seasons brought on by rising temperatures. Additionally, it raises the rate of plant respiration and lowers fertilizer effectiveness. The microcontroller not only manages the actuators but also transmits field-recorded data to the ThingSpeak cloud through a gateway.

C. Communication Layer

Since it performs better at this layer than Bluetooth, the microcontroller uses the Wi-Fi module to connect wirelessly to the gateway. Due to the possibility that the gateway may be far from the monitored field, Bluetooth offers superior short-range connectivity than Wi-Fi. Huge cables prevent Ethernet-based communication. Here, a gateway is used to transmit the microcontroller's sensors, which are positioned above the field being observed, data to the cloud. On the gateway, IP-based protocols are used. To write recorded values to the proper channels, the microcontroller makes HTTP requests to the Thing Speak cloud.

D. Cloud & Application layer

Smart farming may benefit from the new technologies of cloud computing. The suggested concept records data in diverse agricultural sectors using a cloud computing platform. For the purpose of storing field data, many channels are constructed in this layer, each one corresponding to a certain parameter field in the ThingSpeak cloud (temperature, soil moisture).Through a communication protocol, the microcontroller regularly transmits obtained data to each channel. The values of the soil moisture and temperature are shown over time and can be utilised in upcoming analyses. The ThingSpeak web service enables visual remote monitoring of agricultural field conditions (temperature, soil moisture). Create apps for agriculture, put them on the cloud, and give farmers and academics access to them.

EXPERIMENT AND RESULT

The suggested method is put into practise using a variety of tools. A microcontroller called an Arduino UNO board is linked to a few sensors. The temperature sensor was an LM35, while the soil moisture sensor was a VL95. 6-pin relays are used to connect steep motors and fans to the Arduino UNO board and operate high-voltage equipment. The analogue pins on the Arduino board are used to connect the LM35, an integrated circuit temperature sensor. The readings are delivered to the middleware on the Arduino board, and the output of the LM35 sensor is linearly proportional to the temperature in degrees Celsius. Coward. 3 shows the experimental setup for this work. The VL95 is a moisture sensor and connects to analog pins on the Arduino board. The VL95 uses two probes to drive an electric current through the soil and read the resistance to determine soil moisture. The measurements are sent to middleware on the Arduino board. The recorded environmental values are sent to the Arduino board's middleware, which controls the actuators (pump, fan control) based on these values. Arduino IDE is used for middleware design. Apart from the automatic control of the actuators, the Arduino board sends the measured parameters to the cloud platform. The Arduino board communicates wirelessly with the ThingSpeak cloud through a router and stores environmental parameters. This model uses Wi-Fi based communication. ESP8266 module is used as Wi-Fi module. The ESP8266 module connects to a specific Internet-connected gateway device to communicate with the cloud. Based on our experimental setup, the proposed system recorded soil temperature and humidity from a monitored field. Because ThingSpeak requires a 15 second delay between updates, these collected values are displayed every 15 seconds in the ThingSpeak web service deployed in the cloud environment. FIG. 4 shows field temperature values as a function of time. FIG. 5, on the other hand, shows a graph based on soil moisture level against time.

CONCLUSION

Different soil moisture and temperature values are recognized depending on the system parameters mentioned above, and the Arduino board controls high voltage agricultural equipment without the need for a human operator based on established soil moisture and temperature thresholds. To do. When the farm site is unmanned, the system offers constant site monitoring and initiates the necessary events in accordance with specifications. Reduce the cost of agricultural production and labour. Deploying the proposed system in the various soil texture environments listed in Table II requires modification of soil moisture and temperature thresholds, which can be integrated by manually updating the middleware. The system also wirelessly transmits real-time environmental parameter values from the field to the cloud at specified time intervals. These values can be used for future analysis and can consider other parameters to monitor for better growth of the culture, such as biological factors such as fungi, Monera, etc. The soil moisture and temperature thresholds must be changed to implement the proposed system in the various soil texture settings described in Table II. This may be done by manually upgrading the middleware. Additionally, the technology wirelessly sends environmental parameter readings from the field to the cloud at predetermined intervals. These numbers may be utilised for further analysis and can consider additional parameters to monitor the culture's progress, such as biological elements like fungus, Monera, etc.

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Table 1: Comparative study with related work

Authors	Parameters	—Controller	Smart System	Cloud Platform	Storage for Future
A. Mondal, Z. Rehena	Temperature, Soil moisture	Arduino UNO	Yes	Yes	Yes
Abdurrah man, G.M. Gebru and T.T. Bezabih [5]	Soil Moisture	PIC16F887	Yes	No	No
P. A. Bhosale and V. V. Dixit[6]	Soil Moisture, Temp, Wind Speed, Radiation and sunshine	PIC Microcontroller	Yes	No	Yes
J. Balendonc k, *et. al.* [7]	Temperature, Soil moisture	Irrigation Controller (GP1, Delta-T)	Yes	No	Yes
B. Hanson and S.Orloff [12]	Soil Moisture	No	No	No	No

Table 2. Soil moisture content for irrigation in different types of soil

Soil Texture	Soil Moisture Content (%)
Sand	7
Loamy Sand	12
Sandy Loam	15
Silt Loam	20
Loam	23
Silty Clay Loam	28
Clay Loam	27
Sandy Clay Loam	24
Sandy Clay	22
Silty Clay	30
Clay	31
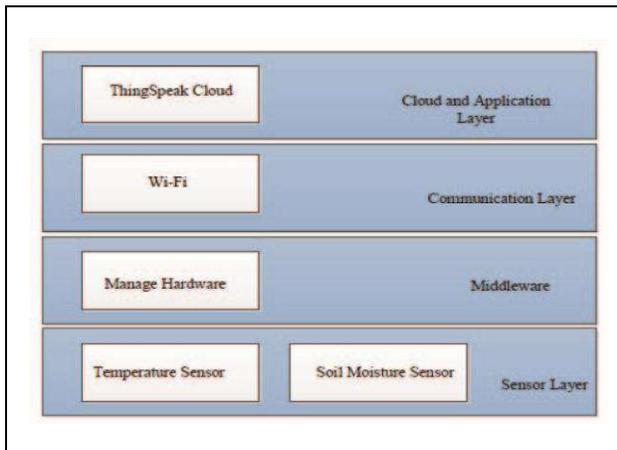
Fig. 1.Different layers of smart Farming System
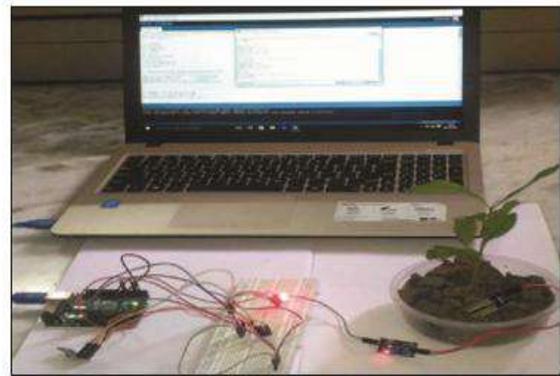
Fig 2: Experimental Setup
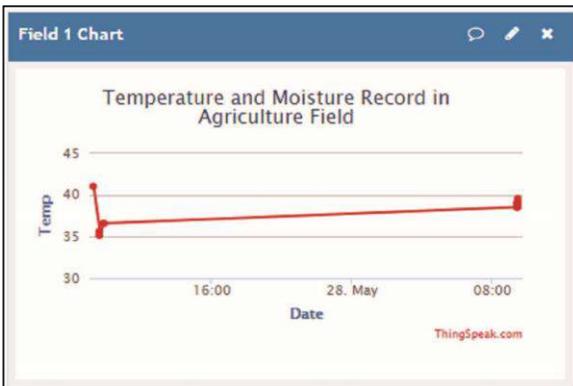
Fig. 3.   Field Temperature with respect to time
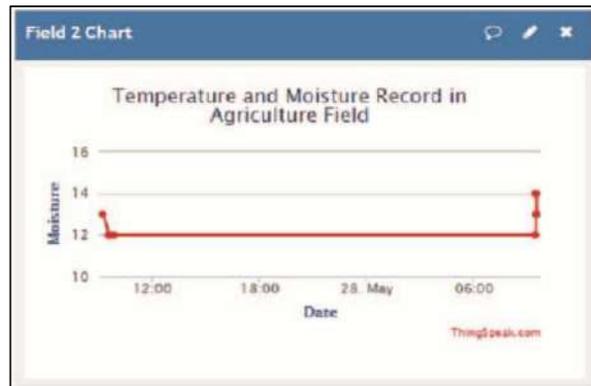
Fig. 4.   Soil Moisture level with respect to time

RESEARCH ARTICLE

Micro-I-α-open sets and Micro-I-α-Continuous Function in Micro Ideal Topological Space

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ABSTRACT

Micro Topological Spaces introduced by S.Chandrasekar and introduces a new type of o(x) (open sets) i.e.MIC-α-o(x).MIC-α-o(x) and MIC-α-continuous functions introduced by Reem O.Rasheed and Taha H.Jasim. In this paper we introduce MIC-α-I-o(x) and MIC-α-I-continuous functions also, find part of their required resources in MITS.

Keywords: MIC-α-I-o(x),MIC-α-I-c(x)(closedsets) ,MIC-Pr-I-o(x),MIC-Se-I-o(x), MIC-I- continuous, MIC-α-I-continuous functions**.**

INTRODUCTION

The Idea of ITS (Ideal Topological Space)was introduced by Kuratowski [1] in 1933 and Vaidyanathswamy [2] in 1944. In 1988 Hamlett and Jankovic [3] introduced the generalization of some of the most important properties in ITS. In 2019 S.Chandrasekar [4] introduced Micro topology. S.Ganesan [9] has developed a new concept of Micro topological space through smaller systems, MIC-α-o(x) and continuous MIC-α functions presented by Reem O.Rasheed and Taha H.Jasim [5] in 2020. In 2018 S.Chandrasekar, G.Swathi [6] proposed a path to MIC-α-o(x). S.Selvaraj Ganesan [7,8] proposed a MIC-G-c(x) and MIC-G-Continuous in MTS and developed closed Micro Ideal Generalized sets for MITS in 2020. In this paper Proposed Method MIC-α-I o(x) and MIC-α-I-continuity in MITS and some of its structures are being investigated.

PRELIMINARIES
Definition2.1
Let $(\mathcal{H},\widetilde{\tau_R(X)},\widetilde{\mu_R(X)}$,ID) be a MITS and S$\subseteq \mathcal{H}$ Then S is reveal to be MIC-Pr-I-o(x) if S$\subseteq$MICR-Int (MICR-clr*(S)) and MICR-Pr-I-c(x)(closed set)if MIC-clr*(MICInt(S))$\subseteq$S.

Definition2.2
Enable $(\mathcal{H}, \widetilde{\tau_R(X)}, \widetilde{\mu_R(X)}$, ID)be a MITS and S⊆$\mathcal{H}$ Then S is impart to be MIC-se-I-o(x), if S⊆MIC-clr*(MIC-int(S)).MIC-se-I-c(x),if MIC-int (MIC-clr*(S))⊆S.

Illustration2.3
Enable $H=\{Б_1, Б_2, Б_3\}$, $H/\mathrm{R}=\{\{Б_3\},\{Б_1, Б_2\}\}$ and $X=\{Б_2, Б_3\}\subseteq H$.
$\widetilde{\tau_R(X)}=\{\varnothing, H, \{Б_2\}, \{Б_3\}, \{Б_2, Б_3\}\}$.Then $\mu=\{Б_1\}$. MIC-o(x)= $\widetilde{\mu_R(X)}=\{\varnothing, H, \{Б_1\}$,
$\{Б_2\},\{Б_3\},\{Б_1, Б_2\},\{Б_1, Б_3\},\{Б_2, Б_3\}\}$, I=$\{\varnothing, \{Б_1, Б_3\}\}$,MIC-pr-I-o(x)=$\{\varnothing, H, \{Б_1\}$,
$\{Б_2\},\{Б_3\},\{Б_1, Б_2\},\{Б_1, Б_3\},\{Б_2, Б_3\}\}$and MIC-se-I-o(x)=$\{\varnothing, H, \{Б_1\ \},\{Б_2\},\{Б_3\}$,
$\{Б_1, Б_2\},\{Б_1, Б_3\},\{Б_2, Б_3\}\}$.

3.MIC-α-I-OPEN SETS
In this section we will demonstrate and focus on some of the MIC-α -I-o(x) Features.

Definition 3.1
Let S be a subset of a MITS $(H, \widetilde{\tau_R(X)}, \widetilde{\mu_R(X)}$,ID), S⊆$H$, at that S is reveal to be
MIC-α-ID-o(x) if S⊆ MIC-int(MIC-clr*(MIC-int(S)),and MIC-α-ID-c(x)if
MIC- clr*(MIC-int(MIC-clr*(S)) ⊆S.

Theorem3.2
Each MIC-α-ID-o(x) is MIC-I-o(x)(open set),yet the converse is not true.

Proof
Enable S be MIC-α-ID-o(x). Then S ⊆ MIC-(S*).Since S is MIC-α-ID-o(x), it follows that Sis MIC-I-o(x). The contradictory form theorem upwards of does not need to be a practical example:

Illustration 3.3
Let $H=\{\hat{e}, \acute{f}, \acute{g}, \acute{h}\}$,with H /R=$\{\{\hat{e}\},\{\acute{f}, \acute{g}\},\{\acute{h}\}\}$and X=$\{\hat{e}, \acute{h}\}\subseteq H$ then $\mu=\{\acute{f}\}$.
MIC-o(x)=$\widetilde{\mu_R(X)}=\{\varnothing, H, \{\acute{f}\},\{\hat{e}, \acute{h}\},\{\hat{e}, \acute{f}, \acute{h}\}\}$,I=$\{\varnothing,\{\acute{g}\}\}$.Let S=$\{\acute{f}, \acute{g}, \acute{h}\}$ then S is
MIC-I-o(x)but S=$\{\acute{f}, \acute{g}, \acute{h}\}$ is not MIC-α-ID-o(x).

Theorem 3.4
Each MIC-α-ID-o(x) is MIC-pre-ID-o(x).

Proof. Let Ş be an MIC-α-ID-o(x) in $(\mathcal{H}, \widetilde{\tau_R(X)}, \widetilde{\mu_R(X)}$,ID).Then, Ş⊆MICR-Int (MICR-clr*(MICR-Int(Ş))).It is evident that Ş⊆MICR-Int(MICR-clr*((Ş))).The discussion of the upwards of theorem does not need to be factual as illustrated by the ensuing example.

Illustration: 3.5
Let $\mathcal{H}=\{ǫ, ř, ş, ţ\}$,with $\mathcal{H}$ /R =$\{\{ ǫ \},\{ř, ţ\},\{ ş \}\}$andX=$\{ ǫ, ş\}\subseteq \mathcal{H}$ subsequently $\mu=\{ ř \}$.
MTS=$\widetilde{\mu_R(X)}=\{\varnothing, H, \{ ř \},\{ǫ, ş\},\{\{ǫ, ř, ş\}$,I=$\{\varnothing,\{ǫ\}, \{ř, ş\}\}$.Take S=$\{ş, ţ\}$ then S is MIC-pr-ID-o(x) yet S is not MIC-α-ID-o(x).

Remark 3.6
MIC-pr-ID-o(x) and MIC-se-ID-o(x) are independent to each other, as seen in the following illustrations.

Illustration 3.7

Enable $H=\{\breve{a}, \breve{b}, \breve{c}, \breve{d}, \breve{e}\}$, with $H/R =\{\{\breve{a}\},\{\breve{b}\},\{\breve{c}, \breve{d}\},\{\breve{e}\}\}$ and $X=\{\breve{a}, \breve{d}, \breve{e}\}\subseteq H$ then

$\mu=\{\breve{a}, \breve{b}\}$.Micro-o(x)=$\widetilde{\mu_R(X)}$=$\{\varnothing, H,\{\breve{a}\}, \{\breve{a}, \breve{b}\}, \{\breve{a}, \breve{e}\}\{\breve{c}, \breve{d}\},\{\breve{a}, \breve{b}, \breve{e}\},\{\breve{a}, \breve{c}, \breve{d}\},$

$\{\breve{a}, \breve{b}, \breve{c}, \breve{d}\},\{\breve{a}, \breve{c}, \breve{d}, \breve{e}\}$, I=$\{\varnothing,\{\breve{b}\}\}$.S=$\{\breve{c}, \breve{e}\}$ is a MIC-pr-ID-o(x) yet not MIC-se-ID- o(x).

Illustration3.8

Enable $H=\{\grave{a}, \grave{b}, \grave{c}, \grave{d}, \grave{e}\}$,with $H/R =\{\{\grave{a}\},\{\grave{b}\},\{\grave{c}, \grave{d}\},\{\grave{e}\}\}$and $X=\{\grave{a}, \grave{d}, \grave{e}\}\subseteq H$ then

$\mu=\{\grave{a}, \grave{b}\}$.MIC-o(x)=$\widetilde{\mu_R(X)}$=$\{\varnothing, H,\{\grave{a}\}, \{\grave{a}, \grave{b}\}, \{\grave{a}, \grave{e}\}\{\grave{c}, \grave{d}\},\{\grave{a}, \grave{b}, \grave{e}\},\{\grave{a}, \grave{c}, \grave{d}\},\{\grave{a}, \grave{b}, \grave{c}, \grave{d}\},$

$\{\grave{a}, \grave{c}, \grave{d}, \grave{e}\}$,I=$\{\varnothing,\{\grave{b}\}\}$.S=$\{\grave{a}, \grave{c}, \grave{e}\}$, $\{\grave{a}, \grave{d}\}$ is MIC-se-ID-o(x) yet not MIC-pr-ID-o(x).

Theorem3.9

Each MIC-α-ID-o(x) is MIC-se-ID-o(x).

Proof.

Let Ş be an MIC-α-ID-o(x) in $(H,\widetilde{\tau_R(X)},\widetilde{\mu_R(X)}$,ID).Then, Ş $\subseteq$MIC-Int(MICR-clr*(MICR- Int(Ş))).It is clear thatMICR-Int(MICR-clr*(MICR-Int(Ş)))$\subseteq$MICR-clr*(MICR-Int(Ş)).So Ş $\subseteq$MICR-clr*(MICR-Int(Ş)).The discussion of the upwards of proposition does not need to be factual as illustrated with the ensuing instance.

Illustration3.10

Enable $H=\{b_1, b_2, b_3, b_4\}$,with $H/R=\{\{b_1\},\{b_2, b_3\},\{b_4\}\}$ and $X=\{b_1, b_4\}\subseteq H$ then

$\mu=\{b_2\}$. MIC-o(x)=$\widetilde{\mu_R(X)}$=$\{\varnothing, H,\{b_2\},\{b_1, b_4\},\{b_1, b_2, b_4\}$, I=$\{\varnothing,\{b_3\}\}$. Take S=$\{b_2, b_3\}$

then S is MIC-se-ID-o(x)yet S is not MIC-α-ID-o(x).

Definition 3.11

Enable MITS($H,\widetilde{\tau_R(X)},\widetilde{\mu_R(X)}$,ID) .Then the MIC-$\alpha$-I-Int(pt)form is called the MIC-α-I-int form Ş, and is signified by MIC-α-I- Int(Ş).

Theorem3.12

1.EnableŞ$\subseteq$ $(H, \widetilde{\tau_R(X)}, \widetilde{\mu_R(X)}$, ID)then MIC-$\alpha$-I-Int(Ş) is equal to the union form all MIC- α-I-o(x) include in Ş. 2.If Ş is a MIC-α-I-o(x)then Ş =MIC-α-I-Int(Ş).

Proof

1.We need to witness that, MIC-α-I-Int(Ş)=∪{ℏ/ ℏ⊂A, B is MIC-α-I-o(x)}is MIC-α-I-o(x).Let x ∈MIC-α-I-Int(Ş).Then there is exist a MIC-α-I-o(x),ℏ such that x∈ℏ⊆ Ş. Hence x∪{ℏ/ ℏ⊂Ş,B is MIC-α-I-o(x)}.Conversely, suppose x∈ ∪ {ℏ / ℏ⊂Ş ,ℏis MIC-α-I-o(x)}, then there is exist a set ℏo⊆Şso x∈ℏo, where ℏo is MIC-α-I- o(x).i.e., x ∈MIC-α-I-Int(Ş). Hence ∪ {ℏ / ℏ⊂Ş,ℏ is MIC α-I-o(x)}.   So MIC-α-I-Int(Ş)=∪{ℏ/ℏ⊂Ş,ℏ is MIC-α-I-o(x)}.

2.Assume Ş is a MIC-α-I-o(x)then Ş ∈{ℏ/ ℏ⊂Ş,ℏ is Mic-α-I-o(x)}, and everything else in this collection is a small subset of Ş. So in part (1)Ş =MIC-I-α-Int(Ş).

Definition 3.13

The MIC-α-I-closure form a set A of a MITS($H,\widetilde{\tau_R(X)},\widetilde{\mu_R(X)}$,ID) is the inter section form all Mic-α-I-c(x) that contain Ş and is revealed by MIC-α-I-clr(Ş).

Theorem3.14

Ş is MIC-α-I-c(x)if and only if Ş =MIC-α-I-clr(Ş).

Proof

MIC-α-I-clr*(Ş) = ∩{ħ/ħ⊃Ş, Q is MIC-α-I-c(x) }.If Ş is a MIC-α-I-c(x)At that time each part Ş has once by assembling one person from above. So their Intersection is Ş and MIC-α-I-clr(Ş)=Ş. Conversely, if Ş=MIC-α-I-clr(Ş),then Ş is MIC-α-I-c(x)by theorem (3.2).

Remark 3.15

1.MIC-α-I-clr(Ş)is also a MIC-α-I-c(x).
2.MIC- α-I-clr(Ş)is smallest MIC-α-I-c(x)containing the Ş.

Proposition 3.16

For a given MITS ($H,\widetilde{\tau_R(X)},\widetilde{\mu_R(X)}$,ID)
(1)MIC-o(x)⊆MIC-α-I-o(x) and MIC-c(x) ⊆MIC-α-I-c(x)
(2)Arbitrary join of point MIC-α-I-o(x) is MIC-α-I-o(x).
(3)Arbitrary intersection point of Mic-α-I-c(x) is Mic-α-I-c(x).

Proof:

(1)Enable E∈MIC-o(x), Since MIC-Int E=E we have E⊆ MIC-Int(MIC- clr*(MIC-Int(E)).Thus E∈MIC-α-I-o(x), similarly, let F∈MIC-c(x),Since MIC-clr*F=F we have MIC-clr*(MIC-Int(MIC-clr*(F)) ⊆F and so F∈MIC-α-I-c(x).(2)Enable {Ş$_j$}$_{j∈J}$ have to be a family MIC-α-I-o(x).Then for each j∈J, Ş$_j$⊆ MIC-Int(MIC- clr*(MIC-Int(Ş$_j$)).Now vŞ$_j$⊆vMIC-Int(MIC–clr*(MIC-Int(Ş$_j$))=MIC-Int-v(MIC-clr*(MICR-Int(Ş$_j$))=MICR-Int-v(MICR-clr*v(MICR-Int(Ş$_j$))=MICR-Int(MICR-clr*(MICR-Int-v(Ş$_j$)),Hence, v Ş$_j$ is MIC-α-I-o(x).The result(3) is dual of(2).

In the theorems above, we find the ensuing diagram.$\breve{X}→\breve{Y}$ (respresent $\breve{X}$implies$\breve{Y}$) but not conversely .
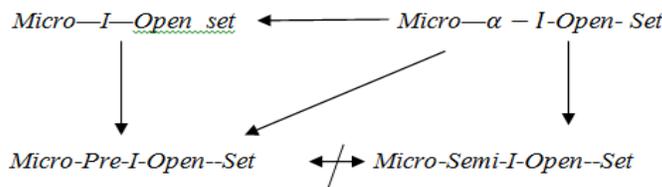
MIC-I-CONTINUOUS FUNCTIONS

Explanation (4.1)

Enable $(\breve{X},\widetilde{\tau_R(X)},\widetilde{\mu_R(X)}$,ID)and $(\breve{Y},\widetilde{\tau_R(Y)},\widetilde{\mu_R(Y)}$,ID)be two MITS.A function $f:\breve{X}→$ $\breve{Y}$is called MIC-I-continuous function if $f^{-1}(U)$ is MIC-o(x) in $\breve{X}$ for every MIC-I-o(x)U in$\breve{Y}$.

Illustration (4.2)

Enable$\breve{X}$={$\tilde{p},\tilde{q},\tilde{r},\tilde{s}$},with $\breve{X}$/R={{$\tilde{p},\tilde{q}$},{$\tilde{r}$},{$\tilde{s}$}} and X={$\tilde{p},\tilde{s}$} ⊆ $\breve{X}$,Then μ={$\tilde{q}$}.
MIC-I-o(x)={∅,$\breve{X}$,{$\tilde{p}$}, {$\tilde{q}$}, {$\tilde{r}$}, {$\tilde{p},\tilde{q}$}, {$\tilde{p},\tilde{s}$}, {$\tilde{q},\tilde{s}$}, {$\tilde{p},\tilde{q},\tilde{s}$}, I={∅,{$\tilde{r},\tilde{s}$}}.
Let$\breve{Y}$={$\breve{1},\breve{2},\breve{3},\breve{4}$}, with $\breve{Y}$/R={{$\breve{1}$},{$\breve{2}$},{$\breve{3},\breve{4}$}} and Y={$\breve{1},\breve{3}$}⊆ $\breve{Y}$, then μ={$\breve{2}$}.
MIC-I-o(x)={∅,$\breve{Y}$,{$\breve{1}$},{$\breve{2}$},{$\breve{3}$}, {$\breve{4}$},{$\breve{1},\breve{2}$},{$\breve{1},\breve{3}$},{$\breve{1},\breve{4}$},{$\breve{2},\breve{3}$},{$\breve{2},\breve{4}$},{$\breve{3},\breve{4}$},
{$\breve{1},\breve{2},\breve{3}$},{$\breve{1},\breve{3},\breve{4}$},{$\breve{1},\breve{2},\breve{4}$},{$\breve{2},\breve{3},\breve{4}$}},I={∅,{$\breve{3}$}. $f:\breve{X}→\breve{Y}$ be a function
defined as$\breve{X}$={$\tilde{p},\tilde{q},\tilde{r},\tilde{s}$}&$\breve{Y}$={1,2,3,4}, $f(\tilde{p})$=$\breve{2}$,$f(\tilde{q})$=$\breve{3}$,$f(\tilde{r})$=$\breve{1}$,$f(\tilde{s})$=$\breve{4}$. Therefore for each MIC-I-o(x) U in$\breve{Y}$, $f^{-1}(U)$is MIC-I-o(x)in$\breve{X}$. Then f is MIC-I-continuous function.

Explanation (4.3)

Let $(\breve{X},\widetilde{\tau_R(X)},\widetilde{\mu_R}(X),ID)$ and $(\breve{Y},\widetilde{\tau_R(Y)},\widetilde{\mu_R}(Y),ID)$ be two MITS. A function $f:\breve{X}\to\breve{Y}$is called MIC-I-continuous at a point $a\in\breve{X}$ if for every MIC-I-o(x) $\breve{X}$containing f(a) in$\breve{Y}$, there are exist a MIC-I-o(x)G containing a in $\breve{X}$, such that $f(G)\subseteq\breve{X}$.

Theorem (4.4)

Enable $f:\breve{X}\to\breve{Y}$ be a function from MITS$(\breve{X},\widetilde{\tau_R(X)},\widetilde{\mu_R}(X),ID)$ and to MITS$(\breve{Y},\widetilde{\tau_R(Y)},\widetilde{\mu_R}(Y),ID)$If $f:\breve{X}\to\breve{Y}$ is MIC-I-continuous, then f (MIC-Int(Ş))$\subseteq$ MIC-I-Int(f(Ş)) for every subset Ş of X.

Proof

Since f(Ş) $\subseteq$ MIC-(Int(f(Ş)))* $\to$ Ş$\subseteq f^{-1}$MIC-(Int(f(Ş)))*is a MIC-I-o(x) in $\breve{Y}$ and f is MIC-I-continuous, then by (4.3) f^{-1}MIC-(Int(f(Ş)))*is a MIC-I-c(x) in $\breve{X}$ comprise Ş. Hence f(MIC-(Int(Ş))* $\subseteq f^{-1}$(MIC-(Int(f(Ş)))*). Therefore f(MIC-(Int(Ş))* $\subseteq$MIC-(Int(f(Ş))*.

MIC-α-I-CONTINUOUS FUNCTION

In this section, we will introduce the concept of MIC-α-I- continuous mapping and more their properties are discussed in detail.

Explanation 5.1

Enable$(\breve{X},\widetilde{\tau_R(X)},\widetilde{\mu_R(X)},ID)$ and $(\breve{Y},\widetilde{\tau_R(X)},\widetilde{\mu_R(X)},ID)$ be two MIC-α-I-o(x) and $\widetilde{\mu_R(X)}$ be an associated MITS with $\widetilde{\mu_R(X)}$. A map f:$(\breve{X},\widetilde{\tau_R(X)},\widetilde{\mu_R(X)}\to(\breve{Y},\widetilde{\tau_R(Y)},\widetilde{\mu_R(Y)},ID)$ is called MIC-α-I-continuous map if the inverse image of each o(x) in $\breve{Y}$ is an MIC-α-I-o(x) in $\breve{X}$.

Illustration (5.2)

Let$\breve{X}=\{\tilde{1},\tilde{2},\tilde{3},\tilde{4}\}$,   with $\breve{X}/R=\{\tilde{1},\tilde{4}\},\{\tilde{2}\},\{\tilde{3}\}\}$,   X=$\{\tilde{2},\tilde{3}\}\subseteq\breve{X}$. Then $\mu=\{\tilde{4}\}$.   MIC-o(x)=$\mu_{\breve{X}R}$ (X)=$\{\varnothing,\breve{X},\{\tilde{4}\},\{\tilde{2},\tilde{3}\}$, $\{\tilde{2},\tilde{3},\tilde{4}\}\}$, I=$\{\varnothing,\{\tilde{2}\},\{\tilde{3},\tilde{4}\}\}$. MIC-$\alpha$-I-o(x)=$\{\varnothing,\breve{X},\{\tilde{4}\},\{\tilde{2},\tilde{3}\},\{\tilde{2},\tilde{3},\tilde{4}\}\}$.
Let$\breve{Y}=\{\dot{n},\dot{o},\dot{p},\dot{q}\}$, with $\breve{Y}/R=\{\{\dot{n},\},\{\dot{o}\},\{\dot{q}\}\}$ and Y=$\{\dot{o},\dot{q}\}\subseteq\breve{Y}$.Then $\mu=\{\dot{n}\}$. MIC-o(x)=$\mu_{\breve{Y}R}$ (Y)=$\{\varnothing,\breve{Y},\{\dot{n}\},\{\dot{o},\dot{q}\},\{\dot{n},\dot{o},\dot{q}\}\}$,I=$\{\varnothing,\dot{p}\}$. MIC-$\alpha$-I-o(x)=$\{\varnothing,\breve{Y},\{\dot{n}\},\{\dot{o},\dot{q}\},\{\dot{n},\dot{o},\dot{q}\}\}$. $f:\breve{X}\to\breve{Y}$ be a function defined as $f(1)=\dot{p}$, $f(2)=\dot{o}$, $f(3)=\dot{q}$, $f(4)=\dot{n}$. Therefore for each MIC-α-I-o(x)U in$\breve{Y}$, $f^{-1}(U)$is MIC-α-I-o(x) in $\breve{X}$. Then f is MIC-α-I-continuous function.

Theorem (5.3)

Each MIC-I-continuous function is MICR-α-I-continuous.

Proof:

Enable $f:\breve{X}\to\breve{Y}$ be MICR-I-continuous. i.e.,f^{-1}(U)is MICR-c(x) in $\breve{X}$, whenever U is MICR-c(x) in $\breve{Y}$. By Theorem (3.12), Each MICR-I-c(x) is MICR- α-I-c(x), and hence $f^{-1}(\breve{Y})$is MICR-α-I-c(x) in $\breve{X}$ whenever U is MICR-c(x)in $\breve{Y}$. Hence. $f:\breve{X}\to\breve{Y}$ be MIC-α-I-continuous.

Theorem(5.4)

Enable $f:\breve{X}\to\breve{Y}$ be a function from MITS $(\breve{X},\widetilde{\tau_R(X)},\widetilde{\mu_R}(X),ID)$ to MITS $(\breve{Y},\widetilde{\tau_R(Y)},\widetilde{\mu_R}(Y),ID)$.If Ş is an MIC-$\alpha$- I - o(x)of X, then f (S)is MIC-α-I-o(x) in$\breve{Y}$

Proof

First, Enable Ş be MIC-α-I-o(x) in $\breve{X}$. There are exist an MIC-α-I-o(x)U in $\breve{X}$such that Ş$\subseteq$ U $\subseteq MIC\text{-}clr^*$(Ş). since f is MIC-$\alpha$-I-o(x) function then f (U) is MIC-I-o(x) in$\breve{Y}$.Since f is MIC-I-continuous function, we have $f(Ş)\subseteq f(U)\subseteq f($ $MIC\text{-}clr^*$(Ş)) $\subseteq$MIC-clr^*(f(Ş)).This show that $f(clr^*(Ş))$MIC-α-I-o(x)in Y. Let Ş be MIC-α-I- o(x) in U. There exist an MIC-α-I-o(x)U such that U$\subseteq clr^*$(Ş))$\subseteq MIC\text{-}clr^*$ (clr^*(Ş). Since f is MIC-I-continuous function, we have $f(U)\subseteq f(clr^*(Ş))\subseteq f(MIC\text{-}clr^*(U))\subseteq$MIC-$clr^*$($f$ (U)) by the proof of first part, f (U) is MIC-α-I-o(x) in $\breve{X}$.Therefore $f(clr^*(Ş))$ is MIC-α-I-o(x) in$\breve{Y}$

CONCLUSION

Here's a look at some of Micro topological spaces , Let's consider something new type Micr- α- o (x) in addition to describing the ongoing work of Micro- α- continuous function in MTS also discuss the properties and its use. This Paper was introduced Micro-α-I-o(x) and Micro-α-I continuity on MITS and investigated some of the basic structures in MITS. Various interesting problems set identified in the analysis . Future research will be considered about MTS applications.

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Contra Harmonic index of Benzenoid Networks

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ABSTRACT

Topological descriptors are numerical invariants that are related with a chemical graph and may be used to predict biological and physiochemical features. In mathematical chemistry, medicine and drug design, and other fields of applied sciences, these descriptors are utilized. In this paper, we determine the Contra Harmonic index of Triangular, Zigzag, Rhombic, Hourglass and Cicumcoronene series of benzenoid networks.

Keywords: Contra Harmonic Index, Molecular graph, Benzenoid networks
AMS Classification: 05C76, 05C09

INTRODUCTION

A topological index is a mathematical function that maps a molecular graph onto a real number. These numbers are called topological indices. Topological indices are used in quantitative structure property relationship (QSPR) studies. The topological indices are also used in quantum mechanics. For example, the energy levels of atoms are determined by the topological indices of the corresponding electronic wave functions. Topological indices are used in chemo informatics to study the structural features of chemicals, drugs and used to study the relationship between the structures of chemicals and their biological activities [8], [11]. Benzenoid hydrocarbons are important in the food and chemical industries, as well as in our environment. Benzenoid molecular graphs are systems in which hydrogens have been removed. It's a linked geometric shape made up of congruent regular hexagons arranged in a plane so that two hexagons are either disjoint or share a shared edge [16]. Contra Harmonic Index CH(G) which is referred as the

sum of the terms $\frac{d(u)^2+d(v)^2}{d(u)+d(v)}$ over all edges uv of G, where d(u) and d(v) indicates the degree of vertices u and v in G respectively [12].

Triangular Benzenoid

Let T_n be a triangular benzenoid system, with p denoting the number of hexagons in the base graph and T_n having a total of $\frac{1}{2}n(n+1)$ hexagon as illustrated in figure.1

Theorem 1

For Triangular Benzenoid Network $T_n, n \geq 2$, $CH(T_n) = \frac{45n^2+107n-36}{10}$.

Proof:

The number of vertices in triangular benzenoid network $|V(T_n)| = n^2 + 4n + 1$ and the number of edges $|E(T_n)| = \frac{3n(n+3)}{2}$.

The partition in the edge set of T_n are as follows,

$E_{(2,2)} = \{e = uv \in E(T_n)|d_{T_n}(u) = 2, d_{T_n}(v) = 2\}$,
$E_{(2,3)} = \{e = uv \in E(T_n)|d_{T_n}(u) = 2, d_{T_n}(v) = 3\}$,
$E_{(3,3)} = \{e = uv \in E(T_n)|d_{T_n}(u) = 3, d_{T_n}(v) = 3\}$
Then $|E_{(2,2)}| = 6, |E_{(2,3)}| = 6(n-1), |E_{(3,3)}| = \frac{3n(n-1)}{2}$

$$CH(T_n) = \sum_{uv \in E} \frac{d(u)^2 + d(v)^2}{d(u) + d(v)}$$
$$= \sum_{uv \in E_{(2,2)}} \frac{2^2 + 2^2}{2 + 2} + \sum_{uv \in E_{(2,3)}} \frac{2^2 + 3^2}{2 + 3} + \sum_{uv \in E_{(3,3)}} \frac{3^2 + 3^2}{3 + 3}$$

$$= 6(2) + 6(n-1)\left(\frac{13}{5}\right) + 3\left(\frac{3n(n-1)}{2}\right)$$

$$= \frac{45n^2 + 107n - 36}{10}.$$

Zigzag Benzenoid network

The zigzag benzenoid system is designated by Z_n, where n is the number of rows in the graph of Zn and each row is made up of two hexagons, as illustrated in Figure2.

Theorem 2

For Zigzag Benzenoid system Z_n, $CH(Z_n) = \frac{132n-5}{5}$

Proof:

The number of vertices in zigzag benzenoid network $|V(Z_n)| = 8n + 2$ and the number of edges $|E(Z_n)| = 10n + 1$.
The partition in the edge set of Z_n are as follows,
$E_{(2,2)} = \{e = uv \in E(Z_n)|d_{Z_n}(u) = 2, d_{Z_n}(v) = 2\}$,

$E_{(2,3)} = \{e = uv \in E(Z_n)|d_{Z_n}(u) = 2, d_{Z_n}(v) = 3\}$,

$E_{(3,3)} = \{e = uv \in E(Z_n)|d_{Z_n}(u) = 3, d_{Z_n}(v) = 3\}$

Then $|E_{(2,2)}| = 2n + 4, |E_{(2,3)}| = 4n, |E_{(3,3)}| = 4n - 3$

$$CH(Z_n) = \sum_{uv \in E} \frac{d(u)^2 + d(v)^2}{d(u) + d(v)}$$

$$= \sum_{uv \in E_{(2,2)}} \frac{2^2 + 2^2}{2 + 2} + \sum_{uv \in E_{(2,3)}} \frac{2^2 + 3^2}{2 + 3} + \sum_{uv \in E_{(3,3)}} \frac{3^2 + 3^2}{3 + 3}$$

$$= (2n + 4)(2) + (4n)\left(\frac{13}{5}\right) + 3(4n - 3)$$

$$= \frac{132n - 5}{5}.$$

Rhombic benzenoid network

The Rhombic benzenoid system is designated by R_n, where n is the number of rows in the graph of Zn and hexagons are arranged to form a rhombic shape, as illustrated in Figure 3

Theorem 3

For Rhombic Benzenoid Network $R_n, n \geq 2$, $CH(R_n) = \frac{45n^2 + 44n - 29}{5}$.

Proof:

The number of vertices in rhombic benzenoid network $|V(R_n)| = 2n(n + 2)$ and the number of edges $|E(R_n)| = 3n^2 + 4n - 1$.

The partition in the edge set of R_n are as follows,

$$E_{(2,2)} = \{e = uv \in E(R_n) | d_{R_n}(u) = 2, d_{R_n}(v) = 2\},$$

$$E_{(2,3)} = \{e = uv \in E(R_n) | d_{R_n}(u) = 2, d_{R_n}(v) = 3\},$$

$$E_{(3,3)} = \{e = uv \in E(R_n) | d_{R_n}(u) = 3, d_{R_n}(v) = 3\}$$

Then $|E_{(2,2)}| = 6, |E_{(2,3)}| = 8(n - 1), |E_{(3,3)}| = 3n^2 - 4n + 1$

$$CH(R_n) = \sum_{uv \in E} \frac{d(u)^2 + d(v)^2}{d(u) + d(v)}$$

$$= \sum_{uv \in E_{(2,2)}} \frac{2^2 + 2^2}{2 + 2} + \sum_{uv \in E_{(2,3)}} \frac{2^2 + 3^2}{2 + 3} + \sum_{uv \in E_{(3,3)}} \frac{3^2 + 3^2}{3 + 3}$$

$$= 6(2) + 8(n - 1)\left(\frac{13}{5}\right) + 3(3n^2 - 4n + 1)$$

$$= \frac{45n^2 + 44n - 29}{5}.$$

Circumcoronene series of Benzenoid

Let H_n denotes the circumcoronene series of benzenoid system which consist several copy of benzene C_6 on circumference as illustrated in figure.4.

Theorem 4

For Circumcoronene series of Benzenoid $H_n, n \geq 1$, $CH(H_n) = \frac{135n^2 - 69n - 6}{5}$.

Proof:

The number of vertices in Circumcoronene series of Benzenoid network $|V(H_n)| = 6n^2$ and the number of edges $|E(H_n)| = 9n^2 - 3n$.

The partition in the edge set of H_n are as follows,

$$E_{(2,2)} = \{e = uv \in E(H_n) | d_{H_n}(u) = 2, d_{H_n}(v) = 2\},$$

$E_{(2,3)} = \{e = uv \in E(H_n) | d_{H_n}(u) = 2, d_{H_n}(v) = 3\},$

$E_{(3,3)} = \{e = uv \in E(C_n) | d_{H_n}(u) = 3, d_{H_n}(v) = 3\}$

Then $|E_{(2,2)}| = 6, |E_{(2,3)}| = 12(n-1), |E_{(3,3)}| = 9n^2 - 15n + 6$

$$CH(H_n) = \sum_{uv \in E} \frac{d(u)^2 + d(v)^2}{d(u) + d(v)}$$

$$= \sum_{uv \in E_{(2,2)}} \frac{2^2 + 2^2}{2 + 2} + \sum_{uv \in E_{(2,3)}} \frac{2^2 + 3^2}{2 + 3} + \sum_{uv \in E_{(3,3)}} \frac{3^2 + 3^2}{3 + 3}$$

$$= 6(2) + 12(n-1)\left(\frac{13}{5}\right) + 3(9n^2 - 15n + 6)$$

$$= \frac{135n^2 - 69n - 6}{5}$$

Hourglass Benzenoid network

Let X_n denotes the benzenoid hourglass, which is obtained from two copies of a triangular benzenoid T_n by overlapping their external hexagons as illustrated in figure.5.

Theorem 5

For Hourglass Benzenoid Network $X_n, n \geq 2$, $CH(X_n) = \frac{45n^2 + 111n - 98}{5}$.

Proof:

The number of vertices in Hourglass benzenoid network $|V(X_n)| = 2(n^2 + 4n - 2)$ and the number of edges $|E(X_n)| = 3n^2 + 9n - 6$.

The partition in the edge set of X_n are as follows,

$E_{(2,2)} = \{e = uv \in E(X_n) | d_{X_n}(u) = 2, d_{X_n}(v) = 2\},$

$E_{(2,3)} = \{e = uv \in E(X_n) | d_{X_n}(u) = 2, d_{X_n}(v) = 3\},$

$E_{(3,3)} = \{e = uv \in E(X_n) | d_{X_n}(u) = 3, d_{X_n}(v) = 3\}$

Then $|E_{(2,2)}| = 8, |E_{(2,3)}| = 4(3n-4), |E_{(3,3)}| = 3n^2 - 3n + 2$

$$CH(X_n) = \sum_{uv \in E} \frac{d(u)^2 + d(v)^2}{d(u) + d(v)}$$

$$= \sum_{uv \in E_{(2,2)}} \frac{2^2 + 2^2}{2 + 2} + \sum_{uv \in E_{(2,3)}} \frac{2^2 + 3^2}{2 + 3} + \sum_{uv \in E_{(3,3)}} \frac{3^2 + 3^2}{3 + 3}$$

$$= 8(2) + 4(3n-4)\left(\frac{13}{5}\right) + 3(3n^2 - 3n + 2)$$

$$= \frac{45n^2 + 111n - 98}{5}.$$

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| **Figure 1: Graph of Triangular Benzenoid system T_n.** | **Figure 2: Graph of Zigzag Benzenoid system Z_n.** |
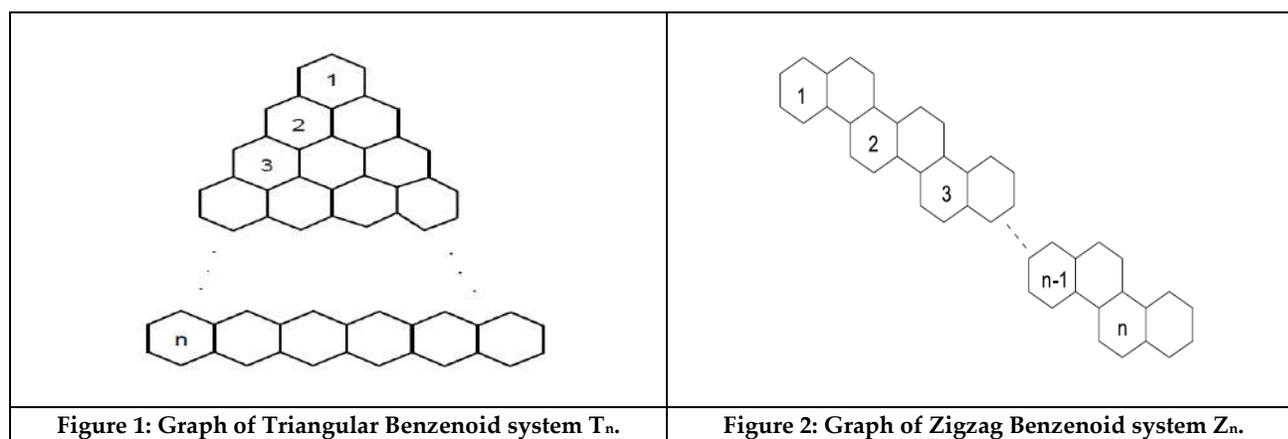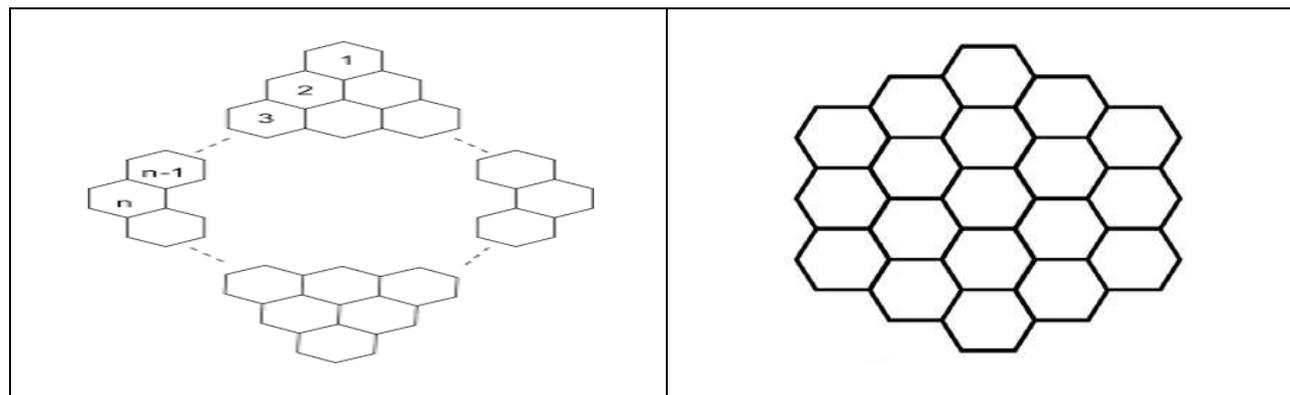
Figure 3: Graph of Zigzag Benzenoid system Z_n

Figure 4: Graph of Circumcoronene of Benzenoid H_3
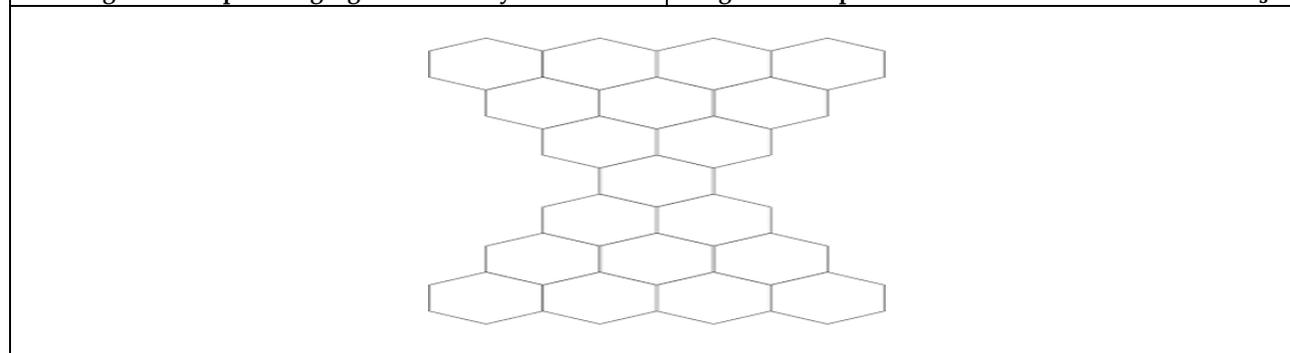
Figure 5: Graph of Hourglass Benzenoid system X_4

RESEARCH ARTICLE

Simple Graphoidal Cover on Bicyclic Graphs

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ABSTRACT

A simple graphoidal cover of *G* is a set ψ of paths in *G* such that every edge is in exactly one path in ψ and every vertex is an internal vertex of at most one path in ψ and any two paths in ψ has at most one vertex in common. The minimum cardinality of the simple graphoidal cover of *G* is called the simple graphoidal covering number of *G* and is denoted by η_s. This paper discusses about decomposition of bicyclic graphs into paths and cycles using simple graphoidal covers.

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Keywords: Graphoidal cover; Simple Graphoidal Cover ; Bicyclic Graphs.

INTRODUCTION

In graph theory, decomposition of graphs has wide range of applications in Networking, Bio Informatics etc. A decomposition of a graph is set of disjoint edge subgraphs in which every edge of *G* is contained by precisely one member of the set. Several authors discuss about the several decompositions of parameters by applying different conditions.The task of locating information about objects on the internet is enormous. Graph networks can be used to accomplish this. Objects and their relationships are reduced to smaller graphs. Furthermore, some objects have one or more relationships with one another. Clearly, some objects are bicyclic graphs in nature. Now we decompose the objects based on the given relationship conditions and retrieve the objects information.

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B.D. Acharya and Sampath Kumar [1] introduced and explored graphoidal cover, which was one of the decomposition types. Several authors [2-12] experimented with various parameters in the graphoidal coverings. Some of them are acyclic graphoidal cover, simple graphoidal, geodesic graphoidal cover, m–graphoidal path cover, 2–graphoidal cover, 2–simple graphoidal and 2–acyclic simple graphoidal covers.

Preliminary Results

In this paper, all of the graphs $G = (V, E)$ are undirected, nontrivial, simple and connected. The order and size of the graph G is denoted by p and q respectively. Harary [13] can be referred for graph-theoretic terminology. If $P = (w_0, w_1, \ldots, w_n)$, then the vertices w_0, w_n are called external vertices and $w_1, w_2, \ldots, w_{n-1}$ are called internal vertices. If no vertex of G is an internal vertex of both P_1 and P_2, then the paths P_1 and P_2 are said to be internally disjoint.

Definition 2.1. [1] A graphoidal cover of G is a set ψ of (not necessarily open) paths in G satisfying the following conditions.
(i) Every path in ψ has at least two vertices.
(ii) Every vertex of G is an internal vertex of at most one path in ψ.
(iii) Every edge of G is in exactly one path in ψ.
The minimum cardinality of a graphoidal cover of G is called the graphoidal covering number of G and is denoted by $\eta(G)$.

The concept of simple graphoidal was introduced by Arumugam and Shahul Hamid [5]

Definition 2.2. [5]   A simple graphoidal cover of a graph G is a graphoidal cover ψ of G such that any two paths in ψ have at most one vertex in common. The minimum cardinality of a simple graphoidal cover of G is called simple graphoidal covering number of G and is denoted by $\eta_s(G)$.

Theorem 2.1. [5] For any simple graphoidal cover ψ of a (p, q) of graph G, let t_ψ denote the number of exterior vertices of ψ and let $t = \min t_\psi$, where the minimum is taken overall simple graphoidal cover ψ of G, then $\eta_s(G) = q - p + t.$

Corollary 2.1. [5] For any graph G, $\eta_s(G) \geq q - p.$. Moreover, the following are equivalent
(i) $\eta_s(G) = q - p.$
(ii) There exists a simple graphoidal cover of G without exterior vertices.
(iii) There exists a set P of internally disjoint and edge disjoint paths without exterior vertices such that any two paths in P have at most one vertex in common.

Corollary 2.2. [5] If there exists a simple graphoidal cover ψ of G such that every vertex v of G with deg v >1 is an internal vertex of a path in ψ, then ψ is a minimum graphoidal cover of G and $\eta_s(G) = q - p + n$, where n is the number of pendant vertices of G.

Theorem 2.2.[5] Let T be a tree with n pendant vertices. Then $\eta_s(T) = n - 1.$

Theorem 2.3. [5] Let G be an unicyclic graph with n pendent vertices. Let C be the unique cycle on G and let m be the number of vertices of degree greater than 2 on C . Then

$$\eta_s(G) = \begin{cases} 1 & if\ m = 0 \\ \\ n+1 & if\ [\,m = 1\,(or)\,m = 2,\ and\ any\ vertex\ on\ C\ has\ degree\ at\ most\ 3] \\ \\ n & otherwise \end{cases}$$

A connected (p,p+1) – graph of G is called a *bicyclic graph*. Let B be a bicyclic graph which contains two cycles $C_t = (u_0, u_1, \ldots, u_{t-1}, u_0\ )$, $C_s = (v_0, v_1, \ldots, v_{s-1}, v_0\ )$ and common vertices l ($l > 0$). We label the vertices in cycle C_t in the clockwise direction and the vertices in the cycle C_s in the anti-clock wise direction. We classify the bicyclic graphs into three different kinds.

(i) **First Kind of Bicyclic graph** $B^1(t,s)$ is obtained by two cycles C_t and C_s, share exactly one common vertex $v_0(u_0)$.

(ii) **Second Kind of Bicyclic graph** $B^2(t,s,r)$ is obtained by connecting two cycles C_t and C_s, by a unique path of length r (r > 1) with starting vertex u_1 and terminal vertex v_1 .

(iii) **Third kind of Bicyclic graph** $B^3(t,s,m)$ is obtained by three pairwise disjoint internal paths { $P_i : i = 1,2,3$ } from a vertex x to a vertex y. The paths are $P_1 = \left(x, v_1, \ldots, v_{(t-1)}, y\right)$ with length t , $P_2 = \left(x, u_1, \ldots, u_{(s-1)}, y\right)$ with length s and $P_3 = \left(x, w_1, \ldots, w_{(m-1)}, y\right)$ with length m ($1 \le m \le \min\ \{t,s\}$).

MAIN RESULTS

Theorem 3.1. Let G be a bicyclic graph with n pendant vertices. Also let $B^1(t,s)$ be the unique bicycle in G and let k be the number of vertices of degree >2 on C. Then

$$\eta_s(G) = \begin{cases} 2 & if\ G = B^1(t,s) \\ \\ n+2 & if\ [\,k = 1, \deg(u_0) = 5\ (or)\,(k = 2, \deg(u_0) = 4\ (or)\ 5,\ \deg(v) = 3), v \in C_t)\,(or)\,(k = 3, \deg(u_0) = 4, \\ & \quad \deg(v) = \deg(w) = 3)\ (or)\,(k = 4, \deg(u_0) = \deg(v_i) = \deg(v_j) = \deg(v_k) = 3,\ v_i, v_j \in C_t, v_k \in C_s\,] \\ \\ n+1 & otherwise \end{cases}$$

Proof. Let $C_t = (u_0, u_1, \ldots, u_{t-1}, u_0\ )$ and $C_s = (v_0, v_1, \ldots, v_{s-1}, v_0\ )$ be two cycles sharing a common vertex $u_0(v_0)$ with $q = p+1$.

Case 1. When $G = B^1(t,s)$

Take $\psi = \{C_t, C_s\}$ is a minimum simple graphoidal cover of G. Therefore $\eta_s(G) = 2$.

Case 2. When $k = 1$ and let u_0 be the unique vertex is of degree >2 on $B^1(t,s)$. Then there are two subcases.

Subcase 2.1. When $\deg(u_0) = 5$

Take $G^* = G - \{C_s\}$ is an unicyclic graph with n pendant vertices with $\deg(u_0) = 3$ and hence by theorem 2.3, $\eta_s(G^*) = n + 1$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{C_s\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \leq n + 2$. Furthermore, for any simple graphoidal cover ψ of G, n pendant vertices and one vertex in the cycle say u_0 in $B^1(t,s)$ are external in ψ so that $t \geq n + 1$. Hence $\eta_s(G) \geq n + 2$. Thus $\eta_s(G) = n + 2$.

Subcase 2.2. When $\deg(u_0) \geq 6$

Take $G^* = G - \{C_s\}$ is an unicyclic graph with n pendant vertices with $\deg(u_0) \geq 4$ and hence by theorem 2.3, $\eta_s(G^*) = n$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{C_s\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \leq n + 1$. Furthermore, for any simple graphoidal cover ψ of G, $t \geq n$. Hence $\eta_s(G) \geq n + 1$. Thus $\eta_s(G) = n + 1$.

Case 3 . When $k = 2$ and let v be the only vertex unique vertex is of degree >2 other than u_0 on $B^1(t,s)$. Then there are two subcases.

Subcase 3.1. When $\deg(u_0) = 4$ (or) 5, $\deg(v) = 3$ and $v \in C_t$

Take $G^* = G - \{C_s\}$ is an unicyclic graph with n pendant vertices with $\deg(u_0) = 2 (or) 3$ and hence by theorem 2.3, $\eta_s(G^*) = n + 1$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{C_s\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \leq n + 2$. Furthermore, for any simple graphoidal cover ψ of G, $t \geq$ n+1. Hence $\eta_s(G) \geq n + 2$. Thus $\eta_s(G) = n + 2$.

Subcase 3.2. When $(\deg(u_0) \geq 6, \deg(v) \geq 3)(or)(\deg(u_0) \geq 4, \deg(v) \geq 4)$ and $v \in C_t$

Take $G^* = G - \{C_s\}$ is an unicyclic graph with n pendant vertices and hence by theorem 2.3, $\eta_s(G^*) = n$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{C_s\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \leq n + 1$. Furthermore, for any simple graphoidal cover ψ of G, $t \geq n$. Hence $\eta_s(G) \geq n + 1$. Thus $\eta_s(G) = n + 1$.

Case 4. When $k = 3$ and let u_0, v, w be the only vertices is of degree >2 on $B^1(t,s)$. Then there are four subcases.

Subcase 4.1. When $\deg(u_0) = 4, \deg(v) = \deg(w) = 3$ and $v, w \in C_t$

Take $G^* = G - \{C_s\}$ is an unicyclic graph with n pendant vertices with $\deg(u_0) = 2$ and hence by theorem 2.3, $\eta_s(G^*) = n + 1$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{C_s\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \leq n + 2$. Furthermore, for any simple graphoidal cover ψ of G, $t \geq n + 1$. Hence $\eta_s(G) \geq n + 2$. Thus $\eta_s(G) = n + 2$.

Subcase 4.2. When $(\deg(u_0) \geq 5, \deg(v) \geq 3, \deg(w) \geq 3)$ (or) $(\deg(u_0) \geq 4, \deg(v) \geq 4, \deg(w) \geq 3)$ and $v, w \in C_t$

Take $G^* = G - \{C_s\}$ is an unicyclic graph with n pendant vertices with $\deg(u_0) \geq 3$ and hence $\eta_s(G^*) = n$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{C_s\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \leq n + 1$. Furthermore, for any simple graphoidal cover ψ of G, $t \geq n$. Hence $\eta_s(G) \geq n + 1$. Thus $\eta_s(G) = n + 1$.

Subcase 4.3. When $\deg(u_0) = 4$ (or) 5, $\deg(v) = \deg(w) = 3$ and $v \in C_t$, $w \in C_s$.

Let P_1 and P_2 denote $(v - u_0)$ and $(u_0 - w)$ section on $B^1(t,s)$. Let v_k be a internal vertex in the path P_1. The paths P_3, P_4 denote $(v - v_k)$ and $(v_k - u_0)$ respectively.

Take $G^* = G - \{P_1\} - \{P_2\}$ is a tree with n pendant vertices and hence by theorem 2.2, $\eta_s(G^*) = n - 1$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{P_3\} \cup \{P_4\} \cup \{P_2\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \leq n + 2$. Furthermore, for any simple graphoidal cover ψ of G, $t \geq n + 1$. Hence $\eta_s(G) \geq n + 2$. Thus $\eta_s(G) = n + 2$.

Subcase 4.4. When $(\deg(u_0) \geq 4, \deg(v) \geq 4, \deg(w) \geq 4)$ (or) $(\deg(u_0) \geq 6,\ \deg(v) \geq 3, \deg(w) \geq 3)$ and $v \in C_t$, $w \in C_s$.

Take $G^* = G - \{P_1\} - \{P_2\}$ where P_1 and P_2 denote $(v - u_0)$ and $(u_0 - w)$ section on $B^1(t,s)$ Clearly G^* is a tree with n pendant vertices and hence by theorem 2.2, $\eta_s(G^*) = n - 1$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{P_1\} \cup \{P_2\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \leq n + 1$. Furthermore, for any simple graphoidal cover ψ of G, $t \geq n$. Hence $\eta_s(G) \geq n + 1$. Thus $\eta_s(G) = n + 1$.

Case 5. When $k \geq 4$ and let u_0, v_i, v_j, v_k be the only vertices is of degree >2 on $B^1(t,s)$. Then there are four subcases.

Subcase 5.1. When $\deg(u_0) \geq 4, \deg(v_i) \geq 3, \deg(v_j) \geq 3, \deg(v_k) \geq 3$ and $v_i, v_j,\ v_k \in C_t$

Take $G^* = G - \{C_s\}$ is an unicyclic graph with n pendant vertices and hence $\eta_s(G^*) = n$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{C_s\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \leq n + 1$. Furthermore, for any simple graphoidal cover ψ of G, $t \geq n$. Hence $\eta_s(G) \geq n + 1$. Thus $\eta_s(G) = n + 1$.

Subcase 5.2. When $k = 4, \deg(u_0) = 4 (or) 5, \deg(v_i) = \deg(v_j) = 3$ $\deg(v_k) = 3$ and $v_i, v_j \in C_t$, $v_k \in C_s$. Let P_1 and P_2 denote $(v_i - u_0)$ and $(u_0 - v_j)$ section on $B^1(t,s)$. Let v_k be an internal vertex in the path P_1. The paths P_3, P_4 denote $(v_i - v_k)$ and $(v_k - u_0)$ respectively

Take $G^* = G - \{P_1\} - \{P_2\}$ is a tree with n pendant vertices and hence by theorem 2.2, $\eta_s(G^*) = n - 1$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{P_3\} \cup \{P_4\} \cup \{P_2\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \leq n + 2$. Furthermore, for any simple graphoidal cover ψ of $G t \geq n + 1$. Hence $\eta_s(G) \geq n + 2$. Thus $\eta_s(G) = n + 2$.

Subcase5.3 When $k \geq 4$, $(\deg(u_0) \geq 4$, $\deg(v_i) \geq 3$, $\deg(v_j) \geq 3$, $\deg(v_k) \geq 4)$ (or) $(\deg(u_0) \geq 4$, $\deg(v_i) \geq 4, \deg(v_j) \geq 3$, $\deg(v_k) \geq 3)$ (or) $(\deg(u_0) \geq 6$, $\deg(v_i) \geq 3$, $\deg(v_j) \geq 3$, $\deg(v_k) \geq 3)$ and $v_i, v_j \in C_t$,$v_k \in C_s$. Take $G^* = G - \{P_1\} - \{P_2\}$ where P_1 and P_2 denote $(v_i - u_0)$ and $(u_0 - v_k)$ section on $B^1(t,s)$ Clearly G^* is a tree with n pendant vertices and hence by theorem 2.2, $\eta_s(G^*) = n - 1$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{P_1\} \cup \{P_2\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \leq n + 1$. Furthermore, for any simple graphoidal cover ψ of $G t \geq n$. Hence $\eta_s(G) \geq n + 1$. Thus $\eta_s(G) = n + 1$.

Subcase 5.4. When $k \geq 5, \deg(u_0) \geq 4, \deg(v_i) \geq 3, \deg(v_j) \geq 3, \deg(v_k) \geq 3, \deg(v_l) \geq 3$ and $(v_i, v_j, v_k \in C_t$,$v_l \in C_s)$ (or) $(v_i, v_j \in C_t$, $v_k, v_l \in C_s)$

Proof is similar as in Subcase 5.3.

Theorem 3.2. Let G be a bicyclic graph with n pendant vertices. Also let $B^2(t,s,r)$ be the unique bicycle in G and let k be the number of vertices of degree > 2 on $B^2(t,s,r)$. Then

$$\eta_s(G) = \begin{cases} 3 & \text{if } G = B^2(t,s,r) \\[2ex] n+3 & \text{if } [(k=3, \deg(u_1) = \deg(v_1) = \deg(v) = 3) \ (or)(k=4, (\deg(u_1) = \deg(v_1) = \deg(v) = \deg(w) = 3, \\ & \quad v \in C_t, w \in C_s)] \\[2ex] n+2 & \text{if } [(k=2, \deg(u_1) \geq 4, \deg(v_1) = 3) \ (or)(k=3 \text{ and } ((\deg(u_1) \geq 4, \deg(v_1) = 3, \deg(v) \geq 3)(or)(\deg(u_1) = 3 \\ & \quad \deg(v_1) = 3, \deg(v) \geq 4) \ v \in C_t)(or)(k=4, ((\deg(u_1) \geq 4, \deg(v_1) = 3)(or)(\deg(u_1) = \deg(v_1) = 3)) \text{ and } \\ & \quad ((\deg(v) \geq 3, \deg(w) \geq 3, v,w \in C_t)(or)(\deg(v) \geq 3, \deg(w) = 3, v \in C_t \ w \in C_s)) \ (or) \ (k=5, ((\deg(u_1) = 3 \\ & \quad \deg(v_1) = 3)(or)(\deg(u_1) \geq 4, \deg(v_1) = 3) \text{ and } ((\deg(u) \geq 3, \deg(v) \geq 3, \deg(w) \geq 3, u,v,w \in C_t)(or) \\ & \quad (\deg(u) \geq 3, \deg(v) \geq 3, \deg(w) = 3, \ u,v \in C_t \ w \in C_s))(or)(k > 5, ((\deg(u_1) = \deg(v_1) = 3) \ (or)(\deg(u_1) \geq 4, \\ & \quad \deg(v_1) = 3)) \text{ and } (\deg(u) \geq 3, \deg(v) \geq 3, \deg(w) \geq 3, \deg(x) \geq 3, u,v,w,x \in C_t)(or)(\deg(u) \geq 3, \deg(v) \geq 3, \\ & \quad \deg(x) \geq 3, \deg(w) = 3, u,v,x \in C_t, w \in C_s))] \\[2ex] n+1 & otherwise \end{cases}$$

Proof. Let $C_t = (u_0, u_1, \ldots, u_{t-1}, u_0)$, $P_r = (u_1, u_t, \ldots, u_{t+r-1}, v_1)$ and $C_s = (v_0, v_1, \ldots, v_{s-1}, v_0)$.

Case 1. Suppose $G = B^2(t,s,r)$

Then $\psi = \{C_t, P_r, C_s\}$ is a minimum simple graphoidal cover of G, u₁ and v₁ with as external vertices in G. Hence $\eta_s(G) = 3$.

Case 2. Suppose k = 2, then there are two sub cases.

Subcase 2.1. When $\deg(u_1) \geq 4$ and $\deg(v_1) = 3$

Take $G^* = G - \{C_s\}$ is a unicyclic graph with (n+1) pendant vertices and hence by theorem 2.3, $\eta_s(G^*) = n+1$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{C_s\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \leq n+2$. Furthermore, for any simple graphoidal cover ψ of G, n pendant vertices and one vertex say v_1 in $B^2(t,s,r)$ are external in ψ so that $t \geq n+1$. Hence $\eta_s(G) \geq n+2$. Thus $\eta_s(G) = n+2$.

Subcase 2.2. When $\deg(u_1) \geq 4$ and $\deg(v_1) \geq 4$

Take $G^* = G - \{C_s\}$ is a unicyclic graph with n pendant vertices and hence by theorem 2.3, $\eta_s(G^*) = n$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{C_s\}$ is a simple graphoidal cover of G, hence

$\eta_s(G) \le n+1$. Furthermore, for any simple graphoidal cover ψ of G, $t \ge n$. Hence $\eta_s(G) \ge n+1$. Thus $\eta_s(G) = n+1$.

Case 3. Suppose $k = 3$, and let v be the only vertex is of degree >2 other than u_1 and v_1. Then there are three subcases.

Subcase 3.1. When $\deg(u_1) = \deg(v_1) = \deg(v) = 3$ and $v \in C_t$

Take $G^* = G - \{C_s\}$ is a unicyclic graph with (n+1) pendant vertices and hence by theorem 2.3, $\eta_s(G^*) = n+2$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{C_s\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \le n+3$. Furthermore, for any simple graphoidal cover ψ of G, n pendant vertices and two vertices say u_1, v_1 in $B^2(t,s,r)$ are external in ψ so that $t \ge n+2$. Hence $\eta_s(G) \ge n+3$. Thus $\eta_s(G) = n+3$.

Subcase 3.2. When $\deg(u_1) \ge 4$, $\deg(v_1) = 3, \deg(v) \ge 3$ (or) $\deg(u_1) = 3$, $\deg(v_1) = 3, \deg(v) \ge 4$ and $v \in C_t$

Take $G^* = G - \{C_s\}$ is a unicyclic graph with (n+1) pendant vertices and hence $\eta_s(G^*) = n+1$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{C_s\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \le n+2$. Furthermore, for any simple graphoidal cover ψ of $G, t \ge n+1$. Hence $\eta_s(G) \ge n+2$. Thus $\eta_s(G) = n+2$.

Subcase 3.3. When $\deg(u_1) \ge 4$, $\deg(v_1) \ge 4$, $\deg(v) \ge 3$ and $v \in C_t$

Take $G^* = G - \{C_s\}$ is a unicyclic graph with n pendant vertices and hence $\eta_s(G^*) = n$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{C_s\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \le n+1$. Furthermore, for any simple graphoidal cover ψ of $G, t \ge n$. Hence $\eta_s(G) \ge n+1$. Thus $\eta_s(G) = n+1$.

Case 4. When $k > 3$ and let v, w be the only vertices is of degree > 2 other than u_1, v_1. Suppose $\deg(v) \ge 3$ and $\deg(w) \ge 3$, then there are four cases.

Case 4.1. When $v, w \in C_t$, then there are two subcases.

Subcase 4.1.1. When $\deg(u_1) = \deg(v_1) = 3$
Proof is similar as in Subcase 3.2.

Subcase 4.1.2. When $\deg(u_1) \ge 3$, $\deg(v_1) \ge 4$
Proof is similar as in Subcase 3.3.

Case 4.2. When $k = 4$, $v \in C_t, w \in C_s$ and let P denote (v_1, w) section of C_s such that it has at least one internal vertex say v_i. Let P_1 and P_2 denote the (v_1, v_i) and (v_i, w) section of P respectively. Then there are two sub cases.

Subcase 4.2.1. When $\deg(u_1) = \deg(v_1) = \deg(v) = \deg(w) = 3$

Take $G^* = G - \{P\}$ is a unicyclic graph with n pendant vertices and hence by theorem 2.3, $\eta_s(G^*) = n+1$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{P_1\} \cup \{P_2\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \le n+3$. Furthermore, for any simple graphoidal cover ψ of $G, t \ge n+2$. Hence $\eta_s(G) \ge n+3$. Thus $\eta_s(G) = n+3$.

Subcase 4.2.2. When either $\deg(v) \geq 4$ (or) $\deg(w) \geq 4$ and suppose $\deg(v) \geq 4$, then there are two cases.

Subcase 4.2.2.1. When $deg(u_1) \geq 3, deg(v_1) = 3$

Take $G^* = G - \{P\}$ is a unicyclic graph with n pendant vertices and hence by theorem 2.3, $\eta_s(G^*) = n$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{P_1\} \cup \{P_2\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \leq n+2$. Furthermore, for any simple graphoidal cover ψ of G, $t \geq n+1$. Hence $\eta_s(G) \geq n+2$. Thus $\eta_s(G) = n+2$.

Subcase 4.2.2.2. When $\deg(u_1) \geq 3, \deg(v_1) \geq 4$

Take $G^* = G - \{P_a\} - \{P_b\}$, where P_a and P_b denote and $(v_1 - w)$ section on $B^2(t,s,r)$. Clearly G^* is a tree with n pendant vertices and hence by theorem 2.2, $\eta_s(G^*) = n-1$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{P_a\} \cup \{P_b\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \leq n+1$. Furthermore, for any simple graphoidal cover ψ of G, $t \geq n$. Hence $\eta_s(G) \geq n+1$. Thus $\eta_s(G) = n+1$.

Case 4.3. When $k = 5$ and let v,w,x be the only vertices is of degree > 2 other than u_1, v_1. Suppose $v,x \in C_t, w \in C_s$, then there are two subcases.

Subcase 4.3.1. When $\deg(u_1) \geq 3$, $\deg(v) \geq 3$, $\deg(x) \geq 3$, $\deg(v_1) = 3$, $\deg(w) = 3$ and $v,x \in C_t, w \in C_s$

Proof is similar as in Subcase 4.2.2.1.

Subcase 4.3.2. When $\deg(u_1) \geq 3$, $\deg(v) \geq 3$, $\deg(x) \geq 3$, $\deg(v_1) \geq 3$, $\deg(w) \geq 4$ and $v,x \in C_t, w \in C_s$

Proof is similar as in Subcase 4.2.2.2.

Subcase 4.4. When $k \geq 6$ and let v,w,x,y be the only vertices is of degree >2 other than u_1, v_1. Then there are two subcases.

Subcase 4.4.1. Suppose $\deg(u_1) \geq 3$, $\deg(v) \geq 3$, $\deg(x) \geq 3, \deg(y) \geq 3$, $deg(v_1) = \deg(w) = 3$ and $v,x,y \in C_t, w \in C_s$

Proof is similar as in Subcase 4.3.1.

Subcase 4.4.2. When $\deg(u_1) \geq 3$, $\deg(v) \geq 3$, $\deg(x) \geq 3, \deg(y) \geq 3$, $deg(v_1) \geq 3$, $\deg(w) \geq 3$ and $v,x \in C_t, w,y \in C_s$

Proof is similar as in Subcase 4.3.2.

Theorem 3.3. Let G be a bicyclic graph with n pendant vertices. Also let $B^3(t,s,m)$ be the unique bicycle in G and let k be the number of vertices of degree > 2 on C. Then

$$\eta_s(G) = \begin{cases} 3 & \text{if } G = B^3(t,s,m) \\[2mm] n+3 & \text{if } [(k = 2, \deg(x) = \deg(y) = 4) \ (or) \ (k = 3, \deg(x) = \deg(y) = 3, \deg(u) = 3) \ (or) (k = 4, \deg(x) = 3 \\ & \deg(y) = \deg(u) = \deg(u) = 3)] \\[2mm] n+2 & \text{if } [\ (k = 2, \ \deg(x) \geq 5, \ \deg(y) \geq 3) \ (or) \ (k = 3, \ (\deg(u) \geq 4, \deg(x) \geq 3, \deg(y) \geq 3) \ (or) (\deg(x) \geq 5, \\ & \deg(y) \geq 5, \deg(v) \geq 3)) \ (or) \ (k = 4, (\deg(u) \geq 4 \ (or) \deg(v) \geq 4, \ \deg(x) \geq 3, \deg(y) \geq 3, (or) \ (\deg(x) \geq 4, \\ & (or) \deg(y) \geq 4, \deg(u) \geq 3, \deg(v) \geq 3) \ (or) (k = 5, \deg(u) \geq 3, \deg(v) \geq 3, (\deg(w) \geq 3, \deg(x) \geq 3, \\ & \deg(y) \geq 3, u,v \in P_1 \ \text{and either} \ w \in P_2 \ (or) P_3] \\[2mm] n+1 & \text{otherwise} \end{cases}$$

Proof. Bicyclic graph $B^3(t,s,m)$ is formed by three internal disjoint paths P_1, P_2, P_3 where $P_1 = \left(x, u_1, \ldots, u_{(t-1)}, y\right), P_2 = \left(x, v_1, v_2, \ldots, v_{(s-1)}, y\right)$ and $P_3 = \left(x, w_1, w_2, \ldots, w_{(m-1)}, y\right)$.

Case 1. When $G = B^3(t,s,m)$

Then $\psi = \{P_1, P_2, P_3\}$ is the minimum simple graphoidal cover of $B^3(t,s,m)$ such that $\eta_s(G) = 3$.

Now, Divide P_3 into two paths say P_a, P_b. Let $P_a = \left(x, w_1, w_2, \ldots, w_{(t-1)}\right)$ and $P_b = \left(w_{(t-1)}, y\right)$.

Case 2. When $k = 2$, then there are two cases.

Subcase 2.1. When either $\deg(x) = 4 \, (or) \, \deg(y) = 4 \, (or)$ both

Take $G^* = G - \{P_3\}$ is a unicyclic graph with n pendant vertices and hence by theorem 2.3, $\eta_s(G^*) = n+1$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{P_a\} \cup \{P_b\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \leq n+3$. Furthermore, for any simple graphoidal cover ψ of $G, t \geq n+2$. Hence $\eta_s(G) \geq n+3$. Thus $\eta_s(G) = n+3$.

Subcase 2.2. When $\deg(x) \geq 5, \deg(y) \geq 3$

Take $G^* = G - \{P_3\}$ is a unicyclic graph with n pendant vertices and hence by theorem 2.3, $\eta_s(G^*) = n$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{P_a\} \cup \{P_b\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \leq n+2$. Furthermore, for any simple graphoidal cover ψ of $G, t \geq n+1$. Hence $\eta_s(G) \geq n+2$. Thus $\eta_s(G) = n+2$.

Case 3. When $k = 3$ and let u be the vertex of degree > 2 other than x and y. Then there are two cases.

Subcase 3.1. When $\deg(x) = \deg(y) = \deg(u) = 3$

Proof is similar as in Subcase 2.1.

Subcase 3.2. When $(\deg(u) \geq 4, \deg(x) \geq 3, \deg(y) \geq 3)$ (or) (either $\deg(x) \geq 5 \, (or) \, \deg(y) \geq 5$ and $\deg(u) \geq 3$) (or) ($\deg(x) = \deg(y) = 4$ and $\deg(u) \geq 3$)

Proof is similar as in Subcase 2.2.

Case 4. When $k = 4$ and let u, v be the two vertices is of degree > 2 other than x and y. Then there are two cases.

Subcase 4.1. When $\deg(u) = \deg(x) = \deg(y) = \deg(y) = 3$ and either ($u, v \in P_1$ (or) P_2 (or) P_3) (or) ($u \in P_1$ (or) $v \in P_2$ (or) P_3)

Proof is similar as in Subcase 3.1.

Subcase 4.2. Suppose (either $\deg(u) \geqslant 4 \, (or) \, \deg(v) \geqslant 4$ and $\deg(x) \geqslant 3, \deg(y) \geqslant 3$) (or) (either $\deg(x) \geqslant 4 \, (or) \, \deg(y) \geqslant 4, \deg(u) \geqslant 3, \deg(v) \geqslant 3$) and $u \in P_1, v \in P_2$ (or) P_3.

Proof is similar as in Subcase 2.2.

Case 5. When $k \geq 5$ and let u, v and w be the three vertices is of degree > 2 other than x and y. Then there are three cases.

Subcase 5.1. When $\deg(u) \geqslant 3, \deg(v) \geqslant 3, \deg(w) \geqslant 3, \deg(x) \geqslant 3, \deg(y) \geqslant 3$ and either $u, v, w \in P_1 \, (or) \, P_2 \, (or) \, P_3$

Proof is similar as in Subcase 2.2.

Subcase 5.2. When $k = 5$ and $\deg(u) \geqslant 3$, $\deg(v) \geqslant 3$, $\deg(w) \geqslant 3$, $\deg(x) \geqslant 3$, $\deg(y) \geqslant 3$ $u,v \in P_1$ and either $w \in P_2$ (or) P_3.

Take $G^* = G - \{P_3\}$ is a unicyclic graph with n pendant vertices and hence by theorem 2.3, $\eta_s(G^*) = n$. Let be ψ_1 the minimum simple graphoidal cover of G^*. Then $\psi = \psi_1 \cup \{P_3\}$ is a simple graphoidal cover of G, hence $\eta_s(G) \leq n + 1$. Furthermore, for any simple graphoidal cover ψ of $G, t \geq n$. Hence $\eta_s(G) \geq n + 1$. Thus $\eta_s(G) = n + 1$.

Subcase 5.3. When $k \geq 6$ and let u_i, u_j, u_k and u_l be the four vertices is of degree > 2 other than x and y. Suppose $\deg(u_i) \geqslant 3$, $\deg(u_j) \geqslant 3$, $\deg(u_k) \geqslant 3$, $\deg(u_l) \geqslant 3$, $\deg(x) \geqslant 3$, $\deg(y) \geqslant 3$ and $(u_i, u_j, u_k \in P_1, u_l \in P_2$ (or) $P_3)$ (or) $(u_i, u_j \in P_1$ and either $u_k, u_l \in P_2$ (or) P_3) Proof is similar as in Sub case 5.2.

CONCLUSION

This model of decomposition helps to create the web tracing the immediate contacts of the infected (x) and to detect the possible infected and the range of disease-spreading through the single infected. Decomposition of bicyclic graphs is of greater help in tracing or creating a web kind of network to trace the infected (or) any other mode of communicable (or) transmittable incident such as organized crimes, communicable diseases, networking, road-traffic, blood donors even at the times of natural disasters like earthquake, cyclones, Tsunami and so on. If an algorithm developed using this decomposition type, it could be of greater help to the public sector for early detection and treatment. Further if any device using AI modeled to trace the infected among the group of people or crowd, it could simplify the tracing for the betterment of human beings.

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RESEARCH ARTICLE

Electric Field Mapping of Any Given Point Charge Distribution using Python

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ABSTRACT

In this article, we present a computational electrodynamic simulator that maps out the electric vector field of any given stationary point chargesystem using python. The motivation behind this particular project was the drawbacks in conventional methods of electric field mapping which use manual methods that result in unwanted errors. In this project we chose Python as our preferred programming language for its simplicity and wide-ranging versatility. The primary packages that were used in developing this application were NumPy, PyCharge, and Plotly. PyCharge [1] is an open-source Python simulator for computational electrodynamics that can auto simulate dipoles modelled as Lorentz oscillators and calculate the electromagnetic fields and potentials produced by moving point charges. Using this package we create a stationary charge with x, y and z coordinates and a value of charge as its inputs. The Point charges that are subclasses of the Charge base class and have predetermined trajectories are calculated by the Simulation class as electromagnetic fields and potentials. The computed electric field magnitude is stored in anumpyarray. A mesh grid is deployed to which the magnitudes stored in the array is fed into. This mesh grid is then used to plot an interactive 3-d plot using Plotly [2], a plotting library. The vectors in the plot are represented using cones and their directions denote the vector's direction as well. And for representing the magnitude of vectors, a color scale is used, hence the color and size of the cones are proportional to the magnitude. Hovering the cursor above the vectors will display the x, y and z coordinates of the individual vectors. Finally, the end result is a vivid interactive 3-D plot of the electric vector field of the given 1-D distribution. The plot can be viewed from any angle and is downloadable as a png.

Keywords: Computational Electrodynamic Simulator, Electric Field, Point Charge, Python, PyCharge, Numpy, Plotly

INTRODUCTION

One of the most fundamental courses offered in any undergraduate physics programme is Introduction to Electrodynamics [3]. It plays a crucial part as a necessary requirement for many courses one might enrol in at the postgraduate level. Therefore, if not fully understood, it would be a significant barrier to learning more complex physics topics. We conducted a brief survey of our physics major classmates to find out which concepts in their Electrodynamics course were the most challenging to understand. It turned out that they had a lot of trouble comprehending electric fields and determining their magnitudes. This ultimately proved to be the main source of inspiration for this particular endeavour. The mapping of the electric fields of a point charge, a dipole, a system of four stationary charges in square configuration, and a system of eight stationary charges in a cubic configuration are the four primary fundamental issues we concentrate on in this article. Of course, the tool is also very scalable. Since this paper's goal is to introduce readers to computation's application in understanding and resolving classical physics problems, only four straightforward situations were simulated. The goal will be achieved once the reader has finished this piece and is able to understand how electric fields work and apply the same methods to mimic the electric fields of more point charge systems. Because of its astounding simplicity and big library of packages that can be utilised for data processing and manipulation, we chose Python as our programming language. We computed the electric field of the given system using Pycharge, an open-source Python simulator for computational electrodynamics, and plotted the results using Plotly, an open-source graphing tool. The other packages that were used to add different functions to the model included Numpy, Matplotlib, and Pandas.

Literature Review
The relative lack of publicly available articles similar to this one was yet another motivation. We analysed 4 additional research articles from our field of study that attempted to address the same issues and pursued comparable goals as our own. We carefully examined them to identify all potential research gaps in the area, and we made every attempt to close those gaps.

1. **"Static Electric Field Mapping Using a Mosquito Racket and Baby Oil"** [4]
   Suggests a straightforward experiment to show how the electric field force lines are created using materials that are readily available. The model is made up of a grass seed display for the field lines, an aluminium bar electrode, baby oil as a dielectric medium, and a mosquito racket that generates high voltage. Grass seeds are scattered on top of the baby oil after it has been put into a container. A voltage is applied after dipping the aluminium electrodes in the oil. The grass seeds show the electric field force lines on the oil surface depending on the charge setup and electrode shape.

2. **"Electric field of a point charge with VPython"** [5]
   UsesVPython, a 3D graphics module based on python, to calculate and plot the electric field of a point charge. This paper too uses an algorithm that uses Coulomb's law for the electric field calculation but unlike the first article, this plots the electric field along all the points around the point charge. Constants such as the Coulomb's constant, the charge of the point charge and the scaling factor are predefined. The end result is an interactive 3-D plot where the point charge is denoted by a sphere and the vectors are denoted by arrows where the length of the arrows is directly proportional to the magnitude of the electric field.

3. **"Python script used as a simulator for the teaching of the electric field in electromagnetism course"** [6]
   Proposes a technique for calculating the electric field created by n electric charges. In three higher education institutions, this tool was used in the laboratory and electromagnetic courses. The module adheres to an algorithmic structure that is implemented using several techniques that react to the number of electric charges. A graph based on the matplotlib. pyplot() module was used to illustrate the charges, position vectors with respect to the origin, and relative position vectors. The main method relied on Coulomb's law for the electric field calculation.

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4. **"PyCharge: An open-source Python package for self-consistent electrodynamics simulations of Lorentz oscillators and moving point charges" [7]**
   Elaborately explains the functioning of PyCharge a self-consistent Python simulator for computational electrodynamics that can calculate the electromagnetic fields and potentials produced by moving point charges and can simulate dipoles modelled as Lorentz oscillators. In order to calculate the electric and magnetic fields of a point charge, the module derives the Lienard-Wiechert potentials from the maxwells equation to obtain the Electric and magnetic fields produced by a moving point charge that are time-varying and relativistically accurate. And if the time parameter is set to zero, then the Electric and magnetic field of a stationary point charge can be obtained.

METHODOLOGY

PyCharge is the model's primary tool for electrodynamic simulations. The point charge sources are defined and computational operations are applied on them using this open-source Python library. For implementation, a very straightforward but highly scalable method was developed. It goes like this:

a) Define the sources of point charges. The Stationary Charge() class is utilised in this. The function's parameters are as follows:
   i) A positional parameter that accepts as input a tuple of float values for the coordinates x, y, and z.
   ii) A positional parameter that accepts as input a tuple of float values for the coordinates x, y, and z.

b) A simulation object is created using Simulation(), the primary class for electromagnetic computations in PyCharge. The class accepts the following parameters:
   i) A source of point charge, or a list of point charges.
   ii) A point charge, or a list of point charges.

c) Define a coordinate system for simulation using numpy meshgrid() function. The electric field due to the source is calculated at all the points within this meshgrid.

d) Calculate the electric field and scalar potential at all the points in the meshgrid using the PyCharge functions calculate_E()and calculate_V().Here PyCharge obtains the electric field by deriving the Lienard-Wiechert potentials from the maxwell's equations [8]:

$$\nabla \cdot D = \rho$$
$$\nabla \cdot B = 0$$
$$\nabla \times E = -\frac{\partial B}{\partial t}$$
$$\nabla \times B = \mu J + \frac{1}{c^2}\frac{\partial E}{\partial t}$$

Where,
D denote the electric displacement vector
E denotes the electric field vector
B denotes the magnetic flux density
J denotes the current density
ϱdenotes the scalar charge density

We also have a set of equations that relate the vector potential **A** and the scalar potential φ to the electromagnetic fields **E** and **B**.

$$B = \nabla \times A$$
$$E = -\nabla \phi - \frac{\partial A}{\partial t}$$

So, if we consider a point charge q_s traveling along an arbitrary path $r_s(t)$ with velocity $v_s(t)$, then the scalar and vector potentialsφ and **A** can be derived relativistically correct Lienard-Wiechart potentials:

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$$\phi = \phi(r,t) = \frac{1}{4\pi\epsilon}\left(\frac{q_s}{(1-n_s(t_r)\cdot\beta_s(t_r))|r-r_s(t_r)|}\right)$$

$$A = A(r,t) = \frac{\mu c}{4\pi}\left(\frac{q_s\beta_s(t_r)}{(1-n_s(t_r)\cdot\beta_s(t_r))|r-r_s(t_r)|}\right)$$

Where,

$$\beta_s(t_r) = \frac{v_s(t_r)}{c}$$

$$n_s(t_r) = \frac{r-r_s(t_r)}{|r-r_s(t_r)|}$$

These are the equations used to represent the expressions for the time varying electric field of a point charge.

e) Create a plotly figure object to which cone and a scatter trace is added [9]. The computed E_field values are fed into this figure object.

f) The computed scalar potentials stored in numpy arrays are reshaped into a pandas dataframe.

g) Create a plotly figure object to which a surface trace must be added. The dataframe that contains the scalar potential values are fed into this figure object.

h) Display both the Plotly figures.

i) This model can be used to obtain the electric field and potentials of any stationary charge system. The system configuration depends upon the number of point charge sources, their polarity, and their charge value.

EXPERIMENTAL RESULTS

On successful execution we obtain an interactive cone plot of the electric field distribution, and an interactive surface plot that displays the scalar potential. For the sake of demonstration only four configurations have been provided below. However, the model does work with many other configurations too. The plot has multiple camera controls such as zoom, pan, orbital rotation and turntable rotation. Hovering over the trace plots displays the respective information such as the coordinates and magnitude of the vector. The size of the vectors is proportional to the magnitude, which is proportional to the charge value. Additional scatter plots can be added to highlight the electric field at a specific point due to the point charge(s). Fig (i) is a plot of the electric field E due to a single point charge, with the charge value set at default i.e., e (=1.602176634 × 10^-19 coulomb). And Fig (ii) is a surface plot of the scalar potential V. As shown in Fig(i), hovering over one of the cones displays the coordinates and magnitude of the vector. The magnitude is also denoted using a color scale. The color scale used here is called *'blues*. The darkest shade denotes the highest magnitude and the lightest the lowest. The E_field scatter plots have been zoomed for the sake of improved detail and the line spacing of the grid is (-2, 2, 10), i.e., each axis has a range of points between -2 to 2 spaced by 10-point intervals in between. (Refer Fig(iii) for reference) Similarly, by increasing the number of parameters given to the Stationary Charge class, the E_field and their respective scalar potentials of various point charge configurations can be obtained. Below Are the results of the same: Fig(iv) and Fig(v) is the E_field and the scalar potential of a system of dipoles with same but opposite charge. Fig(vi) and fig(vii) is the E_field and scalar potentials of a system of 4-point charges in a square configuration respectively. With two like charges and two opposites. Fig(viii) and Fig(ix) is the E_field and scalar potential of a system of 8-point charges in a cubic configuration respectively. With four like charges and four opposites.

CONCLUSIONS

A straightforward approach was used to create this model, with PyCharge—an open-source Python module for computational electrodynamics—at its core. Using NumPy, the computed values were mapped, and Plotly was used to input the data into an interactive 3D plot. The outcome is a practical computational electrodynamic model that undergraduate physics students or any physics enthusiast can use to research and address numerous issues in the

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mapping of the electric field of point charge systems. The reader is invited to execute the code independently and experiment with the parameters by following the GitHub links provided in this article to the Interactive Python Notebooks. In order to execute more operations on point charges, it is a good idea to go one step further and look through the PyCharge documentation and use the myriad of functions available. Only two functions, calculate E and calculate V, have been utilized, just like in this article. As a result, this approach is highly scalable and has numerous potential applications. Another objective of this paper, aside from the technical ones, is to familiarize undergraduate students with computational electrodynamics [10].

Future Work

Although the initial technical goals were met, this model still has a great deal of space for advancement. The immediate objective is to develop this model into a fully functional electrodynamic simulator that can address a variety of electrodynamics-related problems. This resource will be useful for university lecturers as well as students. PyChargepresently only has the ability to operate on point charges, thus by adding new functionality through the creation of new classes and functions that inherit the existing classes' methods, we can also operate on charge distributions like rings, cylinders, and straight lines. Henceforth, efforts will also be made to support the PyChargecommunity by giving the library more functionality.

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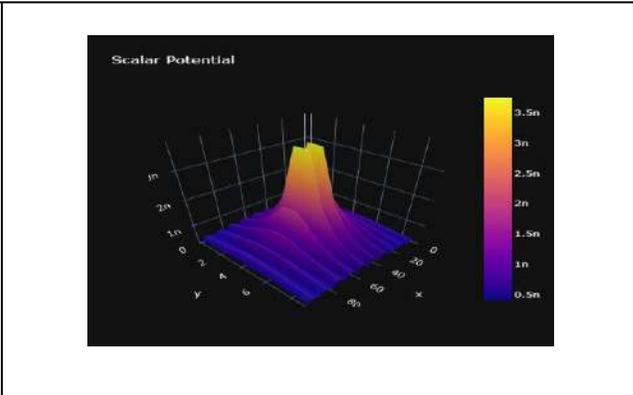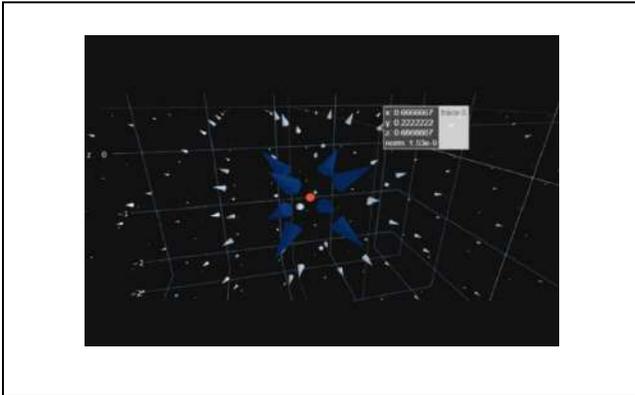
Fig(i) a plot of the electric field E due to a single point	**Fig(ii) A surface plot of the scalar potential V.**
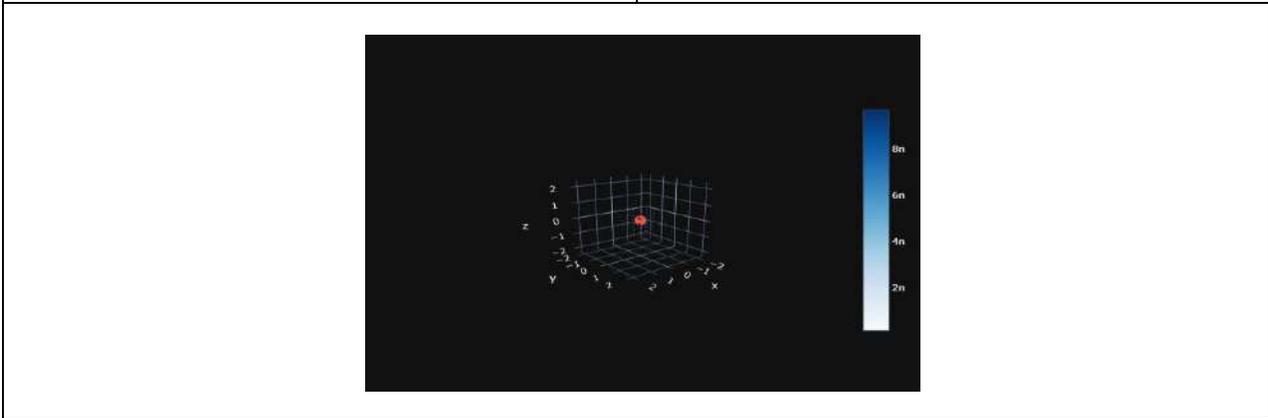
Fig(iii) scalar potentials of various point charge
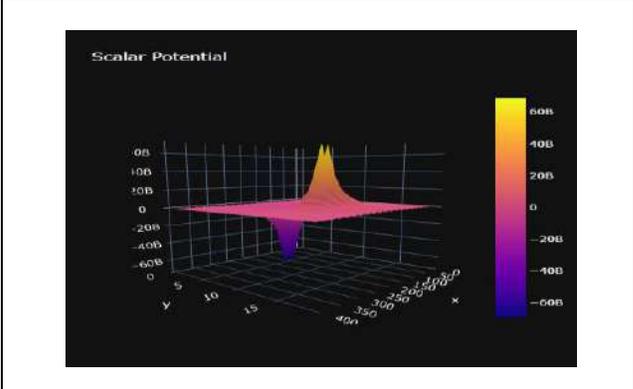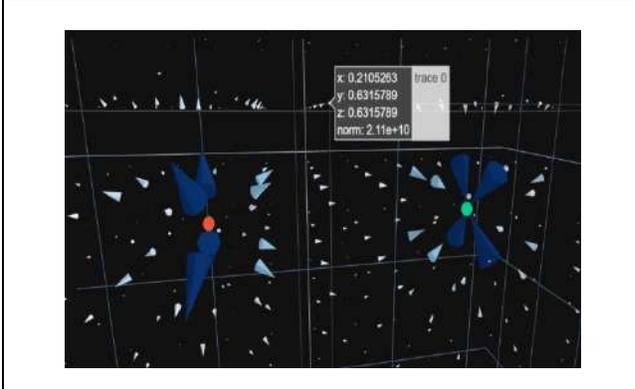
Fig(iv) and Fig(v) is the E_field and the scalar potential of a system of dipoles with same but opposite charge.

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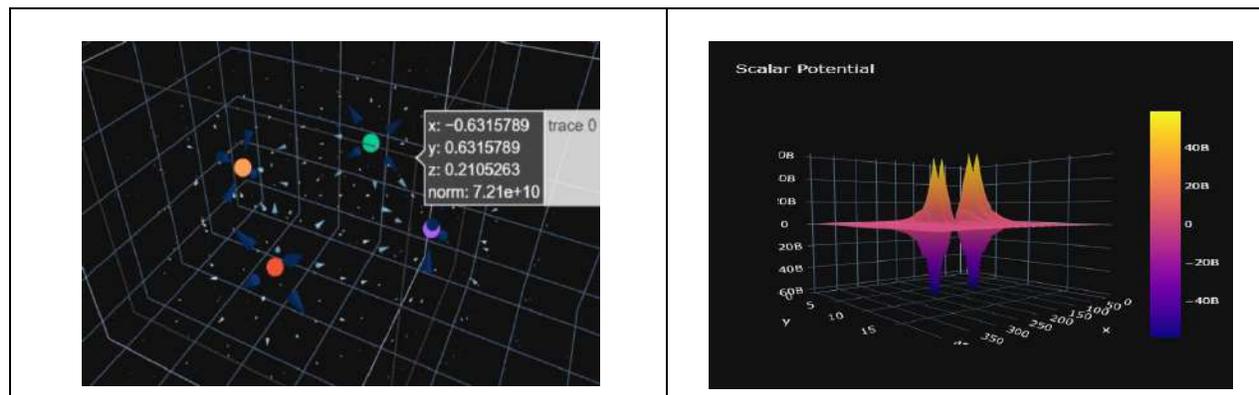
Fig(vi) and fig(vii) is the E_field and scalar potentials of a system of 4-point charges in a square configuration respectively. With two like charges and two opposites.

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RESEARCH ARTICLE
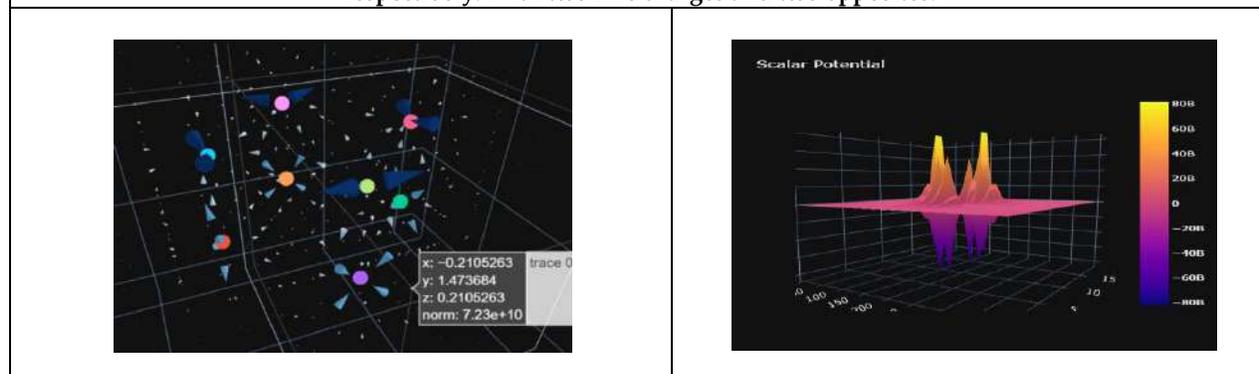
Independent Semitotal Domination of some Special Graphs

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ABSTRACT

A dominating set S of vertices of G without isolated vertices is an independent semitotal dominating set of G if S is an independent dominating set and to each u in S there is a v in S at a distance exactly two. The minimum and maximum cardinality of a minimal independent semitotal dominating set is called independent semitotal domination number and upper independent semitotal domination number of G, denoted by $\gamma_{it2}(G)$ and $\Gamma_{it2}(G)$ respectively. The independent semitotal domination subdivision number $sd_{\gamma it2}(G)$ as the minimum number of edges to be subdivided (where no edge can be subdivided more than once) to increase the independent semitotal domination number. In this paper independent semitotal domination number and subdivision number with respect to this parameter of some special graphs are determined and studied.

AMS SUBJECT CLASSIFICATION: 05C69

Keywords: Total Domination, Semitotal Domination, Independent Semitotal Domination, Subdivision Number, Independent Semitotal Domination Subdivision Number.

INTRODUCTION

Definition1.1.
Let G be a graph with vertex set V and edge set E. A set S of vertices of G is a dominating set if for each not in S there is a u in S such that uv is an edge. The minimum cardinality of a minimal dominating set is denoted by γ(G).

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Definition 1.2. A dominating set S of G is an independent dominating set if < S > consists of isolate vertices. i(G), the independent domination number of G is the minimum cardinality of a minimal independent dominating set.

Definition 1.3. The maximum cardinality of a maximal independent set of vertices of G is the independence number of G, denoted by β_0(G).
The concept of semi total domination was introduced in [1].

Definition 1.4. A set S of vertices of a graph G without isolated vertices is said to be a semi total dominating set of G if S is a dominating set of G and for every vertex in S there is another vertex of distance with in 2 in S. The semi total domination number denoted by γ_{t2}(G) is the minimum cardinality of a minimal semitotal dominating set.
An inequality chain with various parameters was established as given below $ir(G) \leq \gamma(G) \leq i(G) \leq \beta_0(G) \leq \Gamma(G) \leq IR(G)$ in [2]

Extending this chain by means of domination parameters is one direction of research. The above chain was extended using isolate domination parameters $\gamma_0(G)$ and $\Gamma_0(G)$ as follows $ir(G) \leq \gamma(G) \leq \gamma_0(G) \leq i(G) \leq \beta_0(G) \leq \Gamma_0(G) \leq \Gamma(G) \leq IR(G)$ in [3]
We introduced a parameter, independent semitotal domination number γ_{it2}(G) that lies between i(G) and β_0(G) thereby extending the above chain as $ir(G) \leq \gamma(G) \leq \gamma_0(G) \leq i(G) \leq \gamma_{it2}(G) \leq \Gamma_{it2}(G) \leq \beta_0(G) \leq \Gamma_0(G) \leq \Gamma(G) \leq IR(G)$ [4].

Definition 1.5. A set S of vertices of G is an independent semitotal dominating set if S is an independent dominating set and to each $u \in$ S there is a $v \in$ S at a distance exactly two. The minimum and maximum cardinality of a minimal independent semitotal dominating set are called the independent semitotal domination number γ_{it2}(G) and upper independent semitotal domination number Γ_{it2}(G) of G respectively.
This parameter lies between independent domination number i(G) and independence number β_0(G) of a graph. Every graph has a β_0 set which is also an independent semitotal dominating set, hence its existence is guaranteed for all non-complete graph. For complete graph $\beta_0(K_n) = 1$ and hence $\gamma_{it2}(K_n)$ is set as 1.

EXAMPLE1.6.
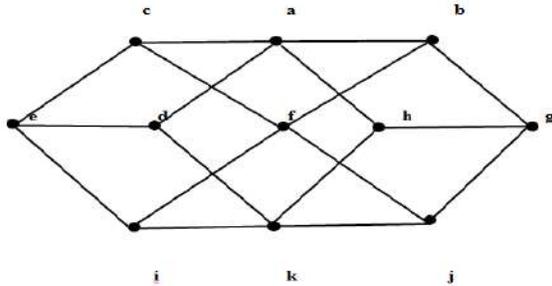
i(G)=|{f,d,h}|=3.
γ_{it2}(G)=|{f,a,k,e,g}|=5.
β_0(G)=|{b,c,i,j,d,h}|=6
i(G)<γ_{it2}(G)<β_0(G)

Definition 1.7. The independent semitotal domination subdivision number of a graph G is the minimum number of edges to be subdivided (where no edge can be subdivided more than once) to increase the independent semitotal domination number. This number is denoted by $sd_{\gamma it2}$(G).

Notation: We denote a graph obtained by subdividing 'i' edges of G by notation G^i.

Definition1.8. The wheel $W_{(n+1)}$ is a joint $C_n + K_1$. The vertex in K_1 is apex vertex , the vertices and the edges in cycle are rim vertices and rim edges respectively. The edges incident with apex vertex are known as spoke edges.

MAIN RESULTS

γ_{it2} value for standard graphs are determined in the following proposition whose proofs have been presented in [4]

Proposition 2.1 [4] (i) $\gamma_{it2}(P_n) = \left\lceil \dfrac{2n}{5} \right\rceil$

(ii) $\Gamma_{it2}(P_n) = \left\lceil \dfrac{n}{2} \right\rceil$

(iii) $\gamma_{it2}(C_n) = \Gamma_{it2}(C_n) = \left\lceil \dfrac{2n}{5} \right\rceil$

(iv) $\gamma_{it2}(W_{n+1}) = \gamma(C_n) = \left\lfloor \dfrac{2n}{5} \right\rfloor = \left\lceil \dfrac{n}{3} \right\rceil$

(v) $\Gamma_{it2}(W_{n+1}) = \left\lfloor \dfrac{n}{2} \right\rfloor$

(vi) $\gamma_{it2}(K_{r1,r2....rn}) = r_i$ where r_i is the minimum vertices of a partite set V_i
(i.e) $r_i = \min(r_1, r_2, \ldots r_n)$
(vii) $\Gamma_{it2}(K_{r1,r2....rn}) = r_j$ where $r_j = \max(r_1, r_2, \ldots r_n)$.

Proposition 2.2 [4]

(i)　　　　For Path P_n, $\mathrm{sd}_{\gamma it2}(P_n) = \begin{cases} 1 & if & n \cong 0,2 \pmod 5 \\ 2 & if & n \cong 1,4 \pmod 5 \\ 3 & if & n \cong 3 \pmod 5 \end{cases} (except P_3)$

(ii)　　　　For Cycle C_n, $\mathrm{sd}_{\gamma it2}(C_n) = \begin{cases} 1 & if & n \cong 0,2 \pmod 5 \\ 2 & if & n \cong 1,3,4 \pmod 5 \end{cases}$

(iii)　　　　For wheel W_{n+1}, $\mathrm{sd}_{\gamma it2}(W_{n+1}) = \gamma_{it2}(W_{n+1})$
(iv)　　　　For Kn, $\mathrm{sd}_{\gamma it2}(K_n) = 1$.
(v)　　　　For Km,n, $\mathrm{sd}_{\gamma it2}(K_{m,n}) = \min(m,n)$.
The proof of above proposition is obvious.

Proposition 2.3
If G is a disconnected graph with components $G_1, G_2, \ldots G_m$ then

(i)　　　　$\gamma_{it2}(G) = \displaystyle\sum_{r=1}^{m} \gamma_{it2}(G_r)$

(ii)　　　　$\Gamma_{it2}(G) = \displaystyle\sum_{r=1}^{m} \Gamma_{it2}(G_r)$

(iii)　　　　$\mathrm{sd}_{\gamma it2}(G) = \min\{ \mathrm{sd}_{\gamma it2}(G_1), \mathrm{sd}_{\gamma it2}(G_2), \ldots \mathrm{sd}_{\gamma it2}(G_r) \} = \min\{ \mathrm{sd}_{\gamma it2}(G_r) + \displaystyle\sum_{s \neq r} \gamma_{it2}(G_s) \}$

Proof
The proof of (i) and (ii) are obvious.

For a disconnected graph, $\gamma_{it2}(G) = \sum_{r=1}^{m} \gamma_{it2}(G_r)$.

To increase $\gamma_{it2}(G)$, it is enough to increase any one of γ_{it2} value of the components G_r's.

We determine $sd_{\gamma it2}$ value for each components separately. Each $sd_{\gamma it2}(G_r)$ will increase each $\gamma_{it2}(G_r)$.

By the definition of $sd_{\gamma it2}(G)$, minimum of $sd_{\gamma it2}(G_r)$ where r=1,2…m is enough to increase the $\gamma_{it2}(G)$.

Hence $sd_{\gamma it2}(G) = \min\{ sd_{\gamma it2}(G_1), sd_{\gamma it2}(G_2),…. sd_{\gamma it2}(G_r)\} = \min\{ sd_{\gamma it2}(G_r) + \sum_{s \neq r} \gamma_{it2}(G_s) \}$.

The complement of a minimal independent semitotal dominating set need not be an independent semitotal dominating set. For example, in a Diamond graph a pair of non adjacent vertices form a minimal independent semitotal dominating set but its complement is not an independent semitotal dominating set. However $\gamma_{it2}(G)$ is not greater than n/2 where n is the number of vertices of the given graph. Here $G \neq K_{1,n-1}$.

Theorem 2.4
If G is connected graph on n vertices and $G \neq K_{1,n-1}$, then $\gamma_{it2}(G) \leq n/2$.

Proof
Let S be a γ_{it2}-set of a graph G on n vertices. Suppose $|S| = \gamma_{it2}(G) > n/2$. Since $G \neq K_{1,n-1}$, V-S has at least two vertices.

Case(i) V-S is independent
Take any two non adjacent vertices arbitrarily. Since S is a dominating set, V-S is also a dominating set and hence V-S is an independent dominating set. Since G is connected, for every vertex in V-S, there is another vertex in V-S at a distance exactly two through a vertex in S. This implies V-S is also an independent semitotal dominating set with $|V-S| < |S|$ which is a contradiction, since S is a γ_{it2}-set. Therefore $|S| = \gamma_{it2}(G) \leq n/2$.

Case(ii) V-S is not independent
We determine $i(<V-S>)$.
Now $i(<V-S>) \cup \{S-N(i(<V-S>))\}$ forms an independent semitotal dominating set of G.
We have $|i(<V-S>)| < |V-S| < |S|$ and
$|N(i(<V-S>))| < |S|$
$|i(<V-S>)| + |S-N(i(<V-S>))| < |S|$ which is a contradiction, since S is a γ_{it2}-set of G
Therefore $|S| = \gamma_{it2}(G) \leq n/2$.

INDEPENDENT SEMITOTAL DOMINATION NUMBER OF SOME SPECIALGRAPHS

Definition 3.1. The friendship graph F_n is of 'n' number of C_3's all intersect at a common vertex. The order of F_n is 2n+1.

Theorem 3.2. For a friendship graph F_n of order 2n+1, $\gamma_{it2}(F_n)=n$

Proof. By the definition of friendship graph, central vertex cannot be in any independent semitotal dominating set. Also since central vertex is in every 3-cycle, one vertex other than central vertex from each cycle is chosen to dominate other two and this set is also minimum.∴$\gamma_{it2}(F_n)=n$.

Theorem 3.3. For a friendship graph F_n of order 2n+1, $sd_{\gamma it2}(F_n)=n$

Proof. $sd_{\gamma it2}(F_n)=n$. One edge from each C_3 must be sub divided to increase γ_{it2} value by1.

Definition 3.4. The gear graph G_n is a graph obtained by adding a vertex between each pair of adjacent vertices of the outer cycle of the wheel graph $W_{(n+1)}$. The gear graph has $2n+1$ vertices and $3n$ edges.

Theorem 3.5. For a gear graph G_n of order $2n+1$, $\gamma_{it2}(G_n) = n$.

Proof. The vertex set of G_n is partitioned into independent semitotal dominating sets of which one partition contains an vertex and the other $n+1$ vertices. $\therefore \gamma_{it2}(G) = n$.

Theorem 3.6. For a gear graph G_m of order $2n+1$, $sd_{\gamma it2}(G_m) = n-1$

Proof. By subdividing either two incident edges of a degree two vertex and remaining on the rim edges or two incident edges of a degree two vertex, one spoke edge and remaining on the rim edges.

Definition 3.7. Helm H_n is a graph with $2n+1$ vertices obtained from a wheel $W_{(n+1)}$ by attaching a pendant edge to each vertex of the outer cycle of the wheel.

Theorem 3.8. For helm graph H_n of order $2n+1$, $\gamma_{it2}(H_n) = n$.

Proof. By the definition of the helm, H_n has n pendant edges. So we need 'n' vertices for domination. To make an independent semitotal dominating set, Choose a pendant vertex in one pendant edge and a support vertex in another pendant edge alternatively. By choosing this way, we get n dominating vertices. Among these vertices, support vertices dominate the apex vertex. These n vertices are the minimum vertices to form independent semitotal dominating set.
$\therefore \gamma_{it2}(H_n) = n$

Theorem 3.9. For a helm graph H_n of order $2n+1$, $sd_{\gamma it2}(H_n) = 2$

Proof. By previous theorem, $\gamma_{it2}(H_n) = n$ If we choose an edge either from pendant or rim or spoke for the subdivision, this will leads to the same γ_{it2} value. By choosing two adjacent spoke edges or by choosing two adjacent edges one as pendant and the other as spoke, will increase the γ_{it2} value by 1. $\therefore sd_{\gamma it2}(H_n) = 2$

Definition 3.10. The sun graph, S_n is the graph of $2n$ vertices obtained from a central complete graph K_n with an outer ring of n vertices, each of which is adjacent to both end points of the closed outer ring of the central complete graph.

Theorem 3.11. Let S_n be sun graph of order $2n$. Then $\gamma_{it2}(S_n) = n-1$.

Proof. By the definition of the sun graph, the central core is the complete graph K_n. To dominate this complete graph, a vertex is enough in the complete graph. By choosing all the vertices which are non-adjacent to the chosen vertex 'v' in the complete graph, we will get the independent dominating set. This will form γ_{it2}-set automatically. Each vertex will make a distance 2 with another vertex in the γ_{it2}-set through a vertex in the complete graph. Then the chosen vertex v in the complete graph K_n is adjacent with n-l vertices and with 2 vertices which are in the outer ring. Since the sun graph has $2n-1$ vertices excluding 'v', the number of non-adjacent vertices of 'v' is $2n-1-[(n-1)+2] = n-2$. $\therefore$ These n-2 non-adjacent vertices along with 'v' will form γ_{it2}-set. $\therefore \gamma_{it2}(S_n) = n-1$.

Theorem 3.12.
Let S_n be sun graph of order $2n$. Then $sd_{\gamma it2}(S_n) = 2$

Proof. Two edges are to be subdivided to increase the γ_{it2} value in one of the following way (i) Two adjacent edges incident with a single vertex of degree two in the outer cycle. (ii) Two non-adjacent edges incident with two non consecutive vertices of degree two in the outer cycle. (iii) Two non-adjacent edges in the outer cycle of the complete graph.

Definition3.13. The n-sunlet graph $(C_n o K_1)$ is the graph on 2n vertices obtained by attaching n pendant edges to a cycle graph C_n.

Theorem 3.14. Let $(C_n o K_1)$ be sunlet graph of order 2n. Then $\gamma_{it2}(C_n o K_1) = n$.

Proof. Since $(C_n o K_1)$ has n pendant edges. For domination, we need n vertices. One pendent and non-adjacent support vertex for each vertex of C_n form a γ_{it2} set. $\therefore \gamma_{it2}(C_n o K_1) = n$

Theorem 3.15. Let $(C_n o K_1)$ be sunlet graph of order 2n. Then $sd_{\gamma it2}(C_n o K_1) = 2$ when n=3,4 and $sd_{\gamma it2}(C_n o K_1)= 3$ when n>4.

Proof. For $C_3 o K_1$, two adjacent edges one on the C_3 and other as pendent edge must be subdivided to increase the γ_{it2} value.
For $C_4 o K_1$, two consecutive pendant edges must be subdivided.

For $C_5 o K_1$ 3 edges must be subdivided in one of the following way.
(i) Three consecutive pendant edges.
(ii) 3 adjacent edges alternatively chosen from pendant edges and edges of the cycle.
For $C_n o K_1$ where n > 5, the same procedure are followed as in n = 5.

Definition3.16. The n-barbell graph B_n is the simple graph obtained by connecting two copies of a complete graph K_n by an edge.

Theorem 3.17. Let B_n be barbell graph of order 2n. Then $\gamma_{it2}(B_n) = 2$.

Proof. By definition of barbell graph, there are two copies of complete graph K_n. For each complete graph, one vertex is needed to dominate all the other vertices. So for the barbell graph, we need two vertices to dominate all the other vertices. These two vertices are one from first copy of K_n and the other from second copy of K_n. we can choose these two vertices such that the distance between them is exactly two. $\therefore \gamma_{it2}(B_n) = 2$.

Theorem3.18. Let B_n be barbell graph of order 2n. Then $sd_{\gamma it2}(B_n) = 1$

Proof. Since $\gamma_{it2}(B_n) = 2$. To increase this value by 1, it is enough to subdivide any single edge from any one of the two complete graphs, but not the bridge.

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RESEARCH ARTICLE

E-Super Arithmetic Graceful Labelling of Certain Corona Graphs

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ABSTRACT

We introduced a new concept called E-Super arithmetic graceful graphs [2]. A (p, q)graph G is said to be E-super arithmetic graceful if there exists a bijection f from $V(G) \cup E(G)$ to $\{1, 2, \ldots, p + q\}$ such that $f(E(G)) = \{1, 2, \ldots, q\}$, $f(V(G)) = \{q + 1, q + 2, \ldots, q + p\}$and the induced mapping$f*$given by $f*(uv) = f(u) + f(v) - f(uv)$ for $uv \in E(G)$ has the range $\{p + q + 1, p + q + 2, \ldots, p + 2q\}$. In this paper we prove that the corona graphs $Cn \odot K2$, $Cn \odot Pm$ and $P(n, 2) \odot K2$ are E-Super arithmetic graceful.

Keywords: gracefulgraphs, E-super, arithmetic, corona graphs

INTRODUCTION

Acharya and Hegde [1] have defined (k, d) −arithmetic graphs. Let G be a graph with q edges and let $k$and $d$be positive integers. A labelling f of $G$is said to be (k, d)−arithmetic if the vertex labels are distinct non-negative integers and the edge labels induced by $f(x) + f(y)$ for each edge $xy$are$k, k + d, k + 2d, \ldots, k + (q - 1)d$.The case where $k = 1$ and $d = 1$ was called additively graceful by Hegde [5].Joseph A. Gallian [4] surveyed numerous graph labelling methods. V. Ramachandran and C.Sekar [5] introduced (1,N) arithmetic labelling. A labelling of(V, E) is said to be E - super if $f(E(G)) = \{1, 2, 3, \ldots . |E(G)|\}$.We introduce a new concept called E-super arithmetic graceful graphs. We define a graph $G(p, q)$ to be E- super arithmetic graceful if there exists a bijection $f$from$V(G) \cup E(G)$ to $\{1, 2, \ldots, p + q\}$such that $f(E(G)) = \{1, 2, \ldots, q\}$, $f(V(G)) = \{q + 1, q + 2, \ldots, q + p\}$and the induced mapping $f*$given by $f*(uv) = f(u) + f(v) - f(uv)$ for $uv \in E(G)$ has the range$\{p + q + 1, p + q + 2, \ldots, p + 2q\}$.In this paper we prove that the corona graphs $C_n \odot K_2, C_n \odot P_m$ and$P(n, 2) \odot K_2$are E-Super arithmetic graceful.

PRELIMINARIES

Definition 2.1. The Corona operation between two graphs was introduced by Frucht and Harary[3]. Given two graphs G (of order p) and H, the corona of G with H denoted by $G \odot H$ is the graph with $V(G \odot H) = V(G) \cup_{i=1}^{p} V(Hi)$ and $E(G \odot H) = E(G) \cup_{i=1}^{p} (E(Hi) \cup \{viu | vi \in V(G) and u \in V(Hi)\})$ where Hi denotes the ith copy of H. In other words, a corona graph is obtained from two graphs G (of order p) and H, taking one copy of G and p copies of H and joining by an edge the ith vertex of G to every vertex in the ith copy of H.

Illustration: Let C$_3$ denote the 3-cycle and K$_2$ denote the complete graph on two vertices. The corona of C$_3$ with K$_2$ denoted by $C_3 \odot K_2$ is shown below
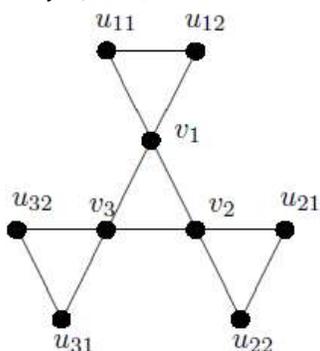
Definition 2.2. The generalized Peterson graph $P(n, k)$, $n \geq 5$, $k \geq 2$ is the graph with vertices $\{u_1, u_2, \ldots u_n\}$ and $\{v_1, v_2, \ldots v_n\}$ and edges $\{u_i u_i + 1\}, \{u_i v_i\}$ and $\{v_i v_i + k\}$ where addition is modulo n. The usual Petersen graph is P(5, 2). P(n, 2) for all $n \geq 5$ is a cubic graph.

MAIN RESULTS

Theorem 3.1. Let C_n denote the n-cycle. The corona graph $C_n \odot K_2$ is E-super arithmetic graceful for all $n \geq 3$.

Proof. Let $v_1, v_2, \ldots, v_n$ be the vertices of C_n. Take n copies of K_2. Let u_{i1}, u_{i2} be the vertices of the ith copy of K_2. The corona graph $C_n \odot K_2$ has the vertex set $V = \{v_i, u_{i1}, u_{i2} | 1 \leq i \leq n\}$ and edge set E = $\{v_i v_{i+1} | 1 \leq i \leq n$ where $v_{n+1} = v_1\} \cup \{u_{i1}u_{i2} | 1 \leq i \leq n\} \cup \{v_i u_{i1}, v_i u_{i2} | 1 \leq i \leq n\}$.

The Corona graph $C_n \odot K_2$ has 3n vertices and 4n edges.

Define $f: V \cup E \longrightarrow \{1, 2, \ldots, 7n\}$ as follows

$f(u_{i1}) = 4n + i, i = 1, 2, \ldots, n$
$f(u_{i2}) = 6n + i, i = 1, 2, \ldots, n$
$f(v_i) = 5n + i, i = 1, 2, \ldots, n$
$f(u_{i1}u_{i2}) = 3n + i, i = 1, 2, \ldots, n \quad f(u_{i1}v_i) = n + i, i = 1, 2, \ldots, n$
$f(u_{i2}v_i) = 2n + i, i = 1, 2, \ldots, n$
$(v_1 v_{1+1}) = i, i = 1, 2, \ldots, n$ where $v_{n+1} = v_1$.

Clearly f is a bijection, $f(E) = \{1, 2, \ldots, 4n\}$, and

$f^*(E) = \{7n + 1, \ldots, 11n\}$

Therefore, $C_n \odot K_2$ is E-super arithmetic graceful.

Example 3.2. E-super arithmetic graceful labelling of $C_6 \odot K_2$
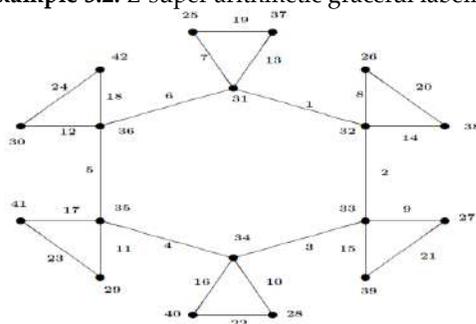
Theorem 3.3. Let C_n be the n-cycle and Pm be the path of length m. The coronagraph P_m is E-super arithmetic graceful for all n ≥3 and m ≥2.

Proof. Let $v_1, v_2 , \ldots, v_n$ be the vertices of C_n.

Let $u_{i1}, u_{i2}, \ldots, u_{i(m+1)}$ be the vertices of the ith copy of P_m.

$Cn \odot Pm$ has $(m + 2)$ vertices and $2n(m + 1)$ edges.

$C_n \odot P_m$ has the vertex set $V = \{v_i u_{i1} \mid i = 1, 2, \ldots, n; j = 1, 2, \ldots, m + 1\}$ and edge set $E = \{v_i v_{i+1} \mid 1 \le i \le n \text{ where } v_{n+1} = v_1\} \cup \{u_{ij} u_{i(j+1)} \mid i = 1,2,\ldots,n; j = 1,2,\ldots,m\} \cup \{u_{ij} v_i \mid i = 1,2,\ldots,n; j = 1,2,\ldots,m + 1\}$

Case (i) m is even and $m \ge 2$.

Define $f: V \cup E \to \{1, 2, \ldots, n(3m + 4)\}$ as follows:

$$f(u_{ij}) = \begin{cases} 2n(m + 1) + i + n\dfrac{(j - 1)}{2}, \text{for i } = 1, 2, \ldots, \text{n and j } = 1, 3, \ldots, (m - 1) \\ n\dfrac{(5m + 8)}{2} + i + n\dfrac{(j - 2)}{2}, \qquad for\, i = 1,2, \ldots, n\, and\, j = 2,4, \ldots, m \end{cases}$$

$$f\big(u_{i(m+1)}\big) = n\frac{(5m + 6)}{2} + i, for\, i = 1,2,\ldots,n$$

$$f(v_i) = n\frac{(5m + 4)}{2} + i, \qquad for\, i = 1,2,\ldots .,n$$

$$f\big(u_{ij} u_{i(j+1)}\big) = \begin{cases} n(m + 2) + i + 2n(j - 1) for\, i = 1,2, \ldots , n\, and\, j = 1,2, \ldots, \dfrac{m}{2} \\ n(m + 3) + i + 2n\left(j - \dfrac{m}{2} - 1\right) for\, i = 1,2, \ldots, n\, and\, j = \dfrac{m}{2} + 1, \ldots, (m - 1) \end{cases}$$

$f(u_{im} u_{i(m+1)}) = n(m + 1) + i, for\, i = 1,2,\ldots,n$

$f(u_{ij} v_i) = i + n(j - 1), for\, i = 1,2,\ldots, n\, and\, j = 1,2,\ldots,m$

$f(u_{i(m+1)} v_i) = n(2m + 1) + i, for\, i = 1,2,\ldots,n$

$f(v_i v_{i+1}) = nm + i, i = 1,2,\ldots, n\, where\, v_{n+1} = v_1$

Clearly f is a bijection, $f(E) = \{1, 2, \ldots, 2n(m + 1)\}$, and $f^*(E) = \{n(3m + 4) + 1, \ldots, n(5m + 6)\}$.

Case (ii) m is odd and $m \ge 3$.

Define $f: V \cup E \to \{1, 2, \ldots, n(3m + 4)\}$ as follows:

$$f(u_{ij}) = \begin{cases} 2n(m + 1) + i + n\dfrac{(j - 1)}{2}, \;\; for\, i = 1,2,\ldots, n\, and\, j = 1,3,\ldots, m \\ n\dfrac{(5m + 7)}{2} + i + n\dfrac{(j - 2)}{2}, \;\; for\, i = 1,2,\ldots, n\, and\, j = 2,4,\ldots (m + 1) \end{cases}$$

$$f(vi) = 5n\left(\frac{m + 1}{2}\right) + i, \quad for\, i = 1,2,\ldots,n$$

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$$f\left(u_{ij}u_{i(j+1)}\right) = \begin{cases} 22n + i + 2n(j - 1) \, for \, i = 1,2, \ldots, n \, and \, j = 1,2,\ldots, \frac{m-1}{2} \\ 3n + i + 2n\left(j - \left(\frac{m+3}{2}\right)\right) for \, i = 1,2, \ldots, n \, and \, j = \frac{m+3}{2}, \frac{m=3}{2} + 1, \ldots, m \end{cases} =$$

$f\left(u_{i\frac{m+1}{2}}u_{i\frac{m+3}{2}}\right) = i, for \, i = 1,2,\ldots,n$

$f(u_{ij}v_i) = n(m + 1) + i + n(j - 1), for \, i = 1,2,\ldots,n \, and \, j = 1,2,\ldots,(m + 1)$

$f(v_i v_{i+1}) = n + i, i = 1,2,\ldots,n \, where \, v_{n+1} = v_1$

Clearly f is a bijection, $(E) = \{1, 2, \ldots, 2n(m + 1)\}$, and $f*(E) = \{n(3m + 4) + 1, \ldots, n(5m + 6)\}$, in this case also.

Therefore, $C_n \odot P_m$ is E-super arithmetic graceful for all $n \geq 3$ and for all $m \geq 2$.

Example 3.4. E-super arithmetic graceful labelling of $C_3 \odot P_6$.
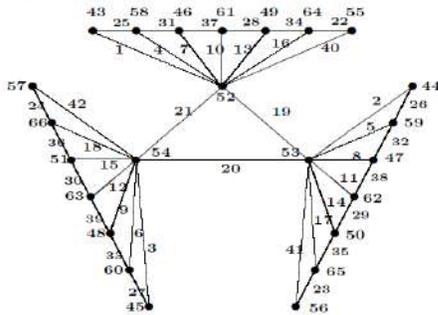
Figure 3.2

Example 3.5. E-super arithmetic graceful labelling of $C_4 \odot P_5$.
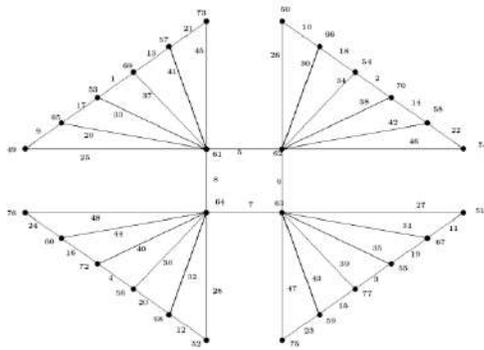
Figure 3.3

Theorem 3.6. $P(n, 2) \odot K_2$ for $n \geq 5$, is E-super arithmetic graceful.

Proof. Let $u_1, u_2, \ldots, u_n$ and $v_1, v_2, \ldots, v_n$ be the vertices of $P(n, 2)$. Let u_{i1}, u_{i2} and v_{i1}, v_{i2} be the vertices of the ith copy of K_2 adjacent to u_i and v_i respectively in the corona graph of $P(n, 2)$ with K_2.

Illustration: $P(5, 2) \odot K_2$.

Figure 3.4

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$P(n, 2) \odot K_2$ has $6n$ vertices and $9n$ edges.

Define $f: V \cup E \to \{1, 2, \ldots, 15n\}$ as follows:

$f(u_i) = 9n + i, i = 1, 2, \ldots, n.$

$f(v_i) = 14n + i, i = 1, 2, \ldots, n.$

$f(u_{i1}) = 12n + i, i = 1, 2, \ldots, n.$

$f(u_{i2}) = 13n + i, i = 1, 2, \ldots, n.$

$f(v_{i1}) = 10n + i, i = 1, 2, \ldots, n.$

$f(v_{i2}) = 11n + i, i = 1, 2, \ldots, n.$

$f(u_i u_{i+1}) = i, i = 1, 2, \ldots, n$ where $u_{n+1} = u_1.$

$f(v_i v_{i+2}) = 8n + i, i = 1, 2, \ldots, n$ where $v_{n+1} = v_1 v_{n+2} = v_2.$

$f(u_i v_i) = n + i, i = 1, 2, \ldots, n.$

$f(u_{i1} u_{i2}) = 6n + i, i = 1, 2, \ldots, n.$

$f(v_{i1} v_{i2}) = 4n + i, i = 1, 2, \ldots, n.$

$f(u_{i1} u_i) = 5n + i, i = 1, 2, \ldots, n.$

$f(u_{i2} u_i) = 7n + i, i = 1, 2, \ldots, n.$

$f(v_{i1} v_i) = 3n + i, i = 1, 2, \ldots, n.$

$f(v_{i2} v_i) = 2n + i, i = 1, 2, \ldots, n.$

Clearly f is a bijection, $f(E) = \{1, 2, \ldots, 9n\}$, and $f^*(E) = \{15n + 1, \ldots, 24n\}.$

Therefore, $P(n, 2) \odot K_2$ is E-super arithmetic graceful.

Example 3.7. E-super arithmetic graceful labelling of $P(6, 2) \odot K_2.$
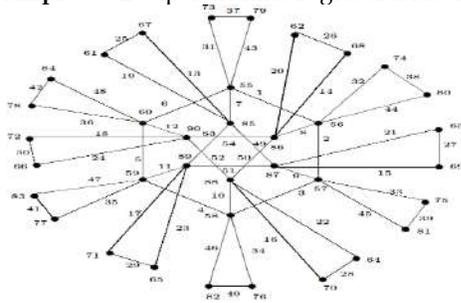
Figure 3.5

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RESEARCH ARTICLE

A Concise Exploration of the Novel: Intuitionistic Fuzzy sets and Intuitionistic Fuzzy Automata

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ABSTRACT

Fuzzy Automataisnot just anothercatchphrasenor isit ephemeralapproachinfuzzy principle, but anauspicious andinnovative branch of fuzzy theory which can excavate new outlooks of application. There has been a significant growth in fuzzy automata theory. In this paper, we have carried out a literature review on different$\mathbb{UJ}_F$- Setsand $\mathbb{UJ}_F$- Automata of few researchers.

Keywords: Fuzzy set, $\mathbb{UJ}_F$ - sets, $\mathbb{UJ}_F$ - sets of second type, $\mathbb{UJ}_F$ -sets of root type and $\mathbb{UJ}_F$ -Automata.

INTRODUCTION

Review about $\mathbb{UJ}_F$-sets
In[20], the idea of **fuzzyset (FS)** wasinstigated by L. A. Zadeh in 1965 and how it is generalized from Classical sets called crisp sets. Author well-defined the fuzzy set as follows

Fuzzy Sets
Consider the nonemptysetμ.A fuzzy set $_F$ inμ is categorized by meansof a membership function $\kappa_F{:}\mu \to [0,1]$with the value of $\kappa_F(\xi)$ at $\xi\epsilon\mu$ signifying the grade of membership of ξ. Also, he discussed about the conception of a fuzzy set with some examples and explained about the important properties like equality, complement, containment, union, intersection, convex, strong convex and boundedness of fuzzy sets. Also we know about the algebraic operations on fuzzy sets. Throughout this paper ω_F- Sets represents Intutionistic fuzzy sets and ω_F-automata represents intuitionistic fuzzy automata.In [1], we understood the set called **ω_F-** Sets which

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was familiarized by Atanassov K. T. An ω_F- Sets $_F$ in μ is of the arrangement { $<\xi,\kappa_F(\xi), \tau_F(\xi)> / \xi\epsilon\mu$ } where μ is an arbitrary fixed set, $\kappa_F(\xi)$: $\mu \to [0,1]$, grade of membership $\tau_F (\xi)$: $\mu \to [0,1]$ grade of non-membership of $\xi\epsilon$ μ, $_F\Box\mu$ such that $0 \le \kappa_F(\xi) + \tau_F(\xi) \le 1$. Also in this paper we came to know about two operators called necessity and possibility of a set $_F\Box\mu$, symbolized by $\wedge_F$ and $\Diamond_F$ respectively and defined by

$\wedge_F = \{<\xi, \kappa_F(\xi), 1 - \kappa_F(\xi) > / \xi \epsilon$ μ }

$\Diamond_F = \{<\xi, 1 - \tau_F (\xi), \tau_F (\xi) > / \xi \epsilon$ μ }

In [2 and 3], Atanassov introduced some new results and operators of $Ш_F$- Sets be side with their chattels were discussed. For every $Ш_F$- Sets namely $_F$ the Closure and Interior of $_F$ is symbolized by $Ć_F$ and I_F respectively and demarcated as follows

$Ć$ $_F = \{ <\xi, H, \Lambda> / \xi \epsilon$ μ }, where H= max $\kappa_F(\xi)$
$\xi\epsilon$ μ
$\Lambda=$ min $\tau_F(\xi)$
   $\xi\epsilon$ μ

$_F = \{ <\xi, \iota, \lambda> / \xi \epsilon$ μ },
where $\iota =$ min $\kappa_F(\xi)$
$\xi\epsilon\mu$
$\lambda=$ max $\tau_F(\xi)$
$\xi\epsilon\mu$

With help of $\wedge,\Diamond,U,\cap,+,.,Ć,I$ more properties of two IFS namely $_F$ and ßwere discussed. Author derived a fixed set from$(+\alpha,-\beta+)$level which is produced by the ω_F Sets using the idea of α level of a fuzzy set. In [4], Atanassov originated the new fuzzy set termed as Interval valued ω_F Sets which is the broad outlook of $Ш_F$ Sets and defined as follows An Interval valued $Ш_F$- Sets$_F$ in μ is an item which is embodied in the succeeding way:
$_F = \{<\xi, \kappa_F(\xi), \tau_F(\xi)> | \xi\epsilon\mu\}$,where $\kappa_F(\xi)\subset[0,1]and\tau_F(\xi)\subset[0,1]$ are intervals and for all$\xi\epsilon\mu$ such that sup$\kappa_F(\xi)$ +sup$\tau_F(\xi)\le$ 1. And some oftheirpropertiesarestudied withhelp of $\wedge,\Diamond,U,\cap$The application of $Ш_F$- Sets is tremendous. Supriya *et al.* [12] studied on $Ш_F$- Sets support in medical diagnosis which is a work on extension of fuzzy set concept. In this publication authors used the notion called $Ш_F$- Medical Knowledge which is an $Ш_F$- Sets relation $\underline{R}$ from $Ś$ (Symptoms) to $Ḍ$ (Diagnoses).Li Dengfeng [6], announced the notion of the grade of resemblance measures between $Ш_F$- Sets to pattern recognitions which is a generalization of fuzzy concept.In [8], Parvathi and Palaniappan followed the definition of $Ш_F$- Sets of Second type by Atanassov which is determined as follows:Let μ be a set, nonempty. An $Ш_F$- Sets of Second type $_F$ is well-defined as $_F =\{<\xi, \kappa_F(\xi), \tau_F(\xi)> / \xi\epsilon\mu$ } where the fuzzy sets$\kappa_F(\xi)$ and$\tau_F(\xi)$ stand for the membership and non-membership functions of $_F$, respectively $0 \le [\kappa_F(\xi)]^2 + [\tau_F(\xi)]^2 \le$ 1 for each $\xi\epsilon\mu$.Then the authors examined some operations on $Ш_F$- Sets of Second type and defined concentration (CONST($_F$)), normalization (NORMST($_F$)) of $Ш_F$- Sets of Second type. Also, the following implication is verified with some examples.

- Every fuzzy set is $Ш_F$- Sets. The contrary is not right.
- Every $Ш_F$- Sets is $Ш_F$- Set of second type But not the reverse.
- Every fuzzy set is $Ш_F$- Sets of second type. The reverse is not right.

In [11], Srinivasan and Palaniappan introduced $Ш_F$- Sets of root type and cleared as follows
Let μ be a non empty set. An $Ш_F$- Sets of root type $_F$ is well- defined as $_F =\{ <\xi, \kappa_F(\xi), \tau_F(\xi)> / \xi\epsilon\mu\}$ where the fuzzy sets $\kappa_F(\xi)$ and $\tau_F(\xi)$ denote the membership and non-membership functions of $_F$, respectively, $0 \le \frac{1}{2}\sqrt{\kappa_F(\xi)} + \frac{1}{2}\sqrt{\tau_F(\xi)} \le 1$ for each $\xi\epsilon\mu$.Then the authors originated few properties of the same using $\wedge,\Diamond,U,\cap+,.,$ $Ć$, I. In [13], Syed Siddiqua and Srinivasan studied about $Ш_F$- Sets of third type, defined as follows

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Let м be a nonempty set. An $Ш_F$- Sets of third type $_F$ is explained as follows: $_F$ ={<ξ, $κ_F(ξ)$, $τ_F(ξ)$ > / ξєм }
where the fuzzy sets $κ_F(ξ)$ and $τ_F(ξ)$ denote the membership and non- membership functions of $_F$, respectively,
$0 ≤ [κ_F(ξ)]^3 + [τ_F(ξ)]^3 ≤ 1$ for each ξєм.
The basic operations and modal operators (^and ◊) are introduced and some of their properties are explained.

Review about $Ш_F$-Automata

One of the most significant bids of fuzzy sets is Fuzzy Automata theory. In [19], Wee introduced the concept fuzzy automata which is basically derived from fuzzy relation by Zadeh which is defined as follows:
A Fuzzy (finite) Automaton is a 5 - tuple, (İ, Ö, Ω̇, f̂, ḡ) where İ is anonempty finite set (inputstates), Ö is a nonempty finite set (output states), Ω̇is a nonempty finite set (internal states),f̂ is a membership function, f̂ : Ω̇ x İ x Ω̇ →[0, 1], ḡ is a membership function, ḡ : Ö x İ x Ö → [0,1]. Also somedistinctive cases of fuzzy automata like Deterministic Automata and Nondeterministic Automata are originated. Then Malik et al. started their study about semi groups in FFSM (It is a 3-tuples Ṁ= (Ω̇, м, $κ_F$) where $κ_F$ is a fuzzy subset, $κ_F$: Ω x м x Ω → [0,1] and then continued in Sub machines and strongly connected submachine of FFSM.Further Malik et al. [7] did a study in FFSM and found the definition of sub systems and strong subsystem of a FFSM in terms of fuzzy as the state membership.

Sub systems
Let Ṁ=(Ω,м,$κ_F$)be a FFSM and ς be as u b set of Ω̇. Then(Ω,,ς,м,$κ_F$)is so called a subsystem of Ṁ if for every ṕ, ṡ in Ω̇, for every ξ in м, ς (ṡ) ≥ ς (ṕ) ∧ $κ_F$(ṕ, ξ, ṡ).

Strong subsystems

Let Ṁ=(Ω̇,м,$κ_F$) be a FFSM and ς be as u b set of Ω̇. Then(Ω,ς,м,$κ_F$)is known as a strong subsystem of Ṁiffforeveryṕ, ṡin Ω̇, if there existsξinм such that$κ_F$(ṕ, ξ, ṡ) >0, then ς (ṡ) ≥ ς (ṕ).Also we can study about some of their algebraic properties. Cyclic and super cyclic subsystems are introduced and the necessary and sufficient condition of a subsystem to become a super cyclic subsystem is explained. If f is an onto strong homomorphism from FFSM Ṁ1 = (Ω1, м, $κ_F$) to FFSM Ṁ2 = (Ω2, м, $κ_F$), ς is a subset of Ω̇1, then f(ς) is a sub system of Ω̇2 . They also identified a decomposition for FFSM into primary sub machines. Young Bae Jun [16]used the notation of IFS, the noriginates $Ш_F$- Finite State Machines and defined in the following way: An $Ш_F$- Finite State Machines is a3-tuple Ṁ = (Ω̇, м, $_F$), where Ω̇ and м are finite nonempty sets, respectively stated as the set of states and set of input symbols where $_F$ is an $Ш_F$- Sets in Ω̇ x м x Ω̇. Also he gave the concept of $Ш_F$- immediate successors of a set Ṭ which is a subset of Ω̇, represented by Ĭ and discussed some of its properties. He also gave the following terms: $Ш_F$- subsystem, $Ш_F$- submachine.

$Ш_F$- subsystem

Let Ṁ = (Ω, м, $_F$) be an $Ш_F$- finite state machine. Let Ṽ= ($κ$Ṽ, ν Ṽ) be an $Ш_F$- Sets-in Ω̇. Then (Ω, Ṽ, м, $_F$) is termed an $Ш_F$- subsystem of Ṁ if for every ṕ, ṡ in Ω and ξ in м,

$κ$ Ṽ(ṡ) ≥ $κ$Ṽ(ṕ)∧ $κ_F$(ṕ, ξ, ṡ)
$τ$ Ṽ(ṡ) ≤ $τ$ Ṽ(ṕ) ∨ $τ_F$(ṕ, ξ, ṡ)

$Ш_F$- submachine:

Let Ṁ = (Ω, м, $_F$) be an $Ш_F$- finite state machine. Let Ῠ be a subset of Ω̇ and ß be an $Ш_F$- Sets in Ῠ x м x Ῠ. Let Ẇ = (Ῠ, м, ß) be an $Ш_F$- finite state machine. Then Ẇ is a $Ш_F$- sub machine of Ṁ if

(i) $κ_F$/ Ῠ x м x Ῠ = $κ$ß and $τ_F$/ Ῠ x м x Ῠ =$τ$ß
(ii) Ĭ (Ῠ) ⊆ Ῠ

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He proved that the union of family of $\mathbb{W}_F$- sub machines is an $\mathbb{W}_F$- submachine and intersection of family of $\mathbb{W}_F$- sub machines is an $\mathbb{W}_F$- submachine. In 2006 Young Bae Jun [17]introduced $\mathbb{W}_F$-finite switch board state machines which is an extension of an $\mathbb{W}_F$- finite state machine An $\mathbb{W}_F$-finite switch board state machines $\dot{M} = (\Omega, \text{м}, \text{ғ})$ is termed as switching if the subsequent circumstance is gratified: $\kappa_F(\acute{s}, \xi, \acute{p}) = \kappa_F(\acute{p}, \xi, \acute{s})$ and $\tau_F(\acute{s}, \xi, \acute{p}) = \tau_F(\acute{p}, \xi, \acute{s})$ for all $\acute{p}, \acute{s}$ in $\acute{\Omega}$ and ξin м. He cleared that if an $\mathbb{W}_F$- finite state machine.is both switching and commutative, then $\mathbb{W}_F$-finite state machine. becomes $\mathbb{W}_F$-finite switchboardstate machines.Young Bae Jun [18], in 2007 discussed about the quotient structures of $\mathbb{W}_F$- finite state machine and he established the new congruence relationssuch that each connected with a semi group with an $\mathbb{W}_F$- finite state machine. Also he took an $\mathbb{W}_F$- finite state machine, raised two semi groups those are finite with identity, then verified that they are isomorphic. It is clear that in the middle of an $\mathbb{W}_F$- finite state machine and the quotient structure of one more $\mathbb{W}_F$- finite state machine, we can derive an isomorphism.In[9], Ravi and Alka Choubey proposed the definitionfor Deterministic Finite Automaton (DFA) and Non Deterministic Finite Automaton (NDFA) with $\mathbb{W}_F$- (final) states. They derived the definition for $\mathbb{W}_F$-regular language.Theapproval of the $\mathbb{W}_F$- regular language by the finite automaton (DFA & NDFA) with $\mathbb{W}_F$- (final) states are analyzed and concluded that finite automaton (DFA & NDFA)with $\mathbb{W}_F$ (final) states is finest for identify ig $\mathbb{W}_F$ regular language. In [14], Tiwari studied about the $\mathbb{W}_F$- topology induced and performed with the help of an $\mathbb{W}_F$-approximation operator with an approximation space (м, $\underline{R}$) where $\underline{R}$ is transitive and reflexive. Then he derived the necessary and sufficientcondition of $\underline{R}$ on м is transitive and reflexive is the connected$\mathbb{W}_F$-approximation operator is a kuratowski drenched operator which is closure on м.In this paper [5], Chobay and Ravi discussed about the relations between $\mathbb{W}_F$- language, interval valued fuzzy language and vague language. It helped us to know about the properties of one language as soon as the other language properties are recognized. Also they extended their study in Myhill – Nerode theorem from Vague Regular Language (VRL) – $\mathbb{W}_F$-Regular Languageandgot an excellent algorithm for minimizing DFA –VS and DFA – IFS. In [15], Uma and Rajasekar proposed to minimization of $\mathbb{W}_F$- automata. First they introduced substitution property for an $\mathbb{W}_F$- finite state automata, then Quotient $\mathbb{W}_F$- automata is initiated. Further the state equivalence and induced substitution partition properties of an $\mathbb{W}_F$–fuzzy finite automata are examined. Finally the finite procedure for the minimal machine is established and compared with the finite state automata and then concluded that the an $\mathbb{W}_F$–fuzzy finite automata is having minimum number of finite states with help of anexample.Ravi et al. [10], identified an an$\mathbb{W}_F$–finite automata automaton model for concluding the likeness among strong pair of strings. In this the author introduced the an$\mathbb{W}_F$–automatonmodalwith8tuples.Ithelpstomatchthefaultystringsbasedonan$\mathbb{W}_F$– sets. It is a vast field with lots of progressive developments. With current advancements in hardware and software, $\mathbb{W}_F$–sets and $\mathbb{W}_F$–automata the oryopens a wide door for various academics and industrialapproaches.

CONCLUSION

This paper is an elaboration on the reviews about $\mathbb{W}_F$– sets and $\mathbb{W}_F$–automata partially. It is aimed to stipulate new futuristic ideas for the upcoming researchers in $\mathbb{W}_F$–automata.

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RESEARCH ARTICLE

Some New Kinds of Support Domination in Fuzzy Graphs using Strong ARC - New Approach

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ABSTRACT

In this paper we extend the concept of Support domination in fuzzy graphs using strong arc to some new kinds of support domination in fuzzy graphs using strong arc. Let G be a fuzzy graph. Then support of u $\in$ V(G) using strong arc is give by suups (u) = {$\sum$ deg (v_i) : $v_i \in N_S(u)$ }. The vertex u is said to be support dominates the vertex v (using strong arc) if $Supps(u) \geq Supps(v)$. A subset D of V is called a support dominating set of G using strong arc if for every   v $\in$ V- D, there exists u $\in$D such that u support dominates v using strong arc. Further new kinds of support domination using strong arc (new approach) in fuzzy graph and the corresponding support domination number using strong arc of some standard fuzzy graphs are determined.

2020 Mathematics Subject Classification: 05C72.

Keywords: Fuzzy Graph,strong arc, Domination number using strong arc,Support of a vertex, Support domination number.

INTRODUCTION

Fuzzy graph is the generalization of the ordinary graph. Therefore it is natural that though fuzzy graph inherits many properties similar to those of ordinary graph, it deviates at many places.The formal mathematical definition of domination was given by Ore.O in 1962. In 1975 A.Rosenfeld introduced the notion of fuzzy graph and several analogs of theoretic concepts such path, cycle and connected. A.Somasundaram and S.Somasundaram discussed the domination in fuzzy graph using effective arc. C.Y.Ponnappan and V.Senthil Kumar discussed the domination in fuzzy graph using strong arc. Before introducing new results in fuzzy graphs using strong arcs, we are placed few preliminary definitions and results for new one.

PRELIMINARIES

Definition : 2.1

Fuzzy graph $G(\sigma,\mu)$ is pair of function $\sigma : V \to [0,1]$ and $\mu : E \to [0,1]$ where for all u, v in V, we have $\mu(u,v) \le \sigma(u) \wedge \sigma(v)$.

Definition: 2.2

A strongest path joining any two nodesu,v is a path corresponding to maximum strength between u and v. The strength of the strongest path is denoted by $\mu^{\infty}(u,v)$. $\mu^{\infty}(u,v) = \sup \{ \mu^{k}(u,v) \mid k= 1,2,3\ldots \}$.

Definition : 2.3

An arc (u,v) of the fuzzy graph $G(\sigma,\mu)$ is called a strong arc if $\mu(u,v) = \mu^{\infty}(u,v)$ else arc (u,v) is called non strong.

Strong neighborhood of $u \in V$ is $N_S(u) = \{ v \in V : \text{arc } (u,v) \text{ is strong}\}$. $N_S[u] = N_S(u) \cup \{u\}$ is the closed neighborhood of u.

Definition : 2.4

Let G be a fuzzy graph. Degree of a vertex $v \in V$ is the number of strong arcs incident with $v \in V$.

Definition : 2.5

Let G be a fuzzy graph. Then support of $u \in V(G)$ using strong arc is give by$\text{supp}_S (u) = \{ \sum \deg (v_i) : v_i \in N_S(u) \}$. And is labeled in fuzzy graph in [ ].

Example: 2.6

(G)
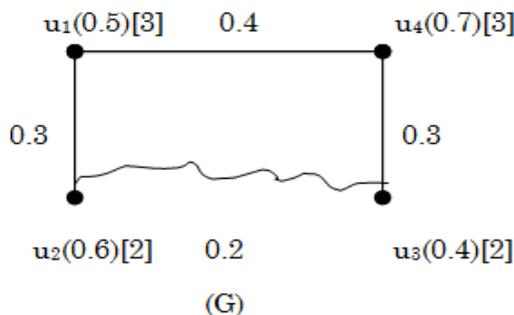
Here $\text{supp}_S(u_1) = 3$; $\text{supp}_S(u_2) = 2$; $\text{supp}_S(u_3) = 2$; $\text{supp}_S(u_4) = 3$;

Definition : 2.7 (Support Domination in Fuzzy Graph Using Strong Arc)

Let G be a fuzzy graph. Let u,v be two strong neighborhood nodes of G. Then the vertex u is said to be support dominates the vertex v (using strong arc) if $Supp_s(u) \geq Supp_s(v)$.A subset D of V is called a support dominating set of G using strong arc if for every v $\in$ V- D, there exists u $\in$D such that u support dominates v using strong arc.A support dominating set D using strong arc is called a minimal support dominating set using strong arc if no proper subset of D is a support dominating set using strong arc.The minimum support fuzzy cardinality using strong arc taken over all minimal support dominating set using strong arc of G is called the support domination number using strong arc and is denoted by γ_{supps}(G) and the corresponding dominating set is called minimum support dominating set using strong arc. The number of elements in the minimum support dominating set using strong arc is denoted by $n[\gamma_{supps}(G)]$.

$\gamma_{supps}(G) = \min \{ \sum supp_s (u) + \sigma (u) , \text{ where } u \in D(G) \}$

Example : 2.8

(G)
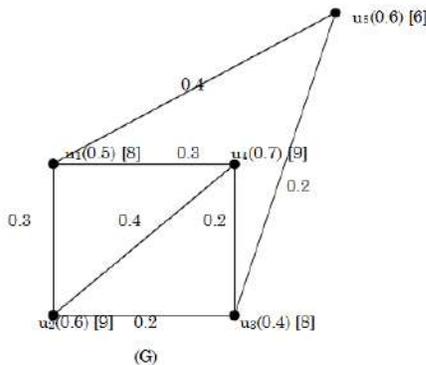
Here u_2 dominates u_1, u_3, u_4 and u_3 dominates u_5. Therefore $D_{supps}(G) = \{ u_2, u_3\}$ and$\gamma_{supps}(G) = 18$; $n[\gamma_{supps}(G)] = 2$.

FUZZY SUPPORT NEIGHBORHOOD CLIQUE DOMINATION USING STRONG ARC.

Definition : 3.1

Let G be a fuzzy graph without isolated vertices. A fuzzy support dominating set $D_{suppncs}$ (G) of V(G) is said to be a fuzzy support neighborhood clique dominating set using strong arc if ‹ $N(D_{suppncs}$ (G)) › is strong complete provided $N(D_{suppncs}$ (G)) contains the fuzzy vertices other than $D_{suppncs}$ (G).The fuzzy support neighborhood clique domination number is the minimum fuzzy cardinality taken over all minimal fuzzy support neighborhood clique dominating sets of G.

Theorem : 3.2

Let G be a strong complete fuzzy graph FK_n with $\sigma(v_i) = C$,$\forall v_i \in$V(G).Then $\gamma_{suppncs}(G) = (n-1)^2+ C$

Proof:

Let G be a fuzzy complete graph FK_n with vertices $\{v_1, v_2, v_3, \ldots. v_n\}$ and $\sigma(v_i) = C$, $\forall v_i \in$V(G).In G each vertex is adjacent to every other vertex using strong arcs. Degree of each vertex is (n-1) and support of each vertex is $(n-1)^2$.

∴$D_{suppncs}$ (G) will contain only one vertex whose cardinality is $(n-1)^2 + C$. Clearly ‹ $N(D_{suppncs}$ (G)) › is a complete graph. Hence the theorem.

Cor

Let G be a strong complete fuzzy graph FK_n with distinct vertex cardinality. Then $\gamma_{suppncs}(G) = (n-1)^2 + \sigma(v_i)$, where $\sigma(v_i)$ is the minimum fuzzy cardinality of the vertex.

Theorem : 3.3

Let G be a strong complete fuzzy graph and $D_{suppncs}$ (G) be the fuzzy support neighborhood clique dominating set of G using strong arc. Then $\gamma_{suppncs}(G) \leq \gamma_{suppncs}(G_1) \leq \gamma_{suppncs}(G_2) \leq \ldots \leq \gamma_{suppncs}(G_{n-1})$ where G_i is a fuzzy graph with V_i = { V- {v_i}/ $\sigma(v_i)$ is the minimum fuzzy vertex cardinality}

FUZZY SUPPORT REGULAR DOMINATION USING STRONG ARC
Definition : 4.1

The support dominating set $D_{supprs}$of the fuzzy graph G is said to be a support regular dominating set using strong arc if every vertex in D is of same degree. The fuzzy support regular domination number using strong arc $\gamma_{supprs}(G)$ is the minimum fuzzy cardinality taken over all minimal support regular dominating sets of G using strong arcs.

Example: 4.2

(G)
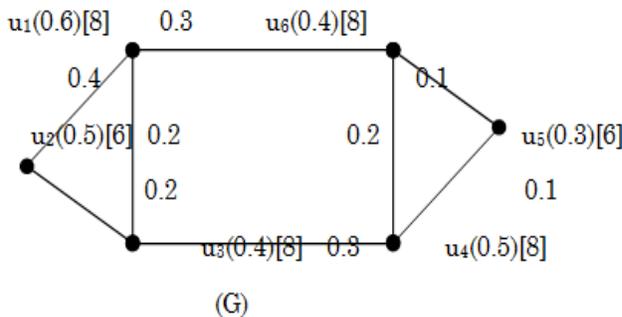
$D_{supprs}(G)$ = {u_3,u_6} and $\gamma_{supprs}(G)$ = 8.4+8.4 =16.8

Theorem: 4.3

Let G = FK_n be a strong complete fuzzy graph. Then $\gamma_{supprs}(FK_n) = (n-1)^2+ \sigma(u)$, $u \in D(G)$ and u is a vertex with minimum fuzzy cardinality and $n[\gamma_{supprs}(FK_n)] = 1$.

Proof

Let G = FK_n be a strong complete fuzzy graph. Each vertex support dominates every other vertices of G. Degree of each vertex is (n-1) and therefore support of each vertex is $(n-1)^2$. The fuzzy support regular dominating set will contain only one vertex with minimum fuzzy cardinality. $\therefore \gamma_{supprs}(FK_n) = (n-1)^2+ \sigma(u)$ where 'u' is a vertex with minimum fuzzy cardinality and $n[\gamma_{supprs}(FK_n)] = 1$.

Theorem: 4.4

In fuzzy cycles FCn with all arcs as strong arcs, $\gamma_{supprs}(FC_n) = 4 \lceil\frac{n}{3}\rceil + \sum\sigma(v_i)$ where $v_i \in D_{supprs}(FC_n)$.

Theorem: 4.5

Let G = $FK_{m,m}$be a fuzzy complete bipartite graph with all arcs as strong arcs. Then$\gamma_{supprs}(FK_{m,m})= 2m^2+\sigma(u) + \sigma(v)$ where $u \in V_1(G)$ and $v \in V_2(G)$ with minimum fuzzy vertex cardinality . Also $n[\gamma_{supprs}(FK_{m,m})] = 2$.

FUZZY SUPPORT REGULAR SPLIT DOMINATION USING STRONG ARC

Definition : 5.1

The support dominating set$D_{supprss}$(G) of the fuzzy graph G is said to be support regular split dominating set using strong arc if (i) every vertex in $D_{supprss}$(G) is of same degree (ii) ‹ V- $D_{supprss}$(G) › is disconnected. The fuzzy support regular split domination number using strong arc $\gamma_{supprss}$(G) is the minimum fuzzy cardinality taken over all minimal fuzzy support regular split dominating sets of G using strong arc.

Theorem: 5.2

Let G be a Fuzzy cycle FCn with all arcs as strong arcs, $\gamma_{supprss}(FC_n) = 4 \lceil \frac{n}{3} \rceil + \sum \sigma(v_i)$ where $v_i \in D_{supprss}(FC_n)$.

Proof:

Let FC_n be a fuzzy cycle with all arcs as strong arcs. All the vertices of FC_n are of degree two and support four. Each vertex can support dominates only two vertices. Therefore number of dominating vertices is $\lceil \frac{n}{3} \rceil$. Hence

,$\gamma_{supprss}(FC_n) = 4 \lceil \frac{n}{3} \rceil + \sum \sigma(v_i)$ where $v_i \in D_{supprss}(FC_n)$.

Theorem: 5.3

Let G be a fuzzy star $FK_{1,n}$. Then $\gamma_{supprss}(FK_1,n) = n + \sigma (u)$, u $\in D_{supprss}(FK_{1,n})$ and$n[\gamma_{supprss}(FK_1,n)] = 1$

Theorem: 5.4

In fuzzy paths FPn, $n[\gamma_{supprss}(FP_n)]$ = $\begin{cases} 1 , & n = 2,3 \\ = 2 , & n= 4 \\ = k+1 , & \text{when n= 3k-1, 3k,} \quad 3k+1 \text{ and } k \geq 2 \end{cases}$

FUZZY SUPPORT REGULAR NON SPLIT DOMINATION USING STRONG ARC

Definition : 6.1

The support dominating set$D_{supprnss}$(G) of the fuzzy graph G is said to be support regular non split dominating set using strong arc if (i) every vertex in $D_{supprnss}$(G) is of same degree (ii) ‹ V- $D_{supprnss}$(G) › is connected. The fuzzy support regular non split domination number using strong arc $\gamma_{supprnss}$(G) is the minimum fuzzy cardinality taken over all minimal fuzzy support regular non split dominating sets of G using strong arc.

Theorem: 6.2

Let G = FK_n be a strong complete fuzzy graph. Then $\gamma_{supprnss}(FK_n) = (n-1)^2 + \sigma(u)$, u $\in D_{supprnss}(FKn)$ and $n[\gamma_{supprnss}(FK_n)] = 1$

Proof

Let G = FK_n be a strong complete fuzzy graph. Then support of each vertex is (n-1)2. Therefore any one vertex with minimum fuzzy cardinality support dominates every other vertex. Also ‹ V – D_{supps}(G) › is connected. Therefore

$\gamma_{supprnss}(FK_n) = (n-1)^2 + \sigma(u)$, u $\in D_{supprnss}(FK_n)$ and $n[\gamma_{supprnss}(FK_n)] = 1$

Theorem : 6.3

Let $FK_{m,m}$be a fuzzy complete bipartite graph with all arcs as strong arcs. Then fuzzy support regular non split dominating set exist for $FK_{m,m}$. Also $\gamma_{supprnss}(FK_{m,m}) = 2m^2 + \sum \sigma(u_i)$, $u_i \in D(FK_{m,m})$ and $n[\gamma_{supprnss}(FK_{m,m})] = 2$

Proof

Let G= $FK_{m,m}$ be a fuzzy complete bipartite graph with all arcs as strong arcs. V(G) = (V_1, V_2) such that no two vertices of V_1 are adjacent and no two vertices of V_2 are adjacent. But each vertex of V_1 is adjacent to every vertex of V_2.

Therefore support of each vertex is m^2. Choose a vertex $u_i \in V_1$ and $v_j \in V_2$ such that u_i and v_j have the minimum fuzzy cardinality . Therefore $D_{supprnss}(G) = \{ u_i, v_j \}$ and $\gamma_{supprnss}(FK_{m,m}) = 2m^2 + \sum \sigma(u_i)$, $n[\gamma_{supprnss}(FK_{m,m})] = 2$

Theorem: 6.4

Let G= FW_n be a fuzzy wheel. Then $\gamma_{supprnss}(FW_n) = 3n + \sigma(u)$, where $u \in D_{supprnss}(FW_n)$ and $n[\gamma_{supprnss}(FW_n)] = 1$

Proof

Let G= FW_n be a fuzzy wheel with (n+1) vertices. Let 'u' be the central vertex and $\{u_1, u_2, u_3, \ldots u_n\}$ be the vertices in the boundary of the wheel such that 'u' is adjacent to all u_i,(i=1,2,…n), u_{i-1} is adjacent to u_i , u_i adjacent to u_{i+1}(i = 2,3,4,…n-1) and u_n is adjacent to u_{n-1} and u_1. Then support of 'u' is 3n and support each u_i (i = 1 to n) is (n + 6). Here 'u' support dominates all u_i (i = 1 to n). $\therefore D_{supprnss}(FW_n) = \{u\}$; $\gamma_{supprnss}(FW_n) = 3n + \sigma(u)$ and $n[\gamma_{supprnss}(FW_n)] = 1$.

Theorem: 6.5

Let G=Sh_n be a fuzzy shell graph with all arcs as strong arcs. Then $\gamma_{supprnss}(FSh_n) = 3(n-5) + \sigma(u)$ where 'u' is the apex of the fuzzy shell graph and $n[\gamma_{supprnss}(FSh_n)] = 1$.

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RESEARCH ARTICLE

Compactness in Grey Metric Space

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ABSTRACT

In this paper, we focus to define compactness and sequential compactness in grey metric space. We also prove some of its properties.

Keywords: grey number, grey set, grey metric space, grey open and grey closed subsets.

INTRODUCTION

The grey system theory was first initiated by Deng Julong in 1982 [1]. As far as information is concerned, the system which lacks information, such as structure message, operation mechanism and behaviour document are referred to as grey systems. In general, a system containing knowns and unknowns is called a grey system. Yingie Yang proposed the grey sets on 2011 [8]. Grey sets apply the basic concept of grey numbers in grey systems, and consider the characteristic function values of a set as grey numbers. They provide an alternative for the representation of uncertainity in sets. In 1906, Maurice Frechet introduced metric space in his work "Sur quelques points du calculfontionnel". However, the name is due to Felix Hausdorff. Metric space is a set together with a metric defined between two member of the set. A metric is a function which defines the concept of distance. We have already defined grey metric space [3]. We have also introduced grey open sets and grey closed sets and studied its properties [6, 7]. In this paper, we like to define compactness and sequential compactness in grey metric space. We also prove some of its properties. In the following section, the basic definitions needed for the study have been given. In the next section, we have studied about compactness.

PRELIMINARIES

2.1 Definition [8]

Let $\mathcal{U}$ be the initial universal set. For a set $A \subseteq \mathcal{U}$, if the characteristic function value of x with respect to A can be expressed with a grey number $g_A^\pm(x) \in \cup_{i=1}^n [a_i^-, a_i^+] \in D[0, 1]^\pm$, $\chi_A: \mathcal{U} \longrightarrow D[0, 1]^\pm$, then A is a grey set. Here, $D[0, 1]^\pm$ refers to the set of all grey numbers within the interval [0, 1].

2.2 Definition [3]

Let U be an initial universe and let $\mathcal{M}(U)$ denote a collection of grey sets of U. A function $d: \mathcal{M}(U) \times \mathcal{M}(U) \to [0,1]$ is called a grey metric on $\mathcal{M}(U)$ if it satisfies the following conditions:

i) $0 \le d(A,B) \ge 1, \forall\, A, B \in \mathcal{M}(U)$

ii) $d(A,B) = 0 \iff A = B, \ \forall\, A, B \in \mathcal{M}(U)$

iii) $d(A,B) = d(B,A), \ \forall\, A, B \in \mathcal{M}(U)$

iv) $d(A,B) \le d(A,C) + d(C,B), \ \forall\, A, B, C \in \mathcal{M}(U)$.

Definition [3]

The ordered pair $(\mathcal{M}(\mathcal{U}), d)$ forms a metric space and is called as grey metric space.

Definition [6]

Consider the grey metric space $(\mathcal{M}(\mathcal{U}), d)$ in U. Let $r \in [0,1]$ and $A \in \mathcal{M}(\mathcal{U})$. The grey open sphere with centre A and radius r, denoted by $\mathcal{S}_r(A)$ is given by $\mathcal{S}_r(A) = \{B : B \in \mathcal{M}(\mathcal{U}), |g_A^-(x) - g_B^-(x)| < r\, and\, |g_A^+(x) - g_B^+(x)| < r\,, \forall x \in \mathcal{U}\}$

Definition [6]

Let $\mathcal{G} \subseteq \mathcal{M}(\mathcal{U})$. $\mathcal{G}$ is said to be a grey open subset of $\mathcal{M}(\mathcal{U})$ if $\forall A \in \mathcal{G}$, there exists $r \in [0,1]$ such that the grey open sphere $\mathcal{S}_r(A) \subseteq \mathcal{G}$.

Definition [7]

Let $(\mathcal{M}(\mathcal{U}), d)$ be a grey metric space and $\mathcal{G} \subseteq \mathcal{M}(\mathcal{U})$. A grey set $A \in \mathcal{M}(\mathcal{U})$ is called a grey limit point of $\mathcal{G}$ if each grey open sphere centered at A contains atleast one grey set of $\mathcal{G}$ other than A.

Definition [7]

Let $(\mathcal{M}(\mathcal{U}), d)$ be a grey metric space and $\mathcal{G} \subseteq \mathcal{M}(\mathcal{U})$. The subset $\mathcal{G}$ is said to be a grey closed set if it contains all its grey limit points.

COMPACTNESS IN GREY METRIC SPACE

Definition

Let $(\mathcal{M}(\mathcal{U}), d)$ be a grey metric space. A collection $\mathcal{C} = \{\mathcal{G}_\alpha : \alpha \in \Lambda\}$ of subsets of $\mathcal{M}(\mathcal{U})$ is said to be a grey cover of $\mathcal{M}(\mathcal{U})$ if $\cup_{\alpha \in \Lambda} \mathcal{G}_\alpha = \mathcal{M}(\mathcal{U})$.

Definition

A sub collection $\mathcal{C}'$ of a grey cover $\mathcal{C}$ is said to be a grey subcover of $\mathcal{C}$ if $\mathcal{C}'$ it self covers $\mathcal{M}(\mathcal{U})$.

Definition

A grey sub cover if $\mathcal{C}'$ of $\mathcal{C}$ is said to be a finite grey subcover if $\mathcal{C}'$ has only a finite number of members.

Definition

A grey cover $\mathcal{C}$ of $\mathcal{M}(\mathcal{U})$ is said to be an open grey cover of $\mathcal{M}(\mathcal{U})$ if every subset in $\mathcal{C}$ is a grey open set.

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Definition

The grey metric space $(\mathcal{M}(\mathcal{U}), d)$ is said to be compact if every open grey cover of $\mathcal{M}(\mathcal{U})$ has a finite grey subcover.

Theorem

Let$(\mathcal{M}(\mathcal{U}), d)$ be a compact grey metric space. Then, a grey closed subset of $\mathcal{M}(\mathcal{U})$ is compact.

Proof

Let $\mathcal{F}$ be a non-empty grey closed subset of $\mathcal{M}(\mathcal{U})$. Let $\{\mathcal{G}_\alpha : \alpha \in \Lambda\}$ be an open grey cover of $\mathcal{F}$. We may write $\mathcal{G}_\alpha = \mathcal{H}_\alpha \cap \mathcal{F}$, where $\mathcal{H}_\alpha$ is a grey open in $\mathcal{M}(\mathcal{U})$ for each $\alpha \in \Lambda$. Then $\mathcal{F} = \cup_{\alpha \in \Lambda} \mathcal{G}_\alpha \subset \cup_{\alpha \in \Lambda} \mathcal{H}_\alpha$. Now $\mathcal{M}(\mathcal{U}) = \mathcal{F} \cup \mathcal{F}^C \subset \cup_{\alpha \in \Lambda} \mathcal{H}_\alpha \cup \mathcal{F}^C$. Since F is grey closed, $\mathcal{F}^C$ is grey open and so $\{\mathcal{H}_\alpha : \alpha \in \Lambda\} \cup \{\mathcal{F}^C\}$ is a grey open cover of $\mathcal{M}(\mathcal{U})$. Since $\mathcal{M}(\mathcal{U})$ is compact, $\{\mathcal{H}_\alpha : \alpha \in \Lambda\} \cup \{\mathcal{F}^C\}$ has a finite grey subcover. In case, the finite grey subcover contains $\mathcal{F}$ as one of its members, remove it since it covers no part of $\mathcal{F}$.Let the remaining finite collection of sets be $\{\mathcal{H}_{\alpha_1}, \mathcal{H}_{\alpha_2}, \dots, \mathcal{H}_{\alpha_N}\}$ such that $\mathcal{F} \subset \cup_{i=1}^{N} \mathcal{H}_{\alpha_i}$. $\Rightarrow \mathcal{F} = \mathcal{F} \cap [\cup_{i=1}^{N} \mathcal{H}_{\alpha_i}] = \cup_{i=1}^{N}[\mathcal{F} \cap \mathcal{H}_{\alpha_i}] = \cup_{i=1}^{N} \mathcal{G}_{\alpha_i}$. $\Rightarrow \{\mathcal{G}_{\alpha_i}\}_{i=1}^{N}$ is a finite subcollection of sets in $\{\mathcal{G}_\alpha : \alpha \in \Lambda\}$ which covers $\mathcal{F}$. Hence $\mathcal{F}$ is compact.

Theorem

Compact subsets of a grey metric space is grey closed.

Proof

Let$(\mathcal{M}(\mathcal{U}), d)$ be a grey metric space. Let $\mathcal{G}$ be a compact subset of $\mathcal{M}(\mathcal{U})$. Let $A \in \mathcal{M}(\mathcal{U}) - \mathcal{G}$. For each $B \in \mathcal{G}$, consider $\delta_B = \frac{1}{2} \min\{ |g_A^-(x) - g_B^-(x)|, |g_A^+(x) - g_B^+(x)|\}$. Then $\{\mathcal{S}_{\delta_B}(B)\}_{B \in K}$ forms an open grey cover for $\mathcal{G}$. Since $\mathcal{G}$ is compact, there exists grey sets $B_1, B_2, \dots, B_k$ in $\mathcal{G}$ such that $\mathcal{G} \subset \cup_{i=1}^{k} \mathcal{S}_{\delta_{B_i}}(B_i)$.This follows that $\cap_{i=1}^{k} \mathcal{S}_{\delta_{B_i}}(A)$ is a grey open set which contains A and $\cap_{i=1}^{k} \mathcal{S}_{\delta_{B_i}}(A) \subset \mathcal{P}(\mathcal{U}) - \mathcal{G}$. Thus $\mathcal{P}(\mathcal{U}) - \mathcal{G}$ is grey open. Hence, $\mathcal{G}$ is grey closed.

Theorem

Let $\mathcal{F}$ be an infinite subset of a compact set $\mathcal{G}$ of $\mathcal{M}(\mathcal{U})$. Then $\mathcal{F}$ has a grey limit point in $\mathcal{G}$.

Proof

If no grey set of $\mathcal{G}$ were a grey limit point of $\mathcal{F}$, then each grey set $A \in \mathcal{G}$ would have a grey open sphere $\mathcal{S}_{r_A}(A)$ which contains at most one grey set of $\mathcal{F}$. It is clear that no finite sub collection of $\{\mathcal{S}_{r_A}(A)\}$ can cover $\mathcal{F}$; and the same is true for $\mathcal{G}$, which is a contradiction to the compactness of $\mathcal{G}$.

Definition

The space $(\mathcal{M}(\mathcal{U}), d)$ is said to be sequentially compact if every sequence of grey sets in $\mathcal{M}(\mathcal{U})$ has a convergent subsequence.

Theorem

Let $\mathcal{G} \subset \mathcal{M}(\mathcal{U})$. If $\mathcal{G}$ is compact, then $\mathcal{G}$ is sequentially compact.

Proof

Assume that $\mathcal{G}$ is compact. Let $\{A_k\}$ be a sequence of grey sets in $\mathcal{G}$.Let $\mathcal{F}$ be the range of $\{A_k\}$. If $\mathcal{F}$ is finite we get a constant subsequence, which is convergent. Therefore $\mathcal{F}$ is an infinite subset of $\mathcal{G}$.Let A be the grey limit point of $\mathcal{F}$. Then for each $\mathcal{S}_{1/n}(A)$, we can choose a grey set A_{k_n} other than A, where $n = 1, 2, 3, \dots$Thus we get a subsequence $\{A_{k_n}\}$ of $\{A_k\}$ such that $A_{k_n} \in \mathcal{S}_{1/n}(A), \forall n$. Also $\left| g_A^-(x) - g_{A_{k_n}}^-(x) \right| < \frac{1}{n} \to 0$ as $n \to \infty$.Similarly, $\left| g_A^+(x) - gAkn+x \right| < 1n \to 0$ as $n \to \infty$.Thus every sequence has a convergent subsequence. Hence $\mathcal{G}$ is sequentially compact.

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CONCLUSION

In this study, we studied compactness and sequential compactness in grey metric space. We also proved some of its properties.

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A Systematic Review of Non-Stationary Fuzzy Sets

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ABSTRACT

In this paper, the authors have studied the concept of non-stationary fuzzy sets and also analyzed the definitions of the essential non - stationary fuzzy sets operators (union intersection, and complement) introduced by Zadeh for type - 1 fuzzy sets. Furthermore, have reviewed the correspondence between non - stationary and type 2 fuzzy sets. Then, the author have read and learned the related topics about non - stationary fuzzy sets.

Keywords: Non - stationary fuzzy sets; Non - stationary and interval type - 2 fuzzy sets; Non - stationary fuzzy systems; Non - stationary recurrent fuzzy neural network; Non stationary fuzzy time series.

INTRODUCTION

The idea of a fuzzy set was presented by Zadeh [19] in 1965. Since then, different researchers have added to the investigation of fuzzy sets and their applications in various manners. A fuzzy set is usually denoted by allows it members to have different grades of membership in the interval [0,1].If Ω is a collection of objects denoted generically by κ, then a fuzzy set in κ is a set of ordered pairs = $\{(x, | x \epsilon \Omega\}$, where is called the membership function or grade of membership.In this paper, we have investigated the non -stationary fuzzy set . A non - stationaryfuzzy set means the methods for catching extra sorts of uncertainty contrasted with the standard type - 1 and type -2 fuzzy sets. Garibaldi Jonathan M [4] introduced the concept of the association between non - stationary and interval type – 2 fuzzy set in 2005,

a case analysis, in which changeability is brought into the participation capacity of a fuzzy framework using irregular adjustments to the boundary of the producing capacity. Ma, Juan, et al.[10], introduced the concept ofnon – stationary stochastic vibration analysis of the fuzzy truessystem in 2006, which has not been additionally evolved similarly as the primary powerful investigation of irregular boundaries. Garibaldi Jonathan M [5,7], elaborately researched on the idea of non- stationary fuzzy sets.

Concept of Non – Stationary Fuzzy Sets

In [4] Garibaldi, Jonathan M., explored the connection between the efficiency of non - stationary fuzzy logicframeworks andintervaltype - 2 fuzzy logic frameworks. Here the author discussed an interesting proposition that the optional participation capacity of the type-2 sets relatingtonon-stationary fuzzy sets creates normal distributed disturbance that are non - uniform.

A non – stationary fuzzy set $\check{N}$ of the universe of discourse Y is characterized by a non – stationary membership function $\mu_{\check{N}}$: Á x Y→ [0, 1] that associate with each element (г, Ş) of Á x Y a time specific variationof $\mu_A(Ş)$. A non - stationary fuzzy set $\check{N}$ is denoted by

$$\check{N} = \int_{г \in Á} \int_{Ş \in Y} \mu_{\check{N}}(г, Ş) / Ş / г.$$

Where N is a standard fuzzy set and a set of time points$Á$, a non - stationaryfuzzy set Nis a set of duplicates of Nvaried over time.

In [5] Garibaldi, Jonathan M., provided the proper definitionof non -stationary fuzzy sets and proposed a variety of variable ideas important to them. Then the author designed the union, intersection, and complement operators, for type –1 fuzzy sets to non-stationary fuzzy sets.For each м∈M, the set $⊡_м$= {t, $\mu_{\check{N}}$(t, м)} where, t ranges over T, defined the temporal membership function F$_M$: T→ {$\mu_{\check{N}}$(t, м)}. The set $⊡_м$ will be called the group of $_{Ft}$.Here, the union, intersection, and complement of non -stationary fuzzy sets $\acute{υ}$, $\acute{ω}$, and $\tilde{Υ}$ is defined as

- Union: The union of $\acute{υ}$ and $\acute{ω}$ is a non - stationary fuzzy set
  $\acute{υ} U\acute{ω}$ = $\int_{t \in T} \int_{x \in X} \mu_{\acute{υ}⊡\acute{ω}}(t, ϰ)$ /ϰ /t.
- Intersection: The intersection of $\acute{υ}$ and $\acute{ω}$ is a non -stationary fuzzy set
$\acute{υ} ∩ \acute{ω}$= $\int_{t \in T} \int_{x \in X} \mu_{\acute{υ}⊡\acute{ω}}$ (t, ϰ) /ϰ /t
- Complement: The complement of $\tilde{Υ}$isa non-stationary fuzzy set
$\tilde{Υ}n$ = $\int_{t \in T} \int_{x \in X} \mu_{\tilde{Υ}}$ (ϰ, t) /ϰ /t

In [10] Ma, Juan, et al., introduced another technique (fuzzy factor method) view of the fuzzy sets theory. Then the author discussed the model qualities, maximums, and minimums of the fuzzy mean square estimation of the primary relocation and stress that are made by the fuzzy factor method. The author applied this strategy and acquired the non-stationary stochastic extraordinary response examination of various types of fuzzy designs, like fuzzy frames.

In this paper, Musikasuwan S., [14] investigated the non-stationary fuzzy frameworks utilizing two distinct states of Membership Functions, i.e. the Gaussian and Triangular Membership Functions. At that point, the investigations were created by developing the interval type-2 a non-stationary fuzzy framework utilizing Gaussian and Triangular Membership Functions (MF's) and the author described it to tackle the standard XOR issue.

In this paper, Salzanstein Fabien, et al. [15] provided a non-stationary Markov chain that is depicted in an unaided way, basedon thenew Markov triplet approach. Then, the author examined this technique in contrast with the non - stationary fuzzy Markov chain model. Both stationary and non -

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stationary methods are enhanced with a defined join thickness, which directs the engaging quality of the adjoined states. A stationary Markov chain $\Omega = (\kappa_s)_{1 \leq s \leq P}$ with continuous statement, i.e., $\Omega_s 2$ [0,1]. To characterize the dispersion $\varrho(\kappa)$ of the variable β, the thickness $\omega(\kappa_1)$ of the underlying dispersion is needed, and the progress densities $p(x_{x-1})_{1 \leq s \leq N}$.

$p(\kappa_1, \kappa_2, \ldots\ldots \kappa_P) = \varrho(\kappa_1). p(\kappa_2 \mid \kappa_1) \ldots\ldots \varrho(\kappa_n \mid \kappa_{P-1})$

A non - stationary Markov chain an initial process Ω and additional process U, which takes in the finite setS = $\{\lambda_1, \lambda_2, \ldots\ldots\lambda_k\}$. The couple $\hat{S} = (\Omega, \omega) = \{(M_1, \vartheta_1), (M_2, \vartheta_2), \ldots, (M_P, \vartheta_P)\}$ should be a stationary Markovchain, where Ω is an interesting non - stationary process and U models auxiliary states.

$\varrho(\varsigma_1 = (\kappa_s, \Omega_s) \mid S_{s-1}, S_{s-2} \ldots\ldots.S_1) = \varrho(S_s \mid S_{s-1}).$

In [6] Garibaldi, Jonathan M., introduced the idea of instantiative fuzzy sets. It is related to the idea of non - stationary fuzzy sets. Then the author described the proper definition of instantiative sets followed by the fundamental classes of instantiative fuzzy setoperators like the union, the intersection, and the complement. The definition of an instantiative fuzzy set given by Garibaldi is as follows:
Aninstantiative type - P:B fuzzy set $M^{P:B}$ the universe of discourse Ω is characterized by the instantiative type

P:B membership function $\mu_M^{P:B} : \psi \times \Omega \rightarrow ?$ which associates each element $(\bar{\psi}, \kappa)$ of $\psi \times \Omega$ with ad-specific variant of $\mu_M^n(\kappa, r)$. In [7] Garibaldi, Jonathan M., investigated the informal notion of non - deterministic fuzzy reasoning in which variability is introducedintothe membership function of a fuzzy frame work through the irregular variation at the boundaries of these functions. Here, the author formalized the idea of non - stationary fuzzy sets. In [8] GajjarPragnesh A., discussed a few properties identified with the conveyance of participation grades for non-stationary fuzzy sets. Here the two cases are considered as the hidden membership functions as Triangular and Gaussian.

The triangular membership function (TMF) is defined by

$$(\Upsilon_r, \Upsilon_s, \Upsilon_?) = \begin{cases} \dfrac{\Upsilon_r - \Upsilon}{\Upsilon_r - \Upsilon_s} & : \quad \Upsilon_r \leq \Upsilon \leq \Upsilon_s \\ \dfrac{\Upsilon_? - \Upsilon}{\Upsilon_? - \Upsilon_s} & : \quad \Upsilon_s \leq \Upsilon \leq \Upsilon_? \\ 0 & : \quad otherwise \end{cases}$$

The underlying Gaussian membership function is

$$\Omega(N, \Upsilon, S) = e^{\frac{-(N-\Upsilon)^2}{2S^2}} : M \epsilon M$$

Where Υ is mean, S^2 is variance, and M is the universe of discourse.

In this paper [2] Benistar compared interval type-2 and non-stationary fuzzy controllers. As opposed to the type-1fuzzy system, the type - 2 fuzzy system contains participation capacities, which in themselves aretype - 1 fuzzy sets. The purpose ofthis paper was to assess several elective regulators, including a proportionalintegral regulator, a type - 1, and an ordinary range type - 2 regulator, when applied to the SASP (Standard Autonomous Sailing Problem). In [20] Zhao Liang, investigated a new idea of NST2FSs (non-stationary type - 2fuzzy systems) and frameworks, which have the benefit that the membership functions are TIFS (Type - 1 Fuzzy Sets). Thetraditional T1FS cannot display the linguistic uncertainty and variety over a long time, Then, the definition of NST2FSs is given belowW is the universe of discourse Ω, can be represented as

$$W = \int_{p \epsilon P} \int_{\omega \epsilon W} \int_{u \epsilon U \omega} \mu_{\tilde{A}}(p, \omega, u) \Big/ (p, \omega, u)$$

Here ∫ represent the union of the element p̱, ω and ʋ in the domains p̱, w, and τω when they are continuous. And also defined the basic set operators (intersection, union, and complement) for the NST2FSs are given

- Union: The union $\dot{M} \cup \dot{N}$ of NST2FSs $\dot{M}$ *and* $\dot{N}$ is

$$\dot{M} \cup \dot{N} = \int_{n\epsilon N} \int_{\kappa\epsilon K} \int_{\omega\epsilon W} \frac{\mu_{\dot{M}\acute{U}\dot{N}}\ (n,\ \kappa,\ \omega)}{(n,\ \kappa,\ \omega)}$$

$$\mu_{\dot{M}\acute{U}\dot{N}}\ (n,\kappa,\omega) = \int_{\upsilon} \int_{v} \frac{f_{\kappa}(n,v)\ \otimes\ g_{\kappa}\ (n,v)}{\upsilon\ \oplus\ v}$$

- Intersection: The intersection $\dot{M} \cap \dot{N}$ of NST2FSs of $\dot{M}$ *and* $\dot{N}$ is

$$\dot{M} \cap \dot{N} = \int_{n\epsilon N} \int_{k\epsilon K} \int_{\omega\epsilon W} n \frac{\mu_{\dot{M}\cap\dot{N}}\ (n,\ \kappa,\ \omega)}{(n,\ \kappa,\ \omega)}$$

$$\mu_{\dot{M}\cap\dot{N}}\ (n,\kappa,\omega)\ = \int_{\upsilon} \int_{v} \frac{f_{x}(n,\ v)\ \otimes\ g_{x}\ (\mathbb{Z},\ v)}{n\ \otimes\ v}$$

- Complement: The complement $\neg\dot{M}$ of NST2FSs of $\dot{M}$ is

$$\neg\dot{M} = \int_{n\epsilon N} \int_{\kappa\epsilon K} \int_{W\epsilon\omega} n \frac{\mu_{\neg\dot{M}}\ (n,\ \kappa,\ w)}{(n,\ \kappa,\ w)}$$

$$\mu_{\neg\dot{M}}\ (n,\kappa,\omega) = \int_{\upsilon} \frac{f_{x}\ (n,v)}{1-v}$$

Here ⊕ indicates t - conorm (maximum) and ⊗ represents t - norm (minimum or product). If more than one calculation pair of υ and ν can obtain an equal points υ⊕ν or υ⊗ν. By [12] Lee reviewed the non - stationary recurrent fuzzy neural network (NSRNN) for non – direct framework control. Then the (NSRNN) has the focus variety of non - stationary fuzzy sets to improve the exhibition of regular enrollment work. The reason for their investigation was to consolidate the benefits of the type - 1 and type -2 logic frameworks and the powerful property of RFNN to provide a non -stationary inserted fuzzy neural organization of non - stationary embedded recurrent fuzzy neural network (NSRFNN). In [13] Leite, Daniel *et al.,* introduced a developing fuzzy granular structure to learn from and model time changing fuzzy information and yield information streams. Then the author discussed a fuzzy set based advancing demonstrating system comprising of a one-pass learning calculation proficient to continuously create the structure of rule-based models. This system is especially appropriate to deal with possiblyunbounded fuzzy information streams and render particular and granular approximations of non - stationary capacities. In [17] Tsagr is studied the transient participation evaluations of non-stationary fuzzy sets with Gaussian basic participation capacities. In this research paper, the author had inferred the appropriation of these evaluations at the point when the non - stationary fuzzy sets are obtained by varieties of the area utilizing an ordinary circulation. By [11] Kan, introduced theprognostic frameworks that have been effectively deployedfor the checking of generally basic pivoting machines. Then, the author developed prognostic methods for such a complex framework operating in reality. In this paper, prognostic procedures were applied to turning apparatus working under non – linear and non - stationary conditions. In [3] Efendi investigated the concept of fuzzy time series (FTS) in the non - stationary time series data forecasting, Then, the author determined these data forecasts by implementing the weight age and linguistic out-of- example strategies. The following were defined in this

paper. Let ϒ(t) (t=…..0,1,2,….), a subset of real numbers, by the universe of discourse on which the fuzzy sets f_i(t), (i= 1,2,…..) are defined in the universe of discourse ϒ(t) and Ω(t) is a collection of f_i(t), (i= 1,2, …..). Then Ω(t) is (FTS) defined on ϒ(t)(t = …….0,1,2….). Therefore, Ω(t) is a linguistic time series variable where f_i(t), (i = 1,2,….), are the possible linguistic variable of Ω(t). In [9] Huang investigated the comparative of type - 2 fuzzy sets, non–stationary fuzzy sets, and cloud models. Then, the author discussed the type - 2 fuzzy sets the fuzziness of the membership function using primary and secondary membership function depending on the insightful numerical strategies. Non - stationary fuzzy sets discussed the randomness of the primary membership function and various work depend on the type - 1 fuzzy sets theory, cloud models provide their regularity of the conveyance of tests in the universe and statistics mathematical method. These three comparative sets are defined by

A type - 2 fuzzy set denoted Ŝ, is characterized by a type -2 MF $\mu_{\hat{s}}$ (n, ω) where a primary variable κ ϵK, and the secondary variable ύ ϵŬ,⊆[0, 1], i.e.,

Ŝ= {((n, ω), $\mu_{\hat{s}}$(n, ω)□ύ ∈ ŬN,⊆ [0,1]}

In which 0≤$\mu_{\hat{s}}$(n, ω)≤1,Ŝ can be expressed as

Ŝ= $\int_{n \in N} \int_{\acute{u} \in \breve{u}n} \breve{U}_N$ ⊆[0,1]

A cloud model denoted ⊡ be the universe of discourse and x be a qualitative idea in ⊡. If k ϵ⊡ is a random instantiation of the T and μ(k) ϵ [0, 1] is the certainty degree (MG) of k belonging to T, μ: ⊡→ [0, 1], □ k ∈⊡, k →μ(k). By [1] Alves, Marcos Antonio, et al, reviewed a non - stationary fuzzy set that expanded the possibility of Fuzzy Time Series, termed Non - Stationary Fuzzy Time Series (NSFTS). Then, the author discussed a couple of models that require new data changing, the NSFTS is useful for adapting to a heteroskedastic time series. The NSFTS defeated other known Fuzzy Time Series (FTS) systems with box –cox change available. In [16] e.silva investigated a non-stationary fuzzy time series that were provided to manage questionable and unsure data true to form plan data and had since become genuine foreseeing models. Then, the author provided an ordinary limitation of continuous fuzzy time series model in their inability to manage non –stationary data. He discussed a non-stationary fuzzy time series method that can dynamically adjust its fuzzy sets to reflect the adjustment in the fundamentals to chastic processs dependent on the residual mistake. Then, the non– stationary fuzzy time series is defined by fuzzy time series is defined by Where ωεϒ is the input value and ℘, b, k ε ϒ are denoted the lower, midpoint and the upper basis of the triangle.

$$\Omega\,(\omega, ℘, b, k) = \begin{cases} 0 & if \quad \omega < ℘\,(or)\,\omega > k \\ \frac{\omega - ℘}{b - ℘} & if \qquad ℘ \leq \omega \leq b \\ \frac{k - \omega}{k - b} & if \qquad b \leq \omega \leq k \end{cases}$$

CONCLUSION

In this paper, we have reviewed the concept of non -stationary fuzzy sets and provided a lot of useful ideas applied. Here, we have studied the comparison of non - stationary and type-2 fuzzy sets. These sets used the definitions of essential non - stationary set operators. This review can also be useful for future research work.

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RESEARCH ARTICLE

Properties of (1,2)*-G* Closed Sets in Bitopological Spaces

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ABSTRACT

The purpose of this paper is to define and study a new class of sets, called this class $(1,2)^*$- G^*-closed sets, which lies between the class of $(1,2)^*$- semi pre closed sets and the class of $(1,2)^*$-g-closed sets. Also, the basic properties of these $(1,2)^*$-G^*-closed sets, $(1,2)^*$- G^*-open sets, $(1,2)^*$- G^*-continuous functions, $(1,2)^*$-G^*-irresolute functions, $(1,2)^*$- G^*-Hausdorff spaces and $(1,2)^*$- G^*-connected spaces are studied in this paper.

Keywords: $(1,2)^*$-G^*-closed sets, $(1,2)^*$-G^*-open sets, $(1,2)^*$-G^*-continuous functions, $(1,2)^*$- G^*-Hausdorff spaces and $(1,2)^*$- G^*-connected spaces.

INTRODUCTION

Lavin [13] introduced the idea of making a generalized the closed set to generalized closed set in topology. Govindappanavalagi [4] was initiated the concept of properties of G^*-closed sets in topological spaces. The concept of bitopological space (X, τ_1, τ_2) was first established by J.C. Kelly [1], where X is a nonempty sets and τ_1, τ_2 are topologies on X. O. Ravi and M. Lellis Thivagar [2] was introduced the concept of $(1,2)^*$-semi open sets and $(1,2)^*$-preopen sets in bitopology. In this paper, we define and study a new set of classes, called the class of $(1,2)^*$-G^*-closedsets which lies between the class of $(1,2)^*$-semi preclosed sets and the class of $(1,2)^*$-g-closed sets. Also, the basic properties of these $(1,2)^*$-G^*closed sets, $(1,2)^*$-G^*-open sets, $(1,2)^*$-G^*-continuous functions, $(1,2)^*$-G^*-irrresolute functions, $(1,2)^*$-G^*-Hausdorff space and $(1,2)^*$-G^*-connected spaces are studied in this paper.

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Preliminaries

Throughout this paper, (X,τ_1,τ_2) and (Y,σ_1,σ_2) (or simply X and Y) represent a bitopological spaces on which no separation axioms are assumed unless explicitly stated. Let A ⊆ X, the closure of A and the interior of A is denoted by cl(A) and int(A) respectively. The complement of A is denoted by

X \ A or A^c.

Definition 2.1

A subset A of a bitopological space (X,τ_1,τ_2) is said to be

- ❖ $(1,2)^*$- semi open set [5] if A⊆ $\tau_{1,2}$-$cl(\tau_{1,2}$-$int(A))$
- ❖ $(1,2)^*$-preopen set [2] if A ⊆$\tau_{1,2}$- int($\tau_{1,2}$-cl(A))
- ❖ $(1,2)^*$-semi pre open set [3] (in short $(1,2)^*$-β-open) if A⊆ $\tau_{1,2}$-$cl(\tau_{1,2}$- $int(\tau_{1,2}$- $cl(A))$
- ❖ $(1,2)^*$-regular open set [6] A = $\tau_{1,2}$-int($\tau_{1,2}$-cl(A))

The complement of these open sets are called $(1,2)^*$-semi closed (resp.$(1,2)^*$-pre closed, $(1,2)^*$-semi pre closed, $(1,2)^*$-regular closed).

Example 2.2

Let X = $\{u_1, v_1, w_1\}$ and the topologies areτ_1= {∅,X}, τ_2= {∅,X,$\{u_1\}$,$\{v_1\}$,$\{v_1, w_1\}$} then A = $\{u_1, v_1\}$ is $(1,2)^*$-semi open and $(1,2)^*$-semi pre open sets but not $(1,2)^*$-regular open and

$(1,2)^*$-pre open sets.

Definition 2.3[5]

The union of all $(1,2)^*$- semi preopen sets contained in A is called the $(1,2)^*$- semi preinterior of A and is denoted by $(1,2)^*$- spint(A). $(1,2)^*$- pint(A) and $(1,2)^*$- sint(A), $(1,2)^*$- rint(A) can be similarly defined.

Defnition 2.4[5]

The intersection of all $(1,2)^*$- semi preclosed sets containing A is called the $(1,2)^*$- semi pre closure of A and is denotedby $(1,2)^*$- spcl(A). $(1,2)^*$- pcl(A) and $(1,2)^*$- scl(A), $(1,2)^*$- rcl(A) can be similarly defined.

Definition 2.5

A subset A of a bitopological space (X,τ_1,τ_2) is called

- ❖ $(1,2)^*$-generalized closed set [3] (in short$(1,2)^*$-g-closed) if $\tau_{1,2}$-cl(A) ⊆U
  whenever A⊆U and U is $\tau_{1,2}$-open in X.
- ❖ $(1,2)^*$-generalized semiclosed set [3] (in short$(1,2)^*$-gs-closed) if $(1,2)^*$-scl(A)⊆U
  Whenever A⊆U and U is $\tau_{1,2}$-open in X.
- ❖ $(1,2)^*$-generalized semi preclosed set [9](in short$(1,2)^*$-gsp-closed) if $(1,2)^*$-spcl(A)⊆U
  whenever A ⊆ U and U is open in X.
- ❖ $(1,2)^*$-generalized pre closed set [6] (in short$(1,2)^*$-gp-closed) if $(1,2)^*$-pcl(A)⊆U
  whenever A⊆U and U is $\tau_{1,2}$-open in X.
- ❖ $(1,2)^*$-generalized pre regular closed set (in short$(1,2)^*$-gpr-closed)
  if $(1,2)^*$-pcl(A)⊆ U whenever A ⊆U and U is $(1,2)^*$-regular open in X.
- ❖ $(1,2)^*$-generalized regular closed set (in short$(1,2)^*$-gr-closed) if $(1,2)^*$-rcl(A)⊆U
  whenever A⊆U and U is $\tau_{1,2}$-open in X.
- ❖ $(1,2)^*$-pre-semi closed set if $(1,2)^*$-spcl(A) ⊆ U whenever A ⊆ U and U is
  $(1,2)^*$-g-open in X.
- ❖ $(1,2)^*$-g^*-closed set [7]if $\tau_{1,2}$-cl(A) ⊆U whenever A ⊆ U and U is $(1,2)^*$-g-open in X.
- ❖ $(1,2)^*$-g*-pre closed(in short$(1,2)^*$-g*p-closed) set if $(1,2)^*$-pcl(A)⊆ U
  whenever A ⊆ U and U is g-open in X.
- ❖ $(1,2)^*$-g*sp-closed set [8]if $(1,2)^*$-spcl(A) ⊆ U whenever A ⊆ U and U is $(1,2)^*$-g-open in X.

Example 2.6
Let X= $\{a_1, b_1, c_1\}$ and the topologies are τ_1= $\{\emptyset,X\}$, τ_2= $\{\emptyset,X,\{b_1\},\{a_1, b_1\}\}$ then A = $\{a_1\}$ is (1,2)*-gp-closed set but not (1,2)*-g-closed set.

Example 2.7
Let X = $\{a_1, b_1, c_1\}$ and the topologies are τ_1= $\{\emptyset,X,\{a_1\},\{a_1,b_1\}\}$, τ_2= $\{\emptyset,X,\{a_1\}\}$ then A = $\{b_1\}$ is (1,2)*-gs-closed but not (1,2)*-g-closed and (1,2)*-g^*-closed set.

Definition 2.8 [11]
The union of all (1,2)*- gsp-open sets contained in A is called the (1,2)*- gsp-interior of A and is denoted by (1,2)*-gspint(A).

Definition 2.9 [11]
The intersection of all (1,2)*-gsp-closed sets containing A is called the (1,2)*- gsp-closure of A and is denoted by(1,2)*- gspcl(A).

Lemma 2.10 [11]
For every subset A ⊆X, the following statements are true.
1. (1,2)*- gspcl(X−A) = X−(1,2)*- gspint(A).
2. (1,2)*- gspint(X−A) = X−(1,2)*- gspcl(A).

Definition 2.11
A function f:$(X, \tau_1, \tau_2) \to (Y, \sigma_1, \sigma_2)$ is called
❖ (1,2)*-pre continuous if $f^{-1}(V)$ is (1,2)*-preopen in X for every$\sigma_{1,2}$open subset V of Y.
❖ (1,2)*-semi pre continuous if $f^{-1}(V)$is (1,2)*-semi preopenin X for every $\sigma_{1,2}$-open subset V of Y.
❖ (1,2)*-g-continuous [12] if $f^{-1}(V)$ is (1,2)*-g-closed in X for every $\sigma_{1,2}$ closed subset V of Y.
❖ (1,2)*-gsp-continuous [10] if $f^{-1}(V)$is (1,2)*-gsp-closed in Xfor every $\sigma_{1,2}$ closed subset V of Y.
❖ (1,2)*-g*-continuous [8] if $f^{-1}(V)$is(1,2)*- g*-closed in X for every $\sigma_{1,2}$ closed subset V of Y.
❖ (1,2)*- g*sp-continuous if $f^{-1}(V)$is(1,2)*- g*sp-closed in Xfor every $\sigma_{1,2}$ closed subset V of Y.

Definition 2.12
A space X is said to be (1,2)*- g-connected if X cannot be written as the disjoint union of two nonempty (1,2)*- g-open sets in X.

Definition 2.13
A space X is said to be (1,2)*- g-Hausdroffif whenever x and y are distinct points of X there exists a disjoint(1,2)*- g-open sets U and V such that $x \in U$ and $y \in V$.

Properties of $(1,2)^*$-G* Closed Sets
Definition 3.1
A subset A of a space X is said to be (1,2)*- G*-closed set if (1,2)*-gspcl (A) ⊆ U whenever A ⊆ U and U is (1,2)*- g-open in X. The complement of a (1,2)*- G*-closed set is called (1,2)*- G*-open set.

Lemma 3.2
Let X be a space. Then,
1. Every $\tau_{1,2}$- closed (and hence (1,2)*- pre-closed, (1,2)*- semi-pre-closed, (1,2)*- r-closed) set is (1,2)*- G*-closed set.

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2. Every (1,2)*- g*-closed (and hence (1,2)*- g*p-closed, (1,2)*- g*sp-closed)set is (1,2)*- G*-closed set.
3. Every (1,2)*- G*-closed set is (1,2)*- g-closed (and hence (1,2)*- gs-closed,(1,2)*- gsp-closed, (1,2)*- gp-closed, (1,2)*- gpr-closed, (1,2)*- gr-closed, (1,2)*- pre-semi closed) set.

Lemma 3.3
Let A be a (1,2)*-G*-closed set of space X. Then,
(i)(1,2)*-gspcl(A) − A does not contain any nonempty (1,2)*-g-closed set.
(ii) If A⊆B⊆ (1,2)*-gspcl(A), then B is also a (1,2)*-G*-closed set of X.

Proof.
(i)   Let F be a (1,2)*-g-closed set contained in (1,2)*-gspcl(A) –A, then (1,2)*-gspcl(A) ⊆ X − F
since X − Fis (1,2)*-g-open with A⊆X − F and A is (1,2)*-G*-closed set.
then, F ⊆ (X−(1,2)*-gspcl(A)) ∩ ((1,2)*-gspcl(A)− A) ⊆ (X−(1,2)*-gspcl(A))∩(1,2)*-gspcl(A) = ∅
Thus, F =∅.
(ii)Let G be a (1,2)*-g-open set of X such that B⊆ G. Then, A ⊆ G.
Since, A ⊆ G and A is (1,2)*-G*-closed set, then (1,2)*-gspcl(A) ⊆ G.
then, (1,2)*-gspcl(B) ⊆ (1,2)*-gspcl((1,2)*-gspcl(A)) = (1,2)*-gspcl(A) since B⊆ (1,2)*-gspcl(A).
Thus, (1,2)*-gspcl(B) ⊆ (1,2)*-gspcl(A) ⊆ G. Hence, B is also a(1,2)*-G*-closed set of X.

Definition 3.4
The union of all (1,2)*-G*-open sets which contained in A is called the (1,2)*-G*-interior of A
and is denoted by (1,2)*-G*int(A).

Definition 3.5
The intersection of all (1,2)*-G*-closed sets containing set A is called the (1,2)*-G*-closure of A
is denoted (1,2)*-G*cl(A).

Lemma 3.6
Let $x \in$ X, then $x \in$ (1,2)*-G*cl(A)⟺ V ∩ A ≠ ∅ for every (1,2)*-G*-open set V containing x.
It is easy to prove and hence ignored.

Lemma 3.7
Let A and B be subsets of X. Then
1. (1,2)*-G*cl (∅**)** =∅ and (1,2)*-G*cl(X) = X.
2. If A⊆B, (1,2)*-G*cl (A)⊆ (1,2)*-G*cl(B).
3. A ⊆ (1,2)*-G*cl (A).
4. (1,2)*-G*cl(A) ∪(1,2)*-G*cl(B) ⊆ (1,2)*-G*cl(A ∪B).
5. (1,2)*-G*cl (A∩ B) ⊆ (1,2)*-G*cl(A) ∩(1,2)*-G*cl(B)

Definition 3.8
A function f: X→Y is called (1,2)*-G*-continuous if $f^{-1}(V)$ is (1,2)*-G^*-closed in X for every $\sigma_{1,2}$ closed subset V of Y.

Definition 3.9
A function f: X→Y is called (1,2)*-G*-irresolute if $f^{-1}(V)$ is (1,2)*-G^*-closed in X for every (1,2)*-G* closed subset V of Y.

Definition 3.10
A function f: X→Y is called strongly (1,2)*-G*-continuous if $f^{-1}(V)$ is $\tau_{1,2}$ open in X for every (1,2)*-G*open subset V of Y.

Lemma 3.11

Let f: X → Y be a function. Then,

1. If f is (1,2)*-continuous (and hence (1,2)*-pre continuous,(1,2)*-semi pre continuous) function, then it is(1,2)*-G*-continuous.

2. If f is (1,2)*-G*-continuous function, then it is (1,2)*-g-continuous.

3. If f is (1,2)*-G*-continuous function, then it is (1,2)*-gsp-continuous.

4. If f is (1,2)*-g*-continuous function, then it is (1,2)*-G*-continuous.

5. If f is (1,2)*-g*sp-continuous function, then it is (1,2)*-G*-continuous.

Lemma 3.12: Every (1,2)*-G*-irresolute function is (1,2)*-G*-continuous

Proof:

Suppose f: X→Y is (1,2)*-G*-irresolute. Let V be any $\sigma_{1,2}$ closed subset of Y. Then V is (1,2)*-G*-closed set in Y, lemma 3.2. Since f is (1,2)*-g*sp-irresolute, $f^{-1}(V)$ is (1,2)*-g*sp-closed in X. Hence proved.

Theorem 3.13: Let f: X→Y be a function. Then the following are equivalent.

(i)f is (1,2)*-G*-continuous.

(ii)The inverse image of each open set Y is (1,2)*-G*-open in X.

(iii)The inverse image of each closed set in Y is (1,2)*-G*-closed in X.

Proof:

(i)$\Rightarrow$(ii): Let U be $\sigma_{1,2}$ open in Y. Then Y − U is $\sigma_{1,2}$ closed in Y. By (i) $f^{-1}(Y-U)$ is (1,2)*-G*-closed in X. But $f^{-1}(Y-U) = X-f^{-1}(U)$ which is (1,2)*-G*-closed in X.

Therefore $f^{-1}(U)$ is (1,2)*-G*-open in X.

Similarly we can prove (ii)$\Rightarrow$(iiii) and (iii)$\Rightarrow$(i)

Theorem 3.14

If a function f: X→ Y is (1,2)*-G*-continuous then f(G*Cl(A)) ⊆ Cl(f(A)) for every subset A of X.

Proof

Let f:X→Y be (1,2)*-G*-continuous. Let A ⊆X . Then cl (f(A)) is $\sigma_{1,2}$ closed in Y. Since f is (1,2)*-G*-continuous, $f^{-1}(cl(A))$ is(1,2)*-G*-closed in X. Suppose y ∈f(x), $x \in$ (1,2)*-G*cl(A). Let U be an open set containing $y \in$ f(x). Since f is (1,2)*-G*-continuous. $f^{-1}(U)$ is (1,2)*-G*-open set containing x so that $f^{-1}(U)$∩A≠ ∅. by Lemma 3.6, Therefore $f^{-1}(f^{-1}(U) ∩A) ≠∅$,which implies f($f^{-1}(U)$ ∩f(A))≠∅ .Since f($f^{-1}(U)$) ⊆A, U∩f(A) ≠∅ .This proves that y ∈cl(f(A)) that implies f((1,2)*G*cl(A)) ⊆$\tau_{1,2}$ -cl(f(A)).

Theorem 3.15

Let f:$(X,\tau_1,\tau_2)\rightarrow (Y,\sigma_1,\sigma_2)$be (1,2)*- G*-continuous and g: $(Y,\sigma_1,\sigma_2)\rightarrow (Z,\eta_1,\eta_2)$ be (1,2)*- continuous, then g∘f: $(X,\tau_1,\tau_2)\rightarrow (Z,\eta_1,\eta_2)$ be (1,2)*- G*-continuous.

Proof:

Let V be any $\tau_{1,2}$ open subset of Z. Then $g^{-1}(V)$ is open in Y, since g is (1,2)*-continuous function. Again, f is (1,2)*-G*- continuous and $g^{-1}(V)$is open set in Y then $f^{-1}(g^{-1}(V)) = (g \circ f)^{-1}(V)$ is (1,2)*-G* -open in X. This shows that g∘f is (1,2)*-G*-continuous.

Theorem 3.16

Let f: $(X,\tau_1,\tau_2)\rightarrow (Y,\sigma_1,\sigma_2)$ be (1,2)*-G*-continuous and g: $(Y,\sigma_1,\sigma_2) \rightarrow (Z,\eta_1,\eta_2)$ be strongly(1,2)*-G*-continuous, then g∘f: $(X,\tau_1,\tau_2)\rightarrow (Z,\eta_1,\eta_2)$ be (1,2)*-G*-irresolute.

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Proof

Let V be any (1,2)*-G*-open subset of Z. Then g^{-1}(V)is open in Y, since g is strongly (1,2)*-G*-continuous function. Again, f is(1,2)*-G*-continuous and g^{-1}(V)is open set in Y then $f^{-1}(g^{-1}$(V)) =(g ∘ f)$^{-1}$(V) is (1,2)*-G*-open in X. This shows that g∘f is (1,2)*-G*-irresolute.

Definition 3.17

A function f: X→Y is called(1,2)*- (g, G*)-continuous if the inverse image of each(1,2)*-g-open set of Y is G*-open in X. Clearly, every (1,2)*- (g, G*)-continuous function is (1,2)*-G*-continuous function, since every open set is (1,2)*-g-open set.

Definition 3.18

A space X is said to be (1,2)*-G*-connected if Xcannot be written as the disjoint union of two nonempty (1,2)*-G*-open sets in X.

Theorem 3.19

Let f: X→Y be a function

(i)If X is G*-connected and if f is (1,2)*-G*-continuous, surjective then Y is (1,2)*- connected.

(ii)If X is (1,2)*-G*-connected and Iff is (1,2)*-G*-irresolute, surjective then Y is (1,2)*-G*-connected.

Proof

(i) Let X be (1,2)*-G*-connected and f be (1,2)*-G*-continuous, surjective. Suppose Y is disconnected. Then Y = A∪B, where A and B are disjoint nonempty open subset of Y. Since f is (1,2)*-G*-continuous and surjective then, $X=$ f^{-1}(A) ∪f^{-1}(B), here f^{-1}(A), f^{-1}(B) are two disjoint nonempty (1,2)*-G*-open subsets of X. This contradicts that X is (1,2)*-G*-connected. Therefore, Y isconnected. This proves (i).

(ii) Let X be (1,2)*-G*-connected and f be (1,2)*-G*-irresolute and surjective. Suppose Y is not (1,2)*-G*-connected. Then Y = A∪B, where A,B are disjoint nonempty (1,2)*-G*-open subsets of Y. Since f is (1,2)*-G*-irresolute, surjective, then X = f^{-1}(A) ∪f^{-1}(B) wheref^{-1}(A) &f^{-1}(B) are disjoint nonempty (1,2)*-G*-open subsets of X. This implies X is not (1,2)*-G*-connected, This is a contradiction. Therefore, Y is (1,2)*-G*-connected.

Theorem 3.20

Let X be a space and Y be (1,2)*-G* -Hausdorff. Iff: X→Y be (1,2)*-G*- irresolute, injective, then X is (1,2)*-G*-Hausdorff .

Proof

Let x and y be any two distinct points of X. Then f(x)and f(y) are distinct points of Y,because f is injective. Since Y is (1,2)*-G*-Hausdorff, there exist two disjoint (1,2)*-G*-open sets U and V such that f(x)∈U and f(y)∈V .Since f is (1,2)*-G*-irresolute and U ∩ V = ∅, we havef^{-1}(U) andf^{-1}(V) are disjoint (1,2)*-G*-open sets in X such that x∈f^{-1}(U) and$y$∈f^{-1}(V). Hence X is (1,2)*-G*-Hausdorff space.

Theorem 3.21

Let X be a space and Y be (1,2)*-g-Hausdorff. If f:X→Ybe (1,2)*-(g, G*)-continuous, injective, then X is (1,2)*-G*-Hausdorff.

Proof

Let x and $y$be any two distinct points of X. Then f(x), f(y) are two distinct points of Y,because f is injective. Since $Y$is (1,2)*-g -Hausdorff, there exist two disjoint (1,2)*-g-open sets U and V such that f(x)∈U& f(y)∈V. Since f is (1,2)*-(g,G*)-continuous and$U∩V = ∅$, we have f^{-1}(U)&f^{-1}(V) are disjoint (1,2)*-G*-open sets in X such that x∈f^{-1}(U)and y∈f^{-1}(V). Hence Xis (1,2)*-G*-Hausdorff space.

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CONCLUSION

In this paper we learned a new sets of classes, called this class$(1,2)^*$- G^*-closed sets, which lies between the class of $(1,2)^*$- semi pre closed sets and the class of $(1,2)^*$-g-closed sets and also, we studied $(1,2)^*$-G^*-closed sets, $(1,2)^*$- G^*-open sets,$(1,2)^*$- G^*-continuous functions, $(1,2)^*$- G^*-irresolute functions, $(1,2)^*$- G^*-Hausdorff spaces and$(1,2)^*$- G^*-connected spaces.

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RESEARCH ARTICLE

Water Quality and Fish Faunal Composition of Poonoor River, Kerala, Southern India

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ABSTRACT

The water quality and fish faunal composition of Poonoor River, Kerala, Southern India was investigated during November 2021. The water and fish samples were collected from the Poonoor River at three different locations namely Chelavore (Station 1), Moozhikkal (Station 2) and Vellimadukunnu (Station 3)for the estimation of water quality parameters such as pH, colour, turbidity, total hardness, total alkalinity, chloride, sulphate, calcium, magnesium, iron, salinity and BOD and fish species composition as per the standard procedures. Among the water quality characteristics, colour and turbidity were recorded to be excess at station 2 whereas the remaining physio-chemical parameters were found within the acceptable limit. In this study, 16 species of fin fishes belonging to 8 families such as Cyprinidae, Cichlidae, Channidae, Anabantidae, Siluridae, Heterpneustidae, Claridae and Anguillidae were identified. Among these, species belonging to the order Anabantiformes and family Channidae were found to predominant. The findings of the present study reveal that the Poonoor River is rich in fish species composition and sustained the acceptable physical and chemical conditions prevailing in the river water

Keywords: Water quality parameters, Finfishes, Faunal composition, Poonoor River, Kerala

INTRODUCTION

Water is the most important assets and general solvent that all living organisms depend on for their survival, growth and reproduction. Without water living organisms are likely not to exist, developed and reproduced because it's the essence of life[1]. Good water quality is obligatory in maintaining the composition of aquatic organisms including fish, declining of the water quality can cause turn down in productivity and biodiversity of aquatic biota[2].Fish is a cold-blooded vertebrate adapted to living in all kinds of aquatic environment. Fish is an essential source of proteins. Fishing activities is attracting too much of attention due to its crucial contribution to the global requirement of proteins[3]. The quality of river water is determined by its physical and chemical characteristics of great value in determining its fitness for a certain use such as public water supply, irrigation, industrial application. The detailed inspection of river exposed those small areas as well as large areas which fall in the way of river, dump and toxic wastes in the river which has caused very acute pollution in the river to the level that its water is posturing danger to the survival of aquatic flora and fauna as well as human life. Anthropogenic activities like discharge of sewage effluents, waste waters from houses, toxic metals as well as metal chelates from different sources and also random use of heavy metal containing fertilizers and pesticides in agriculture resulted in worsening of water quality interpretation serious environmental hazards posing threat on human beings and sustaining biodiversity[3]. Fish is sensitive to changes in water chemistry due to different anthropogenic activities from their catchments. Fish reacts to environmental changes, including hydro-morphological factors are different in time and space in comparison to simpler organisms, as they tend to be integrated over larger intervals. Fish has been identifying as suitable for biological assessment due to its easy identification and economic value[4]. Fish assemblages have widely been used as ecological indicators to assess and evaluate the level of degradation and health of water bodies at various spatial scales[5]. In particular, fish populations are highly dependent upon the variations of physico-chemical characteristics of their aquatic habitat which supports their biological functions[6]. Among the physicochemical factors, temperature, dissolved oxygen, pH, turbidity, water transparency and current among others, and their regular or irregular fluctuations, have been identified as determinants in riverine fish ecology[7]. Therefore, the present study is aimed to assess the physico-chemical characteristics and fish species composition of Poonoor River at Kozhikode district in Kerala, Southern India.

MATERIALS AND METHODS

The present research work was carried out in Poonoor River located at Kozhikode district of Kerala state in India. Poonoor River is a perennial river, it originates from Western Ghats and meets Korapuzha and ends in Arabian Sea. The study was undertaken at three locations of the Poonoor River namely Chelavoor (Station 1), Moozhikkal (Station 2) and Vellimadukunnu (Station 3). The water samples were collected from the Poonoor River at three different stations namelyChelavoor (Station 1), Moozhikkal (Station 2) and Vellimadukunnu (Station 3) on 5th November 2021.Sampling was done with 1 litre bottles which are clean and free from contaminants. Two sets of three samples were collected from different stations of the river. Sample bottles were rinsed with water samples for avoiding the bias results. Samples were labelled with its number, site and date with the time. Sample was preserved at 4oC or in refrigerator as early as possible to prevent change in characteristic of water. The water quality parameters such as pH, Colour, Turbidity, Total Dissolved solids, Total Hardness, Total alkalinity, Chloride, Sulphate, Calcium, Magnesium, Iron, Salinity and BOD were analysed according to the standard procedure [8]. In order to estimating the amount of dissolved oxygen, samples were fixed in the BOD bottles. Fish collections were done from the river areas with the help of local fisherman using gillnets of standardised dimensions with several mesh sizes. The morphological and morphometric identification of fishes were done with the help of subject expert and using taxonomic keys[9].

RESULTS AND DISCUSSION

The maintenance of healthy aquatic ecosystem is dependent on the physico-chemical properties and biological diversity[10]. Thephysical and chemical characteristics of water from the three locations of Poonoor River was estimated and the presented in Table 1.The recoded pH of Poonoor Riverwas ranged between 6.52 and 7.63. Among the three stations studied, the highest pH of 7.63 was noticed from the station 2 (Moozhikkal).The rainwater is responsible for the neutralization and finally to alkaline. The acidic pH recorded might be due to the high organic load and decomposition. All the values of pH measured within the limits of standard ranges. The colour of the water samples collected from station 1 and 2 are within the acceptable limit as per IS 10500:2017 whereas the water sample collected from station 3 showed highest value of 8 which shows the variance from acceptable limit. All the samples showed high value of turbidity. The range of turbidity of the samples lies between 4 and 8 NTU. The total dissolved solids in all the samples are within the acceptable limit. General guidelines for classification of waters are: 0 to 60mg/l as calcium carbonate is classified as soft; 61 to 120mg/l as moderately hard. 121 to 180 mg/l as hard; and more than 180 mg/l as very hard. The present findings clearly reveals that the total hardness of three sampling sites is within the acceptable limit. The acceptable limit of total alkalinity is 200mg/l. Total alkalinity of the samples are within the acceptable range. Chloride content of all the collected three water samples were within the acceptable limit[11]. Among the three stations studied, station 3 has more chloride content than the other two stations. The amount of sulphate in samples lies between the range of 2.6-2.9 mg/l. This amount is also suitable for the growth of fishes. The amount of calcium in all those three sampling stations are lies within the acceptable limit as per IS 10500:2017. The recorded calcium levels in the water samples are varied from 3.23 to 4.85 mg/l which is suitable for aquatic life. Magnesium was also present in an acceptable limit in the water samples (1-2.16mg/l). In station 2 and 3, the reported iron content was found above the acceptable limit. The present study areas were not recorded high range of salinity. It indicates good conditions for fish growth[12].A result shows comparatively more BOD in station 1. Bacteriological analysis is a method of analysing water to estimate the number of bacteria present and if needed, to find out what sort of bacteria they are. The present study inferred that the *E. coli* was present only in station 3. No other samples containing the presence of *E. coli*. From the present study, it is clear that the station 3 (Vellimadukunnu) contains water pollution when compared to station 1 (Chelavore) and station 2 (Moozhikkal). In station 2 (Moozhikkal) and 3 (Vellimadukunnu) the turbidity level was high when compared with other parameters. The results of fish species composition recorded at Poonoor River comprises a total number of 16 species belonging to 8 families such as Cyprinidae, Cichlidae, Channidae,Anabantidae, Siluridae, Heteropneustidae, Claridae and Anguillidae and fiveorders like Anabantiformes, Cypriniformes, Siluriformes,Anguiliformes and Cichliformes (Fig. 1). The species dominance wasrecorded from the order Anabantiformes and dominant family was Channidae. The present study is an agreement with Amal Kumar et al.[13] who stated that the uneven distribution and diversity may be due to the physico-chemical factors of water.

CONCLUSION

The present study was conducted to know the water quality conditions and fish faunal composition of Poonoor River in Kozhikode District of Kerala. From the physio-chemical analysis of water samples, colour and turbidity were recorded to be excess in station 2 whereas the remaining physio-chemical parameters were found within acceptable limit. In this study, there are 16 species of fin fishes belonging to 8 families such as Cyprinidae, Cichlidae, Channidae, Anabantidae, Siluridae, Heterpneustidae, Claridae and Anguillidae were identified. Among these, species belonging to the order Anabantiformes and family Channidae were found to predominant followed by Cypriniformes and Siluriformes which are the second dominant orders and cyprinidae are the second dominant family. The result showed that physico-chemical parameters play a vital role in fish faunal composition. The findings of the present study reveal that the Poonoor River is rich infish diversity which might be due to the availability of food and prevailing favourablephysical and chemical conditions in the river water. However, any changes on the physical and chemical characteristics of the river due to anthropogenic activities around the river become

unfavorable for the reproduction, continued existence and growth of fish fauna. Consequently, there is need of periodical assessment of water quality in order to maintain the fish composition of the river.

ACKNOWLEDGEMENT

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Table 1:Water Quality characteristics of Poonoor River, Kerala

PARAMETERS	STATION 1	STATION 2	STATION 3
pH at 25°C	7.33	7.63	6.52
Colour	4	5	8
Turbidity	2.4	6	8
Total dissolved solids	48	45	47
Total hardness	17	18.26	18.12
Total alkalinity	17.86	17.26	18
Chloride	9	8	13
Sulphate	2.6	2.8	2.9
Calcium	3.23	3.2	4.85
Magnesium	2	2.16	1
Iron	0.84	1.66	3.33
Salinity	0.034	0.032	0.035
BOD	1.9	1.30	1.25
E. coli	ND	ND	D

Note: D= Detected; ND= Not Detected
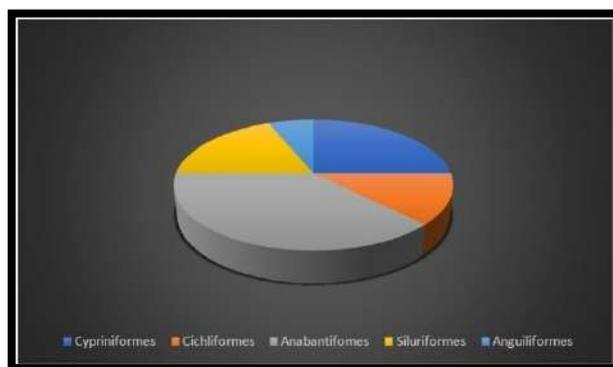
Fig. 1: Fish faunal composition occurring in the Poonoor River, Kerala

RESEARCH ARTICLE

Design of a Mobile Application for Farmers to Get Agricultural Machinery for Farm Work

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ABSTRACT

Agriculture is the backbone of a country. We can live without any machine and technology but can't live without food from agriculture. In recent times, the major problem faced by farmers is shortage of farm workers and non-availability of agriculture machinery like Tractor Trailer, Combine Harvester, Rotavator, Power Harrow, Leveler, water bowser, ripper machine, and disc harrow. On the other hand, most of the above said machineries are searching for work and available without knowing the details of the nearest form work. The proposed system (mobile application) is used to simply connect the both sides with multiple parameters. The system works similar to some cab booking, ticket booking and hotel booking applications. By registering as a member, both farmer and machinery owner can connect each other by booking the work slot with the availability details.

Keywords: E-Farmer, E-Commerce application for farmer, Smart agriculture

INTRODUCTION

Before 2000, agriculture was the main profession for many of the people in a particular village but many people started leaving agriculture and found some other jobs due to the hard situations and work in agriculture. Figure 1 shows the change in number of farmers from the year 1980 to 2020. One of the major problems faced by farmers after

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2000 is non-availability of farm workers and many researches took place in that problem and they created many machinery as replacement of human workers. These machines are capable of doing multiple workers' jobs by using a single operator. Some of the machines even do some impossible work that can't even be done by a human being. Tractor Trailer, Combine Harvester, Rotavator, Power Harrow, Leveler, water bowser, ripper machine, and disc harrow are some of the examples for the agriculture machinery. After the invention of these machines there was a new problem available for farmers. The farmers can't get these machineries easily due to the unavailability but on the other side the owners of these machineries also can't access the farmers easily. The main problem here is that both sides can't get the availability time of each other. If we give a solution to this problem, then both farmers and machinery operators can communicate easily.

Existing System

There are some systems available to connect farmers and consumers like E-Commerce Application for Direct Farmer-to-Consumer Trading, Block chain based Producer-Consumer Model for Farmers. But all these models are used to connect farmers with consumers. In [1], an E-commerce application is designed to reduce the problem of trading cost between the former and the consumer. Usually in a supply chain between farmer and consumer, there are multiple stages like, agri and food industry/processors, wholesalers/distributors and retailers. But these multiple stages were avoided by usage of this mobile application. [2], [3] and [4] were also discussed about the similar concept. Figure 2 shows the normal flow of food in the farmer to consumer supply chain. In [5], they discussed a mobile application, which helps the farmer in two ways like, crop disease detection and selling products by the farmer directly. [14] also discussed a similar mobile application. In [10], they spoke about an e-commerce application for the benefit of fishermen similar to farmer to customer e-commerce mobile application, in that consumers can directly buy fish from fishermen without any distributor and retailer. This system is very useful for both fisherman and consumer.

Proposed System

The proposed system is almost similar to the E-commerce system but it connects the farmer with the owner's of machineries like tractor, rotavator, power harrow, leveler etc. Both the farmer and machinery owner's need to register their names once in the application. After registering the details, now a farmer can search for the machinery he needs and book the best one according to money, distance and feedback. The block diagram of the application is shown in figure 3.

System setup

In the user interface, there are two different logins 1. Farmer login and 2. Machinery owner login as shown in figure 4. Farmers or machinery owners can register first after clicking and entering the respective login icon. There are two pages called home page and search page available after logged in to the account. The backend process in both the pages are shown in figure 5. In the home page a user can select different services like a farmer as a user can select the type of machinery they need and a machinery owner can see the different requests given by the farmers for different jobs. In the search page, a farmer can search by using different search parameters like the machinery, distance, feedback etc. By clicking on a machinery owner name from the listed names, a farmer can view different details of that machinery and service. Similarly the machinery owner can accept the request from a farmer for a job from the available requests and also view the feedback of the previous job done before. The backend of the entire process is stored in a cloud storage and that can be used as learning data for future modifications in the application. Cloud storage is needed to store the datas entered by farmers and machinery owners and this should be refreshed periodically in the view of 'search data' management.

CONCLUSION

The design is fully based on cloud and web application development without any hardware required. There are multiple similar applications available for farmers with different ideas especially e-commerce based applications but this work is having a novelty of the idea, which connects the farmer and machinery owner. This application is also

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useful for the farmers with less knowledge about the different agriculture machineries available to work in farms. In the long run there is a possibility of being chosen based on the feedback that may be created and also suggestions may be given to farmers for their machinery needs.

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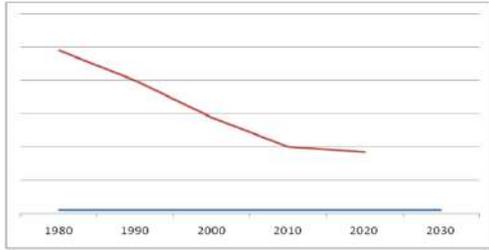
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Figure 1: Change in number of farmers from the year 1980 to 2020
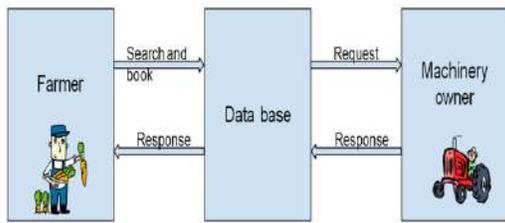

Figure2: Farmer to consumer supply chain
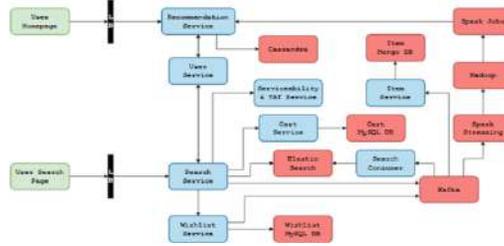

Figure 3: Block Diagram

Figure 4: Application interface

Figure 5: Backend of the application

RESEARCH ARTICLE

Classification of Stages of Plasmodium Falciparum using Machine Learning Techniques

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ABSTRACT

Malaria is a pyretic illness caused by a single-celled parasite of the genus *Plasmodium*. These parasites are transmitted to humans through the bite of an infected female mosquito. The severity of malaria differs based on the species of *Plasmodium*. Incipiently malaria may cause a slight fever, and headache but can also lead to death. Early detection of the type and stage of *Plasmodium* can help in providing efficient treatment and reducing the death rate. Pathology is the branch of medicine that deals with the examination of tissue samples from the human body. Traditionally, pathologists diagnosed malaria by manually examining blood samples under a microscope for parasite-infected red blood cells and provided medication to the patients. For the classification of the stages of *P. falciparum,* images of *Plasmodium falciparum* are acquired. These cell images are the primary data source for classification. Images in their actual form may not provide the important features required for classification purposes. Therefore, to apply machine learning algorithms, various relevant attributes from cell images are extracted to understand the characteristics of *Plasmodium falciparum*. The focus of this study is to determine various stages of *Plasmodium falciparum* using different machine learning models to provide higher accuracy. Machine learning algorithms such as K-Nearest Neighbors, Decision Trees, and Random Forests are implemented to predict models with the best accuracy. To identify the best accurate model, a comparison study is carried out.

Keywords: *P. falciparum*, Parasites, K-Nearest Neighbor, Decision Tree, Random Forest

INTRODUCTION

Malaria is a febrile disease caused by the *Plasmodium parasite*. An infected female Anopheles mosquito bite transmit the disease to humans. Sporozoites are in the early stages. Sporozoites are a form of cells that infect other cells, multiply and travel through the bloodstream to the liver, where they become hepatocytes. Infected hepatocytes degrade and release merozoites. Merozoites are protozoan cells produced by sporozoites. Gradually, merozoites infect a single red blood cell, replicate, and generate new merozoites. During this cycle, the parasite multiplies within the infected human. This development cycle leads to malaria infection in humans. Chronic complications of this disease include jaundice, retinal damage, and coma which can be fatal. There are five types of *Plasmodium* species that infect the humans. They are : *Plasmodium falciparum*: *falciparum* has a ring-shaped structure containing delicate cytoplasm and small chromatin dots. *Plasmodium vivax*: *vivax* is ovoid, scattered with brown pigment, and can nearly fill a red blood cell. *Plasmodium malariae*: Malariae is a parasitic protozoan with a compact cytoplasm and large chromatin dots. *Plasmodium ovale*: the oval trophozoite has stable cytoplasm and large chromatin dots. The objective of this study is to classify different stages of *Plasmodium falciparum* namely Ring, Sporozoite and Trophozoite. *Plasmodium falciparum* is a single-celled protozoan belonging to the lethal species of *Plasmodium.* The structure of *Plasmodium falciparum* can change as it undergoes different stages of its cycle. *Plasmodium falciparum* is characterized by sporozoites. Sporozoites develop into ovoid schizonts in the liver. Within red blood cells, merozoites form ring-like structures and become trophozoites. Trophozoites feed on hemoglobin to produce a coarse-grained pigment called hemozoin. In contrast to other *Plasmodium* species, the gametocytes of *Plasmodium falciparum* are characteristically elongated and crescent-shaped. Microscopic analysis of blood smears reveals only ring trophozoites and gametocytes are found in peripheral blood. Accurate parasite counts are critical for *Plasmodium falciparum* staging and appropriate patient dosing. Modern technology plays an important role in diagnosing these diseases. Image analysis tools and machine learning techniques have been used to calculate parasites from microscopic blood cell images. This helps to identify various types of species and their seed stages. Machine learning algorithms provide dynamic solutions, and their ability to learn data to provide new classes and categories is the primary reason for using these approaches in most of the real-world scenarios. Classification algorithms namely K-Nearest Neighbors, Random Forests, and Decision Trees are very helpful for classification of various data. The success rates of these classification algorithms are useful for implementing classification models for other applications.

Literature Review

Zhaohui Liang *et.al.,* [1] describes a deep learning method for detecting infected red blood cells. A CNN model was also applied. In this paper, the accuracy of transfer learning and CNN models are compared. To assess their suitability for malaria classification, deep learning models were applied to both CNN and transfer learning models. In transfer learning, feature extraction was carried out using a pretrained AlexNet. We implement transfer learning in combination with a traditional SVM classifier and compare it with a CNN model. The proposed CNN model outperformed the transfer learning model in terms of sensitivity, specificity, and accuracy. Microscopy images of blood smears using various computer vision techniques [2] focus on the color segmentation of malaria parasites by an inductive approach (Gaussian Mixture Model fitting algorithm). Improved RBC accuracy by splitting RBC occlusion using a distance transform and local maxima. A classification model's accuracy is influenced by the features that are chosen from a certain dataset. Decision tree and Neural network classifiers improve the accuracy of classification for specific problem domains. Combining multiple classifiers usually improves the performance of classification problems. Researchers have performed malaria classification based on deep learning using images [3]. Here the image is converted to grayscale. To extract appropriate features, noise pixels are removed by applying image morphological operations. SVMs are trained using dominant features extracted from the data. The characteristics of malaria cells are learned using deep learning algorithms such as GoogleNet, LeNet-5, and AlexNet. In addition to being highly accurate, deep learning algorithms have the privilege of being able to automatically extract multi-level features from a given data set.

Researchers have suggested comparing several machine learning methods for detecting malaria parasites using image processing and selecting appropriate models [4]. Initially, images were converted to mask images to extract relevant features. Some contiguous problems have been observed in the mask images as well, so to overcome that watershed segmentation has been applied. Speeded Up Robust Features method has been used for feature extraction. The retrieved features were trained with the help of several machine learning techniques. Machine learning models such as SVM Fine Gaussian, Linear SVM, boosted tree, Cosine KNN, and Subspace K-Nearest Neighbor has been used and a comparative analysis has been performed. Machine learning algorithms are the most effective method for malaria identification. Subspace K-Nearest Neighbor has the best performance among the trained classifiers and outperformed Fine Gaussian SVM in the classification tasks. A RNN model with recurrent gated unit was used to predict gene transcription throughout the life cycle of *Plasmodium falciparum*. Expression profiling of genes in combination with essential enzymes is presumed to reduce the timeframe required to construct these profiles. First, a RNN model was trained and implemented. The gene expression data was then used to forecast the gene expression time series using the RNN model. Finally, a function is applied to smooth the forecast time series [5]. Two RNN models were implemented to run three-time series experiments with different lengths for each experiment. First, the ring stage time series is used to forecast the trophozoite stage, then both the ring stage and trophozoite stage time series were used to forecast the schizont stage time series, and the ring stage time series was used to predict the trophozoite stage time series. These time series were then combined to predict the schizont stage time series.

In order to assess the effectiveness, Holt Winter's exponential smoothing, simple exponential smoothing, and autoregressive moving average are compared with each other. To comprehend the models that offer higher accuracy, research on several machine learning algorithms has been conducted and observed in 2019 [6]. An ELM model with a single feed forward neural network was used. Other machine learning models, including KNN, SVM, CART, RF, CNN, VGG16, RESNET, and DENSENET, have been compared to ELM. To extract prominent features from the images, three different feature extraction techniques have been used. First, the features were extracted according to the shape of the image, and then using the Haralick feature extraction method the character features were extracted. Based on the various colors represented in the image, the Color Histogram Extraction method extracts features from cell images and presents them as histograms. The result represents that ELM outperforms with 99.0 accuracy. A randomly wired neural network is used to identify *P. falciparum* in blood cells. Cell images are colored by Giemsa. In order to diagnose malaria, a deep learning algorithm has been used to separate human infected red blood cells into infected and uninfected *Plasmodium falciparum*. [7]. Four random graphs are used in a randomly wired neural network's design, which uses a convolution operation inside each vertex of the graph. The used graph is a Watts-Strogatz-4 random graph with batch norm regularization and ReLU as the activation function. In contrast to past investigations, which used stochastic gradient descent, this study used a different optimizer, because the SGD is more stable. The findings demonstrate that RWNN models outperformed the transfer learning model in terms of performance. A specially trained CNN can help to identify the presence of Plasmodium parasites and detect malaria disease [8]. Image Data Generator was used to rescale the image to focus on the appropriate and most salient features.

Appropriate parameters are selected that correctly describe the image. The proposed CNN model has 3 convolutional layers, with 32 filters in the first layer, 64 filters in the second layer and 128 filters in the third layer. The activation function was performed using ReLU. When compared to hand microscopic detection, it was clear that the CNN model had performed well, achieving 95% accuracy. A data-driven computational diagnostic approach has the potential to be an innovative solution to detect malaria infection in humans. The image is uncompressed and later converted to tensor format and the tensor values are normalized using the mean and standard deviation. In addition to the transfer learning model and the Google-net and Shufflenet-V2 models, a pre-trained Deep Convolutional Neural Network algorithm was also trained. The Shufflenet-V2 model gained 95.20% accuracy with training times three times faster than Google-net. It is observed that the transfer learning model performed optimally and Shufflenet-V2 performed better than Google-net [9].

Framework

The workflow for *Plasmodium falciparum* species classification together with the model evaluation component is shown in Figure 1. The *P. falciparum* image dataset is collected from the Kaggle data repository. Images are preprocessed to extract proper and dominant features. The most prominent features are extracted from the image using the OpenJ Image Tool. The extracted features are provided as input to the classification model. The features extracted are used by the classification model to categorize the different stages of *P. falciparum*. KNN, Decision Tree and Random Forest algorithms are used for classification. A comparative analysis was later performed to identify the best performing model. The images of three different stages of *falciparum* is shown in Figure 2.

Data Pre-processing

The classification of various stages has been done using the *P. falciparum* image dataset. The different stages of the *P. falciparum* are Ring, Sporozoite and Trophozoite. First, the images are resized to focus on the prominent features. The cell images are converted to a grayscale in order to reduce variations and noise from the images. In the next step, a threshold value was selected that describe the shape of each of the *Plasmodium* stage. The stages of *P. falciparum* are depicted in Figure 3.

Feature Extraction

Each cell image of the dataset has been resized from its actual size to concentrate on the important attribute for classification. ImageJ software tool has been used to extract the shapes from the images. After converting the image to grayscale and enhancing the contrast of the image, the shape of each stage was extracted by identifying the region of interest (ROI) with an appropriate threshold value as shown in Figure 4.

Classification Model

The classification *P. falciparum* stages is performed. Different stages of *P. falciparum* were classified using classifiers, K- Nearest Neighbors, decision tree classifiers, and random forests. The features extracted to identify and predict various stages and categorize the classes are depicted in Table 1. The features are extracted using the Image J tool. The features extracted are then saved in a file and used as the input for the classification model. Following model training, a comparison analysis is done to determine the model that has the highest accuracy.

EXPERIMENTAL RESULTS

A sample set of *P. falciparum* images were downloaded from Kaggle and several other sources. For classification purposes, most of the main features were extracted from the images dataset. The extracted features were appropriately labeled according to class and used as input for training various machine learning algorithms. The experimental results of various classifiers for identifying the stages (Ring, Sporozoite and Trophozoite) of *P. falciparum.* The machine learning algorithms applied for learning and the corresponding learning model accuracy are shown in Table 2. The total number of images used for learning is171 images.

CONCLUSION AND SCOPE

It is observed that machine learning algorithms are an extremely effective tool for the classification of various stages of *P. falciparum*. The results reveal that among the implemented classifiers, the decision tree model performs the best compared to other two models. It is also notable that accurate features can be extracted from cell images using other feature extraction tools. Increasing the amount of the data set for training and validation could increase the model's accuracy. To perform better, the learning rate could also be increased. This research work can be extended using multi-class classification to predict different plasmodium parasites and to identify various stages of each parasite. It is certain that the outcomes will be improved by comprehending the most important and dominant aspects and using the proper feature extraction approaches.

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Table 1. Sample Dataset

32	473820	238.327	28.451	60	255	255	Sporozoite
33	598980	224.494	47.027	0	255	251	Ring
34	548055	203.932	47.964	0	255	209	Ring
35	717118	213.638	34.531	68	255	208	Sporozoite
36	701075	244.651	25.096	46	255	255	Sporozoite
37	896260	239.419	38.144	0	255	255	Ring
38	578602	250.37	23.087	0	255	255	Ring
39	372240	243.516	32.349	0	255	255	Ring
40	577724	248.509	15.726	115	255	255	Sporozoite
41	590742	250.714	12.788	92	255	255	Sporozoite
42	312664	167.226	36.918	0	244	175	Ring
43	228528	158.057	29.147	72	246	153	Sporozoite
44	359840	248.394	24.608	0	255	255	Ring
45	273159	250.916	8.906	16	255	255	Trophozoite
46	203190	246.563	31.333	80	255	255	Sporozoite
47	318828	247.909	19.39	0	255	255	Ring
48	4.211	244.994	18.335	10	255	255	Trophozoite
49	5.371	204.435	71.78	12	255	255	Trophozoite
50	2.815	237.718	27.785	16	255	255	Trophozoite

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Table 2. Model Accuracy

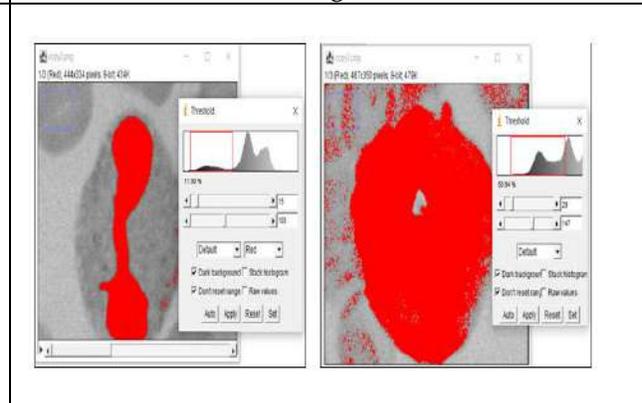| Sl.No	Classifier	Accuracy
1.	K-Nearest Neighbors	67%
2.	Decision Tree	80%
3	Random Forest	78%
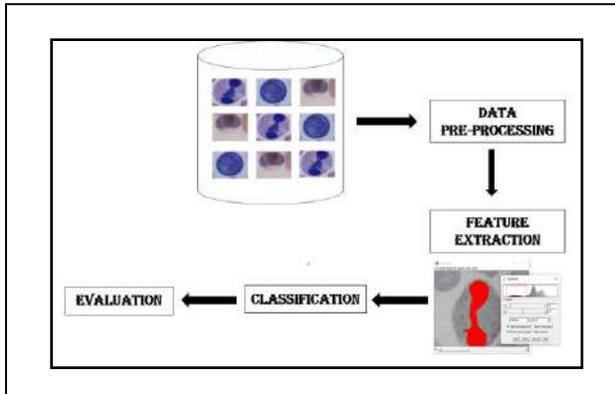
Figure 1: Workflow Diagram
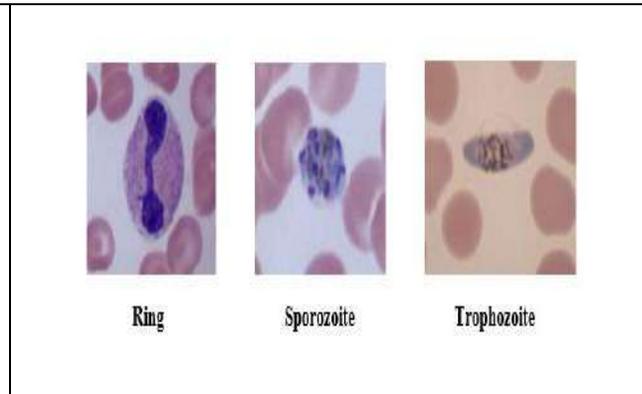
Figure 2: Different stages of *Plasmodium falciparum* Images
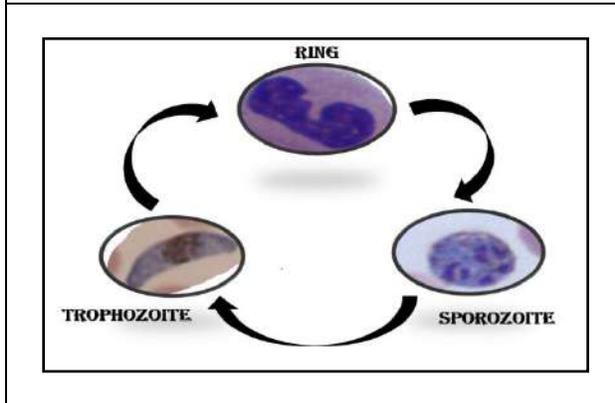
Figure 3. Stages of *P. Falciparum*

Figure 4. Ring Stage and Sporozoite Shape Extraction