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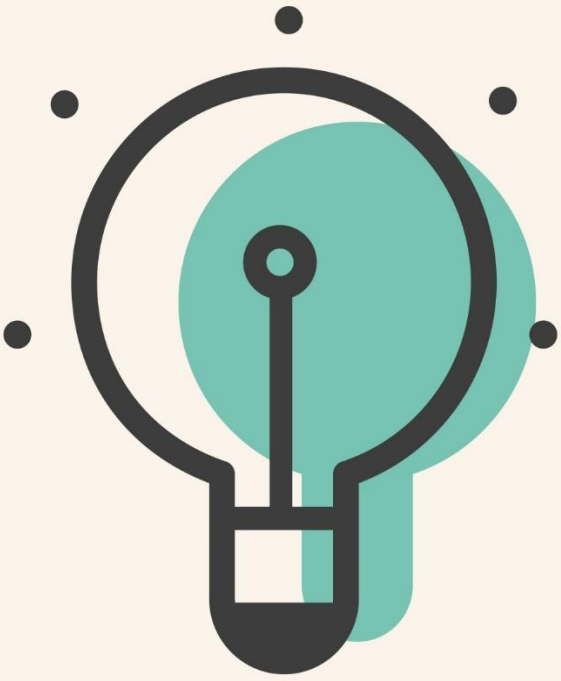

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# About Gandhinagar Institute of Technology

Gandhinagar Institute of Technology was established by Platinum Foundation Trust in December 2006. The Institute is affiliated to Gujarat Technological University and approved by AICTE New Delhi. It is situated near Village “Moti Bhoyan” and 24 km away from Ahmedabad city.

The Trust is registered under Public Trust Act at Ahmedabad, Gujarat. The members of the trust are involved in the social activities and are also promoting the technical interest of the state and country by contributing to the technical institution development.

The vision of the institute is to develop young engineers with active and creative minds. It stresses total development of the students: spiritual, moral, intellectual, social, emotional and physical. The Institute aims to be a leading center for research and engineering study, pursuing knowledge in both fundamental and applied area, and collaborating closely with business and industry in promoting technological innovation and economic development. The institute has team of dynamic and dedicated professors, working hard for overall development of students, so that they get ready for any kind of challenges in their life.

It offers U.G Program in Mechanical Engineering, Computer Engineering, Information Technology, Electronics & Communication Engineering, Electrical Engineering and Civil Engineering. It also offers P.G in Mechanical Engineering with specialization in Thermal Engineering and CAD / CAM and P.G in Software Engineering in Computer Engineering. It also offers MBA Program with specialization in Marketing, Finance, Human Resource, and Information Systems. Gandhinagar Institute of Technology is trying to nurture the intellectual growth of its students and serve humanity through creation, application and dissemination of knowledge relevant to technology and become one of the premier Engineering and Management Institutes and achieve the highest order of excellence in teaching.

Our students are innovative and have excellent acceptability to latest trends and technologies of present time. Our students have also participated in various technical activities as well as sports activities and have achieved various prices at State level and National level. We have two annual publications, a National level research journal 'GIT-Journal of Engineering and Technology (ISSN 2249–6157)’ and 'GIT-A Song of Technocrat' (college Annual magazine). GIT is appending another quill on its cap with the release of its first ever quarterly newsletter. This enhances the documentation culture of the institute. This would definitely create an impact in the minds of readers, by way of providing larger visibility and dimension to the campus. Gandhinagar Institute of Technology is proud to be celebrating it's fifteen years of excellence in Education, but more importantly, taking time to reflect on the past, learn in the moment, and plan for what comes next.

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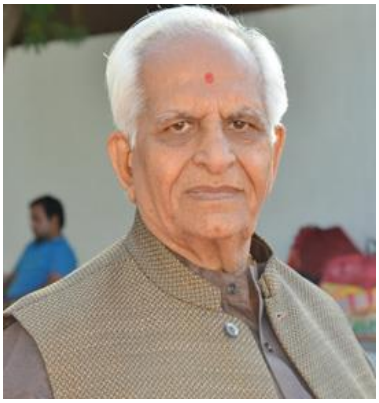

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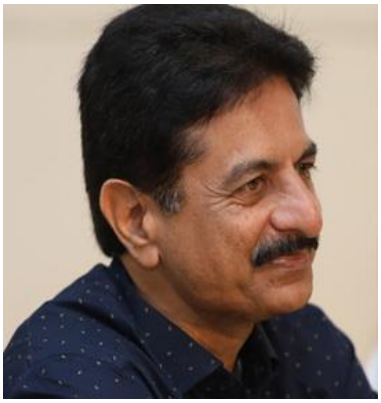

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# Message from the Director

"In the middle of difficulty lies an opportunity." – Albert Einstein"

GIT was established in 2006 and during a short span of fifteen years; it has accomplished the mission effectively for which it was established. Institute has been constantly achieving the glory of excellence in the field of curricular and co-curricular activities. GIT's strongest differentiator is its group of experienced faculty members with diverse academic and professional backgrounds. These academicians are committed to the highest standard of teaching, mentoring and consulting. Faculty members are active and regular participants in national and international conferences, seminars, trade shows, symposia and even contribute to several journals and publication.

It gives me immense pleasure that the thirteenth issue of our National journal 'GIT-Journal of Engineering and Technology' is being published with ISSN 2249 – 6157 for thirteenth successive year. The annual journal contains peer reviewed technical papers submitted by the researchers from all domains of engineering and technology. The issue is a result of imaginative and expressive skill and talent of GIT family. I take this opportunity to thank the esteemed members of the newly constituted Editorial board and Reviewers for agreeing to be a part of our family. I am sure, with their advice and support; the journal will achieve new milestones. Research papers were invited from the researchers of all domains in engineering and technology across India. After peer review, 25 papers are selected and being published in this issue of the journal. I firmly believe that this current issue Volume-13 will turn out to be Reader's delight.

It is a matter of pride that GIT has been recognized and awarded for Excellence in Engineering Education with Campus Placement at 94.3 My FM Business Solitaire Award 2021. Also, GIT received RED FM Awards 2021 for being the Best Engineering College in Gujarat, by Red FM. Six Design Patents have been filed by the students and faculty members of Mechanical Department with the help of GIT IPR Cell. GIT SSIP cell supported six design patents worth Rs. 36,450/- and eighteen POC/Prototype worth Rs. 4,17,883/-. Total fund utilised for student's betterment worth Rs. 5, 32,495/-.

We have started Anveshan- The Research Cell (PG and Research) of GIT which facilitates and encourages research culture among the faculty members and students. Its prime role is to encourage the faculty members and students to serve society through quality research and a good range of publications. It enables an amiable environment for technological development and monitors the research activities of the Institute. Therefore, the present research policy aims to help faculty members and students to achieve excellence in ethical research and contribute to society.

Also, we have started IIC (Institute Innovation Cell) which includes IIC driven activities, Self-driven activities, MHRD's Innovation Cell driven activities, National Innovation Challenge etc. Ministry of Education (MoE) has established MIC to systematically foster the culture of Innovation among all the

Higher Education Institutions. The main intention of establishment of IIC, SSIP, IPR, IQAC cell in the Gandhinagar institute of technology is to develop better cognitive ability among the students. Major focus is to create a vibrant local innovation ecosystem and also to provide start-up supporting mechanisms in the institute. It also Establish function ecosystem for scouting ideas and pre-incubation of ideas. The institute always strives hard to develop young engineers with active and creative minds. I congratulate the team for giving shape to the dreams of institute by giving their remarkable contributions.

I am very much thankful to GIT JET Coordinator Prof. Pooja R. Patanwal and Co-Coordinator Prof. Dhaval H. Panchal for giving proper shape to JET. They started working on JET 2021 from December 2020 and received approximately 100 Manuscripts. After the double-blind review process, with 75% rejection based on Novelty, Originality, and Innovation; 25 final manuscripts are selected for the publication. I congratulate the JET committee who have worked tirelessly to conceptualize and compile this publication.

I am very grateful to our respectable trustees as amidst the nationwide lockdown, no matter how uncertain, strange, challenging and stressful life is in coronavirus pandemic outbreak, the support of our management is unforgettable and appreciated. It gives me immense pride to state that as a result of the collective effort of the faculty, students and staff over the past few years Gandhinagar Institute of Technology today ranks among the top technical institutions of the state. I am hopeful of its acquiring greater heights in the years to come.

Dr H N Shah
Director & Chief Editor

# Editorial Board



# Coordinator & Co-Coordinator of Journal of Engineering & Technology

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# A Review on Design and Development for Compressed Air engine System

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**Abstract**

The compressed air is stored in the tank and used as compressed air as the fuel powered by the engine. Innovative energy has been applied to automobiles to avoid environmental problems. This is one of the most common problems caused by a decrease in the compressor capacity law that lasts so long and is ultimately unable to cope with the demand for air. This paper introduces the air powered engine of the renewable energy engine. Compressed air engines used as fuel that are abundantly available in atmosphere. This technology is cheap in cost and maintenance and does not harm the environment. Thus, compressed air engine will play an important role in reducing air pollution and lowering the earth's temperature. The result show that prototype compressed air engine has good economic performance under low speeds and supply pressure is 8Mpa, Maximum output power 1.38KW, and the maximum efficiency 20%. This research can be referenced in the optimization of compressed air-powered engines.

*Keywords*: *Compressed Air Technology, Zero Pollution Engine, Compreesed Air, Emissions.*

**Nomenclature**

| | |
|---|---|
| *N* | *rotation speed* |
| *P1* | *supply pressure(pa)* |
| *P2* | *atmosphere pressure(pa)* |
| *T* | *torque (Nm)* |
| *V* | *volume(m3)* |
| *Greek symbols* | |
| ω | angular speed(rad/s) |
| η | energy efficiency |
| *Subscripts* | |
| *E* | *expansion power* |
| *T* | *transmission Power* |

## 1. Introduction

A compressed air that uses the compressed air stored in the tank then enters the compressed air engine through the tank which forces the compressed air piston to function and the mechanical energy to be output. Compressed air expander is used to drive their pistons instead of burning the fuel into the air and burning it in the engine. The compressed air engine is the core dynamic system of air powered vehicles. It is a kind of power device which mechanical energy by expanding. The piston converts the compressed air into mechanical energy, which is then transferred to the wheels by means of chain sprocket mechanism and used to operate the vehicles. In compared to the various technology discussed above we use air as fuel and its exhaust is also pure air, here the only source of pollution, which is the process of compressed air production.

### *1.1. Principal of Compressed-Air Engine System*

A compressed air that uses the compressed air that is stored in a tank then through the pressure relief valve and buffer tank then enters the compressed air engine the tank which forces the compressed air piston to work and output mechanical energy. Instead of mixing fuel with air and burning it in engine to drive pistons with hot expanding gases, compressed air engine uses the expansion of compressed air to drive their pistons. The piston converts the compressed air into mechanical energy, which is then transferred to the wheels by means of chain sprocket mechanism and used to operate the vehicle. Gas laws explain how compressed air behaves, Boyles law state that if volume of air halves during compression, then pressure is doubled. Also, Charles law state that volume of gas changes in direct proportion to temperature. Thus, compressed air is used to run the engine by thermodynamic expansion.

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In comparison with various technology discussed above compressed air technology have many potential advantages like in this technology we use air as fuel and its exhaust is also pure air, here the only pollution source is the process of compressed air generation. And the cost of air compression will be significantly cheaper once the demand of compressed air increases because air is an inexhaustible resource.

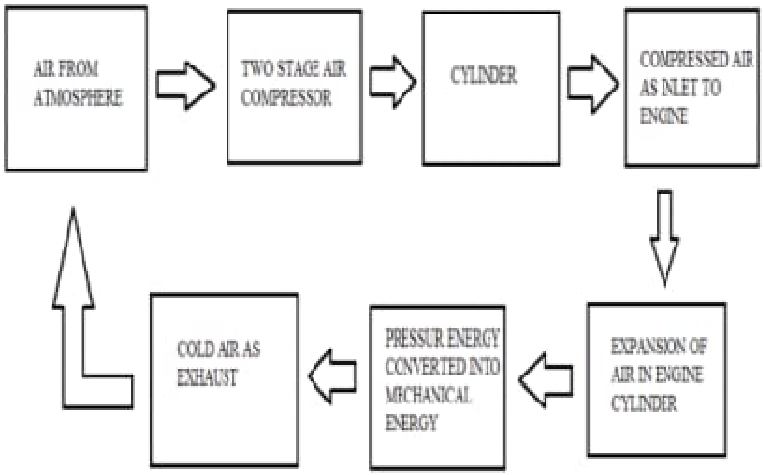


Fig. 1. Working of Compressed Air Engine

*1.2 Design of Compressed Air Engine*

To develop CAE, we have designed the engine with the help of the Solid works software which is advanced and tightly integrates CAD/CAM/CAE product development solution software. It allows to model wooden components and assemblies, to perform engineering analysis, to create tool paths for processes and to perform numerous other engineering design activities in Solid works software.

To begin the designing process, open Solid works software. It may take few minutes to open. Once opened, Unigraphics welcome page be presented on the window screen. To create a new file, click on the 'New' tab on the top of screen, and create part file to start modeling. Solid works part file uses the extension. Part for both components and assemblies of components. After this new session will be open, asking for name and location of the new file to be created.

Fabrication of the model involves the following steps: -

1. Buy crank from the market
2. Fitting of bearing on the crank assembly
3. Fixing of Bearing stand on the crank assembly
4. Fixing the crank assembly frame on the wooden board
5. Fitting of piston cylinder arrangement to crank assembly

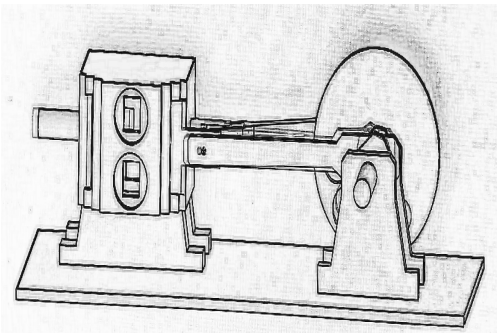

Fig. 2. Compressed Air or Wooden Air Engine

## 2. Literature review

**Prof. B. S. Patel et al. [1]** have been tried to develop a compressed air powered engine by modifying single cylinder four stroke engine by replacing spark plug with the pulsed pressure control valve which can create required pressure. Now valve is controlled by supply of electrical signal to it, for this purpose they suggested an electronic timing circuit and hence speed of engine can also control by input electrical signal. Haisheng Chen et al. [4] experimented on typical compressed air engine system figure shown below of working of CAE and diagram of Temperature versus Entropy.

**Bharat R. Singh et al. [2]** explained the range of pressure and work output of compressor used for CAE. Compressed air piston operates in between 1hp. To 563hp (0.7 kW to 420kW) and generate working pressure of 1.5 bar to 414 bar (21 to 6004psi). Vane type compressors can operate between range of 1.1kW to 75kW (1.5 to 100hp); producing working pressure of 7 to 10bar (101 to 145psi). Air has property to fill up any given space of any shape, the easiest way to understand that is balloon inflation.

**K'Airmobiles[3]** French company K'Air Energy has built prototypes of an air-fuelled bicycle and light road vehicle based on the K'air air compression engine.

**Air Car Factories SA [4]** This Spanish Company has an air car engine currently in development. The company's owner is currently involved in a dispute with former employer Motor Development International (MDI) over the rights to the technology.

**India's Tata Motors [5]** will likely produce the first air car in the marketplace in the next few years. Tata Motors' air car will also use the CAE engine. Although Tata announced in August 2008 that they aren't quite ready to roll out their air cars for mass production, Zero Pollution Motors still plans to produce a similar 26 vehicle in the United States. Known collectively as the FlowAIR, these cars will cost about $17,800.

*2.1 Summary of the entire research survey*

- The research survey was reflected in different types of case study on wooden air engine.
- Some research papers indicated the design for wooden air engine methodology and state of the art for biomimicry in wooden air engine with their benefits.
- Some research papers indicated the material properties of the components in various loading conditions.

*2.2 Objectives*

- The main objective is to develop compressed air engine which can be run by the compressed air.
- Our environment must be protected against various contaminations produced by vehicles driven on I.C. engine which produces some of most adverse environment effects. For example, Nitrogen oxide (NOX) after oxidation forming nitric acid, contributes to acid rain which causes severe damage to environment. Nevertheless, the compressed air technology will contribute to reduce air pollution and tend to zero pollution level and promoting great environment.
- This is because in compressed air engine air is used as fuel and exhaust is also in the form of air.

## 3. Equation and Formulae

Length of Stroke,

$$Power = Pressure(p)\ x\ Volume\ x\ Speed\ of\ Engine$$

So, by Lame"s Equation,

$$\sigma_t = \left[\frac{p_i + d_i^2}{4r^2}\right] x \left[\frac{(4r^2 + d_0^2)}{d_0^2 - d_i^2}\right]$$

Max Shear Stress at internal walls of the cylinder,

$$\tau_{max} = \left[\frac{p_i\ x\ d_0^2}{d_0^2 - d_i^2}\right]$$

The thickness of the cylinder cap or cylinder head secured firmly to the cylinder is given by,

$$t'' = d_i \, x \left[\frac{p_i}{6\sigma_t}\right]^{1/2}$$

Diameter of piston rod is given as,

$$d_{pr} = d_i \, x \left[\frac{p_i}{\sigma_t^*}\right]^{1/2}$$

Now a section of the rod can be determined by considering the buckling about axis xx by the Ranking formulae,

$$Buckling\ Load = \frac{f_{cu} \, X \, A}{1 + a \, x \left(\frac{l}{k}\right)^2}$$

**4. Result And Experimental Analysis**

This project is Compressed air engine and for experimental work, a 4-stroke engine is used. We have modified the camshaft in such a way that it allows the 4stroke engine to work as 2-stroke engine. This means that there will be one power stroke in one complete rotation of crankshaft. Air is freely available in the atmosphere.

According to first experiment: When we varied the pressure and noted the corresponding RPM, we observed that with the increasing pressure, the RPM increases.

According to second experiment: - When we measured the time taken to empty a cylinder with a capacity 160 litre in terms of different pressure, we have observed that as the pressure increases, the time taken to empty by the cylinder decreases.

The output torque declines with an increase in the rotation speed and ascends with increasing the supply pressure. The maximum torque can be obtained at the lowest rotation speed and the highest supply pressure. When the supply pressure is 2 MPa, the output torque is 56.55 N·m.

At the beginning, the output power ascends sharply with the increasing rotation speed and reaches to maximum value. After this peak, the output power drops sharply. When the supply pressure is 2 MPa, 1.5 MPa and 1 MPa, the maximum output power is 1.92 kW, 1.37 kW and 0.85 kW, respectively, and the corresponding speed is 420 rpm, 380 rpm and 340 rpm, respectively.

The energy efficiency declines with increasing in the rotation speed and supply pressure. When the supply pressure is 2 MPa, the maximum efficiency is 25%.

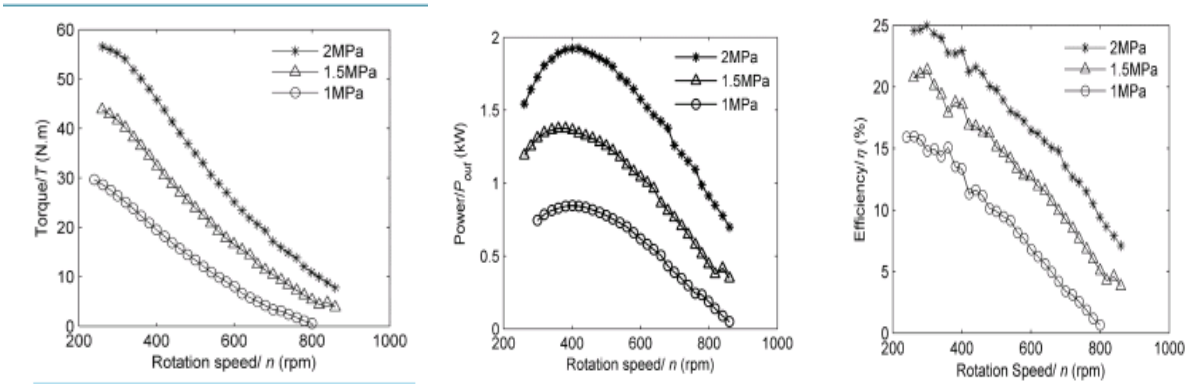

Table 1. Experiment 1

| S. NO. | Pressure (bar) | RPM | | Mean RPM |
|---|---|---|---|---|
| | | Min. | Max. | |
| 1 | 2 | 245 | 255 | 250 |
| 2 | 3 | 455 | 465 | 460 |
| 3 | 4 | 565 | 575 | 570 |
| 4 | 5 | 710 | 720 | 715 |
| 5 | 6 | 895 | 905 | 900 |

Table 2. Experiment 2

| S. NO. | Pressure (bar) | Time (sec) |
|---|---|---|
| 1 | 2 | 670 |
| 2 | 3 | 425 |
| 3 | 4 | 332 |
| 4 | 5 | 207 |
| 5 | 6 | 162 |

## 5. Conclusion

The model designed by us a small-scale working model of the compressed air engine. When scaled to a higher level, it can be used for drive automobiles independently or combined (hybrid) with other engines like I.C. engines. Compressed air is non-conventional energy source, and it is abundant in nature which will exist till sum in universe. Due to global warming, it is demand of time to adopt green technology. We are able to successfully complete the Design and Manufacturing of the compressed air engine. The compressed air engine provides an effective method for power production and transmission. Although currently limited by its applications, further research can provide a wider application.

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# A Review Paper on E-commerce Business

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**Abstract**

E-commerce is a boom in the modern business. E-commerce means electronic commerce. E- Commerce (Electronic commerce) involves buying and selling of goods and services, or the transmitting of funds or data, over an electronic network, predominantly the Internet. E-commerce (Electronic commerce) is a paradigm shift influencing both marketers and the customers. Rather e-commerce is more than just another way to boost the existing business practices. It is leading a complete change in traditional way of doing business. This significant change in business model is witnessing a tremendous growth around the globe and India is not an exception. A massive internet penetration has added to growth of E-commerce and more particularly start-ups have been increasingly using this option as a differentiating business model. Moreover, E-Commerce has significant influences on the environment. Although the model is highly used in current business scenario, but the option has not been explored at its fullest.
The current research has been undertaken to describe the scenario of E-Commerce, analyse the trends of E-Commerce. The study further examines the key variables imperative for the success of E-commerce business models. The objectives of present study are:
1. To understand the present status and trends of E-Commerce; and
2. To reveal the key variables influencing the increased usage of E-Commerce

*Keywords*: E-Commerce, Internet, Self-service, Technology, Internet banking.

## 1. What is E-Commerce?

E-commerce means electronic commerce. It means dealing in goods and services through the electronic media and internet. E-commerce involves carrying on a business with the help of the internet and by using the information technology like Electronic Data Interchange (EDI). E- Commerce relates to a website of the vendor on the Internet, who trades products or services directly to the customer from the portal. The portal uses a digital shopping cart or digital shopping basket system and allows payment through credit card, debit card or EFT (Electronic fund transfer) payments.

A more complete definition is: E-commerce is the use of electronic communications and digital information processing technology in business transactions to create, transform, and redefine relationships for value creation between or among organizations, and between organizations and individuals.

The main types of electronic commerce are: business-to-business (B2B); business to- consumer (B2C); business-to-government (B2G); consumer-to-consumer (C2C); and mobile commerce (m- commerce). [1]

## 2. E-Commerce Facilitators

### *2.1. Internet*

A massive internet penetration has added to growth of E-commerce. Internet and smart phones are becoming an integral part of every life. Internet is no more a source of information but has become an important tool for shopping, learning, communicating and even getting service from plumbers, carpenters, doctors etc. Supply chain is also becoming leaner and smarter as digital platforms are helping to better connect with the customers which significantly reduces the waste and supporting to green businesses.

Over the past 15 years the ICT revolution has driven global development in an unprecedented way. With an immense progress in technology, internet and its services have led to creation of new markets [2].

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The internet user population was small during the 1980s, experiencing a slow but steady growth until 1994 due to an increasing number of text-based users (eg, those using email and file transfer functions).Then, with the introduction of the World Wide Web and subsequent multimedia content expansion, the number of net users exploded. In fact, the internet has grown much more quickly than any other medium in history [3].

The International Telecommunication Union (ITU), a United Nations body, recently predicted in 2015 that 3.2 billion people will be online. The population in May 2015 stood at 7.2 billion. In the year 2000 there were just 400 million internet users worldwide. Internet in India took more than a decade to move from 10 million to 100 million and 3 years from 100 to 200 million, it took only a year to move from 300 to 400 million users. Clearly, Internet is mainstream in India today. This number is expected to further surge to 462 million by June this year as more people come online, especially through their mobile devices. The total Internet user base stood at over 300 million in December 2014, which grew to 375 million by October last year. Currently, India has the second largest Internet user base in the world recently overtaking the US (now the third largest user base). China currently leads with more than 600 million Internet users. Mobile Internet user base in 2015 in urban India has grown 65 per cent over 2014 to reach 197 million, while the rural user base surged 99 per cent to 80 million by October 2015. This is expected to grow to 219 million (urban) and 87 million (rural), respectively [4].

*2.2. Payment Gateways*

A payment gateway is an e-commerce application service provider service that authorizes credit card payments for e-businesses, online retailers, bricks and clicks, or traditional brick and mortar. The life blood of online business is the payment routes which comprises credit card, debit card, online banking payments, electronic funds transfer. The world is transforming from cash to digital money and thus there is a need of payment gateways for sustainable future ecommerce. [5]

*2.3. Analytics*

Analytics is the scientific process of transforming data into insight for making better decisions. Analytics helps businesses to gather, organize, analyze, and report on everything their customers do. The massive increase in the volume of data has forced the businesses to focus on analytics to understand the behavior of the customer. E-tailor need to have real time access to information to measure return on online investments and optimize the channel mix. There are basic analytics capabilities available with the ecommerce players like basket size analysis, average order value, conversion ratio but we need deeper analytics solution for actionable insights of the consumer. [5]

*2.4. Social Media*

Businesses are increasingly making use of social media in order to market their goods and services. Social media refers to websites and computer programs that allow people to communicate and share information on the internet using a computer or mobile phone.

Social media has played a great role in brand building and informing various offers to the customers. It also helps in getting the feedback about the product or service. It provides a platform for brand building, advertisements, developing a community of trusted users, spreading word of mouth etc. [6]

*2.5. Autonomous Vehicles*

An autonomous vehicle is a motor vehicle that uses artificial intelligence, sensors and global positioning system, coordinates to drive itself without the active intervention of a human operator. The age of the autonomous car is coming, and it’s coming fast. Purchasers of autonomous vehicles will have more time to view emails, search the web, buy new products, and see advertisements all around them. With autonomous cars, vast digital marketing experience will present itself. These purchases and search patterns can be tracked to help companies tailor their marketing campaign to capture this new segment.
The scope of big data just got much bigger but will become so tailored and predictive in the years to come that we may never have to manually adjust anything again. [7]

*2.6. 3D Printing*

A 3D printer is a device that's capable of making a three-dimensional object from a digital design. It uses something called "additive manufacturing" -- a layered process that bears some similarity to the way an ink-jet printer sequentially layers its colors on a flat piece of paper.

It is expected that 3D printing, might one day blow away manufacturing of the kind we've been used to since the Industrial Revolution shook up agrarian life in the early 19th century. 3D printing is creating a market in designs that are meant to be printed by the buyer -- or a third-party manufacturer unrelated to the designer. The end product isn't sold -- it's the design that's sold, along with a license for it to be printed. Buried in corners of the Internet are marketplaces where budding designers are selling their plans for printing at home or in the workplace. Customers can use their own printers, or they can buy the design and have it printed on the marketplace's printer and then delivered.[8]

**3. E-Commerce Trends -A New Business Revolution in India**

E-commerce is a boom in the modern business. It is a paradigm shift influencing both marketers and the customers. Rather e-commerce is more than just another way to boost the existing business practices. It is leading a complete change in traditional way of doing business. This significant change in business model is witnessing a tremendous growth around the globe and India is not an exception. Moreover, E-Commerce has every potential to curb the pollution and thus producing significant influences on the environment.

Buying goods and services via E-Commerce allows consumers the freedom to choose when and where to shop and the opportunity to research the product, the seller, and any other available options. Shopping has been revolutionized through the availability of online information. Just about anything that can be bought in a merchandise store can be bought via E-commerce, even perishables like groceries. And consumers have embraced these possibilities around the globe.

The effects of e-commerce are already appearing in all areas of business, from customer service to new product design. It facilitates new types of information-based business processes for reaching and interacting with customers like online advertising and marketing, online order taking and online customer service. In now days E-commerce uses the WWW at least some point in transaction lifecycle. It can also reduce costs in managing orders and interacting with a wide range of suppliers and trading partners, areas that typically add significant overheads to the cost of products and services. For developing countries like India, e-commerce offers considerable opportunity. In India it is still in nascent stage, but even the most-pessimistic projections indicate a boom. There has been a rise in the number of companies' taking up e-commerce in the recent past. Major Indian portal sites have also shifted towards e-commerce instead of depending on advertising revenue. Many sites are now selling a diverse range of products and services from flowers, greeting cards, and movie tickets to groceries, electronic gadgets, and computers, etc. (Mitra Abhijit, 2013). E-commerce has reached to an extent that the cow dung patties are also selling like hot cakes online in India.
India’s e-commerce market is likely to touch $38 billion mark in 2016, a massive jump over the $23 billion revenues clocked by the industry in 2015, according to an Assoc ham study. Increasing internet and mobile penetration, growing acceptability of online payments and favorable demographics have provided the unique opportunity to companies to connect with their customers. On the other hand, mobile commerce (m-commerce) is growing rapidly as a stable and secure supplement to the e-commerce industry. Shopping online through smartphones is proving to be a game changer. It is believed that m-commerce could contribute up to 70 per cent of their total revenues. [9][10]

**4. Underlying Factors in E-Commerce**

Nair et. all Study (2016) found the highest growth rate in the apparel segment, almost 69.5 per cent over 2014, followed by electronic items, up 62 per cent, baby care products, up 53 per cent, beauty and personal care products at 52 per cent and home furnishings at 49 per cent. Rapid growth of digital commerce in India is mainly due to increased use of smartphones. Mobiles and mobile accessories have taken up the maximum share of the digital commerce market in India, noted the study. Moreover, almost 45 per cent online shoppers reportedly preferred cash on delivery over credit cards (16 per cent) and debit cards (21 per cent). Only 10 per cent opted for internet banking and a scanty 7 per cent preferred cash cards, mobile wallets, and other such modes of payment. The 18-25 years of age group has been the fastest growing age segment online with user growth being contributed by both male and female segments. The survey highlights that 38 per cent of regular shoppers are in 18-25 age group, 52 per cent in 26-35, 8 per cent in 36-45 and 2 per cent in the age group of 45-60. Nearly 65 per cent online shoppers are male and 35 per cent female. [9]

Mitra et. all (2013) suggests E-Commerce has unleashed yet another revolution, which is changing the way businesses buy and sell products and services. New methodologies have evolved. The role of geographic distances in forming business relationships is reduced. E-Commerce is the future of shopping. With the deployment of 3G and 4G wireless communication technologies, the internet economy will continue to grow robustly. In the next 3 to 5 years, India will have 30 to 70 million internet users which will equal, if not surpass, many of the developed countries. Internet economy will then become more meaningful in India. With the rapid expansion of internet, E- commerce is set to play a very important role in the 21st century, the new opportunities that will be thrown open, will be accessible to both large corporations and small companies. The role of government is to provide a

legal framework for E-Commerce so that while domestic and international trade are allowed to expand their horizons, basic rights such as privacy, intellectual property, prevention of fraud, consumer protection etc. are all taken care of. [12]

Chanana and Goele (2012) propose that the future of E-Commerce is difficult to predict. There are various segments that would grow in the future like: Travel and Tourism, electronic appliances, hardware products and apparel. There are also some essential factors which will significantly contribute to the boom of the E-Commerce industry in India i.e. replacement guarantee, M-Commerce services, location based services, multiple payment option, right content, shipment option, legal requirement of generating invoices for online transactions, quick Service, T & C should be clear & realistic, the product quality should be same as shown on the portal, dedicated 24/7 customer care center should be there. [3]

Awais, M., & Samin, T (2012) indicate that use of internet has made the world a global village. The use of Internet has reduced the distances and brought the people together. A nation's back bone is commerce, and it will be strengthened if backed by electronic tools in which e-commerce plays a vital role. The important feature in ecommerce is privacy which not only increases competitive advantage but confidence level also. E-commerce brings sellers and potential buyers at the distance of one click and it saves time as it is cost effective, as E-commerce is becoming key to success. Internet banking, one among the innovative and significant internet-based services has experienced explosive growth and led to transformation of traditional banking practice. Online banking or net banking in today's dynamic age of banking has made things much easier for the people and saves a lot of time for its customers. The traditional way of standing in the queues and filling up all the forms are well solved and now it is no hassle for making any transaction with the banks by virtue of internet banking. The financial institutions which operated traditionally are now able to lower their operational costs and increase the consumer retention by virtue of technology. Internet banking as a latest and potential means for banking now holds a similar importance as that of ATM's, phone banking and traditional bank branches. The works by ABA, 2004; Fox, 2005 suggest that an internet banking strategy may be effective, with reports of more profitable, loyal and committed consumers compared with traditional banking consumers [1]

Pujari, D. (2006) found tangibles have the highest impact on overall customer satisfaction. The largest discrepancy between the customer expectations and perceptions is in terms of empathy which includes Bank locations and ATM machines in convenient places and tele- banking and internet banking facility. The study regards this major source of concern for Indian banking industry as a huge service quality gap exists for all the banks in this category. [6]

Blasio (2008), in his study does not find the support for the argument that the Internet reduces the role of distance. Internet usage is much more frequent among urban consumers than among their non-urban counterparts. The use of e-commerce is basically unaffected by the size of the city where the household lives. Geographically remote consumers are discouraged from purchasing goods by the fact that they cannot inspect them beforehand. Leisure activities and cultural items (i.e., books, CDs, and tickets for museums and theaters) are the only goods and services for which e-commerce is used more in isolated areas. Finally, e-banking bears no relationship to city size. In choosing a bank, non-urban customers give more importance to personal acquaintance than do urban clients, partly because bank account holders in remote areas are more likely to have taken out a loan from their bank. [2]

Ozok et al (2007) identified ten items contributing to overall consistency in e-commerce customer relationship management. These items are consistency of transaction steps, consistency of Web site design, consistency of navigation, consistency of promotions, consistency of in-stock indications, consistency of product variety, consistency of fraud protection, consistency of product guarantees, consistency of overall site fairness, and consistency of return policies. This list of consistency items includes three usability items. It can be concluded that sites with good usability have a better chance of having successful CRM implementation in their business. Consistency of promotions, in-stock indications, product variety, fraud protection, guarantees, fairness, and return policies indicate mainly that customers in fact demand a high level of security-related information as well as trustworthiness and high ethics on the shopping site to become regular customers of e- vendors. Customers demand equal and consistent treatment concerning products and product- related services. The findings indicate that the level of security and guarantees presented to customers has a significant positive effect on customer retention and customer acquisition. [13]

Rust and Chung, (2006) suggests to know not just what customers do in any particular e- commerce contact but also what they do (and how they perceive and feel) across multiple contacts. The work also suggests to investigate the kinds of online services that promote growth of the customer relationship, and the most effective ways to combine the online relationship with the offline relationship, with the idea that the full relationship with the customer is not complete without considering both online and offline, as well as how they interact. [17]

Korir, E. J (2020) examined what a firm should consider in order to encourage customers to at least try, and eventually adopt, the SST offered by a firm into the customer's regular routine. The result suggests that before a firm makes the leap into adding SST to their product/service line, they need to invest the time in seeing if they are ready themselves. Customers want what they have always wanted. They want reliable, affordable, quality service that is convenient and easy to acquire. If firm can't provide an SST

that is at least as reliable, if not more so, than no-technology customer service, then firms isn't prepared to properly implement SST.[20]

Devashish Pujari, (2004) explored the issues relating to service recovery in case of SST failure and effects of favorable/ unfavorable SST encounters on business relationships. The key findings of the study show that key sources of satisfaction are different for B2B clients than for end consumers, as evidenced in previous studies by Meuter et al. (2000) and Srijumpa et al. (2002). The study shows that in the event of SST failures, service recovery is very critical to clients. In a situation where service personnel are not involved in the service encounter, client needs a quick and complete recovery after reporting the failure. Clients may also expect that SST delivery should have the capability to transmit the failure to their service provider on a real time basis. The results of this study also echo that satisfying SST incidents will lead to future behaviors such as word of mouth and repurchase intentions. [6]

Snellman and Vihtkari, (2003) in their study reveal that, in general, failures are very common in both, interpersonal service encounters and technology-based service encounters. In interpersonal service encounters, unfriendly or impolite service and time-related aspects are the most common causes for dissatisfaction. On the other hand, dissatisfaction in technology-based encounters is often related to failures in technology, service design or in the service process. [19]

Chou and Chou (2000) reveal that with the astonishing growth of electronic commerce, banks around the world now see a huge potential market for internet banking. In order to provide efficient services to its customers, a bank needs to design and implement a robust internet system. Several technological issues must be considered before adapting to a specific internet environment including network technologies, platform and standards, scalability, security and intelligent software agents. In order to meet the needs of global business communities, the banking industry needs to carefully select suitable networking technologies to serve the internet market. As banks select electronic commerce as one of their mission-critical business processes, managing risk and liability become important. Internet security is always a major concern in a digital economy; it involves the application of both technical and nontechnical practices. The non-technical ways of pursuing security on the internet include formulating a corporate security policy and educating and training users about that policy. On the other hand, major technical measures consist of access controls, authentication, encryption, firewalls, audit, antivirus tools, and self-assessment tools. The bank needs to select suitable security tools and policy to protect itself and its customers. Specific security policy can be posted on the website for user's reference. [4]

## 5. Conclusion

A developing country may well attempt to be modernized if it introduces e-commerce effectively and efficiently. It will improve its output and lead to its competitive advantage. Information Technology (IT) has uplifted ecommerce worldwide. Now it's at ease to enter to a new market and marketers' can easily evaluate their product and company's performance. The research works on E-commerce propose good number of variables to be taken care of if marketers need to be successful in this newly business model. The factors which will significantly contribute to the success of the E-Commerce industry and focused upon should be consistency of transaction steps, consistency of Web site design, replacement guarantee, M- Commerce services, consistency of promotions, consistency of in-stock indications, consistency of product variety, location based services, multiple payment option, right content, shipment option, legal requirement of generating invoices for online transactions, quick Service, T & C should be clear & realistic, the product quality should be same as shown on the portal. The important feature in ecommerce is privacy which not only increases competitive advantage but confidence level of the customers. The research also suggests 18-35 as the good customer age to be promising and to be targeted irrespective of gender for better results. Social media may be a boon for brands and marketers looking to reach target buyers without wasting big bucks on traditional media, but luxury brands have recently found it challenging as unauthorized sellers are luring buyers, most of who fall into the temptation of getting discounts of up to 50-70% have cropped up using platforms like Facebook, Instagram, Twitter and WhatsApp. Firms must closely monitor such accounts and spend money on legal checks controls.

In a marketplace model, the ecommerce firm provides just the technology platform while sellers on the site own the inventory. Most E-commerce companies have call centers to connect with customers, the pressing need is the initiative to set up call centers to deal exclusively with merchants as increasing the number of sellers in a marketplace becomes the next battlefront in the E-Commerce. The need is 24/7 call centers should be dedicated. The e-commerce industry participants must also understand and address the cultural issues that are unique to the target country and relate to off-site transactional process, the large-scale diffusion and success of such endeavors will be greatly impeded. E-Commerce firms must also find most effective ways to combine the online relationship with the offline relationship, with the idea that the full relationship with the customer is not complete without considering both online and offline, as well as how they interact. The governments should offer a level field to its E-commerce firms to allow the country's significant development. The thrust on E-Commerce should be to offer a legal framework so that while domestic and international trade are allowed to expand their horizons, basic rights such as consumer protection, privacy,

intellectual property, prevention of fraud, etc are highly protected. The banks also need to select suitable security tools and policy to protect itself and its customers.

E-Commerce is a boon for any country- if given right impetus and good environmental framework to prosper can significantly lead to country's progress and development.

**Implications for Researchers**

Our study, being conceptual in nature, raises a number of opportunities for future research, both in terms of theory development and concept validation. More empirical research will in fact be necessary to refine and further elaborate findings in the area of ecommerce.

The study is an eye opener for the researchers who have ample interest in E-commerce. This review paper will offer them the leads towards the better understanding of the key variables of the recent E-commerce platform that is revolutionizing the business.

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A small website as this one has required help from many quarters. We realized this when we ventured into the area of web development from the beginning everyone co-operated, supported us for which we express our sincere acknowledgement.

Training is the first step in the practical field from where one learns how to apply theory principles for this the practical purposes. To develop a successful website, one needs understanding and co-ordination from all those who are directly and indirectly involved in this.
We, the students of Engineering College, find ourselves to be privileged to have golden opportunity to develop website under the guidance of such people without whom designing and developing website successfully would have been just impossible for us. We are thankful to them.
We would like to thank all those who have supported us. A person can be successful only when the team and organization for which they are working have unlimited goal of his perseverance. We hereby, like to show our deep gratitude towards our instructor and project in charge all faculty of college helped us very much.

We are obliged to them for successful completion of our E-Commerce Project.

Last but not the least;
Above all, we should not forget the great director of the world,
'The Almighty'; let us thank the Almighty for His inspiration.

# A Survey on Sentiment Analysis and Opinion Mining using NLP

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**Abstract**

As Sentiment analysis is the computational study of opinions, sentiments, evaluations, attitudes, views and emotions expressed in text. That contains feelings categorized in Positive, Negative and Neutral. With Various Fields now a day Sentimental analysis of data collected from Social Media has been accepted as a part of major factor in further decision. Social Media Sentimental Analysis is used in mostly English Language. Sentimental Analysis in other languages has much scope of research. Various Machine Learning Techniques can be used for the same. Some of the algorithms those can be used are SVM, Viterbi etc.

*Keywords*: NLP, Sentimental Analysis, SVM, Social Media, Gujarati Text.

## 1. Introduction

In current era, large amount of text data which we come across on a day starts from the news we read, the emails that we send/receive, the texts we share, the posts we view/share in online social networks, the products we purchase online and the bill we pay for the same and much more [1]. As an individual if we could generate or come across so many types of data in a single day, then the drastic growth of data every other day could be visualized. “Exponential growth of data” has now become a common phrase these days that serves as a measure for building new applications by using Natural Language Processing (NLP). From the statistics taken on July 2017 on Facebook users, the count has crossed two million. If the same is inferred on the different social media (Twitter, Facebook app, etc.) available, then the amount of data generated from the social media alone could cross several billions and trillions. This type of text content may be in any languages. There are several techniques for Sentimental analysis from this type of text.

## 2. Various Methodology

NATURAL LANGUAGE PROCESSING (NLP): NLP also allows computer to communicate with people, using human language. A language can be defined as a set of rules or set of symbols. Symbols are combined and used for broadcasting the information for understanding the language to machine. The ultimate objective of NLP is to read, decipher, understand, and make sense of the human languages in a manner that is valuable.

Steps followed by the NLP:

- A human talk to the machine.
- The machine captures the data as audio.
- Audio is converted into text format for better understanding.
- Processing of the text data.
- Data i.e. text is converted into audio.
- The machine responds to the human by playing the audio.

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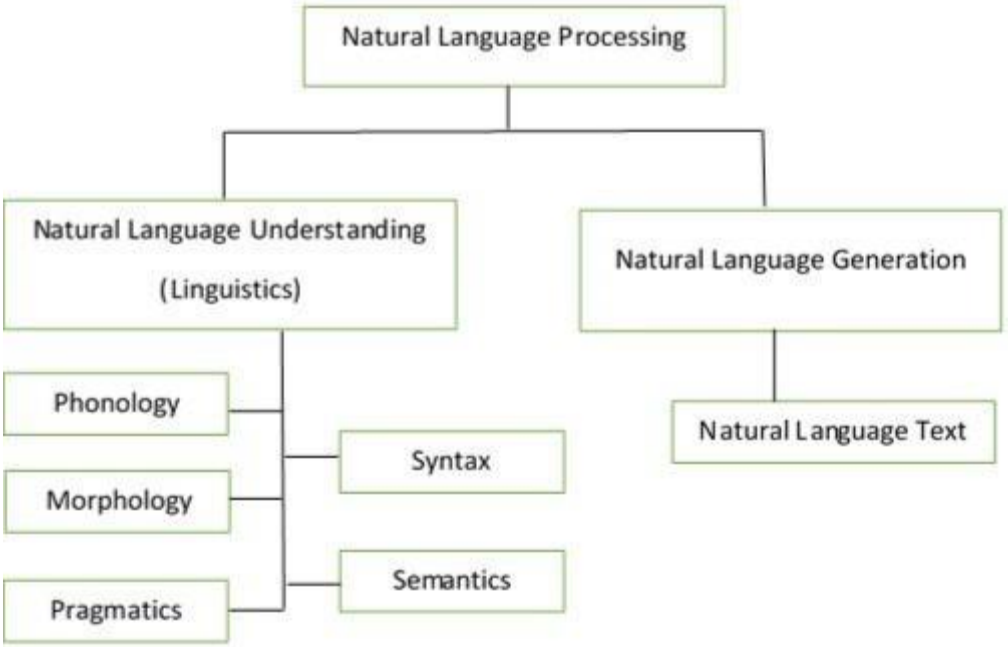


Fig. 1. Classification in NLP.

*Natural Language Understanding (NLU):*

1) Phonology: Phonology is the part of Linguistics which refers to the systematic arrangement of sound. The term phonology comes from the Ancient Greek and the term phono- refers to the voice or sound, and the suffix –logy refers to the word or the speech. This level deals with the interpretation of speech sound within across word. There are three types of rules used in phonological analysis:

- Phonetic rules – It used for sounds within words.
- Phonemic rules – It used for the variations of pronunciation when words are spoken together, and.
- Prosodic rules – It used for the fluctuation in stress and intonation across a sentence.

2) Morphology: The different parts of the word represent the smallest units of meaning known as Morphemes. Morphology comprise of Nature of words, are initiated by morphemes. The most important term in morphology is morpheme and its defined as the “minimal unit of meaning”. For e.g., the word:” unhappiness”. It can be broken down into three morphemes (i.e. prefix, stem, and suffix), and each part of word have some form of meaning: the prefix un- refers to “not being”, while the suffix -ness refers to “a state of being”.

3) Lexical: In Lexical, the NLP systems interpret the meaning of individual word with respect to their lexical meaning and part-of- speech. This level of linguistic processing utilizes a language’s lexicon, which is a collection of individual lexemes. A lexeme is a basic unit of the lexical meaning, and its an abstract view unit of morphological analysis that represents the set of forms or “senses” taken by a single morpheme. For e.g., “Duck”, it can take the form of a noun or a verb but it’s a part-of-speech and lexical meaning and it can only derived in context with other words that are used in the phrases/sentence.

4) Syntactic: The output of the lexical analysis can be used as the input in this stage. In this stage the NLP systems sets the words in the sentence in grammatical manner which is easier to understand for human. Both grammar and parser are required in this level. There are many computer algorithms that are used to apply grammatical rules to a group of words and derive meaningful word from them.

5) Semantic: Semantic processing interprets the possible meanings of a sentence by giving priority on the interactions among word- level meanings in the sentence. This level focuses on interpretation of the meaning of sentences, rather than the analysis at the level or the individual words or phrases.

6) Discourse: The discourse level of NLP travail with units of text longer than a sentence i.e, it does not depend upon multi sentence texts as just sequence sentences, apiece of sentence that can be judge singly. Rather, discourse mainly focuses on the properties of the text as a whole that convey meaning by making the connection between component of the sentence.

*Natural Language Generation (NLG):* Natural Language Generation (NLG) is the process of producing phrases, sentences and paragraphs that are meaningful, easier and understandable in internal representation.

Components of NLG are as follows:

1) Speaker and Generator – To generate a text we need to have a speaker or an application and a generator or a program that converts the application's intentions into fluent phrase relevant to the situation i.e., conversion into natural language.

2) Components and Levels of Representation – The process of language generation involves the following ways:

**Content Selection:** Information should be selected and included in the set. Depending on how this information is parsed into representational units to machine, parts of the units may be removed while some others may be added by default.

**Textual Organization:** The information must be textually organized according to the grammar; it must be ordered both sequentially as well as and in terms of linguistic relations like modifications.

3) Application or Speaker – This is only for maintaining the model of the situation. Here the speaker just initiates the process doesn't take part in the language generation. It stores the history, structures the content that is potentially relevant and deploys a representation of what it actually knows. All these forms the situation, while selecting subset of propositions that speaker has. The only requirement is the speaker has to make sense of the situation.

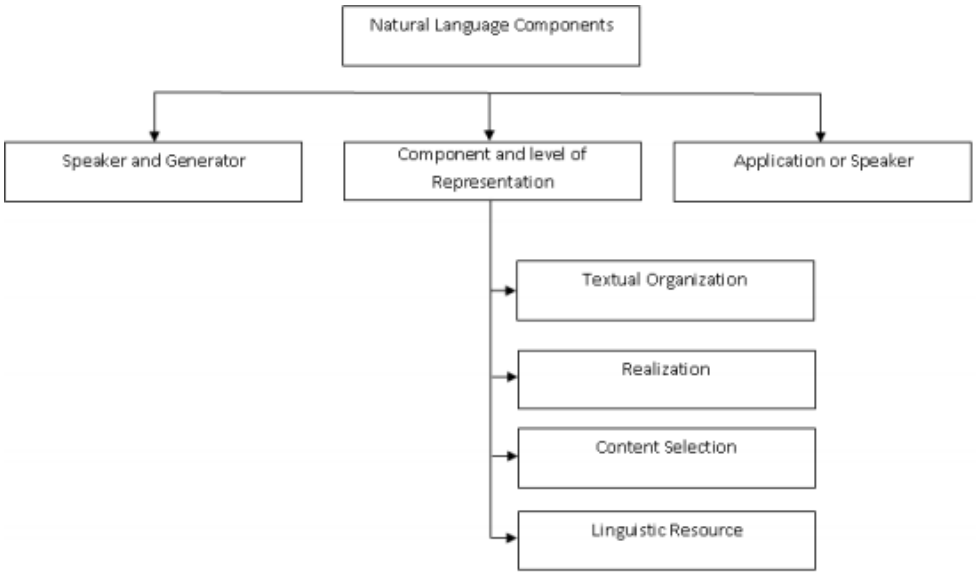


Fig. 2. Components of NLG.

**Proposed Steps**

Step 1: Read Social Media Data (Twitter)
Step 2: Languages Detection using Google API
**Step 3: Generate Dataset for Gujarati Content**
Step 4: Clean the Content (Remove Stop Words)
Step 5: Apply NLP for Gujarati Language (to get meaning word based on Position)
**Step 6: Apply Doc2Vec for Missing Target Word (if any)**
Step 7: Filtering (Remove Duplicates)
Step 8: Feature Selection
Step 9: Classification (SVM)
Step 10: Performance Evaluation

**Proposed Work Flow Block Diagram**

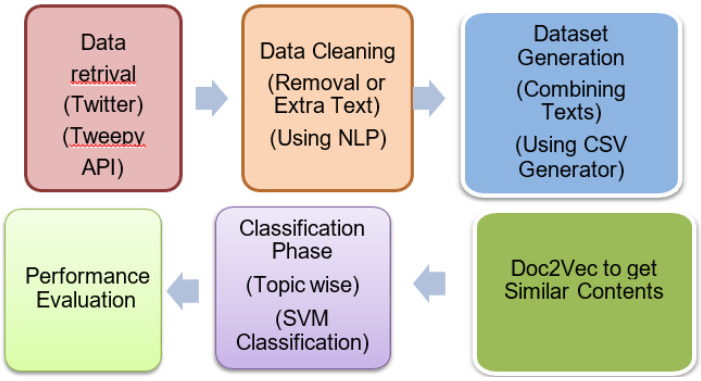


Fig. 3. Proposed Block Diagram.

In proposed System Data Retrieval will be performed using Twitter API. After Data Retrieval Data Cleaning Process will be performed using NLP. Then we will generate a Single Dataset from the clean data. After Generating Dataset, we will apply Doc2Vec and feature selection and Classification methods. At last Performance Evaluation is done.

**Implementation Input Output**

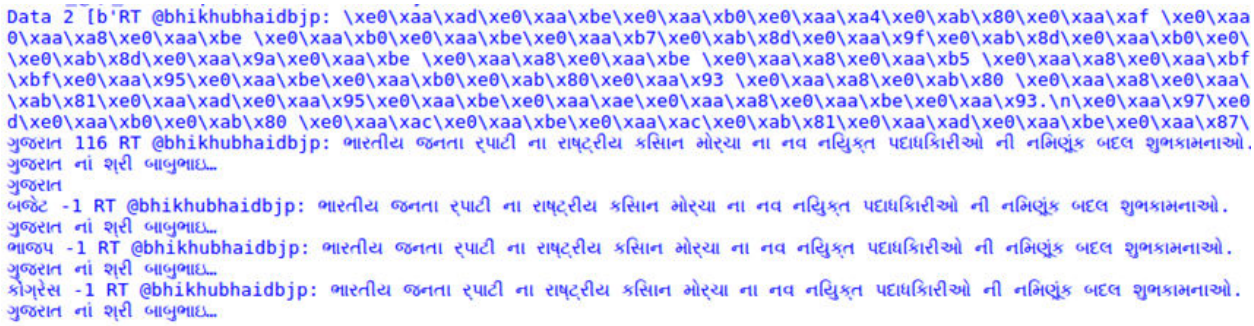


Fig. 4. Reading tweets.

Here in this chapter we have included some our implementation screens and result retrieved from the research. In figure shows some of the functions those are used and implemented for cleaning the tweets, extracting the hash tag etc. These functions mainly use text processing and extraction techniques.


Fig. 5. NLP Process.

In previous figure shows some of the training dataset for NLP Gujarati Text.

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Matching of  UPI દ્વારા નાણાકીય વ્યવહારો થયા સરળ  with  સેવા હી સંગઠનના મંત્ર સાથે ભારતીય જનતા પાર્ટી દ્વારા રસીકરણ અભિયાનને અપાઈ રહી છે ગતિ  is  0.9819158315658569
Matching of  UPI દ્વારા નાણાકીય વ્યવહારો થયા સરળ  with  ભારતીય જનતા પાર્ટી અમરેલી જીલ્લા દ્વારા આયોજીત કોરોના રસીકરણ કેન્દ્ર અભિયાન કાર્યક્રમમાં સહયોગી સામાજીક સંસ્થાઓ ના ,
Matching of  UPI દ્વારા નાણાકીય વ્યવહારો થયા સરળ  with  ખંભાત થી આણંદ વિજિળીકરણ પુરણ થયુ.હવે ખંભાત થી આણંદ-અમદાવાદ સળંગ ટ્રેન દોડવવા નો કાર્યક્રમ ની તારીખ આપવામાં આવશે?.
Matching of  UPI દ્વારા નાણાકીય વ્યવહારો થયા સરળ  with   ખેડૂતોને સિંચાઈ માટે ઓછા ખર્ચે પાણી મળે તે હેતુથી વીજબિલમાં સબસિડીની યોજના  is  0.9387350678443909
Matching of  UPI દ્વારા નાણાકીય વ્યવહારો થયા સરળ  with   વર્ષ 2020-21માં 6,015 રૂટ કિ.મી. સેક્શનોનું થયું વિદ્યુતીકરણ  is  0.921762228012085
Matching of  UPI દ્વારા નાણાકીય વ્યવહારો થયા સરળ  with  વીજળીથી વિકાસની ક્રાંતિ સર્જતી ભાજપ સરકાર  is  0.8728670477867126
Matching of  UPI દ્વારા નાણાકીય વ્યવહારો થયા સરળ  with  જનજન સુધી, ઘરઘર સુધી ફેલાયેલી ભાજપની પાંખો  is  0.8708087801933289
Matching of  UPI દ્વારા નાણાકીય વ્યવહારો થયા સરળ  with  મહામારીમાં આપત્તિને અવસરમાં પરિવર્તિત કરતી ભારતીય રેલવે  is  0.8500303626060486
Matching of  UPI દ્વારા નાણાકીય વ્યવહારો થયા સરળ  with  વરસાદી પાણીનો સંગ્રહ થાય અને દરેક  is  0.847313642501831
Matching of  UPI દ્વારા નાણાકીય વ્યવહારો થયા સરળ  with   UPI દ્વારા નાણાકીય વ્યવહારો થયા સરળ  is  0.8344695568084717
Matching of  UPI દ્વારા નાણાકીય વ્યવહારો થયા સરળ  with   માર્ચ-2021માં 273 કરોડ ટ્રાન્ઝેક્શન થયા  is  0.8299968242645264
Matching of  UPI દ્વારા નાણાકીય વ્યવહારો થયા સરળ  with  Control knobs  is  0.7347310781478882
Matching of  UPI દ્વારા નાણાકીય વ્યવહારો થયા સરળ  with  Station  is  0.3833545446395874
Matching of  UPI દ્વારા નાણાકીય વ્યવહારો થયા સરળ  with    is  -0.30498597025871277
```

Fig. 6. DOC2VEC.

Applied In previous figure Doc2Vec is applied for data.

```
વિસાસણ ગીર નેશનલ પાર્ક,… https://t.co/6l3JHnZv1a
RT @DrPrashantkorat: મારૂં ગામ કોરોના મુક્ત ગામ એ સંકલ્પ કરવાનો છે. મારૂં ગામ કોરોના મુક્ત બનાવીશું અને એના માટે ગામમાં 10 લોકોની ક
RT @DrPrashantkorat: વૈશ્વિક સ્વાસ્થ્ય સંકટ કોરોના મહામારીના વિકટ કાળમાં આજરોજ કરૂણાની મહાનગરના નાડીયા વોર્ડ ખાતે નાગરિકોના તં
RT @mahiti_bvn: 'મારું ગામ -કોરોના મુક્ત ગામ' અભિયાનનો રાજ્યવ્યાપી  ઇ-પ્રારંભ કરાવતા રાજ્યપાલશ્રી અને મુખ્યમંત્રીશ્રી
ooooooo
મહુવા અને બા…
વલસાડ ઈજીનીયરી કોલેજ તીથલ રોડ  માંથી, અશોકભાઈ કાનજીભાઈ મંગે ની  ખુબજ જેમત અને મહેનત એમની રંગ લાવી
વલસાડ વાપી બીલ્ડર એ… https://t.co/bBPMORWJll
total number:  30
positive number:  15
negative number:  5
neutral number:  10
```

Fig. 7. SVM Classification.

In previous figure shows SVM Classification for our proposed system.

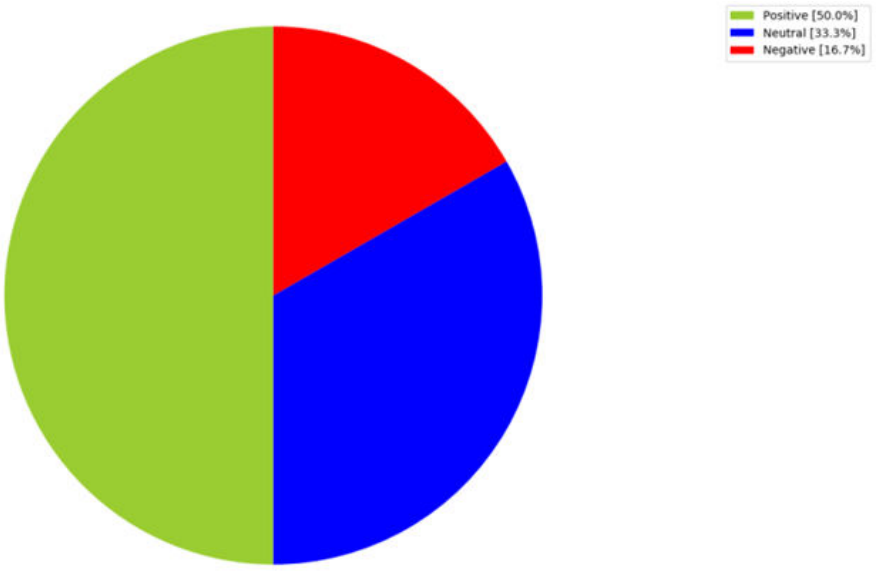


Fig. 8. Result Graph.

In previous figure shows the classification result for sample tweets.

**Conclusion & Future Work**

After analyzing the data, we have founded that text in Gujarati on Twitter has more positive sentiments over negative sentiments. It is also depends of the time and Event for which tweet has been published. SVM classifier performs better in sentimental analysis in Gujarati Text also.

In Future more data collection sources can be added and strong sentimental training dataset for Gujarati can be added. In our system there is scope for more Neutral result due to less training dataset records. NLP algorithms can also leads for better result in future.

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# AI Based Medical Transcription

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**Abstract**

We describe a method for automated recognition of x-ray osteoarthritis (OA) in knee X-ray images. The recognition is based on the Kellgren–Lawrence (KL) categorization assessment, which resemblance to the different stages of OA severity. The classifier was built using manually classified X-rays, representing the first four KL assessment (*normal*, *doubtful*, *minimal*, and *moderate*). Image analysis is performed by first identifying a set of image content descriptors and image metamorphose that are informative for the recognition of OA in the X-rays and allocate weights to these image features using Fisher scores. Then, a simple weighted nearest neigh or rule is used in order to predict the KL grade to which a given test X-ray sample belongs. The dataset used in the appraisal contained 350 X-ray images classified manually by their KL assessment. Appraisal results show that moderate OA (KL grade 3) and minimal OA (KL grade 2) can be differentiated from normal cases with accuracy of 91.5% and 80.4%, respectively. Doubtful OA (KL grade 1) was discernment indubitably with a much lower accuracy of 57%. The source code mature and used in this study is available for free download at www.openmicroscopy.org.

*Keywords:* Automated recognition, image categorization, Kellgren–Lawrence (KL) categorization, osteoarthritis (OA), X-ray.

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## 1. Introduction

OSTEOARTHRITIS (OA) is a highly prevalent chronic health condition that causes substantial disability in late life [31]. It is estimated that ~80% of the population over the Manuscript received January 3, 2008; revised July 10, 2008. First published October 7, 2008; current version published March 25, 2009. This work was supported by the Intramural Research Program, National Institute on Aging, National Institutes of Health (NIH). Asterisk indicates resemblance author.*L. Shamir is with the Image Informatics and Computational Biology Unit, Laboratory of Genetics, National Institute on Aging (NIA), National Institutes of Health (NIH), Baltimore, MD 21224 USA (e-mail: shamirl@mail.nih.gov).S. M. Ling is with the Clinical Research Branch, National Institute on Aging, Baltimore , MD 21225 USA, and also with the Division of Geriatric Medicine, Gerontology and Rheumatology, Johns Hopkins University School of Medicine, Baltimore, MD 21205 USA. He is also with the University of Maryland, College Park, MD 20742 USA.W. W. Scott, Jr., is with the Arthritis Canter, Johns Hopkins School of Medicine, Baltimore, MD 21205 USA.A. Bos was with the Clinical Research Branch, National Institute on Aging, Baltimore, MD 21225 USA. He is now with the Institute of Geriatrics and Gerontology, Pontifical Catholic University of Rio Grande do Sul, Porto Alegre 90690, Brazil N. Orlov, D. M. Eckley, and I. G. Goldberg are with the Image Informatics and Computational Biology Unit, Laboratory of Genetics, National Institute on Aging (NIA), National Institutes of Health (NIH), Baltimore, MD 21224 USA.T. J. Macura is with the Image Informatics and Computational Biology Unit, Laboratory of Genetics, National Institute on Aging (NIA), National Institutes of Health (NIH), Baltimore, MD 21224 USA, and also with the Computer Laboratory, Trinity College, University of Cambridge, Cambridge CB2 1TQ, U.K.L. Ferrucci is with the Clinical Research Branch, National Institute on Aging, Baltimore, MD 21225 USA. Colour versions of one or more of the figures in this paper are available online at http://ieeexplore.ieee.org.Digital Object Identifier 10.1109/TBME.2008.2006025age of 65 have x-ray evidence of OA [29] and given the prolonged life expectancy in the United States and the aging of the "baby boomer" cohort, the prevalence of OA is expected to increase further. Although newer methods, such as MRI, offer an assessment of periarticular as well as articular structures, the availability of plain radiographs makes them the most commonly used tools in the evaluation of OA joints [2], despite known limitation in detecting early disease and subtle changes overtime. While several methods have been proposed [3], the Kellgren–Lawrence (KL) system [12], [13] is a validated method of classifying individual joints into one of five assessments, with 0 representing normal and 4 being the most severe x-ray disease. This categorization is based on features of osteophytes (bony growths adjacent to the joint space), narrowing of part or all of the tibial–femoral joint space, and sclerosis of the subchondral bone. Based on these three indicators, KL categorization is considered more informative than any of the three elements individually. Since the parameters used for OA categorization are continuous, human experts may differ in their assessment of OA and therefore reach a different conclusion regarding the presence and severity.

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## 2. Data

The data used for the appraisal are successive knee X-ray images taken over a course of two years, as part of Baltimore Longitudinal Study of Aging (BLSA) [30], which is a longitudinal normative aging study. X-ray images were obtained in all participants, irrespective of symptoms or functional limitations, thereby providing an unbiased representation of knee X-rays in an aging sample. The fixed-flexion knee X-rays were acquired with the beam angle at 10°, focused on the popliteal fossa using a Sire mobile Compact C-arm (Siemens Medical Solutions, Malvern, PA). Original images were 8-bit 1000×945 grayscale Digital Imaging and Communications in Medicine (DICOM) images, converted into tagged image file format (TIFF) format. Left knee images were flipped horizontally in order to avoid an unnecessary variance in the data. Each knee image was independently assigned a KL grade (0–4) as described in the Atlas of Standard Radiographs [13] by two different readers, with discordant assessment adjudicated by a third reader. In 79.8% of the cases, the two readers assigned the same KL grade, and the remaining images were adjudicated by a third reader. The X-ray readers were radiologists with at least 25 years of reading experience who read from 50 to 100 musculoskeletal X-rays per day. To maximize comparability between readers, all readers received training using a set of "gold standard" X-rays. Each knee image was also assessed for osteophytes, joint space narrowing and sclerosis of the medial and lateral compartments, and tibial spine sharpening. The total number of knee X-ray images used was 350, divided into four KL assessment as described in Table I. In the proposed classifier, each KL grade is considered a class, so that a complete automated KL grade recognition is a four-way classifier. KL assessment 4 (severe OA) and 5 (knee replaced) remained outside the scope of this study due to the severe symptoms of pain that accompany this assessment of OA, making a computer-based recognition less effective at KL grade 4, and irrelevant at KL grade 5.

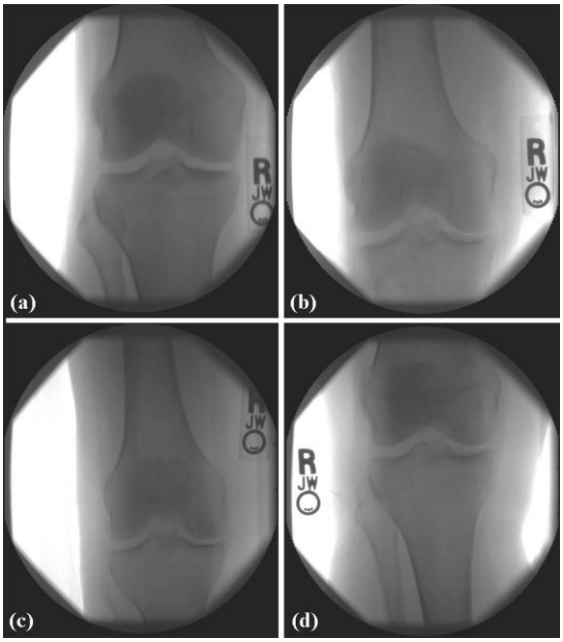


Fig. 1. X-ray images of four different KL assessment. (a) 0 (normal). (b) 1 (doubtful). (c) 2 (minimal). (d) 3 (moderate).

figure, most parts of an X-ray image are background or irrelevant parts of the bones, while only the area around the joint contains useful information for the purpose of OA recognition. The X-rays also contain some metadata in the form of the letters *R* and *L*. These letters are the effect of small letter-shaped metal plates that are placed near the knee when the X-ray is taken, preventing any chance of confusion between the left and right knees. The samples of Fig. 1 demonstrate how the different KL assessment may look fairly similar to the untrained eye. Even experienced and well-trained experts can find it difficult to assign the KL grade and assess the OA severity, and a second (and sometimes also a third) analysis is often required to obtain a reliable and accurate diagnosis. Despite providing a valuable approximation of the status of the knee, the manual KL categorization cannot be considered a gold standard for the actual OA severity. The reason is that KL categorization is based on a set of radiography visual elements that have been observed to be correlated with OA, but no claim has been made that this set of elements is complete. Therefore, one can reasonably assume that the OA can be discernment by more elements that have not yet been isolated and well characterized, or that their signal is too weak to be sensed by an unaided eye. The incompleteness of the set of KL elements can be evident by the partial correlation between pain symptoms and the KL categorization. Another important feature of the data is that the progress of OA is continuous, while KL assessment are discrete. That is, a knee X-ray classified as KL grade 1 can actually be somewhere between grade 0 and 1, but since KL assessment are discrete.

## 3. Joint Recognition

Despite the attempts of making the X-rays as consistent as conceivable, the nature of working with human patients, especially at elderly ages, makes it practically inconceivable to repeat the procedure in the exact same fashion due to the differences in the flexibility of the patients and their ability to place their knee in the right position, as well as their ability to sustain these poses until the X-rays are taken. As a result, the position of the joint within the X-ray image can vary remarkably.

Since in each X-ray image the joint can appear at different image coordinates, a joint recognition algorithm is required to find the joint and separate it from the rest of the image. This is done by using a fixed set of 20 preselected images, such that each image is a 150×150 window of a centre of a joint. For example, Fig. 2 is the centre of the joint of the X-ray of panel (a) in Fig. 1. These images are then de-escalating by a factor of 10 into 15×15 images. Finding the joint in a given knee X-ray image is performed by first de-escalating the image by a factor 10, and then scanning the image with a 15×15 shifted window. For each position, the Euclidean distances between the 15×15 pixels of the shifted window and each of the 20 15×15 predefined joint images are computed using.

$$d_{i,w} = \sqrt{\sum_{y=1}^{15}\sum_{x=1}^{15}(I_{x,y} - W_{x,y})^2}$$

(1)

where $W_{x,y}$ is the intensity of pixel $x, y$ in the shifted window $W$, $I_{x,y\,is}$ the intensity of pixel $x, y$ in the joint image $I$, and $d_{i,w}$ is the Euclidean distance between the joint image $I$ and the 15×15 shifted window $W$. Since the proposed implementation uses 20 joint images, 20 different distances are computed for each conceivable position of the shifted window, but only the shortest of the 20 distances is recorded. After scanning the entire $(\text{width}/10 - 15) \times (\text{height}/10 - 15)$ conceivable positions, the window that recorded the smallest Euclidean distance is determined as the centre of the joint, and the $250 \times 200$ pixels around this centre form an image that is used for the automated analysis.

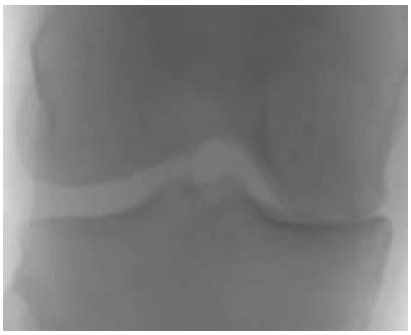

Fig. 3. Joint area of a knee X-ray.

Fig. 3 shows an example of the $250 \times 200$ joint area. Since each image contains exactly one joint, and since the rotational variance of the knees is fairly minimal, this simple and fast method was able to successfully find the joint centre in all images in the dataset.

Using these smaller images for the automated categorization keeps them clean from the various background features and makes the images invariant to the position of the joint within the original X-ray. No attempt is made to fix for the rotational variance of the images, as this small variance is not expected to affect the image analysis described in Section IV and does not justify automated correction, which can introduce some inaccuracies resulting from the nontrivial task of estimating the exact angle of the joint.

## 4. Image Categorization

Modern radiography instruments are many times more sensitive than the human eye that observes the resulting images. Therefore, it can be reasonably assumed that OA can be discernment by more elements than those proposed by Kellgren and Lawrence but are not used for the categorization due to inability of the human eye to sense them. Since computers are substantially more sensitive to these small intensity variations, an effective use of the strength of computer-based recognition would be based on a data-driven categorization, rather than an attempt to follow each of the manually classified elements used by Kellgren and Lawrence. The method works by first extracting a large set of image features, from which the most informative

features are then selected. Since image metamorphose can often provide additional information that is difficult to deduce when analysing the raw pixels [11], image features are computed not only on the raw pixels, but also on several metamorphose of the image, and also on metamorphose of metamorphose. These image content descriptors extracted from metamorphose and compound metamorphose have been found highly effective in categorization and similarity measurement of biological and biometric image datasets [11], [25], [26], [28].

For image feature extraction, we use the following algorithms, described more thoroughly in [25].

1) *Zernike features* [35] are the absolute values of the coefficients of the Zernike polynomial approximation of the image as described in [24], providing 72 image content descriptors.
2) *Multiscale histograms* computed using various numbers of bins (3, 5, 7, and 9), as proposed by [17], providing $3 + 5 + 7 + 9 = 24$ image content descriptors.
3) *First four moments* of mean, standard deviation, skewness, and kurtosis computed on image "stripes" in four different directions ($0^\circ$, $45^\circ$, $90^\circ$, $135^\circ$). Each set of stripes is then sampled into a three-bin histogram, providing $4 \times 4 \times 3 = 48$ image descriptors.
4) *Tamura texture features* [34] of *contrast*, *directionality*, and *coarseness*, such that the coarseness descriptors are its sum and three-bin histogram, providing $1 + 1 + 1 + 3 = 6$ image features.
5) *Hara lick features* [18] computed on the image's cooccurrence matrix as described in [24] and contribute 28 image descriptor values.
6) *Chebyshev statistics* [16]—A 32-bin histogram of a $1 \times 400$ vector produced by Chebyshev transform of the image with order of $N = 20$.

The image metamorphoses used by the proposed method are the commonly used wavelet (Symlet 5, level 1) transform, Fourier transform, and Chebyshev transform. Additionally, three compounds metamorphose are also used, which are Chebyshev transform followed by Fourier transform, wavelet transform followed by Fourier transform, and Fourier transform followed by Chebyshev transform. Since human intuition and analysis of image features extracted from metamorphose and compound metamorphose are limited, the compound metamorphose were selected empirically by testing all two-level permutations of the three basics metamorphose (wavelet, Fourier, and Chebyshev) and assessing the contribution of the resulting content descriptors to the accuracy of the categorization.

$$W_f = \frac{1}{N} \sum_{c=1}^{N} \frac{(\overline{T_f} - \overline{T_{f,c}})^2}{\sigma_{f,c}^2} \tag{2}$$

Where $W_f$ is the Fisher score of feature $f$, $N$ is the total number of classes, $T_f$ is the mean of the values of feature $f$ among the images allocated for training, and $T_{f,c}$ and ${}^{\sigma}{}_{f,c}{}^2$ are the mean and variance of the values of feature $f$ among all training images of class $c$. The Fisher score can be conceptualized as the ratio of variance of class means from the pooled mean to the mean of within-class variances. All variances used in the equation are computed after the values of feature $f$ are normalized to the interval $[0,1]$. Fisher score values rank the image features by their informativeness and are assigned to all 1470 features computed by extracting the 210 image content descriptors from the seven different images metamorphose (including the original image). Once each of the 1470 image features is assigned with a Fisher score, the weakest 90% of the features (with the lowest Fisher scores) are rejected, resulting in a feature space of 147 image content descriptors. As discussed in Section V, this setting provided the best performance in terms of categorization accuracy. The distribution of the different types of image features and image metamorphose is described in Table II. As the table shows, the most informative image content descriptors are the Zernike polynomials and both Haralick and Tamura texture features. The radial nature of Zernike polynomials allows these features to reflect variations in the unit disk, so that these features are expected to be sensitive to the joint space in the X-ray images. As observed and thoroughly discussed by Boniatis *et al.* [5], the pixel intensity variation patterns mathematically described by the texture features correlate with biochemical, biomechanical, and structural alterations of the articular cartilage and the subchondral bone tissues [1], [23]. These processes have been associated with cartilage degeneration in OA [8], [27] and are therefore expected to affect the joint tissues in a fashion that can be sensed by the x-ray texture. Since not all x-ray elements of OA have been isolated and well characterized, not all discriminative image features are expected to resemblance to a known OA element. Therefore, a small portion of the discriminative values such as the statistical distribution of the pixel values of a Fourier transform followed by a Chebyshev transform is difficult to associate with a known x-ray OA element. Additional algorithms for extracting image features have been tested but were found to be less informative for the categorization of the KL assessment. These image content descriptors include Radon transform features [20], which were expected to correlate with joint space, but were outperformed by Zernike polynomials. Gabor filters [14] capture textural information that could also be useful for the analysis but were found to be less informative than the Hara lick and Tamura textures. Since the areas of interest have relatively low intensity variations, high contrast features such as edge and object statistics as described in [26] do not provide useful information. After computing all feature values of a given test image, the resulting feature vector is classified using a simple weighted nearest neigh or rule, which is one of the most effective routines for nonparametric categorization [4], [36]. The weights, in this case, are the Fisher scores computed by (2).

Table 1. Distribution Of Types of Features By Algorithms And Image Metamorphose

| Transform | Zernike polynomials | Haralick textures | Tamura textures | First four moments | Multi-scale histogram | Chebyshev statistics | Total |
|---|---|---|---|---|---|---|---|
| Raw pixels | 10 | 8 | 1 | 0 | 0 | 6 | 25 |
| Wavelet | 22 | 1 | 4 | 3 | 0 | 0 | 30 |
| Chebyshev | 26 | 0 | 2 | 1 | 2 | 4 | 35 |
| Fourier | 0 | 2 | 2 | 2 | 0 | 0 | 6 |
| Fourier + Chebyshev | 0 | 10 | 0 | 5 | 7 | 0 | 22 |
| Fourier + Wavelet | 9 | 0 | 1 | 0 | 0 | 4 | 14 |
| Chebyshev + Fourier | 0 | 10 | 0 | 4 | 1 | 0 | 15 |
| Total | 67 | 31 | 10 | 15 | 10 | 14 | 147 |

Table 2. Confusion Matrix Of Moderate Oa And Normal

| | Normal (KL grade 0) | Moderate OA (KL grade 3) |
|---|---|---|
| Normal (KL grade 0) | 613 | 87 |
| Moderate OA (KL grade 3) | 32 | 668 |

$$\text{KL} = \frac{(K_1/d_1 + K_2/d_2)}{(1/d_1 + 1/d_2)} \tag{3}$$

Where KL is the resulting interpolated KL grade, and $d_1$ and $d_2$ are the distances from the nearest two samples that belong to different KL assessment $K_1$ and $K_2$, respectively.
The main advantage of this interpolation is that it can potentially provide a higher resolution estimation by determining the OA severity within the grade (e.g., KL grade 1.6 for a case of OA severity between KL grade 0 and 1). This, however, is more difficult to evaluate for accuracy since the data used as ground truth only specify the OA severity in resolution of KL assessment.

## 5. Appraisal of All Results

The proposed method was tested using the dataset described in Section II, where the ground truth was the manual categorization of the X-rays. In the first appraisal, the proposed method was tested by indubitably classifying moderate OA (KL grade 3) and normal knees (KL grade 0). The appraisal was performed by using 55 X-ray images from each grade, such that 20 images from each grade were used for training and 35 for testing.
This test was repeated 20 times, where each run used a different random split of the training and test images. Since the dataset has more grade 0 images than grade 3, each run used a different set of 55 grade 0 images, randomly selected from the dataset. The and none of the knees was classified by one reader as *normal* and by the other reader as *moderate*. Therefore, experienced and knowledgeable readers should be able to tell *moderate* OA from normal knees with accuracy of practically 100%.
A similar appraisal tested the categorization accuracy of KL grade 2 (*minimal* OA). Since this categorization problem is more difficult, five more training images were used for each class so that the training set consisted of 25 images of grade 0 and 25 images of grade 2. The use of a larger training set improved the categorization accuracy, while increasing the training set in the grade 3 recognition did not contribute to the performance, as will be discussed later in this section. The categorization accuracy was ∼80.4% ($P < 0.0001$), and the confusion matrix is given in Table IV. As can be learned from the table, the specificity of the recognition is ∼79.3%, with susceptibility of ∼81.4%. These numbers show that the recognition of KL grade 2 is less effective than the automated recognition of KL grade 3. This can be explained by the fact that the progress of OA is continuous, so that KL grade 2 is expected to be visually more similar to 0 than KL grade 3. We also tried to classify KL grade 1 (*doubtful* OA) from 0, which provided categorization accuracy of 54% when using 25 images per class for training and 14 images for testing. Increasing the size of the training set to 70 samples per class (and 32 samples for testing) marginally increased the performance to 57%. This can be explained by the fact that these two assessments are visually very similar, and even experienced human readers often have to struggle to differentiate between the two. Also, since the KL assessment are discrete while the actual OA progress is continuous, the very many in-between cases can remarkably contribute to the confusion. Table V shows the categorization accuracy when classifying between any pair of KL assessment. In all cases, 25 images were used for training, 14 images for testing, and the categorization accuracy was computed by averaging the accuracy of 20 random splits to sets of training and test images.

Categorization between two neigh boring KL assessment is less accurate than categorization of non-neigh boring assessment. We can also see that the two-neigh boring KL assessment 2 and 3 can be differentiated with accuracy of 65%, while the categorization

of assessment 1, 2 and assessment 0, 1 provide accuracy of 60% and 54%, respectively. This may indicate that neigh boring KL assessment are visually more similar to each other in the early stages of OA. It is also noticeable that the categorization accuracy improves as the difference between the KL assessment gets larger. For example, the categorization accuracy of KL assessment 3 and 0 is better than the categorization accuracy of KL assessment 3 and 1. These results agree with the continuous nature of OA.
Testing the categorization accuracy when classifying all four KL assessment was performed by randomly selecting 25 images from each class for training and then selecting 14 of the remaining images of each class for testing. This appraisal was repeated 20 times, such that in each run, the training and test sets were determined in a random manner. The overall categorization accuracy of this classifier was 47%, as described by the confusion matrix of Table VI. Categorization accuracy of 47% may not be considered strong, and it is remarkably lower than the 79.8% of agreement between the two human experts. However, the confusion matrix shows that from all cases of KL grade 3, only ∼4% were classified as non-OA (KL grade 0) and ∼13% as doubtful (KL grade 1). Examining the false positives, the confusion matrix shows that ∼7% of the X-rays classified manually as KL grade 0 were falsely classified by the proposed method as KL grade 3 (moderate), and ∼11% of KL grade 1 were mistakenly classified as KL grade 3. Since the actual OA progress is a continuous variable, there are many in-between cases that can be classified to either of the two closest classes of the given case. For example, OA progress between KL grade 1 and KL grade 2 can be classified to either 1 or 2. As described in the end of Section IV, the resulting value of the image categorization can also be an interpolation of the two nearest KL assessment, rather than a single KL grade class.

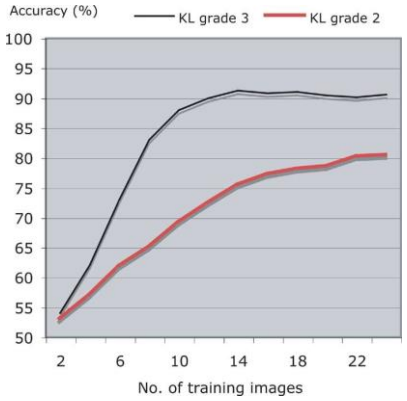


Fig. 4. Categorization accuracy (%) of KL assessment 2 and 3 as a function of the size of the training set.

The efficacy of this interpolation can be demonstrated by computing the Pearson correlation coefficient between the predicted and actual KL assessment (when using all four KL assessment as described in Table VI). When using the interpolated value as the predicted grade, Pearson correlation is 0.73, compared to 0.49 when the predicted KL grade is simply the class of the nearest training sample. A knee is classified as OA positive if it has been classified as KL grade 2 or higher. By merging the images of KL assessment 2 and 3, we introduced a new class called *OA positive* that contained 78 images (39 from each class). An appraisal was performed by building a two-way classifier using this newly defined class and KL grade 0, such that 60 images from each class were used for training and 18 for testing. The purpose of this appraisal was to classify OA positive X-rays from OA negatives. The categorization accuracy of this classifier was ∼86.1%, with susceptibility and specificity of ∼88.7% and ∼83.5%, respectively. It is also important to mention that the X-rays were taken from randomly selected human subjects who participate in the BLSA study, and not necessarily from patients who reported on pain symptoms or were diagnosed as OA positive in one of their other joints. This policy provides a uniform representation of the elderly population, and therefore it can be assumed that the results presented here can be generalized to the entire elderly population. The categorization accuracy may be affected by the size of the training set such that it is expected to increase as the number of training samples gets higher. Fig. 4 shows the categorization accuracy of the categorization of KL assessment 2 and 3 from KL grade 0 as a function of the size of the training set. As can be learned from the graph, for KL grade 3 the categorization accuracy improves as the size of the training set gets larger but stabilizes at ∼14 training images per class. Categorization accuracy of KL grade 2 also increases with the number of training images, but our dataset is not large enough to determine whether it reached the peak of accuracy. In terms of computational complexity, classifying one X-ray image takes 105 s, using a system with a 2 GHZ Intel processor and 1 MB of RAM. While the time required for the joint recognition described in Section III is negligible, nearly all of the CPU time is sacrificed for metamorphose the image and extracting image features. Major contributors to this complexity are the 2-D Zernike features, which are known to be computationally expensive [19], [37]. This downside of the classifier makes it unsuitable for real-time applications or other tasks in which speed is a primary concern but may be fast enough for categorization of single X-ray images, especially considering the fact that the entire procedure of taking X-rays can take a much longer time. An improvement in the response time of the classifier can be achieved by parallelization of the feature extraction algorithms. Since most of the image features are not dependent on each other, the algorithm becomes trivial to parallelize so that many image features can be computed concurrently by different processors. For instance, while one processor can compute Hara lick features on the Chebyshev transform, another processor can extract Hara lick features from the Fourier transform, or Zernike features from the

Chebyshev transform. In order to take full advantage of the parallelization, the algorithm has been also implemented using the Open Microscopy Environment (OME) software suite [15], [33], which is a platform for storing and processing microscopy images. A detailed description of the parallelization of the image metamorphoses and image feature extractions in OME can be found in [21].

## 6. Conclusion

In this paper, we described an automated approach for the recognition of OA using knee X-rays. In the absence of an accurate method of OA diagnosis, the manually classified KL grade is used here as a "gold standard," although it is known that this method is less than perfect. The categorization is not performed in a way that attempts to imitate the human categorization but is based on a data-driven approach using manually classified X-rays of different KL assessment, representing different stages of OA severity.

Appraisalal results suggest that more than 95% of moderate OA cases were differentiated accurately from normal cases, with a false positive rate of ∼12.5%. Categorization accuracy of differentiating *minimal* OA from normal cases was ∼80%, and recognition of *doubtful* OA cases was far less convincing. Future attempts of improving the recognition accuracy of *doubtful* OA will include integration of relevant clinical information such as history of knee injury, body weight, and knee alignment angle, and will also use more X-ray samples as they become available. However, due to the subjective nature of the "gold standard," it is conceivable that a 100% correlation between computer-based and manual categorizations may not be achieved. KL assessment 4 (severe OA) and 5 (knee replaced) remained outside the scope of this study due to the severe symptoms that accompany these stages, and the relatively easy recognition of OA in these stages.

While the categorization accuracy of KL assessment 1 and 2 cannot be considered strong, it is important to note that radiograph readers are often challenged in attempting to distinguish between these assessments, and therefore the confusion of the automated recognition between these two assessments cannot be considered surprising.

We acknowledge that the equipment used to obtain the knee images does not allow for maximal resolution of joint structures. We speculate conventional x-ray images would predictably allow for better delineation of OA assessment, particularly in cases with less severe disease. Certainly, conventional radiography is capable of delineating joint structures more readily but achieves this at the cost of greater radiation exposure. The application of this imaging software to the interpretation of X-ray images occurs without the bias inherent in a clinical interpretation. Finally, this study was conducted within the context of a longitudinal aging study that will enable the comparison of imaging data not only to clinical OA features as pain, but also to physiologic measures relevant to aging body systems that might contribute to OA severity.

Future plans include testing of this automated technique in the evaluation of longitudinal knee images obtained over time, to check whether OA can be discernment before x-ray evidence are noticeable by a human reader. We also plan to develop similar techniques to classify hand X-rays with attention to the signal joints predisposed to the development of OA.
The full source code used for the appraisal is available for free download under standard GNU general public license (GPL) via concurrent versions system (CVS) at www.openmicroscopy.org. Scientists and engineers are encouraged to download, compile, and use this code for their needs.

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# Billboard Price Comparison Application

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**Abstract**

Advertisements play an important role in the economic and competitive world today. They encourage people to buy new products or goods that are essential for their day to day lives. Advertisers today look for cheap and effective way to reach out their customers in the best possible way through the method of billboard advertising. As there are various dealers for billboard advertising its is difficult task for the advertiser to personally look for advertising agencies and select the best out of them. These price comparison application or portal play a vital role for small business and help them to reach out the to maximum customers and help them to grow their business. Advertisements mainly comprise for clothing, watches and many other things that can easily engage customers to buy that product or goods from that shop.

*Keywords*: Billboard price, Billboard Price Comparsion, Advertising

## 1. Introduction

### *1.1 Brief Background*

The idea of price comparison application or web application was first developed by Andersen Consulting (now Accenture) with their shopping agent Bargain Finder, this experiment was carried out and published in the year 1995. Jango was the first commercial internet price comparison service which was produced by NetBot and later sold itself to Excite in the year 1997. Many of the price comparison websites were later started and listed in the Times Magazine under the title of top 50 websites in year 2008.

### *1.2 Definition*

The definition primarily focuses on bringing all the dealers in the stream of advertising agencies together to make it easy for the advertisers to make choice from the various dealers. This will help the user or the customer of advertisement agency to make the best possible use of the platform to get in direct touch with the dealer an ask for quotations from them as per their requirement and the users of this platform even get a variety of billboards to choose from be it digital billboard, lamp post billboard, taxi/bus size billboards and many other types of billboard that are used in the present world. Not only that the user will also be able to use the map or the location feature to find out bust traffic roads so that a customer looking for advertisement can also look for ways to promote their business to a wide range of audience at a same time. Here the busy traffic areas and crossroads having signals play an important role as on the signals people wait and the billboard advertisements reach out to a variety of audience during that moment.

The main objective of this application is to make the use of the online platform so that the person looking for advertisement does not have to call that agency and go to each agency to find out their rates and compare manually with each agency. When everything is going online why to leave this step which is needed the most these days to run a business successfully in the initial years.

Price comparison sites can collect data directly from merchants. Retailers who want to list their products on the website then supply their own lists of products and prices, and these are matched against the original database. This is done by a mixture of information extraction, fuzzy logic and human labour. We will be manually collecting the data of the agencies surely it will be much of work from out end but once the data and the rates of the different types of billboard is listed on one platform it becomes easy to collaborate with the internet services to publish out the with new features in the application. Yet another approach is to collect data is through crowdsourcing. This lets the price comparison engine collect data from almost any source without the complexities of building a crawler or the logistics of setting up data feeds at the expense of lower coverage comprehensiveness.

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Sites that use this method rely on visitors contributing pricing data. Unlike discussion forums, which also collect visitor input, price comparison sites that use this method combine data with related inputs and add it to the main database though collaborative filtering, artificial intelligence, or human labour. Data contributors may be rewarded for the effort through prizes, cash, or other social incentives.

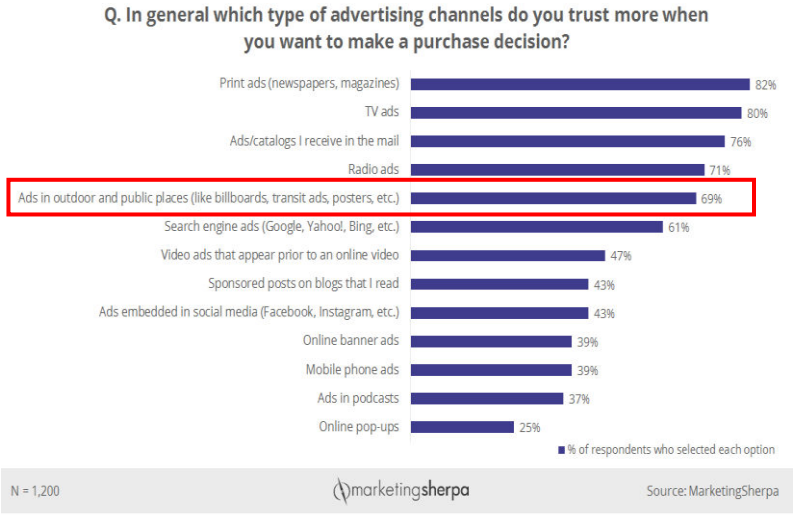


Fig. 1. Advertising channels that are trusted more while making a purchase decision.

We researched more on how billboarding system was useful for the business and we found out that 69 percent people made their decisions for making a purchase of a products after they saw the advertisement on the billboard and the ways they found the advertising content on the billboard interesting. This could allow them to make their purchase decisions easily. This benefits the advertiser making it easy for them to choose the correct type of advertising method.

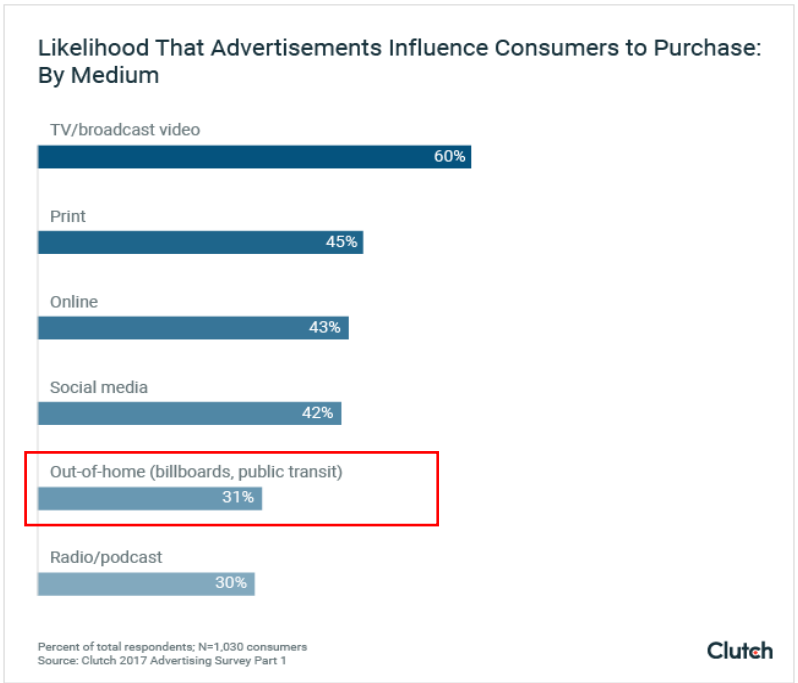


Fig. 2. Advertisements influence customers to purchase (Courtesy: Medium)

## 2. Organize profile

Billboard advertisements are designed to catch a person's attention and create a memorable impression very quickly, leaving the reader thinking about the advertisement after they have driven past it. Places to use billboard as listed as follows: -

1. Highways
2. Railways
3. In city
4. Heavily traffic areas

Non-commercial use : Not all billboards are used for advertising products and services—non-profit groups and government agencies use them to communicate with the public. Early billboards were basically large posters on the sides of buildings, with limited but still appreciable commercial value. As roads and highways multiplied, the billboard business thrived. Another way of billboard advertising is through vehicles. There are various companies that allow advertising on vehicles and their owners are paid advertising.

Today every product's survival depends on its advertising hence it is very important to pay attention to it specifically. There are many factors to be considered while deciding the advertising strategy for example:

1. Mode of advertising
2. Target audience
3. Places to advertise.

Our idea of the project will help the users to analyse the factors themselves and then decide accordingly. Working on a single platform to analyse every factor of advertising is a great way to come up with the best advertising strategy so our idea will play a major role.

## 3. Literature Review

We have done our part in investigating helpful data to actualize the thoughts into the application and for that, we ensured that we assemble all the conceivable data from the resources that were accessible to us. This helped us in choosing about the functionalities and framing a platform that will have the potential bring the dealers and their customers on one platform.

We referred to many different research papers that were available to us regarding the type of system that was depicted in the study paper by Ad Age India [1] on system and method for the presentation of advertisements wherein they represented methods and way to put up an advertisement that could be noticed by public to increase the sales of the products.

Secondly, we came across a study with reference to selected consumer durable and non-durable goods [2] which was focused on predictive modelling for e-commerce advertising systems and methods which had few limitations but despite of few limitations it gave us an idea regarding building up an e-commerce which is completely dedicated to the environment of billboard advertising.

Thirdly, we came through the business method for billboard advertising which was an article of the marketing hierarchy of effects [3] for developing a business model out of the billboard advertising application. They suggested may ways through which we could generate revenue out of this project and make it available to the public.

We literature or the existing application that we referred to be the applications that we use in our day to day lives like the Trivago, Make My Trip and many other websites so that we could make a user-friendly interface that could be easy for the users to use and access our application by different customers and help them with the advertisement that they are looking for the promotion of their business.

## 4. Application description

The application focuses on billboard advertising only so in the initial stage data from various types of agencies is collected and are the collaboration with the application interface takes place. This process is done manually as there is no data of companies into billboard advertising available on the internet services.

To be more precise on the invention that we able to perform is bringing all the advertising agencies at one platform in the customer to easily compare different prices and offers according to the range of price that they want for the Billboard advertisement through this platform we will be providing the customers various dealers having various quotations where in the customer who wants to advertise can select one of them then the next step that is involved is generation of quotations from the selected dealers later on after the quotations are presented before the customer the customer then selects one dealer amongst the previously selected dealers. Later, the customer can even find out busy traffic via the map feature that is inculcated in our

application which would be shown by using markers on the map. Account of future we could even add payment gateways to an application to make get an E-Commerce in all terms.

## 5. Objective

The main purpose of the invention is to provide one stop solution to each, and every dealer present in the country or the city for the time being at one platform and initiate the process of advertisement online through an e-commerce website which makes it easy for the dealers as well as customers to advertise and buy billboards at one platform. Not only it would be limited to propose but we could even use it for social media ads, website ads, Google ads, television ads and many other such kind of advertisements in your future. This could change the process that a customer courses through advertising his or her business on billboards. It even makes it easy for them to compare price and locate the busy areas in their locality to put up a Billboard of the business. Even the payment methods could be simplified by this E-Commerce via online payment methods using payment gateways in our application. This is the main idea for developing the application.

## 6. Tools and Technology

Asking about the issues with the functionalities and the fulfilment with the current framework, we needed to ensure that the clients were clear about the inquiries we posed to them. After get-together enough data, we had a few various plans to actualize which required conceptualizing about the innovations to be utilized later. To start with android studio, we had to install different packages that were required to build the application. To work with the android studio, we had to set up an environment that made our work easy and efficient.

The main challenge was the RAM that was required to be changed as it was not compatible with android studio. We updated that and made all the required changes. For Android application: -

- IDE - Android Studio
- Database – MySQL
- Language - Java

## 7. Conclusion

Our idea of the project will help the users to analyse the factors themselves and then decide accordingly. Working on a single platform to analyse every factor of advertising is a great way to come up with the best advertising strategy so our idea will play a major role in it. Let us see this with an example: why advertising? Consider we are introducing a product or service in a highly competitive market. We have worked perfectly on its quality, production etc. But we did not pay proper attention to its advertising then definitely our product or service will fail to compete in the market.

Where to advertise (target audience)? Suppose the product that we want to introduce is a luxury product and we are trying to advertise it in a rural area. this will not work. so, it is important to analyse our audience. Which place to advertise? Considering that our product is in the category of personal care, and we are trying to place a hoarding on a highway. this will have less impact as such. And so, our idea will provide all these suggestions regarding the different types of audience, places, and most effective mode to advertise etc. To optimize our advertising strategy.

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# Design & Fabrication of Fertilizer Spreader

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**Abstract**

India is agriculture-based country. This project is based on automatic fertilization process. Our aim was to improve the performance of fertilizer distribution in sustainable fertilizer spreader. The project design divided into three stages. First stage consist hopper. Middle stage consist impeller. Last stage consist motor. The whole design is supported by frame. For small-scale uses, it not possible to use costly tractor mounted spreaders. This project solves the problem of manually spreading of fertilizer. It also reduces waste of fertilizer due to overlapping.

***Keywords*****:** *Uniform Spreading, Fertility, Agriculture Mechanism, Fertilizer Spreader, Centrifugal Spreading, Productivity.*

## 1. Introduction

Agriculture is the backbone of India. India has an agriculture-based economy 43% of India's territory remains employed in agricultural activities as against 11% in the world. In India around 70% of the population earns its livelihood from agriculture. India's geographical condition is unique for agriculture because it provides many favorable conditions. India is agricultural based country. Near about 70% of people of our country are farmer. Our economy also depends on agricultural product. Now a day tremendous changes have occurred in conventional method of agriculture like seed plantation, irrigation system, pesticides & spray used for developing our economic condition. It is necessary to increase our agricultural productivity & quality also.

Fertilizer is any material of natural or synthetic origin used to enhance the growth of plants. This improves the soil's physical properties, with better retention of moisture and more aeration. Fertilizers are commonly used for growing all crops, with application rates depending on the soil fertility, usually measured by a soil test and according to the particular crop. A major technical problem in agriculture, directly related to increasing production in sustainable agriculture is optimization of the construction of agricultural machinery to increase its reliability and efficiency. For small-scale uses, it not possible to use costly tractor mounted spreaders. Hence, in this framework, Mathematical models can be used to improve performance and field's works. It is helping for farmers with smallholding of agricultural land for improving crop cultivation with less effort and less cost. So, we are going to design automatically fertilizer spreader by taking into consideration the user group and their needs which helps to them to work easy and better functionality. This spreader machine controls the flow of fertilizers along to two direction which helps to elimination of waste of fertilizer with no overlapping & uniform spreading.

### *1.1 Farm Mechanization:*

a) Ensure timely field operations to increase productivity, reduce crop losses and improve quality of agro produce.
b) Increase land utilization and efficiency.
c) Increase in labor productivity using labor saving and drudgery reducing devices besides, being cost effective and eco-friendly. Appropriate machinery has been adapted by farmers for ensuring timely field operations and effective application of various crop production inputs utilizing human, animal and mechanical power sources.

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*1.2 Uniform Spreading:*

In conventional fertilizing spreading system, waste of fertilizer is considerably large because of overlapping spreading. In our model, issue of overlapping is resolved. Thus, the uniform spreading can be achieved.

*1.3 Different types of Fertilizer Spreader:*

There are different types of spreaders we can utilize to fertilize the farm. Some of them are follows:

A. Handheld Spreaders
B. Drop Spreaders
C. Rotary Fertilizer Spreader
D. Liquid Fertilizer Spreader

*1.4 Unique Points:*

1) Combination of seed and fertilizer feeder for cultivation.
2) Elimination of waste of fertilizer.
3) No over lapping and uniform spreading.
4) Proper utilization of fertilizer.
5) Increase crop quality and soil fertility.

**2. Literature Review**

There are different researchers who invented different types of fertilizer spreading machines. They publish their papers and the papers published are given below:

- **Arun Abraham s**tudied that, Conventional spreading of fertilizers for small-scale farming are by hand. The farmers have to carry heavy bags throughout the spreading process. Therefore, it is necessary to develop a fertilizer spreader for small-scale farming. The proposed fertilizer spreader uses a trolley type of mechanism. The main part is spreader disk, which helps for uniform spreading. The feed for the disk is from the wheels of the trolley using gear transmission. By using this spreader, a lot of time can be saved, human effort used for carrying heavy bags of fertilizer is reduced and wastage of fertilizer can also be avoided. [4]

- **S. Ramchandra s**tudied that, In India 73% of population is directly or indirectly depends upon the farming. Until now, our farmers are doing farming in same traditional way. The main objective of fertilizer broadcaster at sowing time is to uniformly distribute the fertilizer over entire field. [4]

- **Joao P.A.R. Cunha s**tudied that; the quality of fertilizer distribution process is important to the success of agriculture. This research aimed to study the distribution uniformity of fertilizers with spreaders capable of performing variable rate. Evaluations were carried out in different farms, in the Southwest region of the State of Goias, Brazil. [4]

- **Narode R. R. s**tudied that; He has generated a method to spread the fertilizer uniformly over a fallow land by dropping the fertilizer over the impeller disc. The system consists of three wheels, two at the front and one at the back. These two wheels at the front are used to impel the fertilizer. The two hoppers are used to store the fertilizer; these hoppers are placed at some height from the wheel axle so that the fertilizer falls on to the impeller. The hopper is provided with flow control mechanism. In fertilization, the flow maintenance is necessary. Generally, every crop should get sufficient amount of fertilizer. This condition is satisfied by Spring Mechanism. [9]

- **Vignesh B. s**tudied that; A method was generated to spread the fertilizer automatically over the agricultural land by dropping the fertilizer over the impeller disc. A 25cc engine is used to rotate impeller disc in which the fertilizer drains and spreads from hopper where it is introduced. In tractor mounted or manual system they carry four and three wheels respectively. But here two wheels are used in which the bigger front wheel is connected to engine through supporting wheel can be adjustable.

The speed of wheel is varied by control lever connected through a cable. From this method the cost fertilizer spreader is reduced by 50%. [11]

*2.1. Objectives:*

- Precision farming with lower fertilizing time
- Reduce physical strength of farmers
- Precisely spreading of fertilizer
- Convenient technique compared to conventional method
- No need to manually (by own hands) spread fertilizer
- Better and Accurate mechanism
- Eliminate the wasting of fertilizer
- Do not require carrying of heavy bags
- Uniform spreading of fertilizer over the farm
- Affordable farming method for farmers

*2.2. Design Models:*

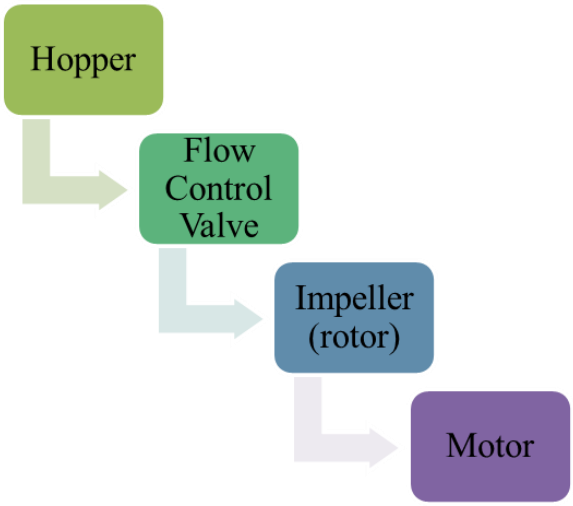


Fig.1. Flow Chart of Fertilizer Spreader

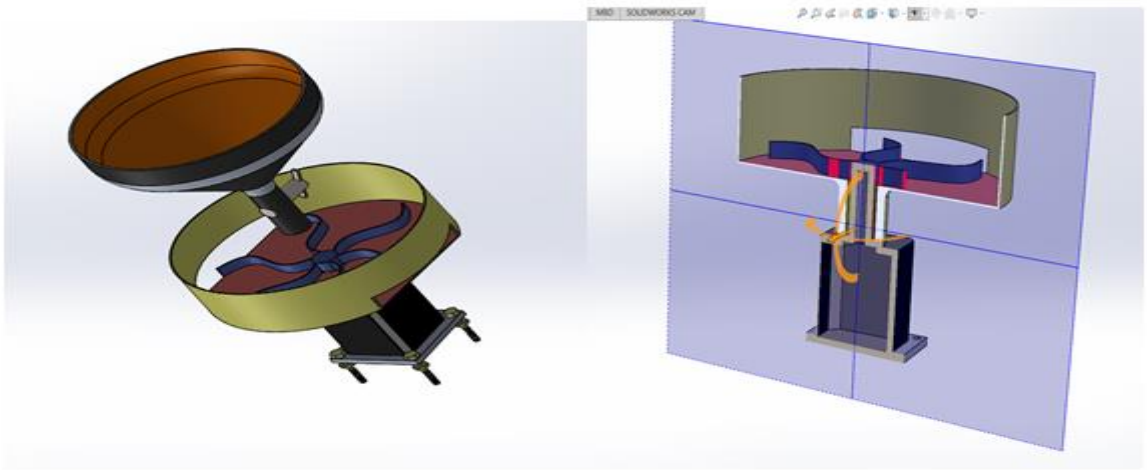

Fig. 2. Isometric and Cross-section View of Fertilizer Spreader

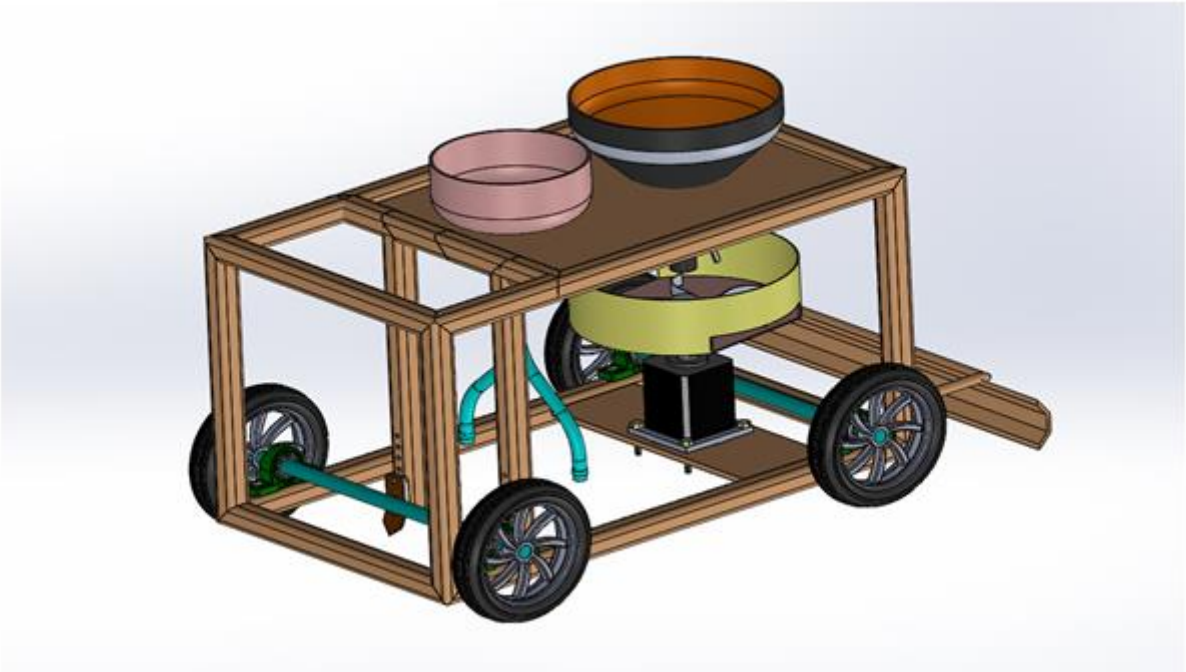

Fig. 3. Main Four Processes(ploughing, seed sowing, fertilizer spreading, levelling) Explaination Drawing

Fig. 4. Real Image of Fertilizer Spreader

Fig. 5. Real Image of Main Four Processes Explanation Model

## 3. Calculation

Power required to drive the impeller of fertilizer spreader:

- Diameter of impeller = 30 cm
- Thickness of impeller = 0.254 cm
- Density of ss plate = 0.007850 kg/cm$^3$
- R.P.M. of impeller (n) = 200 r.p.m.

$$W = \pi/4 \text{ X } d^2 \text{ X t X } \rho \text{ X g}$$
$$= 0.785 \text{ x } 900 \text{ x } 0.254 \text{ x } 0.007850 \text{ x } 9.8$$
$$= 13.80 \text{ N}$$

$$T = F \times r$$
$$= 13.80 \times 0.30$$
$$= 4.14 \text{ Nm}$$

$$P = T \times \omega$$
$$= (F \times r) \times 2\pi n/60$$
$$= (13.80 \times 0.30) \times 20.93$$
$$= 86.66 \text{ w}$$

## 4. Problem Definition

In the recent days it has been observed that farmers are not able to grain more crop production by use of conventional agriculture methods. And the manually spreading of the fertilizers in the farm creates some of the problems like uneven spreading of the fertilizers and this process is time consuming and this conventional method is inconvenient. As we can see now a day, the major problem face by the farmer is shortage of labor's and the time required for fertilization is more. In conventional method, uniform spreading of fertilizer is not possible and wasting of fertilizer is occur due to overlapping of fertilizers. Also, farmers are spreading fertilizers with the use of their own hands. So, in this process physical strength of farmers are required very high. Furthermore, presently available farm machineries are costly and not useful for small scale farmers. So, in order to have solution to it, it was necessary to manufacture a fertilizer spreader.

### 4.1 *Advantages and limitations:*

- **Advantages**

  - Time saving.
  - High speed fertilization.
  - Easy & better controlling of features.
  - Uniform spreading is possible.
  - Flow control valve controls flow of fertilizer.
  - No skilled operator required.
  - Pollution free operation.
  - Low cost.

- **Disadvantages**

  - DC electric power required.
  - Useful for small & medium farms.

## 5. Conclusion

The main objective of our project was to fulfil the need of farmers suffering from the problems of fertilizing timing is more, high physical strength of farmer is required, manually spreading of fertilizer, precisely spreading of fertilizer is not possible, carrying of heavy bags. Also, this fertilizer spreader provides convenient technique to fertilize the whole farm with uniform spreading of fertilizers and eliminate the wasting of fertilizers. The drawbacks in the existing spreader model are reduced in this system. In addition, this machine is easy to operate with low capital cost and less troubleshoots.

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# Design and Control of Reduction of Harmonics in Power Factor Correction (PFC) Technique

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**Abstract**

Knowing the current scenario that the requirement of the electrical power is very high, as most of the devices around us depend on it and also due to the increment of industrial sector that causes a huge power loss because of the reactive component or the inductive loads in the power, resulting in a high energy consumption. Hence, to overcome this issue, power factor improvement techniques have already been in use. But the problem with that is the blowing out of the capacitor banks too early resulting because of the harmonics contents created in the line current of it. Hence, here, there is an approach for the same to overcome this effect in order to protect the APFC panel and increase its efficiency by working on its MATLAB based simulation.

*Keywords* – Power Factor, Harmonics, Total Harmonic Distortion (THD), diode, inductor

## 1. Introduction

Here, in India, we know that there is a huge need of electrical power, and this requirement is increasing day by day. But, due to the large industries, there has also been huge amount of losses occurring due to more usage of inductive loads, which in turn, causes the production of low power factor resulting due to the more amount of the reactive component in the electrical network. To gain over this problem, there is the need of generating reactive power in order to compensate the losses produced due to the reactive power [5]. There has been the manufacturing of the power factor improvement panels for the same, which contains a unit of capacitor banks or synchronous condensers and its relay unit (for driving the capacitors) which are used to compensate the reactive power generated. But those panels also generate a lot of harmonic contents in the circuit which may degrade the life span of the capacitor bank and other electronic components in the unit and also the load might fall its efficiency as harmonics are basically the distortions produced in a circuit [2]. Hence, in order to overcome this problem, this study initiates about the decrease in the level of the harmonic contents, as they cannot be removed completely once introduced. By showing the MATLAB simulations below, this paper gives a complete theoretical knowledge one of the ways of reducing the harmonics contents introduced inside the Power Factor Correction (PFC) panel keeping the power factor unchanged so that the life span and efficiency could be increased to a certain level.

This project will make the consumers actually see the effect of high and low harmonics in their consumption of energy. When the harmonic content is very low, they may be able to see the effect and reach out to make the operating system change as needed. They can increase the power factor by using the automatic power factor compensation which use capacitors/synchronous condensers and micro controller as the main components. Thus, may also help in stabilizing the power factor of a system. Additionlly, the current demand on energy is increasing day by day and the industries growth are inclining and on the other hand, the energy sources are depleting due to increase in population [1]. Hence, there should be some change in the ongoing technique by increasing the life span and efficiency of the system by the means of reducing the harmonic contents in the power system.

The power electronic converters distort the supply waveform by injecting significant amount of harmonic current from the switching devices due to high switching frequencies of them. Improving the poor power quality becomes a great challenge for power supplying utilities as well as power converter manufacturers. Low electromagnetic interference (EMI) can be achieved by employing boost type PFC converter as compared to other types of active PFCs in continuous conduction mode (CCM). Moreover, most of the bridge less topologies implemented so far are boost type configuration because of its low cost and its high performance in terms of efficiency, power factor and simplicity.

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## 2. Theory

*1. Power factor correction*

Power factor compensation/correction can be defined as a process of correcting the lagging current by producing leading current so that the angle between voltage and current reduces. There will be no power loss if the current and voltage are in phase, thus it can improve the power factor value to nearly unity or even unity. This process is done by connecting few capacitors (capacitor bank) or synchronous condensers at the service mains where the power factor is attuned by an adequate value of capacitance [4].

Power factor correction can be applied by the electrical utility to improve the stability and efficiency of the transmission network or, it can be installed by the electrical consumer to reduce costs charged by the electrical provider. Power factor correction (or improvement) is economically practicable whenever the decrease in the annual cost of electricity exceed the pay back cost of installing the required capacitors. In some cases, the customer has no choice but must obey with the minimum power factor specified by the utility company. The power factor may be amended by installing capacitors or synchronous condensers at the commercial enterprise or at the service entrance of the factory [3]. In other cases, if the power factor is particularly low, it may be necessary to correct the power factor of the device or machine individually by connecting an PFC or APFC panel across the device [4]. There are two techniques by which the power factor can be compensated, namely 1. Active Power Factor Compensation 2. Passive Power Factor Compensation

**Active Power Factor Compensation:** Active PFC is a power electronic system that modified the wave shape of current drawn by a load to correct the power factor. The reason is to make the power factor corrected appear purely resistive so that the voltage and current are in phase and the reactive power consumption is zero. This allows the most efficient distribution of electrical power from the power company to the consumer. There are few types of active PFC which are Boost, Buck and Buck-boost.

**Passive Power Factor Compensation:** Passive PFC needs lager inductor than active PFC but it still cost less. This is an easy way to correct the non-linearity in a load by using capacitor bank but it is not as effective as active PFC. These power factor correction techniques are used at different industries and in different fields such as motor control centres, utility energy meters, at substation transformers and at those industries where, inductive loads are more.

*2. Harmonic reduction in power factor control (PFC)*

When there is the need of Power Factor Control (PFC) technique, there is also the production of the harmonic contents due to the presence of passive electrical and electronic components in the network. In order to reduce this harmonic content, in this paper the study has been described which is based on the experimental observations and results simulated in the MATLAB software.

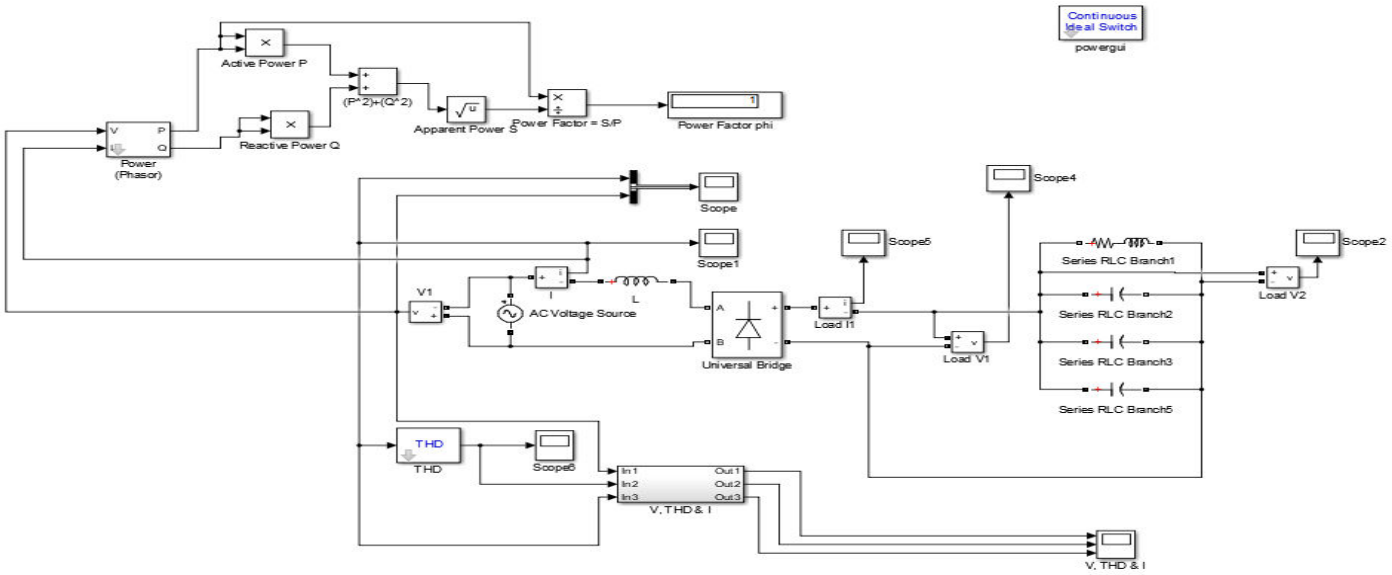


Fig. 1. Circuit diagram of PFC Before Harmonic Correction

As shown in the above given fig. 1, first of all, for the necessity of compensating the reactive power inducing due to the inductive loads, the power factor correcting unit must be connected across the load(having resistance of 230Ω and inductance of (260mH)

by giving it a diode/thyristorized power input. Now, the main problem of harmonic contents comes here, which are produced due to the presence of capacitors (each of 130uF) connected in parallel to the load. Hence, by observing the results in MATLAB, there came a conclusion that there should be a "**DIODE"** provided across the load so that it can protect the capacitor from short circuiting and blowing during its initial ON state. This results in effective distribution of current in the circuit, which can reduce the circuit failing probability further decreasing the risk to the load.

### 3. Experiment and Result

As the network simulation is carried out using MATLAB SIMULINK software, the below given figure 2 is the Waveform of the Total Harmonic Distortion vs Time(seconds) when there was no harmonic reduction. The X-axis represents time in seconds and the Y-axis represents THD, which must be as small as possible. We already know that the Total Harmonic Distortion must be minimum, and figure 2 clearly show us that without Harmonic reduction, the THD is nearly about 0.05to 0.025 which can be regarded as nearly 2.5% to 5%. Similarly, figurer 3 shows the waveform of Voltage, THD and Current respectively.

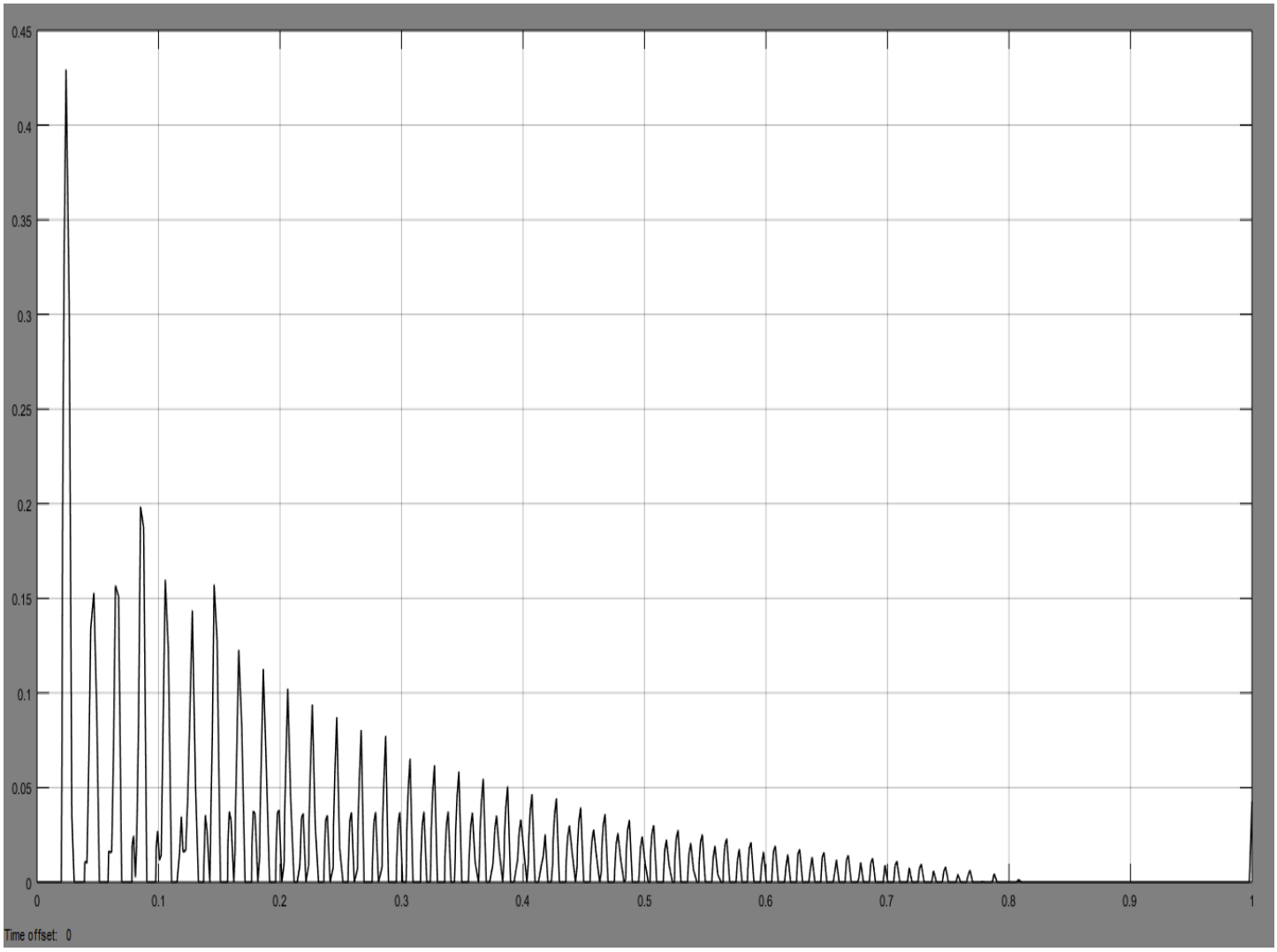


Fig. 2. Waveform of THD Before Harmonic Reduction

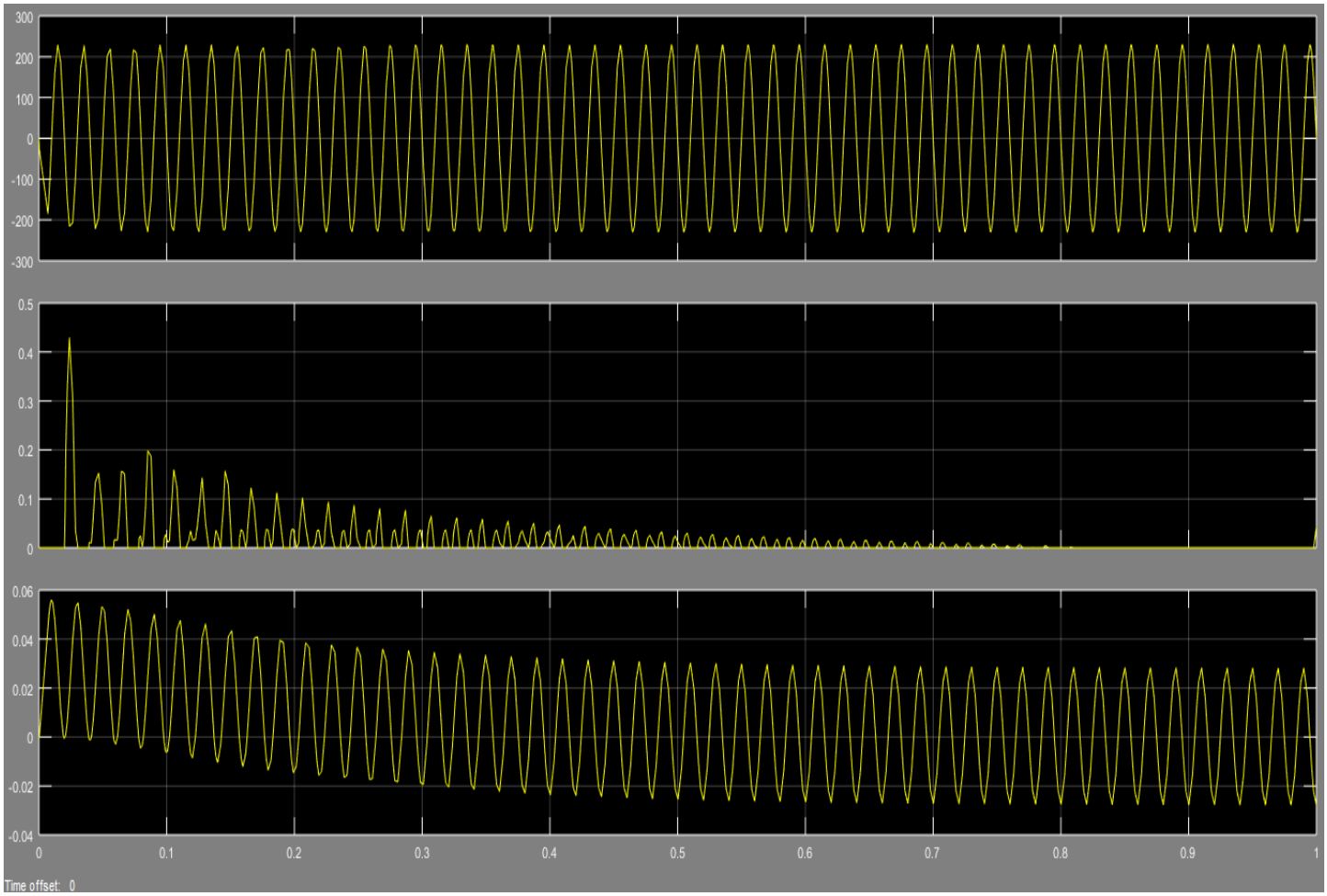


Fig. 3. Waveform of Voltage, THD and Current Before Harmonics Reduction

From the above given graph 3, it can be clearly regarded that the current waveform unevenly changes it's amplitude (from high to low) due to the induction of harmonics in the system. This cannot be permissible as the load needs the current constant as per its requirement.

Hence, in order to reduce the harmonics to a certain limited value, there must be the introduction of some passive component in the network. This has been overcome by the introduction of a diode in parallel with a series RC snubber circuit. In ON-state, the diode model has an internal resistance and inductance. For most applications, the internal inductance should be set to zero. The diode's impedance is infinite in OFF-state mode. The simulation of the model for the same is shown in the below given figure 4 that is the circuit diagram of the harmonic reduction technique. It depicts that the harmonics contents can be reduced by keeping the power factor constant (here it is unity due to the proper values of capacitors across the load) as it was before the harmonic reduction.

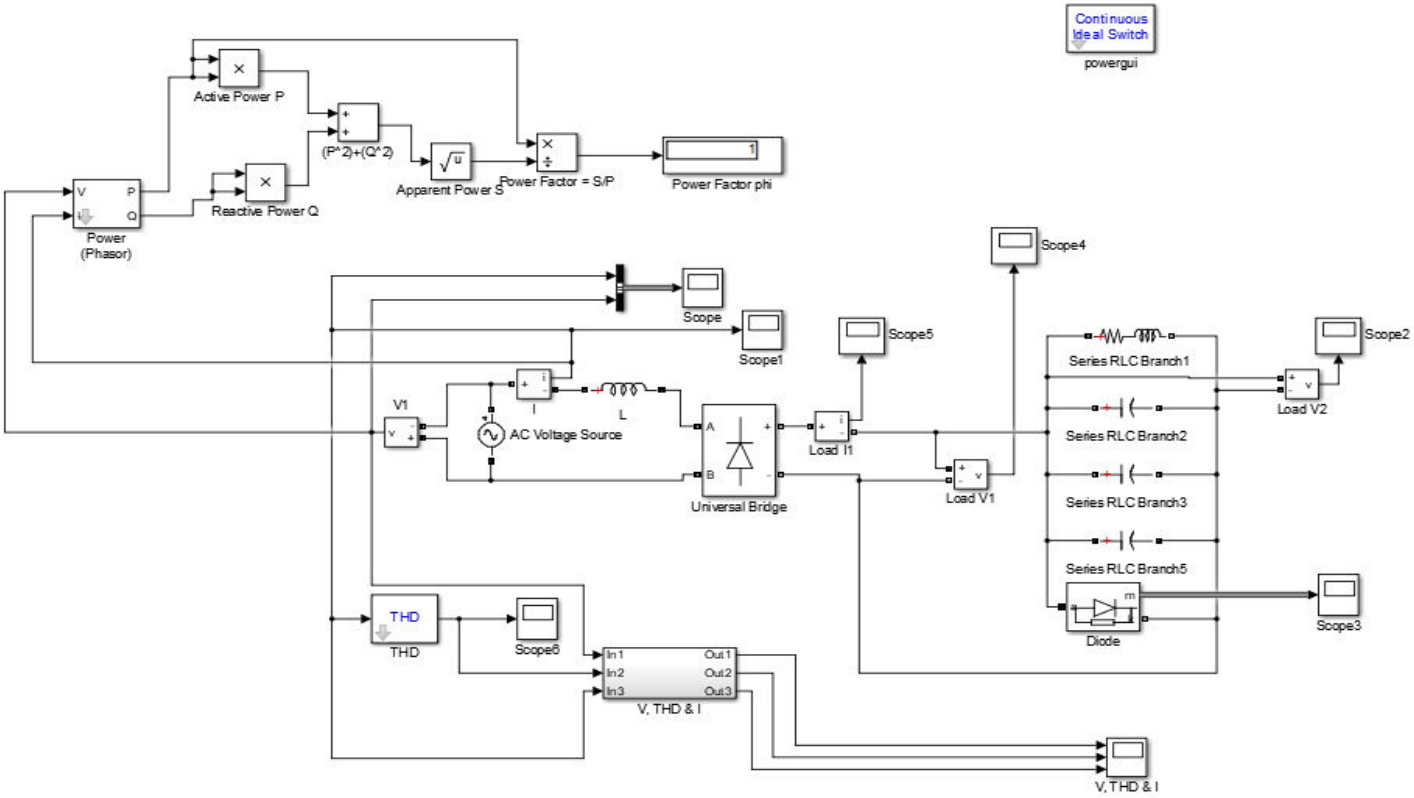


Fig. 4. Circuit Diagram After Harmonic Reduction

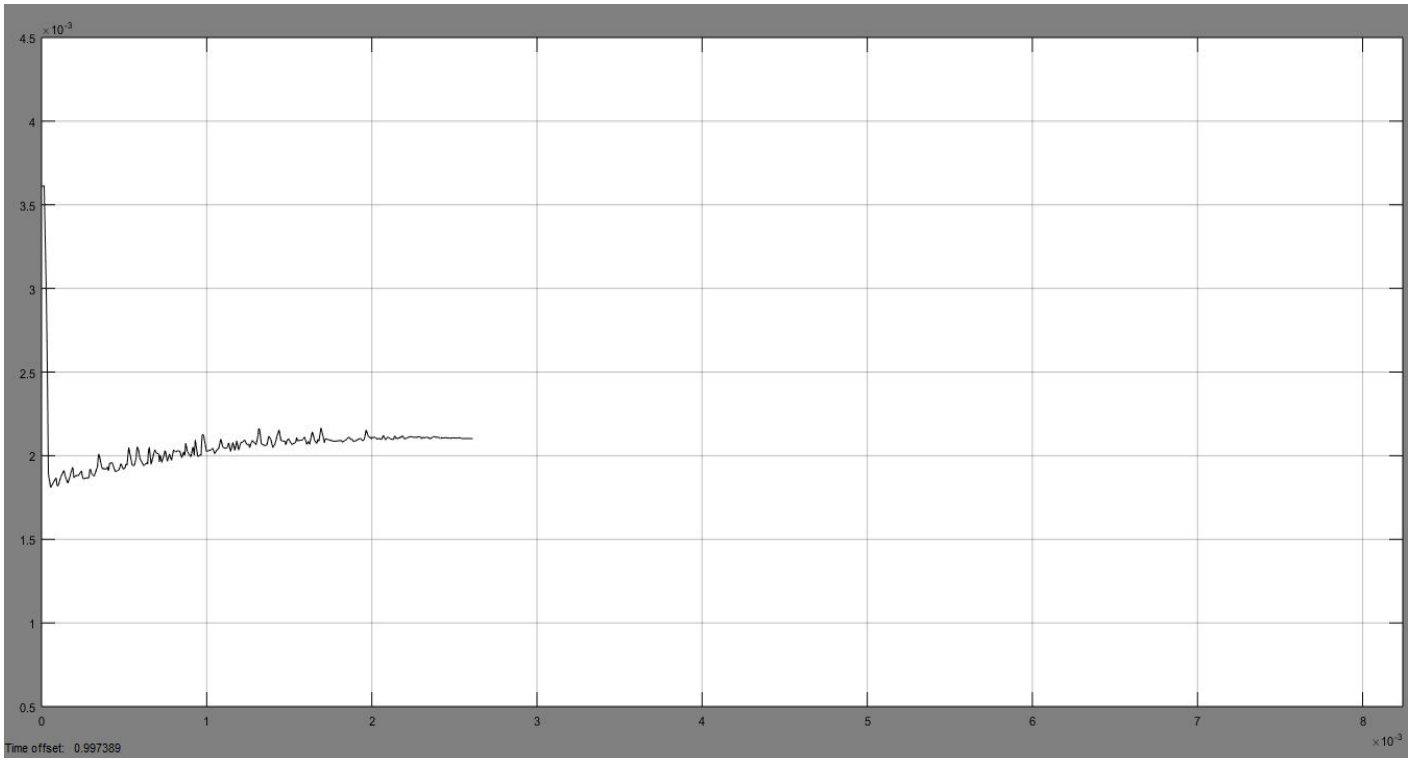


Fig. 5. Waveform of THD After Harmonic Reduction

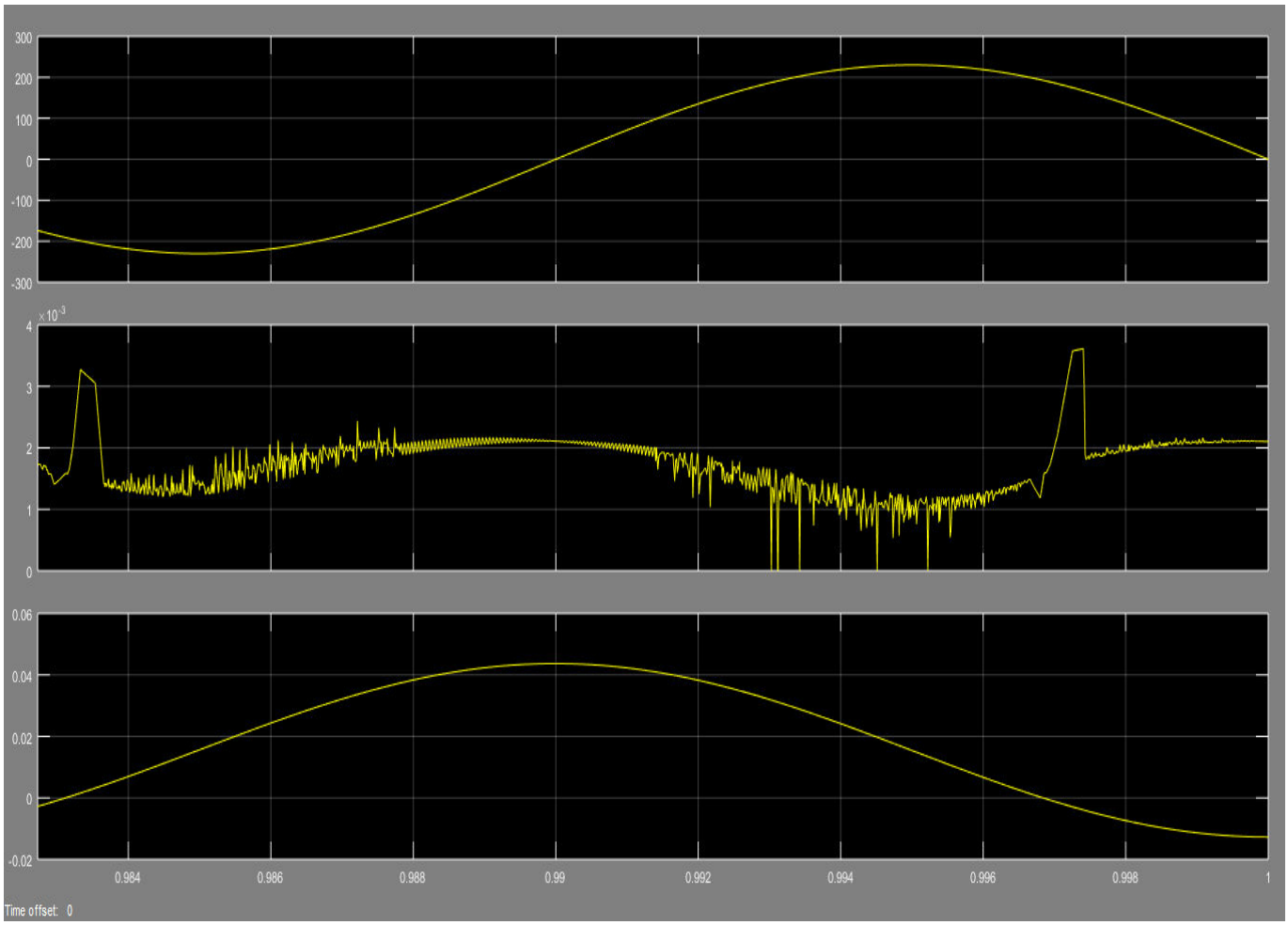


Fig. 6. Waveforms of Voltage, THD and Current After Harmonic Reduction

The above given figure 5 shows that after connecting the diode across the load and capacitors, there is an effective decrement in the harmonic contents of the system which directly decreases to 10 to the power of (-3) means to millis and reduces the THD to 0.0021 to 0.0018 that is 0.2%-0.18%, which is completely permissible. Further, figure 6 explains that by reducing the harmonic contents, the current waveform of the system gets even and there will not be any fluctuations in the load.

## 4. Conclusion

By studying and observing the above discussed theory, we can conclude that in order to reduce the number of ripples occurring in the output waveform produced due to the harmonics, there must be introduced a diode along with it's snubber circuit, the diode being connected across the capacitor bank as it readily provides a solution of reduction of harmonic contents of the network. Also the harmonic contents can be reduced from 2.5%-5% to 0.19%-0.21% by using this method which is clearly explained in this paper.

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# Design and Route Cause Analysis of Hot Air Chamber

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**Abstract**

The recent tread of industrial required different types of hot air chambers for different purposes like chemical, petroleum, food, and agriculture industries for drying such components, dies, vegetables, food for such temperature. These are the industrial problem which having existing design there were thermal losses in the chamber due to such internal arrangement and improper design of door lock so we will do find different route causes of losses hot air in hot air chamber according to modified as per customer need. We will be using such CAD tools likes Solid Works 2016 for 3 D Modeling and also analyze such components for modification then conclude our project.

*Keywords*: Desgin, Route Casue Analysis, Hot Air Chamber, Improvement, Performance Nomenclature

## 1. Introduction

Hot air ovens are electrical devices that use dry heat to sterilize. They were originally developed by Pasteur. Generally, they use a thermostat to control the temperature. Their double-walled insulation keeps the heat in and conserves energy, the inner layer being a poor conductor and the outer layer being metallic. There is also an air-filled space in between to aid insulation. An air circulating fan helps in uniform distribution of the heat. These are fitted with the adjustable wire mesh plated trays or aluminum trays and may have an on/off rocker switch, as well as indicators and controls for temperature and holding time. The capacities of these ovens vary. Power supply needs vary from country to country, depending on the voltage and frequency (hertz) used. Temperature-sensitive tapes or biological indicators using bacterial spores can be used as controls, to test for the efficacy of the device during use.

Fig. 1. Hot Air Oven

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*1.1 Usage*

A complete cycle involves heating the oven to the required temperature, maintaining that temperature for the proper time interval for that temperature, turning the machine off and cooling the articles in the closed oven till they reach room temperature. The standard settings for a hot air oven are:

- 1.5 to 2 hours at 160 °C (320 °F)
- 6 to 12 minutes at 190 °C (374 °F)

Plus, the time required to preheat the chamber before beginning the sterilization cycle. If the door is opened before time, heat escapes and the process become incomplete. Thus, the cycle must be properly repeated all over.
These are widely used to sterilize articles that can withstand high temperatures and not get burnt, like glassware and powders. Linen gets burnt and surgical sharps lose their sharpness.

*1.2 Advantages and Disadvantages*

They do not require water and there is not much pressure build-up within the oven, unlike an autoclave, making them safer to work with.
This also makes them more suitable to be used in a laboratory environment. They are much smaller than autoclaves but can still be as effective.
They can be more rapid than autoclave and higher temperatures can be reached compared to other means.
As they use dry heat instead of moist heat, some organisms like prions, may not be killed by them every time, based on the principle of thermal inactivation by oxidation.

## 2. Literature Review

K.Nagendra Babu, P.Sudheer Kumar, D.Yamuna (2019) [1] were represented Solar energy heating apparatus to dry food and other crops that can enhance the quality of the product while reducing the wasted product. Drying is an eminent way to preserve the food and solar energy food drying is an approximate food preservation mechanism for a sustainable real world. This fixed solar dryer has the capacity of 15 kg which is used for the preservation, drying of grapes, potatoes, onions, mango pulp, chilies, green leafy vegetables, jack fruit pulp, green pepper, herbal medicines, ginger, etc., more than 50 kinds have been dried using this solar dryer at various AKRUTI'S. Drying will generally refer to the removal of moisture content by evaporation rather than by pressure or other physical parameters. Our country is blessed with ample solar energy around the year. The principle of this dryer is that hot air is lighter than the cool air and it raises the altitude. While raising this warm air comes in contact with food slices and draws the moisture from it. The repeated cycle of this process makes it a low cost, very healthy, long term investment. Generally, the sun's power of heat is used to dry up the moisture content of the fruits or vegetables.

Faiza Jamil, Rizwan Arshad, Dr. Muhammad Azhar Ali (2018) [2] was presented solid residue that remains after fresh fruits are squeezed for their juices. Pakistan is among the top ten citrus producing countries in the world. Pakistan is contributing 2.16 million tons per annum in fruit waste generation. Fresh food waste is often used locally to feed animals as milk enhancers. When fresh fruit is squeezed, a solid residue is produced which is commonly known as citrus waste. Fresh citrus waste has a natural acidity, but it is still a perishable product due to its high moisture content and soluble sugar. Dehydration method is usually applied for the removal of moisture content up to less than 10 % to increases the shelf life for easy handling and transportation. The present study enables the design of a rotary-hot air dryer having an internal rotating body. The drying efficiency increased with the increase in the internal temperature and the airflow rate in the rotary drum, while the drying efficiency decreases with increasing the drum speed. The drying process provided the optimal results concerning drying time and Vitamin C concentration. The present designed hot-air dryer provides fundamentals for the fruit pulp industry who can easily adopt this technology. This dryer can be installed within the pulp industry and waste can be processed at the source point. The dehydration process increases the shelf life of citrus fruit waste, and it will be available throughout the year around the country. The dehydrated material can enhance the milk quantity of animals.

Miguel Andrés Daza Gómez, Carlos Andrés Gómez Velasco (2018) [3] had represented growing considerably due to the great demand to have non-perishable food. Convective drying is one of the most popular equipment in the drying industry (food, chemical, pharmaceutical, etc.). One of the drawbacks of this equipment, when it is used for convective drying, is the non-uniformity in the final product quality. This study presents the development of a mathematical model trough Computational Fluids Dynamics (CFD). The drying chamber of a heat pump dryer is assessed from a drying air velocity and temperature profiles perspective. The model was developed by solving different transport phenomena related equations. The established procedure was set up to evaluate the distribution of drying air velocity and temperature on the drying chamber to define the need for redesigning it. The profile results of the air velocity and the temperature show that there is a need to redesign the chamber. Only trays 2, 3,

and 4 are the ones that could achieve the drying of the products. The proposed solution is to implement air distributors or to modify the tray positioning to make the distribution of the drying air and temperature homogeneous.

Lyes Bennamoun, Patricia Arlabosse, Angélique Léonard (2018) [4] had represented to give the fundamental information that should be known about wastewater sludge drying. Three methods are mainly applied: convective drying, conductive drying, and solar drying, each one presenting different characteristic. When applying convective drying three phases are distinguished: adaptation phase, constant drying rate phase and falling drying rate phase. Experimental works show that several parameters influence the drying kinetic during this process, such as the origin of the sludge and operating conditions. Imaging techniques allow observing three phenomena that happen during convective drying: shrinkage, cracks and skin formation. When applying conductive drying and considering the torque variations, the product passes through the pasty phase, lumpy phase, and granular phase. The results show no regular shape of the drying kinetic with high values of the drying rate and the heat transfer coefficient during the first phase. A special focus is given into the sticky phase which reduces performances of the dryer. The third applied drying method is solar drying, which depends wholly on climatic conditions, such as solar radiations and air temperature. Besides, for this method, no regular shape of the drying kinetic can be observed, with high drying rate values during favorable conditions and low drying rate values during unfavorable conditions. The presented studies dealing with solar drying of wastewater sludge are limited to the variations of the different air temperatures registered inside and outside the drying chamber with the product temperature and their humidity with the study of the pathogen reduction. Finally, some innovative developed methods are exposed in this review, such as the use of frying and superheated steam.

J. A. K. M. Fernando and A. D. U. S. Amarasinghe (2017) [5] had represented the properties of compressed coir pith discs that were analyzed. Coir pith particles were oven-dried in the range of temperatures from 100 to 240 °C and the rehydration ability of compressed coir pith was evaluated by finding the volume expansion. The optimum drying temperature was found to be 140 °C. Hot air drying was carried out to examine the drying kinetics by allowing the coir pith particles to fluidize and circulate inside the drying chamber. Particle motion within the drying chamber closely resembled the particle motion in a flash dryer. The effective moisture diffusivity was found to increase from 1.18 × 10−8 to 1.37 × 10−8 m2/s with the increase of air velocity from 1.4 to 2.5 m/s respectively. Correlation analysis and residual plots were used to determine the adequacy of existing mathematical models for describing the drying behavior of coir pith. The empirical models, Wang and Singh model, and linear model were found to be adequate for accurate prediction of drying behavior of coir pith. A new model was proposed by modifying the Wang and Singh model and considering the effect of air velocity. It gave the best correlation between observed and predicted moisture ratio with a high value of the coefficient of determination (R2) and lower values of root mean square error, reduced Chi-square ($\chi 2$) and mean relative deviation (E%).

S. Janjai, C. Phusampao, W. Nilnont, P. Pankaew (2014) [6] had represented experimental performance and modeling of a greenhouse solar dryer for drying macadamia nuts. The dryer consists of a parabolic roof structure covered by polycarbonate sheets on a concrete floor. The dimension of the dryer is 9 m in width, 12.4 m in length and 3.45 m in height. Six 15-W DC fans powered by two 50-W PV modules were used to ventilate the dryer. The dryer was installed at a macadamia nut producer in Loei Province, Thailand. To investigate its performance, the dryer was used to dry six batches of macadamia nuts. For each batch, 730 kg of in-shell macadamia nuts were dried in the dryer. Results obtained from this investigation showed that drying air temperatures in the dryer varied from 30°C to 65°C. The drying time for macadamia nuts was within 5 days and the good quality dried product was obtained. To model the performance of the greenhouse solar dryer, a system of partial differential equations describing heat and moisture transfer during drying of the macadamia nuts in the dryer was formulated. This system of partial differential equations was solved numerically using the finite difference method. The simulation results agreed well with the experimental data for the solar drying of the macadamia nuts. The estimated payback period of the dryer is 1 year.

Chandrakumar B Pardhi and Jiwanlal L Bhagoria (2017) [7] had represented the controlled condition of drying experiments, a mixed-mode solar dryer with forced convection using smooth and rough plate solar collector was constructed. This paper describes the development of dryer considerations followed by the results of experiments to compare the performance of the smooth and the roughed plate collector. The thermal performance of a solar collector was found to be poorer because of low convective heat transfer from the absorber plate to air. Artificial rib roughness on the underside of the absorber plate has been found to considerably enhance the heat transfer coefficient. The absorber plate of the dryer attained a temperature of 69.2°C when it was studied under no-load conditions. The maximum air temperature in the dryer, under this condition, was 64.1°C. The dryer was loaded with 3 kg of grapes having an initial moisture content of 81.4%, and the final desired moisture content of 18.6% was achieved within 4 days while it was 8 days for open sun drying. This prototype dryer was designed and constructed to have a maximum collector area of 1.03 m2. This solar dryer has been being used in experimental drying tests under various loading conditions.

Suhaimi Misha, Sohif Mat, Mohd Hafidz Ruslan, Kamaruzzaman Sopian, and Elias Salleh, (2013) [8] had represented the most extensively used because of its simple and economic design. In a tray dryer, more products can be loaded as the trays are arranged

at different levels. The product is spread out on trays at an acceptable thickness. The drawback of this dryer is non-uniformity in the desired moisture content of the end product due to poor airflow distribution in the drying chamber. Computational fluid dynamics (CFD) are used extensively because of their capability to solve equations for the conservation of mass, momentum, and energy using numerical methods to predict the temperature, velocity, and pressure profiles. This research is to predict drying uniformity of the new design of the commercial tray dryer for agricultural products. The temperature and velocity profile, streamline and velocity on each tray were analyzed to study the uniformity of the drying. The 3D simulation is done to represent the actual model. Generally, the temperatures are considered uniform for all trays. However, the average air velocity at several trays which is at tray number 1, 7, 8 and 15 are much higher than other trays. The rest of the trays are looking more uniform. The average air velocity above the tray is about 0.38 m/s.

*2.1 Design Analysis of Hot Air Oven*

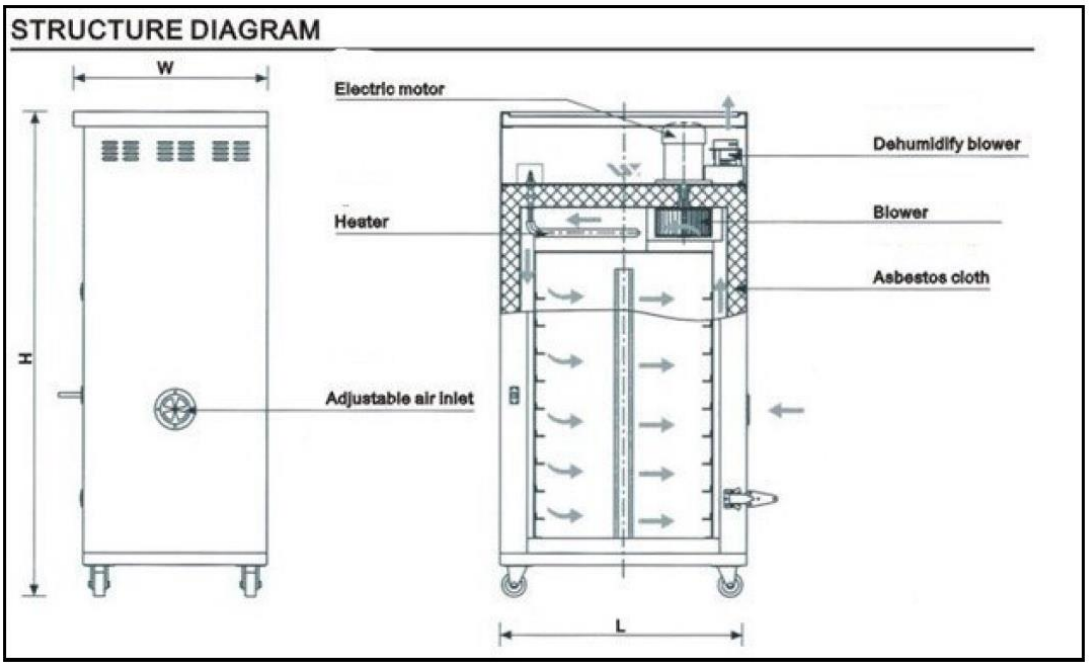


Fig. 2. Structure Diagram of Hot Air Oven

Hot air oven is a device used for heating applications such as drying and sterilizing dental tools, surgical tools, so other, this device is thermostatically controlled and electrically heated [9].

The hot air oven does not require water and there is not much pressure build-up within the oven, unlike an autoclave, making them safer to work with. This also makes them more suitable to be used in a laboratory environment. They are much smaller than autoclaves but can still be as effective. They can be more rapid than autoclave and higher temperatures can be reached compared to other means. As they use dry heat instead of moist heat, some organisms may not be killed by them every time.

*2.2 The parts of the oven*

1. Mechanical part.
2. Electric part.

1. Mechanical part:

1. The Coat (outer shield).
2. Fiberglass.
3. The chamber.
4. The shelves (mesh).

1. *The coat:*

The coat is made of aluminum or stainless steel because it is characterized by the following:

a) Resisting the mechanical shocks
b) Resisting the oxidation.
c) Rectangular solid shape to be easily placed anywhere in the laboratory.
d) The coat consists of several surfaces an isolator material prevents heat from getting outside.

2. *Fiberglass:*
There are two types of fiberglass:
a) Brown fiberglass: be somewhat cheap, but it is a dangerous substance because it causes inflammation in the respiratory system and should be careful in dealing with [10].
b) Yellow fiberglass: available by variously and it is less dangerous than the brown, the skin is sensitive to it and should wear gloves when dealing with. The advantage of fiberglass is a good insulator of heat, and it is used in the oven to prevent the transfer of heat from inside the device to the outside and maintain the internal temperature.

3. *The chamber:*
The chamber is completely made of aluminum or stainless steel because it has the following characteristics:
a) Rectangular solid shape to suit dealing with various objects.
b) It has thermally insulated from all other parts of the oven to prevent effective on them.
c) It has ribs to put shelves in the wanted levels.
d) It is made from materials characterized by oxidations' resisting.

4. *The shelves (mesh):*
They are plates on which the objects are placed, the number of shelves is varying according to the number and size of objects, t the oven capacity [11]. It characterized by:
a) They are made of aluminum which is considered as oxidation resisting material.
b) When they are placed in their locations on the ribs some area is lifted to allow movement of air, some shelves contain openings to help this purpose.

2. *Electric part:*
1. The power supply.
2. The heater.
3. Thermostat.
4. Temperature indicator (thermometer).
5. Timer.
6. Fuses.
7. Control panel.

*1. Power supply:*
The used supply in the oven is 220v – 50Hz transformer and rectifying circuit (AC to DC convert) to run the control panel if the parameters, numeric or other departments in the modern fashion.

*2. The Heater:*
The electric heating system is the system in which heating produce by rising temperatures caused by the passing of electric current through a conductor having a high resistor to current flow. Generally, they can be operated from 50 to 300 °C. The heaters can be used for hot air oven applications with the following voltages:
• 347 volts/1 phase
• 600 volts/1 phase
• 600 volts/3 phases
• 208/240 volts/1 phase
• 208 volts/3 phases
The heater element has the following characteristics:
1- High resistance.
2- Electrical insulation.
3- Thermal conductivity.

There are 6 types of heaters used in the dry oven:
1- One side circular type heater.
2- One side U type heater.
3- One side wave-type heater
4- One side square type heater
5- Three sides type heater.
6- Four sides type heater.

3. *Thermostat:*
It is a semiconductor made of ceramic, it characterized by having thermal resistance with a high negative temperature coefficient, this means the resistance of thermostat decrease as temperature increases and vice versa. So it is a sensor of heat connecting directly with heater and the separation of the heater in certain degrees to obtain the temperature we need as needed and also used to protect the device [12].

*4. Temperature indicator:*
Two's way is used in temperature indicator there are thermometer and thermocouple & Identified for the internal temperature.

*5. Timer:*
There are two types of timers electrical or mechanical at a range 5-60 min given period required for sterilization.
*6. Fuse:*
To protect the circuit from the high current due to the high loads or short circuits.

## 3. Specification of Hot Air Oven (EIE-101)

Fig. 3. Hot Air Oven (EIE-101)

- Internal circuit wiring as per CE norms.
- 65mm high-density glass wool insulation on all sides to offer minimum chamber heat loss.
- The oven is fitted with heating elements on all three sides, ensuring uniform temperature distribution throughout the working chamber.
- Sealed and enclosed heaters to the working chamber for minimum heat loss.
- 80/20 chrome heating elements, ensuring long-lasting and continuous heating within the chamber.
- Special heavy-duty stainless-steel lock and door hinges with spring and roller mechanism.
- Stainless steel crimped wire mesh shelves to withstand heavy load and to offer minimum resistance to air circulation for better heat distribution.
- Provision to add more shelves, as per requirement or test adjustable shelves to place test samples or glassware of varying dimensions.
- Adjustable air ventilation mounted at the top.
- Operation on 220/330 Volt, 50 Hz, Single Phase, AC supply.
- With built-in forced air circulation arrangement for uniform heat distribution inside the working chamber.
- Complete with pilot indicating lamps, 2-meter cord wire, and power plug.

Technical Specification of Hot Air Oven

- Inner working size: 45 X 45 X 45 CM (H X W X D)
- Chamber volume: 91 liters
- No. of trays: 2 No. (Additional shelf at extra cost)
- Rating: 1.5 KW
- Outer Chamber: CRC powder coated
- Inner chamber: Made of stainless-steel S.S. 304 – mirror polished material
- Temperature range: 50°C to 250°C
- Controlling System: Microprocessor-based Auto-Tune – PID controller
- Control: ± 1°C or better
- Power Consumption: 220/230 Volt, 50 Hz, Single Phase, AC Supply.

## 4. Conclusion

The research survey was represented basic research on dryer system in different areas likes' development, design, and fabrication, etc.

Some research paper indicated about the different range of hot air chamber likes fixed solar dryer, rotary hot air dryer, convective drying chamber, drying process to wastewater sludge, hot air drying of coconut coir pith, greenhouse solar dryer, mixed-mode solar dryer with forced convection, tray dryer system, etc. As per the instruction of design engineer, we were analyzed of existing hot air oven base structure static analysis in Solid works 2016 as per given boundary and loading condition which gives as a result of von mises stress and deformation were 0.490169 MPa and 0.00172974mm respectively. As per the result of the existing product, there was no issue in base structure so only change the internal and external design will be modified. After feedback of customer and technical aspect to change both internal and external design of existing hot air oven.

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# Design of NEU type Shell and Tube Heat Exchanger

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**Abstract**

Shell and tube heat exchangers are the most commonly used heat exchangers given their robust construction, ease of fabrication and cheaper to fabricate & maintain. This work was carried out to design a NEU type shell and tube heat exchanger as per TEMA and ASME standards for high pressure, high temperature gaseous helium application and discusses in detail about the thermal design and mechanical design of the heat exchanger.

*Keywords*: TEMA, NEU, ASME

**Nomenclature**

*TEMA: Tubular Exchangers Manufacturer's Association*
*ASME: American Society of Mechanical Engineers*
*MAP N&C: Maximum Allowable Pressure New & Cold conditions*
*MAWP H&C: Maximum Allowable Working Pressure Hot & Corroded Conditions*

## 1. Introduction

Shell and Tube heat exchangers are the most versatile type of heat exchangers used in process industries, oil & gas industries conventional and nuclear power plants as condensers, evaporators, steam generators and feed water heaters and applied for various energy applications like thermal, air conditioning and refrigeration, off-shore etc. These types of exchangers are generally of indirect contact type i.e., the heat is exchanged without the hot and cold fluid getting mixed. These are built of number of round tubes stacked in a tube bundle and mounted in a large cylindrical shell with the tube axis parallel to that of the shell. The simplest form of a horizontal shell-and-tube type heat exchanger with various components is shown in Figure 1 [1].

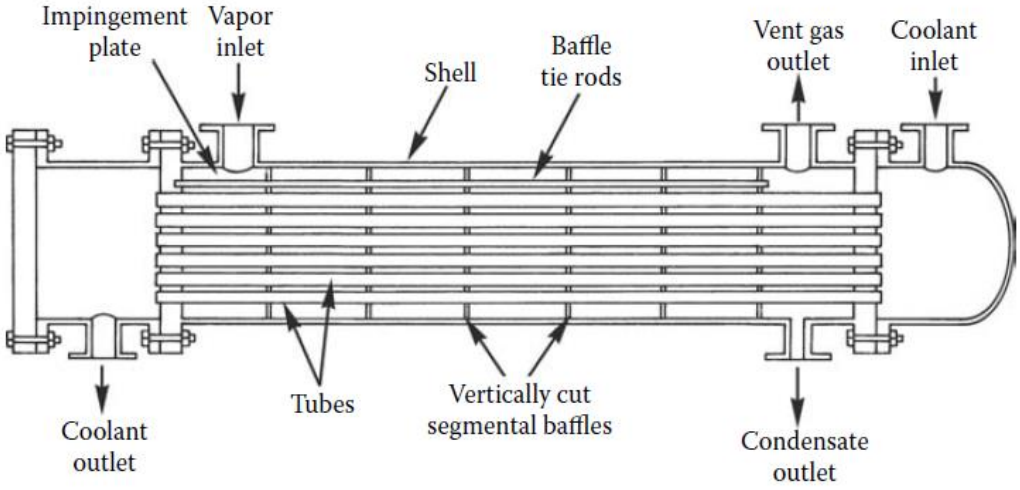


Fig. 1. Various Components of Shell and Tube Heat Exchanger

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## 2. Literature survey

An exhaustive literature survey was conducted to analyze on-going works related to design optimization and obtaining best performance of heat exchangers for their application in high pressure, high temperature closed loops. As per [2], a parametric study was studied to understand the effect of various variable factors like shell diameter, baffle spacing, tube length, fouling factor etc on the overall heat transfer coefficient and pressure drop of the heat exchanger. Similarly, as per [3], selection of proper tube layout is critical to the performance of the heat exchanger.
Finally, in [4] and [5], it is studied that these types of exchangers have wide application in critical high pressure, high temperature closed gas loops. These exchangers can also be used for future fusion power plants too.

## 3. Discussion on design and analysis

### *3.1. Input parameters*

The input parameters for performing the thermal and mechanical design of the heat exchanger are presented in Table-1.

Table 1. Input parameters

| Parameters | Shell Side | | Tube Side | |
|---|---|---|---|---|
| Fluid | Water | | Helium Gas | |
| Flow rate (kg/s ) | 1.5 | | 0.4 | |
| Operating pressure (bar) | 3.0 | | 80.0 | |
| Design pressure (bar) | 5.0 | | 100.0 | |
| Operating temperature (C ) | 35 | <55 | 120 | 60 |
| Design temperature (C ) | 75 | | 150 | |
| Material of construction | SS316L | | | |

### *3.2. Discussion on thermal design aspects*

Selection of proper type of heat exchanger is a critical factor for performance of the heat exchanger. As per TEMA standards, various standard nomenclatures of exchangers are available but looking into the critical nature of helium gas application and given input parameters, NEU type was selected. “N” type front head has a channel integral with tube-sheet and removable cover. “E” type shell is a one pass shell to accommodate the tubes and “U” is a U-type tube bundle to take care the thermal expansion of the tubes due to high temperature difference of helium gas.
The given input parameters as mentioned in table -1 were used for performing thermal design i.e., sizing and rating of the heat exchanger on HTRI software. Below are the brief details of the results presented in table 2. Also, the tube layout and elevation view of the exchanger is presented in figure 2.

Table 2. Thermal design results

| Parameters | Result |
|---|---|
| TEMA Class | C |
| Shell Diameter | 154 mm |
| Tube (OD and Thickness) | OD = 9.52 mm, t = 1.25 mm |
| Tube Length | 1200 mm |
| No. of tube passes | 2 |
| Type of tube | Plain |
| Tube layout | Triangle (30°) |
| Tube pitch | 12.5 mm |
| No. of U-tubes | 76 |
| No. of Baffles | 10 |
| Overall heat transfer coefficient | 1695 $W/m^2K$ |
| Pressure drop in tube side | 0.34 bar |
| Surface Area | 2.8 $m^2$ |
| Rating | 125 KW |

The above results of the thermal design were validated using [6] having following set of analytical equations:

- Sizing of heat exchanger (Ao)

$$A_o = \frac{Q}{u_o \Delta T_{lm}} = \frac{Q}{u_o F \Delta T_{lm,cf}}$$

- Overall heat transfer coefficient (Uo)

$$\frac{1}{u_o} = \frac{A_o}{A_i}\left(\frac{1}{\eta_i h_i} + \frac{R_{fi}}{\eta_i}\right) + A_o R_w + \frac{R_{fo}}{\eta_o} + \frac{1}{\eta_o h_o}$$

- Heat load (Q)

$$Q = (\dot{m}c_p)_c (T_{c2} - T_{c1}) = (\dot{m}c_p)_h (T_{h1} - T_{h2})$$

- Total number of tubes (Nt)

$$N_t = 0.785 \left(\frac{CTP}{CL}\right) \frac{D_s^2}{(PR)^2 d_o^2}$$

- Shell diameter (Ds)

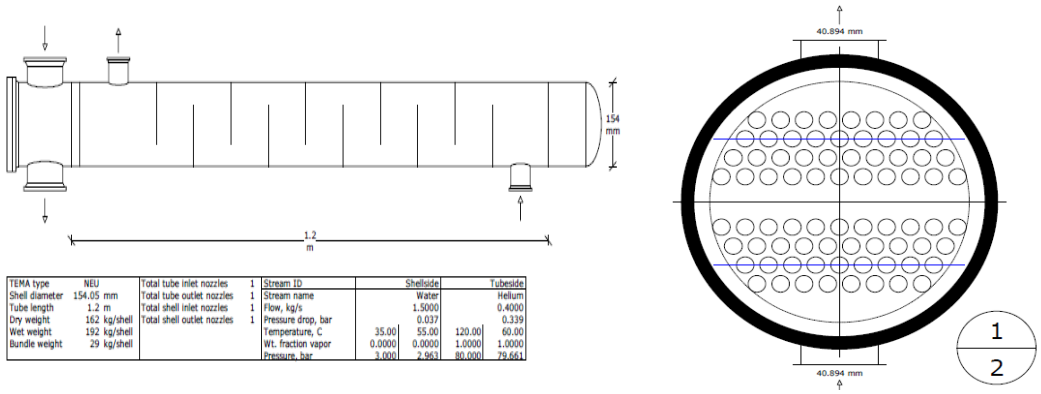
$$D_s = 0.637 \sqrt{\frac{CL}{CTP}} \left[\frac{A_o (PR)^2 d_o}{L}\right]^{1/2}$$

- Shell side pressure drop ($\Delta p_s$)

$$\Delta p_s = \frac{f G_s^2 (N_b + 1) D_s}{2 \rho D_e \phi_s}$$

- Tube side pressure drop ($\Delta p_t$)

$$\Delta p_t = 4 N_p \frac{\rho u_m^2}{2}$$




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| TEMA type | NEU | Total tube inlet nozzles | 1 | Stream ID | | Shellside | Tubeside |
| Shell diameter | 154.05 mm | Total tube outlet nozzles | 1 | Stream name | | Water | Helium |
| Tube length | 1.2 m | Total shell inlet nozzles | 1 | Flow, kg/s | | 1.5000 | 0.4000 |
| Dry weight | 162 kg/shell | Total shell outlet nozzles | 1 | Pressure drop, bar | | 0.037 | 0.339 |
| Wet weight | 192 kg/shell | | | Temperature, C | 35.00 | 55.00 | 120.00 | 60.00 |
| Bundle weight | 29 kg/shell | | | Wt. fraction vapor | 0.0000 | 0.0000 | 1.0000 | 1.0000 |
| | | | | Pressure, bar | 3.000 | 2.963 | 80.000 | 79.661 |

Fig. 2. Elevation and tube layout of NEU type heat exchanger

*3.3. Discussion on mechanical design details*

The output results of thermal design were used to perform the mechanical design. PVElite software was used to perform the mechanical design as per ASME Sec. VIII Div.1 code. The following load cases were considered for performing the mechanical design of the heat exchanger:

1. Design pressure (P)
2. Static head of fluid (Ps)
3. Dead weight of the vessel, supports etc; (D)
4. Imposed loads on the nozzles (L)
5. Seismic load (S)

Following load combinations w.r.t. table 4.1.2 of part4 of ASME Section-VIII Div.1 [7] were used for performing stress analysis:

1. P + Ps +D
2. P + Ps + D + L
3. P + Ps + D + S
4. 0.9P + Ps + D + 0.75L + 0.75S
5. 0.9P + Ps + D + (W or 0.7E)
6. 0.9P + Ps + D + 0.75 (W or 0.7E) + 0.75L + 0.75S
7. 0.6D + (W or 0.7E)

Based on the above load combinations, the stress analysis was performed on PVElite. The result of stress analysis for the shell and tube side is presented in table-3.

Table 3. Maximum pressures and thickness in tube and shell side

| Maximum Pressures - Tube side (bar) | | | Thickness (mm) | Maximum Pressures - Shell side (bar) | | | Thickness (mm) |
|---|---|---|---|---|---|---|---|
| **Component** | **MAPN&C** | **MAWPH&C** | | **Component** | **MAPN&C** | **MAWPH&C** | |
| Left channel cover | 196.55 | 110.42 | 41.00 | Main shell | 288.84 | 288.84 | 22.00 |
| Left channel head flange | 106.10 | 103.53 | 28.00 | Tube bundle | 208.59 | 160.51 | 1.24 |
| Left channel | 288.84 | 288.84 | 22.00 | Tubesheet | 132.24 | 100.27 | 30.00 |
| Tube bundle | 335.62 | 335.62 | 1.24 | Right Head | 155.13 | 155.13 | 10.00 |
| Tubesheet | 133.25 | 101.28 | 30.00 | Nozzle#S1 | 161.97 | 161.97 | 3.68 |
| Nozzle#T1 | 324.63 | 324.63 | 8.74 | Welding neck flange #S1 | 15.90 | 14.30 | 12.00 |
| Welding neck flange #4 | 206.80 | 157.00 | 28.00 | Nozzle#S2 | 161.97 | 161.97 | 3.68 |
| Nozzle#T2 | 324.63 | 324.63 | 8.74 | Welding neck flange #S2 | 15.90 | 14.30 | 12.00 |
| Welding neck flange #5 | 206.80 | 157.00 | 28.00 | | | | |

## 4. Conclusion

Based on thermal and mechanical design analysis, it is safe to say that the NEU type heat exchanger design is qualified as per TEMA and ASMESection-VIIIDiv.1 for specified loading conditions. The stress values developed for the calculated thickness of shell, head, tubesheet, nozzle, saddle support, etc of heat exchanger are less than the code allowable stress values. The hydrotest pressure of the exchanger is 130 bar (g). The U-tubes serves the purpose of accommodating the thermal expansion in the tubes. The selection of welded will ensure adequate strength and minimizes the chances of helium leak.

## 5. Future work

The next work will start with creation of fabrication drawings and plan for overall fabrication in the shop floor. The detailed fabrication procedures including the NDT test techniques will be carried out in future.

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# Development of Security Platform in Fog Computing

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**Abstract**

Fog computing could also be a replacement paradigm that extends the Cloud platform model by providing computing resources on the edges of a network. Fog computing inform a decentralized computing structure, where resources, including the info and applications, get placed in logical locations between the info source and thus the cloud; it's also known by the name 'fogging' and 'fog networking.' Fog computing even have some distinguished features like geo-distribution, location awareness and low latency. Fog computing faces various sorts of security and privacy challenges. Security is one among the foremost important aspects for developing the communication applications. Many sorts of security mechanisms are developed so on realize the info security. Cryptography is one of them. it's the study of mathematical techniques that are associated with the aspects of data security like confidentiality, data integrity, authentication, and availability. Advanced Encryption Standard (AES) is one method which may be wont to secure data by encrypting and decrypting an information. AES is additionally an algorithm that features a fast encryption process and has been widely implemented in various fields. AES algorithm is known for its resistance against the known attacks, its design simplicity, fast data processing and code compactness. But whoever has the key can read the message easily. The existing algorithm uses 128, 192 and 256 bits of key size. As the size of the key increases it is hard to decrypt the encrypted text. Therefore, size of input and key are extended to 512 bits which ensures greater security. The number of rounds for processing the plain text is increased to 22, where the first 21 rounds perform all the four operations of the AES algorithm, and the final round implements three of the four operations for encryption. Decryption is done by using the inverse operations of the encryption algorithm. AES-S will be suitable for applications with high security and throughput requirements without increasing the overall design when compared to original AES-128 bits. This project with expanded key of size 512 bits can also be enhanced to be used for encryption and decryption of images.

*Keywords*: Fog computing, security, Advance Encryption standard-512 bit.

## 1. Introduction

If in this era each and each organization from large scale to small scale industries are being counting on the cloud computing technology to store their data also on use the resources as per their requirement. Cloud provides pay per use concept. at the present it seems to be ok to store and retrieve the info but because the number of devices connected to internet increases there would be a drag in storage also as information retrieval process. Hence, to beat the above problem the fog computing [Fig. 1] concept has been introduced. In cloud computing concept all the info produced from the users are going to be directly stored into the cloud then it is analysed with large warehouse analytics happening it then decisions are made to act on data and eventually notifications are pushed to act on those decisions. Fog computing is defined as a distributed computing paradigm that fundamentally extends the services provided by the cloud to the edge of the network Fog computing is a mediator between hardware and remote servers. It regulates which information should be sent to the server and which can be processed locally. In this way, fog is an intelligent gateway that offloads clouds enabling more efficient data storage, processing and analysis. Fog computing operates as a bridge between IoT devices and cloud computing.

Fog computing is defined as a distributed computing paradigm that fundamentally extends the services provided by the cloud to the sting of the network Fog computing may be a mediator between hardware and remote servers. It regulates which information should be sent to the server and which may be processed locally. In this way, fog is an intelligent gateway that offloads clouds enabling more efficient data storage, processing, and analysis.[14] Fog computing operates as a bridge between IoT devices and cloud computing [4]. Fog Computing may be a paradigm that extends the Cloud Computing services to the sting of the network. Major characteristics of Fog Computing are a) Mobility, b) Geographical dispensation, c) Low latency, d) sizable amount of nodes, e) Prominent role of wireless access, f) Presence of real time & Streaming applications, g) Diversity, h) Local location awareness [4].

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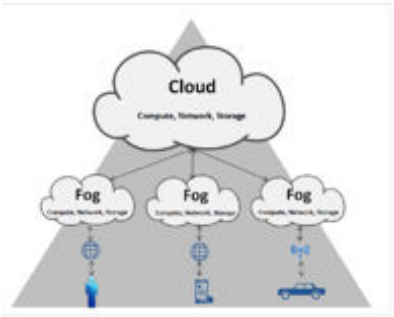


Fig. 1. Fog Computing Architecture.

In fog computing the users are going to be notified what are the actions that are needed to be taken on the info then analytics are applied on the received data and stored it into the cloud. Within the fog computing process, application involves the info not the info to the applications. Fog computing is claimed to be an extension of the cloud but not a replacement of it. Because the number of the devices connected to the web has been increasing at rapid speed and even advancement within the Internet of Things has led this number to extend drastically. Within the future, the planet would be filled with sensors and there would be huge amount of knowledge produced by these devices and storing data into cloud and retrieving is very difficult. In cloud computing there are many security issues as of man within the middle attack and even the encryption of knowledge is not safe method for cloud. It does not identify the difference between user and attacker. It does not consider the safety of the info. Twitter was one among the

Examples for the info theft within the cloud. Cloud provides various services for storing and accessing of the info during which the main problem is that failure to supply security for the info against attackers. it is not providing any level of assurance to the user about the safety of the info. Hence developing a more secured cloud is not enough because there would be continuous attacks happening on the cloud and there are chances that the info would be leaked, or it would be lost forever. Hence, fog computing came into existence which is taken into account to be the foremost secured sort of data storage.

Fog computing is a decentralized computing architecture whereby data is processed and stored between the source of origin and a cloud infrastructure. Fog computing or fog networking, also known as fogging, is an architecture that uses edge devices to carry out a substantial amount of computation, storage, and communication locally and routed over the backbone. Fog computing is defined as a distributed computing paradigm that fundamentally extends the services provided by the cloud to the edge of the network Fog computing is a mediator between hardware and remote servers. It regulates which information should be sent to the server and which can be processed locally. In this way, fog is an intelligent gateway that offloads clouds enabling more efficient data storage, processing, and analysis.[14] Fog computing operates as a bridge between IoT devices and cloud computing [4]. Fog Computing is a paradigm that extends the Cloud Computing services to the edge of the network. It provides a new category of assistance for users and applications. Major characteristics of Fog Computing are a) Mobility, b) Geographical dispensation, c) Low latency, d) Large number of nodes, e) Prominent role of wireless access, f) Presence of real time & Streaming applications, g) Diversity, h) Local location awareness [4]. This article elaborates the motivation and advantages of Fog computing, Fog computing as a platform for Internet of Things (IoT) & how it can minimize the attacks and provides security in cloud computing environment.

Currently in Fog Computing, Decoy system is getting used as current security system for authorization of knowledge. Decoy system is claimed to be a system of deception during which phony components are setup for enticing of the unauthorized users by giving vulnerabilities of a system thereby restricting unauthorized access to the network. it's a process where the files are filled with traps and are included by the service provider. This decoy system consists bogus files in it with the sensitive names like Social Security number, credit cards detail as file names thereon. These are presumably deceivable part for the attackers and there are chances that they could click thereon and check out to download it. Once they download the file, an alert is going to be generated and system are going to be notified with the attack. This decoy system method has been incorporated with the user behavior profiling where any unauthorized access is going to be notified to the system.

There are still some problems with the prevailing method resulting in hacking and accessing of knowledge in fog. This motivated us to think for encryption of knowledge within the level of fog in cloud system. Hence, during this we try to realize more security at the extent of fog by introducing encryption to the info by using the Advanced Encryption Standard algorithm technique. The paper introduces AES algorithm within the fog environment, so whenever user sends data to fog for storing within the cloud, the fog will encrypt the info and send it to the cloud. And whenever user requests for the info, the encrypted data travels from cloud

to fog and fog to finish user and therefore the data are going to be decrypted at user. The Algorithm are going to be AES which is claimed to be most advanced and secured encryption algorithm. This paper majorly focuses on implementing this algorithm in mobile device as user and even to point out which sort of dataset are going to be suitable for this type of encryption technique making use of various sorts of datasets for evaluating their performance over encryption. It includes analysing of best and worst possible cases for every of the dataset in order that suitability of AES in environment of fog are often evaluated. This paper contributes to security of knowledge by introducing AES algorithm in fog computing.

## 2. Literature Review

There are differing types of cryptography techniques used for privacy and security of the info. Encryption is broadly divided into asymmetric and symmetric encryption. Within the asymmetric encryption technique, it uses two different key- a public key (for encryption) and a personal key (for decryption). Within the symmetric encryption it uses just one key which is understood because the private key which is employed for both encryption and decryption. Symmetric encryption is extremely secured, simpler and 1000 times faster and since it uses just one secret key for both encryption and decryption i.e. less computation power needed. This paper focuses on the symmetric encryption technique called Advance Encryption Standard (AES). SHA-2 could also be a kind of cryptographic hash functions that's designed by the NSA (U.S. National Security Agency). SHA stands for Secure Hash Algorithm. Cryptographic hash functions are the mathematical operations that run on the digital data. a private can determine the data's integrity, by comparing the computed "hash" to a known and expected hash value. SHA-256 can accept messages with arbitrary lengths up to 264-bit. The Hash computation produces a final digest message of 256 bits that depends upon the input message, composed by multiple blocks of 512-bit each. This input block is expanded, and it's fed to the 64 cycles of the SHA-256 function in words of 32-bit.

Table 1. Literature Review

| AUTHOR | YEAR | TITLE | AIMS | METHOD | CONCLUSION |
|---|---|---|---|---|---|
| Shanhe Yi, Zhengrui Qin, and Qun Li | 2017 | Fog computing security: a review of current applications and security solutions | This paper also determines the impact of those security issues and possible solutions, providing future security-relevant directions to those responsible for designing, developing, and maintaining Fog systems. | AES algorithm, CAI (Confidentiality, Integrity, and Availability) | The purpose of this study was to review and analyse real-world Fog computing applications to spot their possible security flaws. The aim of those security solutions is to guard the CIA of entire Fog system and its users.[11] |
| Mithun Mukherjee | 2017 | Security and Privacy in Fog Computing: Challenges | Some of the security issues discussed are trust, authentication, secure communications in fog computing, end-user privacy, and malicious attacks. | Denial-of-Service (DoS) attack.[26] | Few solutions got on the grounds of fog network scalability, authentication and privacy-preserving schemes for fog computing, fog forensics. a number of the open research challenges were also discussed like Trust, Privacy Preservation, Authentication and Key Agreement, Intrusion Detection Systems, Dynamic Join and leave of fog node, cross-border issue and fog forensic.[26] |
| Archana Lisbon A, Kavitha R | 2017 | A Study on Cloud and Fog Computing Security Issues and Solutions[25] | The Internet of Things (IoT) will be using the Fog computing to implement the smart World concept. So, in the future we have to handle huge amount of data and we need to provide the security for the Data. This study | Decoy technique, Biometric based authentication method can provide authentication to the users.[25] | Concludes that Fog computing is expansion of cloud with some prominent attributes for the service providers also user. Fog Computing isn't a standby for Cloud Computing. This paper explains cloud computing characteristics and security threats of cloud computing that's obvious motive for the expansion of fog computing. |

| | | | | | |
|---|---|---|---|---|---|
| | | | gives the security solutions available for the different issues. | | |
| Akhilesh Vishwanath ,Ramya Peruri , Jing (Selena) He | 2016 | Security in Fog Computing through Encryption | Performance of encryption is evaluated over selected datasets for accuracy if the entire data is correctly encrypted and decrypted along with the time, User load, Response time, Memory Utilization over file size. Further best and worst cases among the datasets are analysed thereby evaluating the suitability of AES in fog. | AES algorithm [26] | Considered data security because the key factor and implemented Advanced Encryption Standard (AES) within the fog computing. This adds a second layer of security for data and makes difficult for intruder to sense the info. Different datasets are choose and applied the AES algorithm for encryption and decryption for every of the dataset. Analysing of various metrics is completed so on evaluate the adaptability of AES in second layer of cloud system of fog. Consideration over time has also been undertaken to ascertain that each one the datasets might be processed within a fraction of your time regardless of its size and sort. As our future work, we might wish to implement AES with key size of 512 bytes in fog.[26] |
| K. Anand, Dr. A. Chandra Sekar, Dr. G. Nagappan | 2017 | Enhanced AES Algorithm using 512 Bit Key Implementation | Implement AES Algorithm using 512 bit. | AES Algorithm [27] | expanded key of size 512 bits can also be enhanced to be used for encryption and decryption of images.[27] |
| Gohar Rahman1 and Chuah Chai Wen2 | 2018 | Fog Computing, Applications, Security and Challenges, Review [28] | Aim to summarize related fog computing. | Overview of fog computing | summarize and overview fog computing model architecture, characteristic, similar paradigm and various applications in real-time scenarios such as smart grid, traffic control system and augmented reality. Finally, security challenges are presented.[28] |
| Julien Gedeon, Jens Heuschkel, Lin Wang, Max M¨uhlh¨auser[29] | 2018 | Fog Computing: Current Research and Future Challenge | Fog application | Describe how to use fog computing in different application | In this vision paper, we summarize these current research efforts, describe applications where fog computing is beneficial and identify future challenges that remain open to bring fog computing to a breakthrough [29]. |
| Jasleen Kaur, Alka Agrawal & Raees Ahmad Khan [30] | 2020 | Security Issues in Fog Environment: A Systematic Literature Review | Review different kind of security issue in fog computing. | Security algorithm used. | The authors have thus conducted a systematic literature review (SLR) on security issues in fog computing scenario.[30] |
| Gollaprolu Harish, S.Nagaraju, Basavoju Harish, Mazeeda Shaik[31] | 2019 | A Review on Fog Computing and its Applications | Describe fog computing and it's application | Various algorithm used | s. During this article, IoT design victimization Fog Computing is proposed that works as service entrance to multiple IoT services to build an efficient IoT application to hooked up the responses through the nodes, sensors and devices used to investigate [31]. |

## 3. Solution

AES encryption algorithm has been analyzed. We have formulated the code using Java language objects and classes as main constructs. The code has been simplified by making use of static constructs to yield good space and time complexity.

**Proposed Methodology:**

Advanced Encryption Standard which is also known as Rijindeal is an encryption technique used by US government. AES is known for design-based principle which has substitution and permutations and is said to be fast in both software as well as hardware. AES operate on the 4x4 column major order. AES will be performing many rounds of transformation to convert the plaintext to cipher. Below are the number of repetitions for each of the size of bit key.

In this work, the key size and input size for AES-S algorithm is increased to 512 bits. Plain text of 512 bits is given as input to the algorithm, enters the encryption loop and gives the cipher text as output and the cipher text is taken as input into the decryption loop and the original plain text is got as output. AES-S will be suitable for applications with high security and throughput requirements without increasing the overall area when compared to original AES-128 bits.

AES uses a variable number of rounds, Nr which are fixed: A key of sizes 128, 192 and 256 bits have 10, 12 and 14 rounds respectively. For the extended block size of 512 bits, the number of rounds Nr is calculated as 22.

**A. Implementation of AES encryption**

AES operates on a 16×32 array of bytes, termed the state. The input key for encryption is 512 bits. To represent the 512 values 9 bits are required. So each entry in S-box of AES 512 is 9 bits long. The cipher is specified in terms of repetitions of processing steps that are applied to make up rounds of keyed transformations between the input plaintext and the final output of cipher-text. The encryption procedure of AES 512 has been illustrated in figure 1. Each round in AES 512 encryption includes four different round transformations namely Substitute Bytes, Shift Rows, Mix Columns and Add Round Key. The last round of AES 512 encryption alone does not include the Mix Columns transformation.

**B. Implementation of AES decryption**

A set of reverse rounds are applied to transform ciphertext back into the original plain-text using the same encryption key. The four reverse transformations used are Add Round Key, Inverse Mix Columns, Inverse Shift Rows and Inverse Substitute Bytes. The inverse S-box contains 512 values in its 16x32 array of bytes. Each round in decryption of AES 512 includes all the four reverse transformations except in the first round. The Inverse Mix Column transformation is violated in the first round of decryption since it does not occur in the last round of encryption.

Each round consists of four byte-oriented cryptographic transformations:

1. Byte Substitution
2. Shifting rows of the State Array
3. Mixing data within a column of the State Array
4. Round Key addition to the State Array

**4. Performance Evaluation:**

The performance of AES 512 is evaluated on the basis of two major parameters: security and speed. AES 512 has better security than the AES 256 algorithm since the number of rounds is increased. Optimization is done on AES 512 to improve its speed. We found that, the optimized AES 512 has an acceptable speed of encryption and decryption when compared to the AES 512 that was not optimized. For implementing this encryption process over the data, we have chosen three datasets using some sources that contain different types of data of different sizes. The datasets which were considered for implementing the encryption over are:

• Hospital Data- Contains information about inpatient and outpatient services. [21]
This dataset is chosen to indicate performance over large data as it has many different types of fields with numbers, strings, special characters.

A) Simulation Settings

Now the implementation for AES encryption over these data sets are performed, where the entire data of datasets is encrypted and is decrypted as well without any loss of data. So as to perform such process over the layer of the cloud system Android device is considered and the algorithm has been deployed into the mobile.
Environment for the edge device:

- Development tool-Android SDK
- Programming language-JAVA
- JDK, JRE
- Database-MySql.

The metrics that are compared with the datasets over encryption are:

1. User load vs CPU time
   This considers how the CPU time varies when AES is being used on different sizes of datasets. So it gives the CPU time for each size of datasets which were selected.
2. File size vs Encryption time of data
   This is used to calculate the time taken for encryption in case of each dataset of different sizes.
3. File size vs Decryption time.
   This is used to calculate the time taken for decrypting each dataset of different sizes.
4. File size vs Memory utilization.
   This gives results of how much memory will be utilized on using different size of datasets. So it gives the utilization of memory for each size of datasets which were selected.

## 5. Conclusion & Future Plan

Fog computing is taken into account to be one among the main part within the computing world, and as there are many devices connected and as IOT would be a serious a part of it, there could also be tons of issues on security. So our research here considered data security because the key factor and implemented Advanced Encryption Standard (AES) within the fog computing. This adds a second layer of security for data and makes difficult for intruder to sense the info. Different datasets are chosen and applied the AES algorithm for encryption and decryption for every of the dataset. Analyzing of various metrics is completed so on evaluate the adaptability of AES in second layer of cloud system of fog. Consideration over time has also been undertaken to ascertain that each one the datasets might be processed within a fraction of your time regardless of its size and sort. As our future work, we might wish to implement AES with key size of 512 bytes in fog.

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# Fake News Detector

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**Abstract**

Over the last few years, the term "fake news" gained international popularity. This can include blog and social media posts and fake online media releases. Many Research started in the field of Natural Language Processing, Machine Learning, Deep Learning to detect the fake news and to take actions against it. Even big IT giants are getting their hands Dirty to protect their users and their platform, keeping the popularity of fake news, research of ways to limit the spread has also increased. This paper aim to look at the current research of this area in order to see what kind of fake news detection methods exist and are being developed, which can help online users in protecting themselves against fake news.

*Keywords*: fake news, fake news detection

## 1. Introduction

Fake news detector is a web-app that will help the user know whether the news article provided by him/her is fake or reliable. As digital platforms, companies are trying to eliminate fake/unreliable news/comment/post to maintain the purity of their platform. This may protect the people from the trap of fake news thus may increase peace in surrounding**.**

This type of fake news, which can spread among millions of people online, has attracted much attention from researchers, and many studies have been made in order to examine fake news and its impact on society and democracy.

**Objectives**
It will help the user know whether the news article provided by him/her is fake or reliable.

## 2. Literature Review

NLP is a processing technique to understand text data in easier manner. Natural language processing (NLP) is one of the trendier areas of data science. Text data has numerous information to extract, and we can find the different things.

The literature we reviewed was **A Machine Learning Approach to Fake News Detection Using Natural Language Processing.**

## 3. Approach

We are trying to create a machine learning model which is **trained on** the top of the data. Our goal is to create a model with the better accuracy. So that we can achieve the result as we desired. Text classification is the most popular approach of automated fake news detection, and the majority of the collected papers propose solutions using such methods. As s Fake News Detector, it is designed to predict whether the news article provided by user was fake or reliable. This can be done with help of a simple and easy to use UI for providing information and displaying results based on User's Query.

Following approach/algorithms can be used:

**Naive Bayes Classification Method:**

The naive bayes classifier technique is based on the bayesian theorem. It is particularly used when dimensionally of the input is high. Nave Bayes can often more sophisticated classification method.

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First step of the nave bayes classifier is to classify the objects and to classify new cases as they arrive that means to decide to which class label they belong based on the currently existing system. Then on the priority basis the bayesian analysis is done. The final classification is produced by combining all the information gathered by bayesian analysis.

We used the following metrics to test the performance of our model: -

- **Classification Report**
  Below figure describes the Classification Report of our project:
  Classification Report consist of Precision, Recall, f1-score, support and their values.

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0 | 0.91 | 0.97 | 0.93 | 1036 |
| 1 | 0.95 | 0.87 | 0.91 | 793 |
| accuracy | | | 0.92 | 1829 |
| macro avg | 0.93 | 0.92 | 0.92 | 1829 |
| weighted avg | 0.93 | 0.92 | 0.92 | 1829 |

Fig. 1. Classification Report

- **Confusion Matrix**

Below figure Fig 2 describes the **Confusion Matrix** of our project:
**Confusion Matrix** consist of True Positive, False Positive, False Negative, True Negative and their respective values.

In our Case,

True positive (TP): correct positive prediction = 1000
False positive (FP): incorrect positive prediction = 36
True negative (TN): correct negative prediction = 689
False negative (FN): incorrect negative prediction = 104

```
[[1000   36]
 [ 104  689]]
```

Fig. 2. Confusion Matrix

- **Accuracy Score**
- Below figure Fig. 3 shows the **Accuracy Score** of our project
- **Accuracy Score = (TP+ TN)/( TP+ FP+ TN + FN)**

```
0.9234554401312193
```

Fig. 3. Accuracy

**Recurrent Neural Networks (RNNs):**

RNNs are ideal for text. The most commonly used RNNs are,

**Long Short Term Memory (LSTMs):**

LSTMs which can solve this long term dependency problem capable of maintaining shorter sequential information.

Our LSTM model takes a sequence of words as input. An embedding layer transforms one-hot-encoded words to dense vector representations and a spatial dropout, which randomly masks 10% of the input words, makes the network more robust. To process the sequence of word embedding's, we use an LSTM layer with 128 units, followed by a dropout of 10%. Finally, a dense layer with a Sigmoid activation makes the prediction for the binary classification.

Tested but results were not good.

**Bidirectional Long Short Term Memory (BiLSTMs):**

**BiLSTMs** are generally better version of **LSTMs** capable of maintaining/preserving the context of the sequential input.

Our BILSTMS model takes a sequence of words as input. An embedding layer transforms one-hot-encoded words to dense vector representations and a spatial dropout, which randomly masks 10% of the input words, makes the network more robust. To process the sequence of word embedding's, we use BILSTMS layer with 64 units, followed by a dropout of 10%. Finally, a dense layer with a Sigmoid activation makes the prediction for the binary classification.

Tested but results were not good.

## 4. Experiments and Results

Text classification is the most popular approach of automated fake news detection, and the majority of the collected papers propose solutions using such methods.

**Dataset**: We collected dataset from various and multiple online sources and created a corpus evaluate our approach. Datasets consist of two output labels as reliable and not reliable.

Different approach can be taken for training data can be done using Machine Learning and Deep Learning, but which suits the system can be used further and optimization of models is also necessary after some point of data can be added further for better accuracy generated from model. So whole process is consisting of trial and error phase which ever gives best suitable output can be evaluate as best model and used in production. For best output is depends upon the algorithm being used, feature scaling, model cross validation methods and suitable data. Once the data is train on set of data can be used for predication which takes input data from user and appropriate output can be given.

Once the data is train on set of data can be used for predication which takes input data from user and appropriate output can be given. This text data goes through the following processes in the given sequence Tokenization, Removing Stop-words, Stemming and Lemmatization and then creating Bag of Word/ TF-IDF/Word Embedding and then model building, model evaluation and displaying result to the user.
This dataset goes through process described in Fig.4:

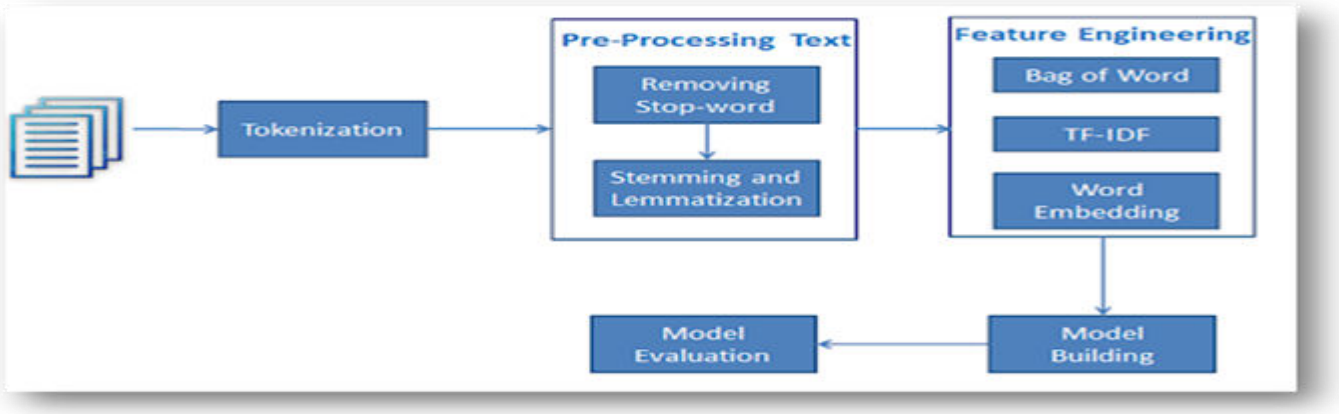


Fig. 4. Process

We experimented with different types of neural networks, Machine Learning Algorithms and types of word vector representation technique.

## 4. Conclusion

The main objective is to detect the fake news, which is a classic text classification problem with a straight forward proposition. It is needed to build a model that can differentiate between “Real” news and “Fake” news. We are trying to create a Fake News Detector. This Fake News Detector takes three inputs from user side i.e., Title, Author and the message. The goal of this project is to explore how artificial intelligence technologies, particularly machine learning and natural language processing, might be leveraged to combat the fake news problem. We believe that these technologies hold promise for significantly automating parts of the procedure human fact checkers use today to determine if a story is real or a hoax.

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# Image Caption Generation

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**Abstract**

In the past decades, there are many significant advances in the field of Deep Learning and Computer Vision which has led to the development of exceptional Image Captioning Models using advanced algorithmic techniques. While these techniques are accurate, they often rely on the very expensive computer hardware which it more difficult to apply these techniques in real-world scenarios. In this paper, we try to understand the core concepts and most common procedures used in the Image caption generation and then we are trying to implement an encoder and decoder-based model with optimizations and modifications in the model's architecture which will eventually help us to run the model on a low-cost hardware efficiently. We also compare and evaluate our result with state-of-the-art models and analyze where our model needs improvement due to trade-off between the quality and speed for computation.

*Keywords*: Deep Learning, Caption Generation, Deep Learning, Convolutional Neural Network (CNN), Recurrent Neural Network (RNN), Long Short-Term Memory (LSTM).

## 1. Introduction

Automatically generating natural language description of an image has been at the most challenging and interesting topic for most of the researchers. The reason for this is that this task connects two major fields in the artificial intelligence fields: computer-vision and natural language processing. The solution of this problem has many real-world applications such as helping visually blind people. Generating natural language description of the image requires a whole different level of understanding than which is required for classification or object detection.

There are mainly two approaches which can be used to generate caption of an image: top-down and bottom-up approach **[1]**. In the top-down approach we get a gist of the image and then a natural language description is generated while, in bottom-up approach first comes words and these words are used to describe various aspects of the image and finally, these words are combined to generate a natural language description of the image **[1]**.

The state-of-the art model is a top-down approach where a recurrent neural network [RNN] is used for the end-to-end formulation of the image to sentence generation. All the parameters of this neural network can be learned using training data. There is a disadvantage in top-down approach, it is difficult to take attention of fine details in the image which may be useful to generate description. Bottom-up approach do not suffer from this issue because they operate on any type of resolution of the image. But, they suffer from different problems such as lack of end-to-end formulation of the process and going from individual aspects of the image to generating the natural language description of the image. So, in this paper we are trying to combine both top-down and bottom-up approach and generate an image captioning model through a sematic approach model. The overview of how our algorithm works can be noticed in the below figure:

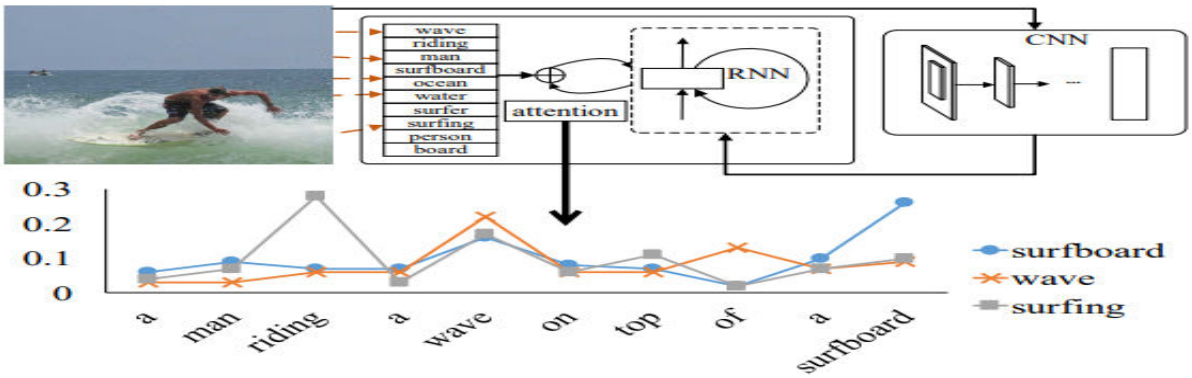


Fig. 1. Model Architecture

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## 2. Proposed System

### Dataset Description

For training our model we used Flickr8k dataset which is comprised of 8000 images and each image is also mapped to five different natural language descriptions of the image. We also used transfer learning to achieve more accuracy as the model trained on 8000 images is not enough to classify objects and also generate the natural language description.

### Training process

First of all, we mapped the file that was containing the description of the images to the images that were stored in the specific directory **[2,4]**. Then, we removed noise from the description file. Noise can be present in the form of special characters such as hashtag, punctuations, numbers. We removed this noise as it is difficult for a computer to understand these things if they are present in the text **[2,4]**. Also, we removed stop words and then we using NLTK library we performed Lemmatization and Stemming.

After this process is completed then we mapped the images in the training set to their corresponding natural language descriptions. While mapping these images to their respective descriptions we added unique words at the beginning and end to identify the start and end of the natural language description generated **[2,4]**. Then encoded the images so that computer can understand the images and also can find patterns in them. For this encoding task we used transfer learning i.e., we used a pre-trained model that has been trained on large datasets and we then use the extracted features of the image generated from the model for our purpose. For the pre-trained image model, we used XCeption **[2,4]**.

### RNN model

The most common problem in training and designing RNN is its ability to deal with vanishing and exploding gradients. So, we try to solve this issue by using Long Short-Term Memory (LSTM). At the heart of the LSTM model is a memory cell c encoding knowledge which at every step-in time keeps note of what inputs have been observed up to a specific step. The behavior of LSTM is controlled by gates layers which are multiplicatively applied **[3]**. Thus, these cells can store value if the gate value is 1 and zero value if the gate value is 0. In LSTM particularly three gates are used: forget gate (f), input gate (i) and the output gate(o).

The below diagram 2 [**3**] shows LSTM memory block:

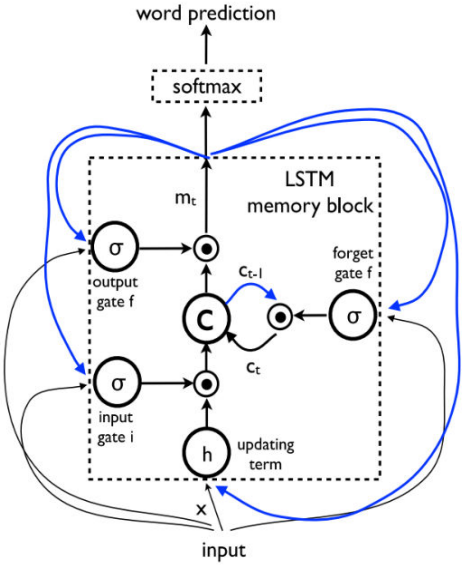


Fig. 2. LSTM architecture

### Model Structure

For defining the structure of our model, we used Keras Model from Functional API. For architecting our model, we followed these steps:

1)Photo Feature Extractor: We extracted the features of the image from the pretrained model XCeption.

2) Sequence Processor: The word embedding layer that handles the text, which is then followed by LSTM.

3) Decoder: Both model 1 and model 2 produces a fixed length h vector. They were merged together and processed by dense layer to make the final prediction.

For training our model, we used Adam's optimizer and the loss function as categorical cross-entropy loss. The model was trained on 50 epochs which is enough to produce the output. We used 50 epochs and the batch size was 256 images. As, we didn't have much computation power. If you have more computational power, then you can train this model up to 200-300 epochs which would give the accuracy higher and loss comparatively lower.

The below image shows a sample predicted output generated by our model:

Fig. 3. Image used for Caption Generation

The caption generated from the image is as follow:

**Start Two boys are playing soccer in the field End**

## 3. Applications

1.This model can be used to stop users from posting "hostile" posts on social media platforms.

2.We can use this model as "supplement" to help blind people in their daily lives. Color blind condition is often inherited. So, we can use this model to help this kind of people also.

3.This model also helps hackers (unfortunately) for "egregious" purposes. They can use this to spy on other people.

## 4. Conclusion

In this paper we presented a novel approach for the generating caption of the image which achieves the goal of generating the natural language description of the image. There are different methods from previous works which uses top-down approach and bottom-up approach to extract richer information from an image and then couples this information with a Recurrent Neural Network which selectively operates on greater semantic attributes detected from an image. The power of model lies in its ability to detect these aspects and smoothly combine global and local information for the generation of natural language description.

### Future Work

We will try to test our trained model by using several methods like CIDER, METEOR, ROUGE, BLEU-4 **[5]**. Also, will try to analyze the attention of the model. We will try to use different datasets like MSCOCO or Flickr30k to achieve higher accuracy and as these datasets have a greater number of images and more vocabulary (words) which can help us getting more accurate generation of the natural language description of the image.

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# Implementation of Crop Disease Detection System Using flutter

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**Abstract**

This project is about detecting diseases in crops and to provide solutions for the same. It uses Machine Learning and Deep Learning to detect diseases in the crops, Deep Neural Network and Convolutional Neural Network a part of Deep Learning has been used to detect diseases in the crops. To make the code available on all platforms i.e. Web, iOS, or Android a cross-platform code has been made using Flutter and Dart. Farmers usually detect diseases in the crops using their naked eyes which eventually leads them to make wrong predictions regarding diseases in the crops, they might use wrong fertilizers or more than the normal dose of it which could damage the plants or soil and fields. Thus, this project detects diseases in the crops precisely and provides solutions for the same.

*Keywords*: Crop Disease Detection; Flutter and Dart; Convolutional Neural Network (CNN); Deep Neural Network (DNN).

## 1. Introduction

As we know that farmers face difficulties detecting diseases in crops. Also, if due to lack of knowledge, the farmer uses more amount of fertilizer than it could destroy the crop eventually leading to a lesser crop yield. To overcome this, we are making a crop disease detection system in which the user with just his phone would be able to detect the disease in crop with great precision. A user with the camera of a smartphone or either an image of the affected crop would be able to easily detect the disease in crop.

Crop Disease, there are various diseases in crops, and also there are various stages of the same. Few examples of crop diseases include: - bacterial leaf spot, early blight and late blight. As there are multiple diseases of same kind and type seen in crops, if the farmer does not accurately measure the type or kind and if he uses a greater amount of fertilizer than it could damage the crop thereby leading in lower crop yield.

Hence, as there are various diseases in crops it is difficult for farmers to accurately detect the diseases in them, but by leveraging the power of deep learning it is possible to detect diseases in crops accurately.

## 2. Existing system

Almost all previous research on crop disease detection included the traditional machine learning techniques. Also, all the developments done using deep learning were also reviewed [1] [2] [3] [4]. [1] In this research Convolutional Neural Networks (CNN) were used to detect disease diseases in crops, also transfer learning was used to build on the existing ImageNet models. In the research DenseNet201 model was used because of its lower complexity and cost-effective computation. The final score had a log loss of 0.288 on the test dataset, on the test sample of 610 images it translated to approximately 580 correctly classified instances giving the accuracy of 95%. [2] In this research AlexNet and GoogLeNet was used with a training mechanism of transfer learning. In this research with a dataset type Color with a set distribution of training set to 80% and testing set to 20% it achieved an accuracy of 99.34% on PlantVillage dataset.

In both the research paper the implementation of the system is not done and only an accuracy was achieved using various methods. The models are not implemented in real life either using a web application or an iOS or Android application for common person to take advantage of the same.

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## 3. Proposed system

### 3.1 *Dataset description*

In this research a public dataset is used which contains – images of diseased and healthy plant leaves. The images cover two species of crops which includes cotton and tomato. It contains some basic diseases found in cotton and tomato crops.

#### 3.1.1 *Augmentation of images*

Using ImageDataGenerator the images in validation as well as training dataset are rescaled, rotated by 40%, the width and height of the image is shifted by 20%, the shear and zoom ranges are set to 20% and at last the image is flipped horizontally. Here the image size reduced to 150px * 150px and the batch size is taken as 32.

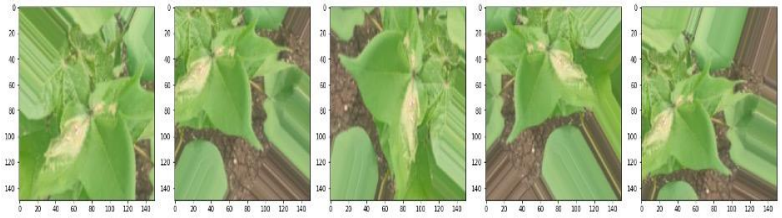


Fig. 1. Plotting of images after going through the mentioned process.

### 3.2 *Network architecture*

In this research a deep learning model is used namely Convolutional Neural Networks (CNN). It has its main applications in image and video recognition and is also used in recommender systems. Firstly, to build this model four convolutional layers with filter size 64,128 and 256 is taken and four max pooling layers with size 2 is taken. Here first the convolutional layer is taken which is followed by a max pooling layer. Secondly, four dropout layers, a flattening layer and three dense layers are taken respectively. The input passed to the dropout layer is, first 50% then 10% and at last 25%. Two activation function are used in the dense layer is ReLU and SoftMax. To compile the CNN model, Adam optimizer with learning rate of 0.0001 and using sparse_categorical_crossentropy for loss is used with metrics set to accuracy.

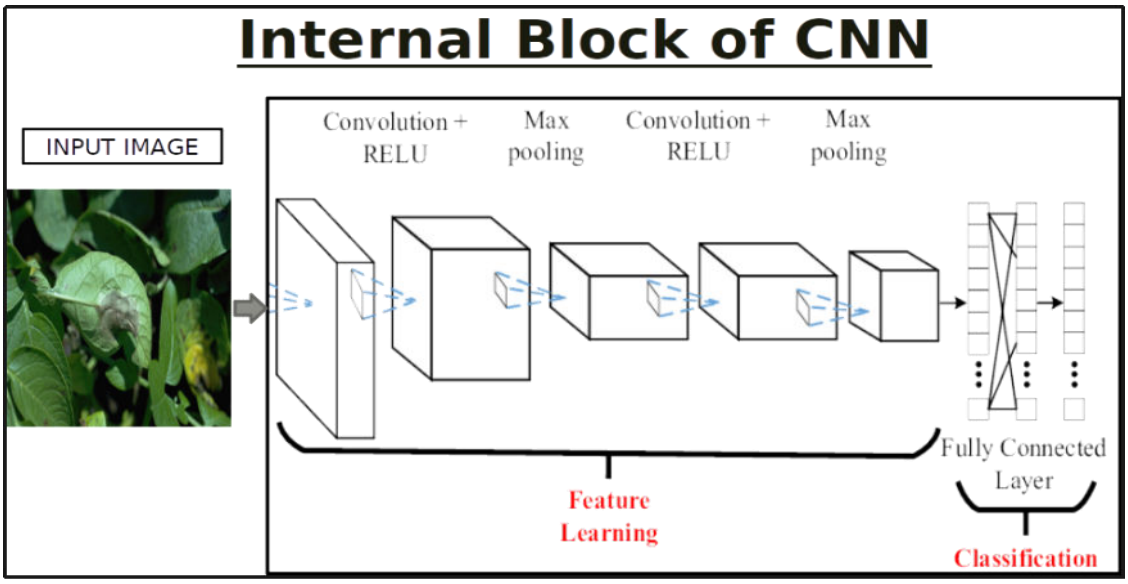
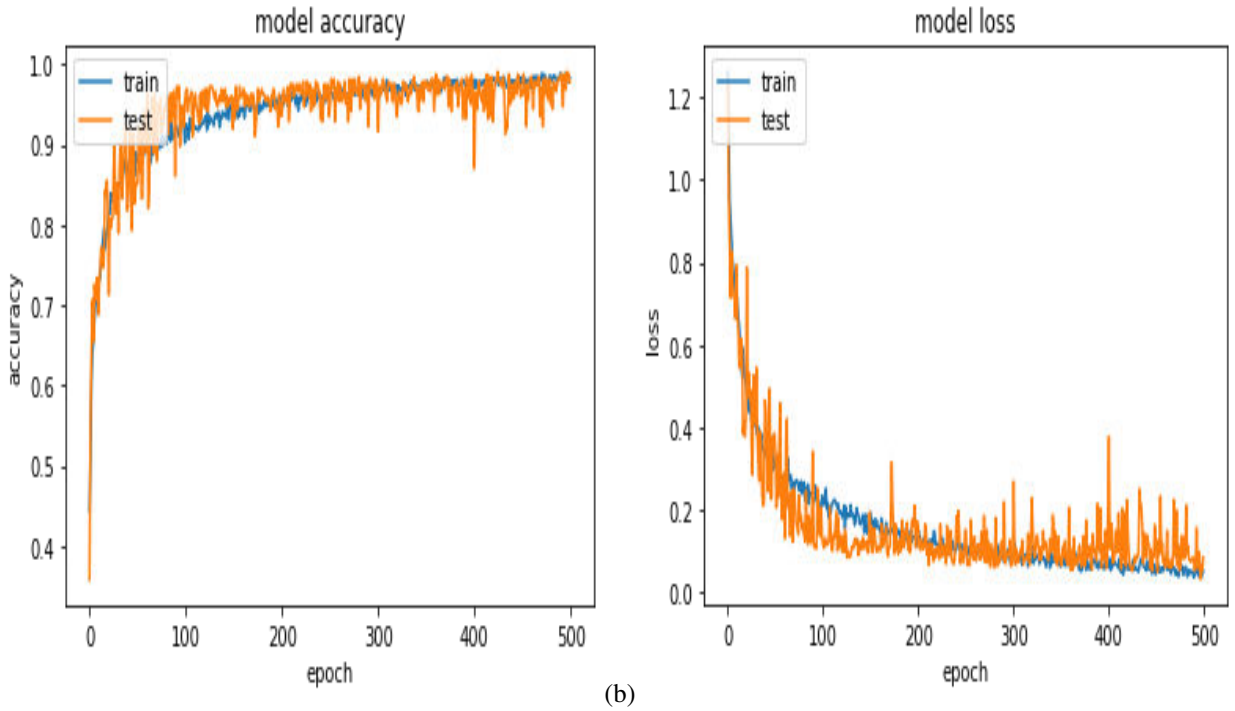



Fig. 2. Network Architecture of the Convolutional Neural Network Model

3.3 *Results*

To train the model mentioned total of 500 epochs were taken which resulted in an accuracy of 99.074% with a loss of 0.666%. The accuracy and loss graphs are shown below:




(a) (b)

Fig. 3. Results after training the model (a) Model accuracy graph of the model (b) Model loss graph of the model

3.4 *Implementation using flutter*

The model discussed above would be of no use if it is not available for users to use and take the advantage of it. Hence, to let the users which are basically farmers, benefit from the model it is implemented in real life using flutter with dart as the programming language. As flutter lets the developer deploy the application on Web, iOS and Android using just a single codebase, the user would be able to use the application on any platform. To let the model, communicate with application it is converted to TensorFlow lite version or tflite version. A flutter application is built where the user can select from available crops for which the disease could be detected. The user could insert the image of the crop plant or crop leaf either from his/her galley or from his/her camera available in the device for which the disease, if present, is to be detected. The image inserted from the user is loaded into the model, the model checks for the disease and if present, the user is provided the solution for the same by the application. The flow chart of the process is given below:

3.5 *Implementing the deep learning model thorugh an android application*

The deep learning model is implemented using Flutter and Dart. It is deployed through an android application. The android application deployed is shown below:

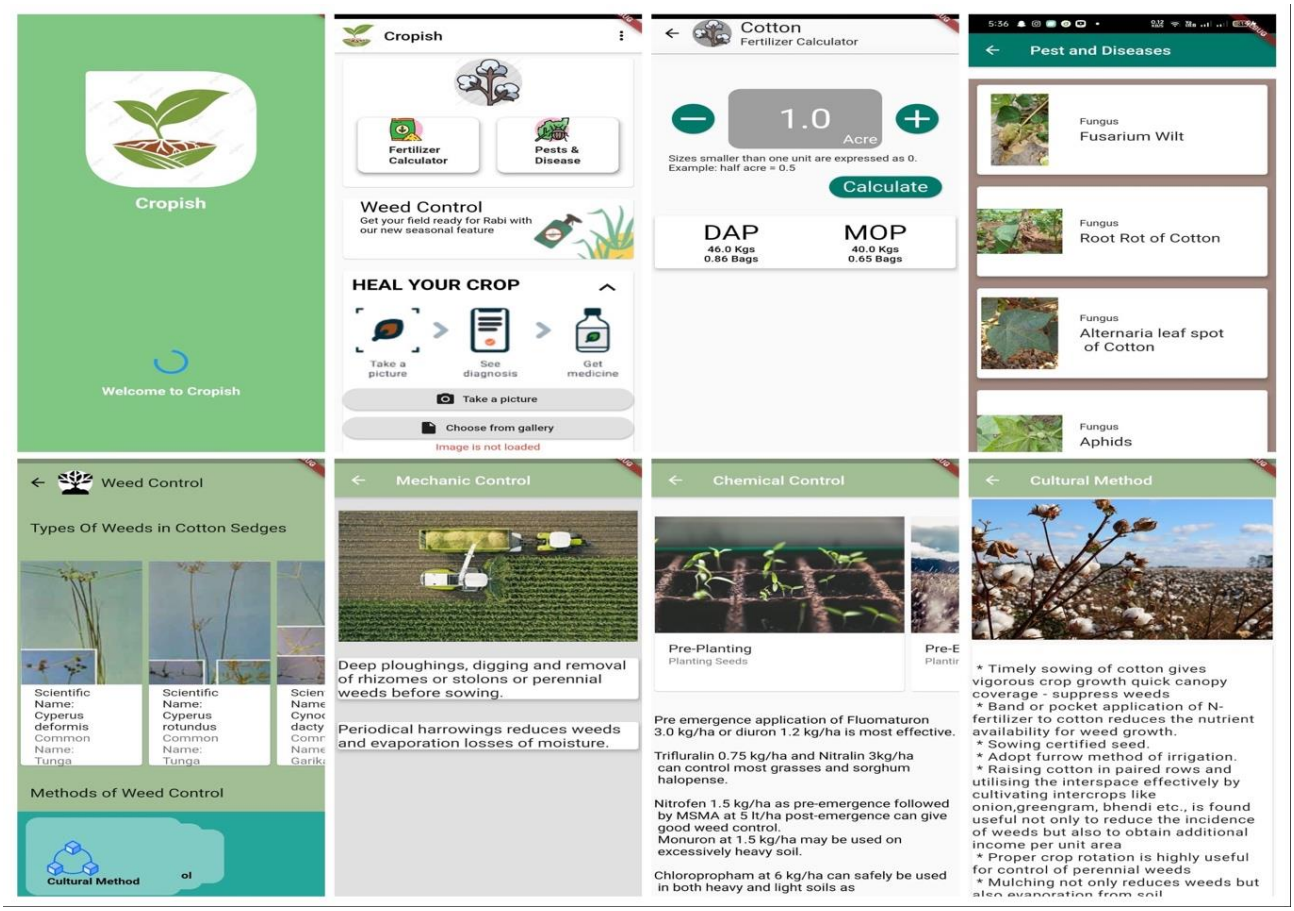
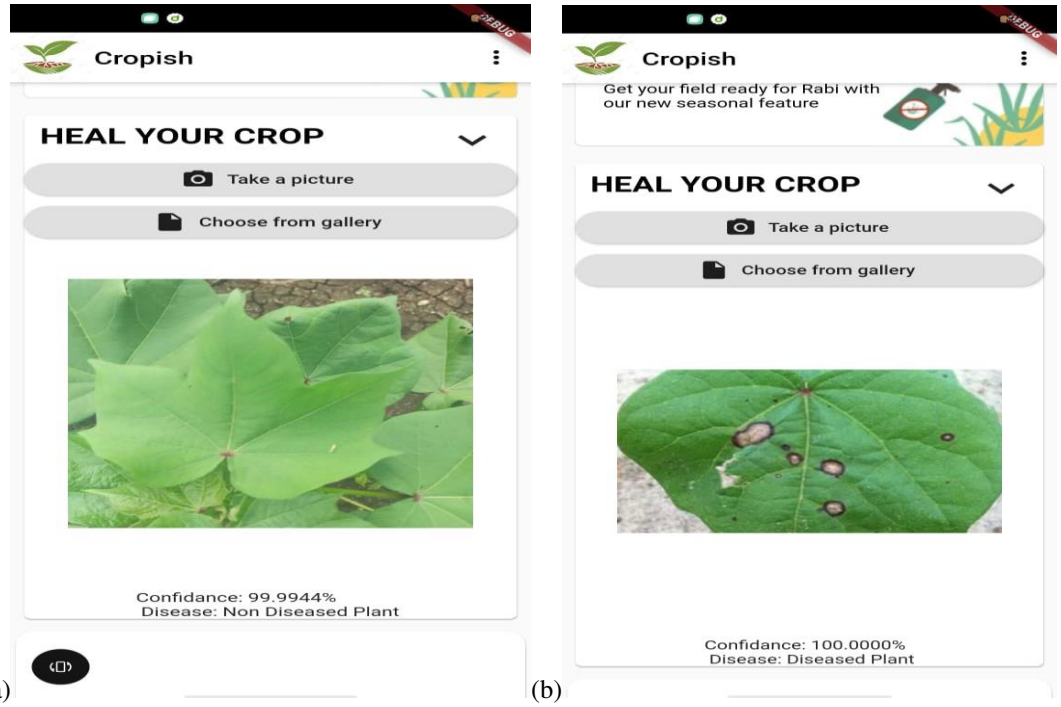



Fig. 4. All the functions of the application apart from crop disease detection, that is fertilizer calculator page, pest and diseases page and weed control page.




(a) (b)

Fig. 5. The deep learning model is implemented using an android application (a) Detection of a non-diseased cotton crop with a confidence of 99.9944% (b) Detection of a diseased cotton crop with a confidence of 100%.

3.6 *Process*

The fertilizer calculator section of the application calculates how much fertilizer is required for particular kind of disease in the crop. It enlightens the farmer about an accurate amount of fertilizer that they should spray to save the crop from a disease. The pest and diseases section of the application informs the farmer about the types of diseases a crop could get affected by and also of its symptoms. Weed control, weed is a general term for any plant growing where it is not wanted, this section of the application enlightens the farmer about types of weed growing along with a particular crop, also it informs them about the methods for weed control. Methods for weed control includes mechanical control, chemical control and cultural method.

Crop disease detection section of the application follows the following procedure. The image inserted by the user is sent to the model. The model is trained through Google Collaboratory and its TensorFlow lite or tflite version is used in building the android application. The image is sent through the model and after the procedure mentioned above, the type of crop, the disease it is affected by is displayed as an output through which the user could get the information of what type of disease the crop is affected by.

## 4. Applications

This project is to help users mostly farmers detect diseases in crops with accuracy so that they could use right number of fertilizers to cure the diseases in crops. To provide the user with both options that is either web application or mobile application, so that he could easily access the crop disease detection system it is deployed using flutter and dart. The user basically farmer have superficial knowledge about the type of disease the crop is infected by which could be dangerous because if the farmer sprays large amount of fertilizer on the crop it might die and if he sprays a little than the disease would still remain. Hence, this crop disease detection system plays a vital role in overall harvest of the crops. By using this application, the farmer has access to the following features:

- Correct detection of various crop diseases.
- Accurate measurement of amount of fertilizer to be sprayed.
- A fertilizer calculator which measures the amount of fertilizer to be sprayed on an infected crop.
- Dynamic insertion of images of disease affected crops.

## 5. Future Scope

Crop monitoring is something that needs to be focused on. Crop monitoring provides the users with facilities such as watering the crops timely, number of fertilizers that needs to be given to a certain crop and also predicting rough weather that could hinder crop growth. Inputting a greater number of images that is a greater number of crop diseases to the dataset would affect the accuracy of the model eventually leading to a less accurate model which might result in a less effective crop disease detection system. Handling a large number of images might increase the size of the application, also the application might need to be optimized to carry a large number of images.

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## Acknowledgement

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# Machine Learning Algorithms

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**Abstract**

Machine learning is a growing technology in the upcoming era. It's a technology which is used by computer to auto learn from pass data. Its used by computer to provide data as human thoughts. Machine learning is one kind of AI which provide the data based to sequence and different match using the pattern search and also uses algorithm for data search. Here in the paper, we can show the different algorithm of machine learning which is used for data.

*Keywords*: Machine Learning, ML Algorithm, Supervised Learning, Unsupervised Learning, Reinforcement Learning

## 1. Introduction

Machine Learning is a technology which is used for learning and extract data from the historical data. Now-a-days ML used in the different filed of email filtering, image recognition, speech recognition, Facebook auto-tagging, recommender system, and many more. The flow of the machine learning technology is that it learns from historical data then make a modal and when it get new data it uses modal and predict a new output from them. Graphically represent here about the ML Work.

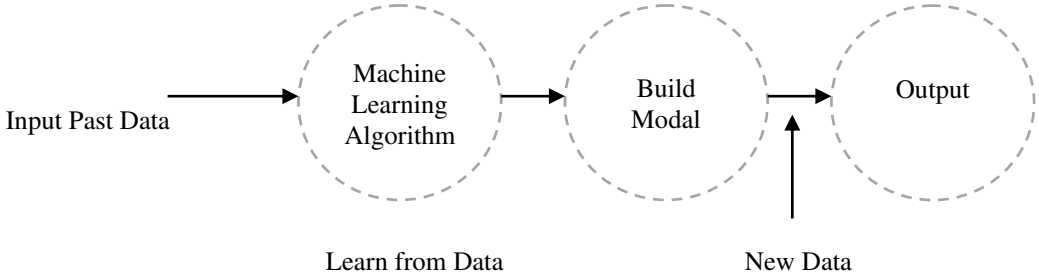


Figure 1. Flow of Machine Learning

## 2. Types of Machine Learning

Broadly there are three types of machine learning i.e. Supervised Learning, Unsupervised Learning and Reinforcement Learning. Here shown the detail on its types.

### *2.1 SUPERVISED LEARNING*

In this kind of ML, system provides sample data to the system and ML read it. it predicts the data and generate the output.in the supervised learning it predict the modal and when it gets data, based on the modal previously created by system will implement and generate the output. After that to check the system, it provides sample data to ML and verify the exact output will return or not. The goal behind this of machine learning is that it maps input data and the output data. Good example of the supervised learning is a spam mail filtering. This kind of ML are further divided into two parts i.e. classification and regression.

### *2.2 UNSUPERVISED LEARNING*

In this kind of ML, system learn without any modal or under any supervision. The training is provided to the machine with the set of data that has not been labeled, classified, or categorized, and the algorithm needs to act on that data without any supervision.

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The goal of unsupervised learning is to restructure the input data into new features or a group of objects with similar patterns. In this learning system cannot have any predetermined result, it populates the data from the huge data source and generate a new result based on the past data. This learning further classified into two categories i.e., clustering and association.

*2.3 REINFORCEMENT LEARNING*

In this kind of ML, system learn based on the feedback. Here the learning agent get a feedback and based on positive feedback it learns and on negative feedback it changes the prediction and improved the system, here in this learning system continuous interact with the system and its environment. System maximum try to make a positive feedback from the system to improved themselves.

## 3. Algorithm Of Machine Learning

*3.1 LINEAR REGRESSION*

This algorithm estimates real values based on continuous variable. Here, establishes relationship between independent and dependent variables by fitting a best line. This best fit line is known as regression line and represented by a linear equation Y= a *X + b.

The best way to understand linear regression is to relive this experience of childhood. E.g., you ask a child in fifth grade to arrange people in his class by increasing order of weight, without asking them their weights! What do you think the child will do? He / she would likely look (visually analyze) at the height and build of people and arrange them using a combination of these visible parameters. This is linear regression in real life! The child has actually figured out that height and build would be correlated to the weight by a relationship, which looks like the equation above.

In this equation:

Y – Dependent Variable
a – Slope
X – Independent variable
b – Intercept

These coefficients a and b are derived based on minimizing the sum of squared difference of distance between data points and regression line.

3.2 *Logistic Regression*

It is a classification not a regression algorithm. It is used to estimate discrete values (Binary values like 0/1, yes/no, true/false) based on given set of independent variables. In simple words, it predicts the probability of occurrence of an event by fitting data to a logit function. Hence, it is also known as logit regression. Since, it predicts the probability, its output values lie between 0 and 1 (as expected) lets explain with example friend gives you a puzzle to solve. There are only 2 outcome scenarios – either you solve it or you don't. Now imagine, that you are being given wide range of puzzles / quizzes in an attempt to understand which subjects you are good at. The outcome to this study would be something like this – if you are given a trigonometry based tenth grade problem, you are 70% likely to solve it. On the other hand, if it is grade fifth history question, the probability of getting an answer is only 30%. This is what Logistic Regression provides you.

*3.3 Decision Tree*

It is a type of supervised learning algorithm that is mostly used for classification problems. Surprisingly, it works for both categorical and continuous dependent variables. In this algorithm, we split the population into two or more homogeneous sets. This is done based on most significant attributes/ independent variables to make as distinct groups as possible.

*3.4 SVM*

In this algorithm, we plot each data item as a point in n-dimensional space (where n is number of features you have) with the value of each feature being the value of a particular coordinate.

For example, if we only had two features like Height and Hair length of an individual, we'd first plot these two variables in two-dimensional space where each point has two co-ordinates (these co-ordinates are known as Support Vectors)

*3.5 Naive Bayes*

It is a classification technique based on Bayes' theorem with an assumption of independence between predictors. In simple terms, a Naive Bayes classifier assumes that the presence of a particular feature in a class is unrelated to the presence of any other feature. For example, a fruit may be considered to be an apple if it is red, round, and about 3 inches in diameter. Even if these features depend on each other or upon the existence of the other features, a naive Bayes classifier would consider all of these properties to independently contribute to the probability that this fruit is an apple.

Naive Bayesian model is easy to build and particularly useful for very large data sets. Along with simplicity, Naive Bayes is known to outperform even highly sophisticated classification methods.

Bayes theorem provides a way of calculating posterior probability P(c|x) from P(c), P(x) and P(x|c)

*3.6 kNN*

It can be used for both classification and regression problems. However, it is more widely used in classification problems in the industry. K nearest neighbors is a simple algorithm that stores all available cases and classifies new cases by a majority vote of its k neighbors. The case being assigned to the class is most common amongst its K nearest neighbors measured by a distance function.

These distance functions can be Euclidean, Manhattan, Minkowski and Hamming distance. First three functions are used for continuous function and fourth one (Hamming) for categorical variables. If K = 1, then the case is simply assigned to the class of its nearest neighbor. At times, choosing K turns out to be a challenge while performing kNN modeling.

*3.7 K-Means*

It is a type of unsupervised algorithm which solves the clustering problem. Its procedure follows a simple and easy way to classify a given data set through a certain number of clusters (assume k clusters). Data points inside a cluster are homogeneous and heterogeneous to peer groups.

*3.8 Random Forest*

Random Forest is a trademark term for an ensemble of decision trees. In Random Forest, we've collection of decision trees (so known as "Forest"). To classify a new object based on attributes, each tree gives a classification, and we say the tree "votes" for that class. The forest chooses the classification having the most votes.

*3.9 Gradient Boosting algorithms*

*3.9.1 GBM*

GBM is a boosting algorithm used when we deal with plenty of data to make a prediction with high prediction power. Boosting is actually an ensemble of learning algorithms which combines the prediction of several base estimators in order to improve robustness over a single estimator. It combines multiple weak or average predictors to a build strong predictor. These boosting algorithms always work well in data science competitions like Kaggle, AV Hackathon, Crowd Analytix

*3.9.2 XGBoost*

The XGBoost has an immensely high predictive power which makes it the best choice for accuracy in events as it possesses both linear model and the tree learning algorithm, making the algorithm almost 10x faster than existing gradient booster techniques.

The support includes various objective functions, including regression, classification and ranking.

One of the most interesting things about the XGBoost is that it is also called a regularized boosting technique. This helps to reduce overfit modelling and has a massive support for a range of languages such as Scala, Java, R, Python, Julia and C++.

*3.9.3 LightGBM*

LightGBM is a gradient boosting framework that uses tree-based learning algorithms. It is designed to be distributed and efficient the framework is a fast and high-performance gradient boosting one based on decision tree algorithms, used for ranking, classification and many other machine learning tasks. It was developed under the Distributed Machine Learning Toolkit Project of

Microsoft.

*3.9.4 CatBoost*

It's a open source ML algorithm from Yandex, its easily integrated with Deep learning. Catboost can automatically deal with categorical variables without showing the type conversion error, which helps you to focus on tuning your model better rather than sorting out trivial errors.

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# Mask Detection and Temperature Measurement

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**Abstract**

In this paper, we have introduced an affordable solution that aims to increase COVID-19 indoor safety, covering several relevant aspects: Mask Detection and Contactless Temperature Sensing. Contactless temperature sensing subsystem depends on Arduino Uno which uses thermal specified camera or sensor which can be used for infrared, while mask detection checks are performed by leveraging computer vision techniques through video streaming.

Looking at the current scenario due to the occurrence of highly spreading infection COVID-19, it has become very necessary to ensure the safety of people. The COVID-19 pandemic is causing a global health crisis so among all the measures to fight against this infection, protective face masks (PFMs) and temperature measurement plays a huge role to reduce its spread. Our project mainly aims to detect the face mask on a person's face on an image/video stream along with which it is used to determine whether the person is covering his/her face with a mask or no mask. It also measures the body temperature of a person. If these two criteria are fulfilled, then it allows the person to move ahead or else the person is restricted through custom alert. Our system can therefore be used in real-time applications which require face mask detection and temperature measurement for safety purposes due to the outbreak of Covid situation.

*Keywords*: Mask, Detection, Temperature, Measurement

## 1. Introduction

According to the current scenario, one would definitely think whether to go outside or not due to COVID-19 situation. So, the main goal of our project is to reduce the spreading of the covid-19 infection. Our project uses face mask detectors to detect masks on the face of a person and it would restrict the person from moving ahead if the person is not wearing a mask. Our system will also check the body temperature of the person and if the temperature is normal, it would allow the person to move ahead or else it would restrict the person at the entrance only. Our project checks if all the criteria are fulfilled or not and then allows the person to move ahead or not.

Our project is very useful to reduce the risk of highly spreading COVID -19 infection. Our application is used to detect if a person is wearing a face mask or not wearing it. It also measures the body temperature of a person. If both conditions are satisfied, then you will be welcomed. But if these two criteria are not fulfilled then the person is restricted through custom alerts.

- Face mask detection: First of all, a person will stand in front of the camera and our face mask detector will compare the image captured by camera with different dataset, which are already loaded in the disk of the model.
- Temperature measurement: If the person standing has weared the mask then it's temperature will be checked using a temperature measurement circuit which is integrated with face mask detector.
- Custom alert: If the above two criteria are not full filled then the person is restricted to move ahead using custom alert.

## 2. Objective

Basically, we want to create our project as accurately as possible for which we have applied many different ideas and code in our project to achieve safety and security of people from this pandemic phase. The main objective of our project is to reduce the spread of Covid-19 infection by undertaking various measures like face mask detection and body temperature measurement.

With this we are trying to achieve our goal by restricting people who are not fulfilling above criteria to move ahead by using custom alerts. Since our project is providing various facilities to ensure safety of people, it can provide huge usage if implemented correctly.

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## 3. Purpose

Our project is highly used in this pandemic situation to fight against the Covid-19 infection. The main purpose of our project is to reduce the spread of Covid-19 infection by undertaking various measures like face mask detection and body temperature measurement. The face mask detector is used at various places like airports, schools and other public places to detect if a person is wearing a face mask or not. Example: The Face Mask Detection System could be used at airports to detect if the travellers are wearing face masks or not. If they are not wearing a face mask, then their picture is sent to the airport authorities so that they could take quick action against them. The goal of measuring body temperature is to measure the core approximate body temperature so as to check if a person is having high temperature or normal temperature. Our project does not need to install any additional hardware as the system can be connected with your existing surveillance system only.

## 4. Related Work

There are several existing works that contain some of the elements relevant to the work presented in this paper. However, to the best of our knowledge, there is no such solution covering all the aspects together to achieve this goal while allowing execution on low-cost devices at the same time.

Moreover, a high accuracy method for facial mask detection based on a fully convolutional network is being used. When it comes to temperature measurement, there are several variants of Arduino-based solutions.

## 5. Scope

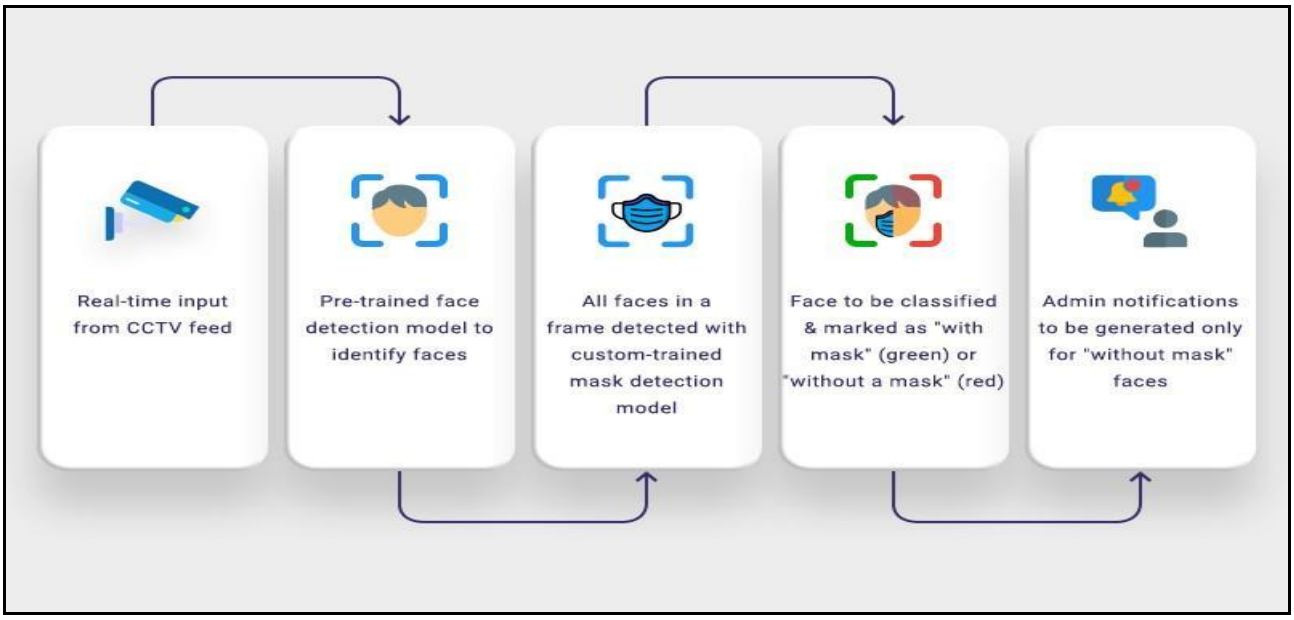
- Since our project provides various facilities to ensure safety of people, it can provide huge usage if implemented correctly.
- This project can be integrated with various embedded systems for application in airports, railway stations, schools, and other public places to ensure public safety and security from this COVID situation.
- Our project could be used at various places for safety purposes not only in this covid situation but could also be used in the coming future if any such situation arises again.
- The system is easy to implement in any existing organizational system.
- Custom alerts can be sent to the person with or without a face mask or the one whose face is unrecognizable in the admin system.

## 6. Implementation

Our system consists of the following subsystems: 1. Computer vision subsystem for mask detection 2. Temperature measurement subsystem based on Arduino Uno 3. Barrier Subsystem for movement restriction.

- **Face mask detection:** First of all, a person will stand in front of the camera and our face mask detector will compare the image captured by the camera with different datasets, which are already loaded in the disk of the face mask detector.
- **Temperature measurement:** If the person standing has worn the mask, then its temperature will be checked using a temperature measurement circuit which is integrated with the face mask detector.
- **Custom alert:** If the above two criteria are not full filled then the person is restricted to move ahead using custom alert.
- So firstly, mask detection of a person is held, and it indicates if a person is wearing a mask or not.
- Then if a person is wearing a mask the body temperature of the person is measured through a temperature measurement circuit.
- If these two criteria are full filled, then the person is allowed to move ahead else the person is restricted using custom alert.

*6.1 Figures*



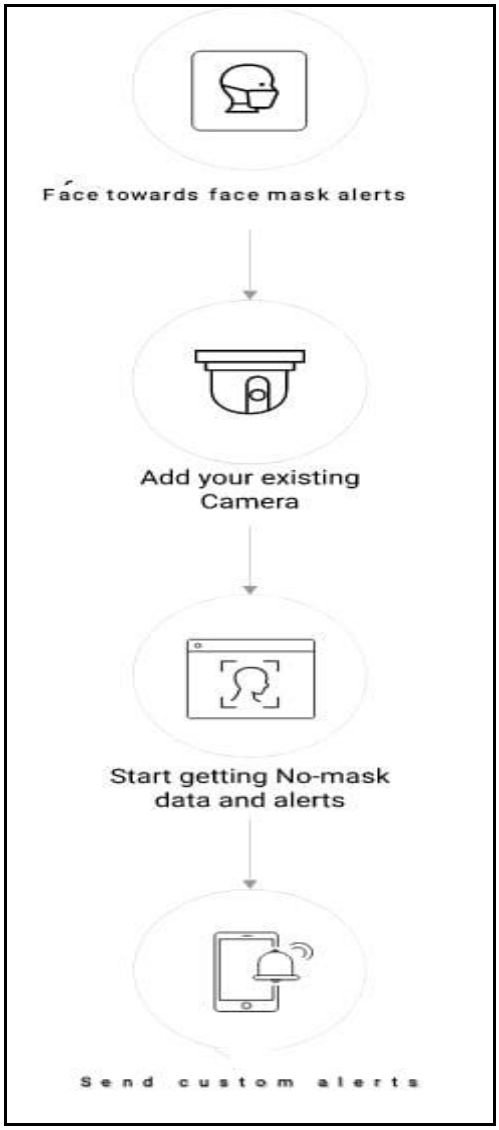




Fig. 1.

*6.2 Dataset*

Dataset consists of two main categories: Masked Dataset and Unmasked Dataset, which is mainly used to match with images from real time video streams. It is used to display a green border if a person is wearing a mask and it displays a red border if the person is without a mask.

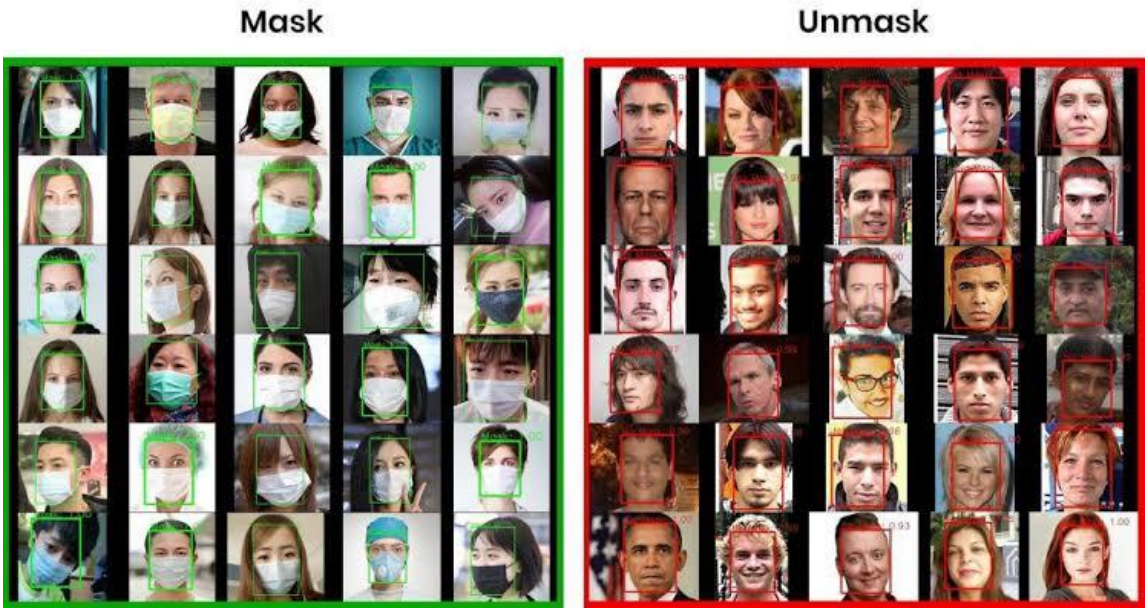



Fig. 2. Mass Detection

## 7. Conclusion

- We are hoping to build a project that can provide real time implementation and can help all the people to ensure their safety.
- This idea can replace normal temperature measurement systems with integrated face mask detection systems along with temperature measurement systems.
- So basically, the main aim of our project is to reduce the spreading of the highly spreading covid19 infection.
- According to the achieved results, the proposed solution is usable for its purpose under certain performance limitations (such as number of processed frames or measurements per second).

## 8. Future Work

- We are hoping for the best evolution ahead in future to provide accurate safety.
- Our project could be used at various places for safety purposes not only in this Covid situation but could also be used in the coming future if any such situation arises again.
- In future, it is planned to experiment with various deep learning and computer vision frameworks for object detection in order to achieve higher framerate.
- Moreover, we would like to extend this solution along with environment sensing mechanisms so that it could be adapted at various building air conditioning and ventilation airborne protection in order to reduce the spread.
- This technique could be implemented in order to enable efficient security personnel scheduling and mask allocation, together with risk assessment based on statistics about respecting the safety guidelines.

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# Medicine Reminder and Advisor

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**Abstract**

The aftermath of the development and implementation of the Android operating system and its associated Application Programming Interfaces (API) by Google culminated in the development more mobile device-enabled applications designed for our day-to-day businesses and personal use, however in recent times we are experiencing a massive revolution in the use of mobile technology in the health sectors of our economy and this revolution is termed as Medicine Reminder and Advisor (MRA). When medications are prescribed, a patient frequently does not follow the administration instructions included with the medication. A patient often forgets the specific time of day that the medication should be taken or miscalculates the interval between doses which results in the patient either taking medication too frequently, too infrequently or not at all. This can lead to a variety of pharmacological and/or toxicological problems to the patient which, ultimately, may result in ineffective treatment of a disease and/or harm to the patient. Frequently, patients who may need to take several different medications during the course of a day, become confused both with the frequency and particular medication that needs to be taken at a particular time resulting in the above problems. And so, this is the idea behind developing the reminder application. Another feature as mentioned earlier was advisory. As in our app, doctors/hospitals could register themselves, it will be easy for users to directly contact and enquire. Many times, we face problems as we are not sure about hospital timings or when will be the doctor available to us. Specially in times of covid, we have made various observations regarding this as in until and unless we visit the hospitals, we cannot be sure if the doctor will be available or in that particular hospital, covid patients are taken or not. But as in our app we will be providing info according to category, users won't face such problems as they can directly look up to particular specialist and list will be visible of hospitals registered there and also can contact directly. Also, a map feature is added which will enable user to easily find nearby hospitals according to their live location.

*Keywords*: Mobile, Android, Google, Map, Live Location

## 1. Introduction

Medicine Reminder and Advisor (MRA) is the use of mobile applications for provision and delivery affordable healthcare. It is a young and dynamic field that could be explored and harnessed to improve the health conditions of people around the world. The development of Mobile health applications can lower the costs of health care delivery and improve the quality of healthcare as well as shift behaviour to strengthen prevention and treatment of reported cases at the, all of which can improve health outcomes over the long term. One of the main goals of using mobile technology in the health sector is to improve the quality of and access to health care. In accordance with the invention, a medication reminder system for reminding patients to take medications is provided, the system comprising: After logging up as user, a page asking for details of prescription is displayed, which includes, name of medicine, dosage, type and timings. In this feature, we will be trying to add another feature for directly scanning on-page prescription and filling up the details accordingly.

In accordance with the invention, another feature of advisor, includes: There will be a login page for doctors/hospitals who want to register themselves in our app. Once they fill up the details, their details will be added in particular health category and likewise other registrations will take place. With the help of the details, users can directly contact them through the app for enquiry. Even in the past systems related to same inventions, we didn't find apps having both the features simultaneously and so this is the highlight line which we creating to differ from past systems.

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## 2. Conceptual Framework

MRA is defined as an Android Application which is come to encompass any use of mobile technology to address healthcare challenges such as affordability, quality, access and searching specialist. Mobile Technologies/Applications cannot take care of our health physically, but they can carry and process information in many forms: coded data, text, images, and audio/video.

*2.1 MRA CONTAINS:*

1. User's information in database.
2. User's Names with ID and password.
3. User's medicine details in a database.
4. Alarm for medicine.
5. Map for nearby hospitals.
6. Doctor's detail in database.

*2.2 VARIOUS OPERATIONAL WORKS PROPOSED IN THE SYSTEM ARE:*

1. Recording information of the user in database.
2. Providing best health Specialist accordingly.
3. Reminding user to take medicine.
4. Can get in touch with the doctor directly.
5. Find nearby hospitals with respect to current location.

*2.3 SURVEY OF SIMILAR SYSTEMS*

*2.3.1 Pill Reminder Medicine App- MedControl*

MedControl is a free pill reminder and medication tracker. This medicine app helps you to remember about every pill you need to take regardless of how complex your treatment is.

*2.3.2 Medica: Medication Reminder, Pill Tracker & Refill*

Medica Application reminds you to take the right medication at the right time and also to refill you stocks of pills before they run out.

*2.3.3 Find a Doctor- MARHAM*

MARHAM Application is your one-stop solution to find the right doctors nationwide, in your locality and also, the best option to Book Appointment and consult a doctor through Online Consultation. Get assistance in your ailing healthcare needs.

*2.3.4 DocOn for Patients*

DocOn to Book In-clinic and video consultation appointments with your doctor and maintain medical history and share reports with doctor. DocOn provide free follow-up on chat.

*2.3.5 Medication Reminder*

Medication Reminder helps you keep track of all of your pills and remind you when it's time to refill prescription. Medication Reminder even tells you to take your pill before or after eating and reminds you the right dosage of medicine. App helps you

create habits that keep you healthy and lets you always have the right medication in the right medication in the right dosage at the right time.

## 3. Methodology

The methodology employed in this paper is organized into several stages and sections as indicated below:

### *3.1 General Objectives*

It is a real time application; the main objective is to design and implement an application that will create an online platform to find the particular doctor and reminds you the right dosage of medicine.

#### *3.1.1 Specific Objective*

1. To develop an application that will create an online platform for remind the medication and find the specialist of particular diseases or problems.

2. The system will also display the list of doctors/specialists of particular diseases nearby user's area.

#### *3.1.2 The scopes of application development are:*

1. This Application system with multiple user connection development on android studio (minimum version 4.0) based on the java programming language (Android Studio IDE-Integrated Development Environment version-4.1.2), Android SDK-Software Development kit and Android API level 29.

2. The user interfaces include, login interface, chat interface, blog interface, chat list interface.

3. The backend development is based on google firebase real-time communication and database Application Programming Interface 00

### *3.2 System Requirement Specification*

The application requirements can be divided into Functional and Non-Functional requirements. Functional requirements define the capabilities and functions that a system must be able to perform successfully. Non-Functional requirements define the qualities and criteria that can be used to judge the operation of a system.

#### *3.2.1 Functional Requirements*

1. Users must be able to sign up.

2. Manager must create profile of certified doctors on the system.

3. Users must be able to log into the system.

4. Users must be able to logout of the system at any time.

5. System must provide an error message in case of login failure for certain number of times.

6. System must display a list of particular doctors or specialist for diseases.

7. System must provide the map for find nearby hospitals or doctors.

8. User must be able to take appointment directly.

9. Users must be able to add the schedule of pills.

10. System must remind to take pills at the right time.

*3.2.2 Non-Functional Requirements*

1. The graphical user interface and sub interfaces of the application must be user friendly.
2. The system should show clear and detailed notification messages to the user.
3. The system must have lack of bugs and inform the user of every wrong operation.
4. The system will be able to run on all Android devices.
5. The system will request a password for each user account.
6. The system supports simultaneous users.
7. User manual must be developed to help a new user understand the usage of the system.

*3.3 Pictorial Representation*

*3.3.1 Use Case Diagram for Proposed System*

Actors: Users, Doctors, Administrator

Use cases:
1. Register in Application
2. Logging into system
3. Signing Up user
4. Logging out of the system
5. Enter schedule of pills
6. Remind to take pills at right time
7. Enter Disease
8. Display list of doctors
9. Search nearby doctor through MAP
10. Take appointment through the app

Use case diagram in figure:

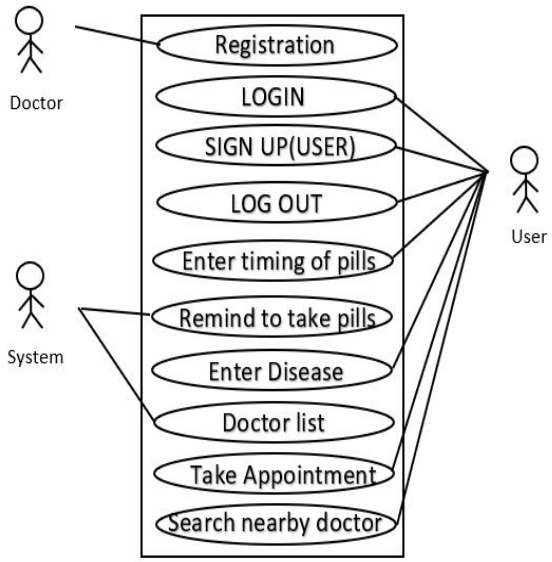


Fig. 1. Case Diagram

*3.3.2 Class Diagram*

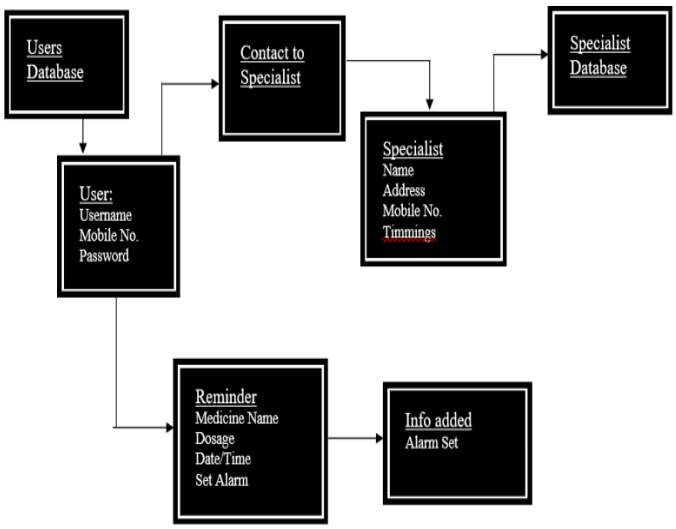


Fig. 2. Class Diagram

*3.3.3 Activity Diagram*

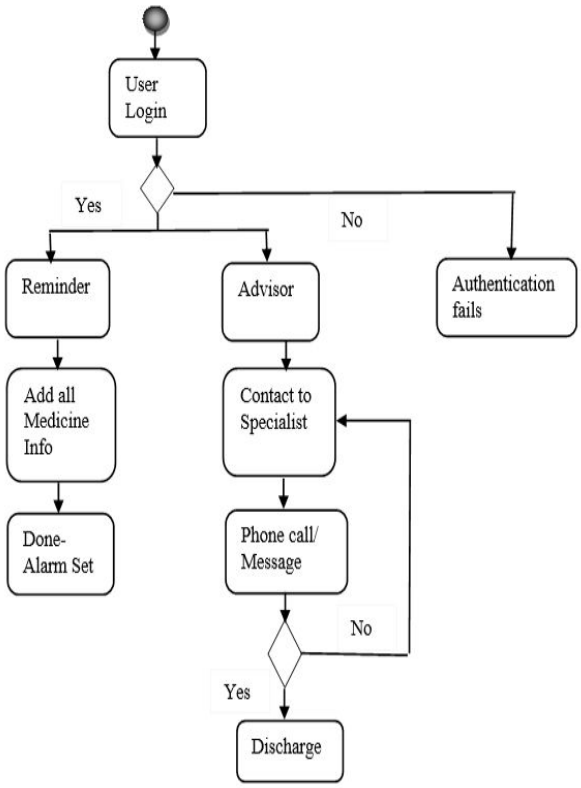


Fig. 3. Activity Diagram

## 4. System Design

The design of this project is an integration of a real-time mobile-based communication among multiple users on a single platform. It includes three main areas: Architecture Design, Model design, backend design and user interface design.

*4.1. Architectural Design - Firebase*

Firebase is a fully managed platform for building iOS, Android, and web apps that provides automatic data synchronization, authentication services, messaging, file storage, analytics, and more. Starting with Firebase is an efficient way to build or prototype mobile backend services.

*4.2. Firebase mobile app backend service*

This project employs the complete firebase-powered apps design pattern. In this architecture, your app only consists of static content and assets, and all your dynamic content and user data is stored and retrieved from Firebase. With this technology, Firebase-powered apps, user authentication can be handled by our Simple Login service which supports Facebook, Twitter, GitHub and Google; in addition to a regular email/password login scheme. Simple Login eliminates the need for you to write your own server-side authentication code.

*4.3. User Interface Design*

*4.3.1 Login Page*

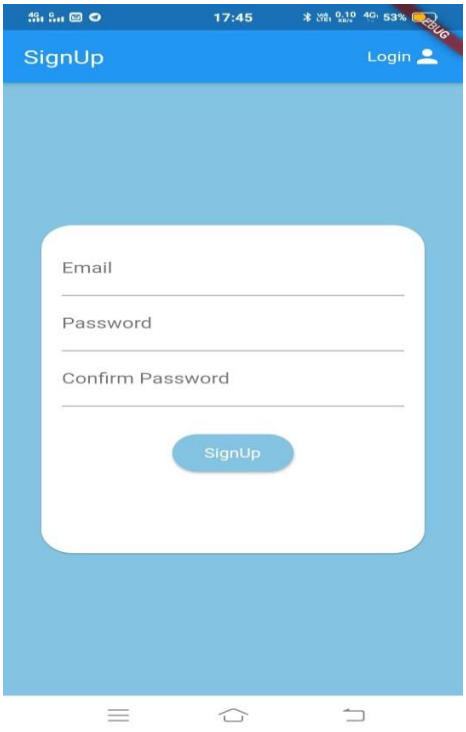


Fig. 4. Login Page

- This is the login page of the app. User have to fill Email ID and password for Sign up/Login.

*4.3.2 Home Page*


Fig. 5. Home Page

- This is the home page of ou app, where features are listed ➔ Reminder, Advisor, Finder.
- Clicking on any feature will direct the user to that page.

*4.3.3 Reminder Page*

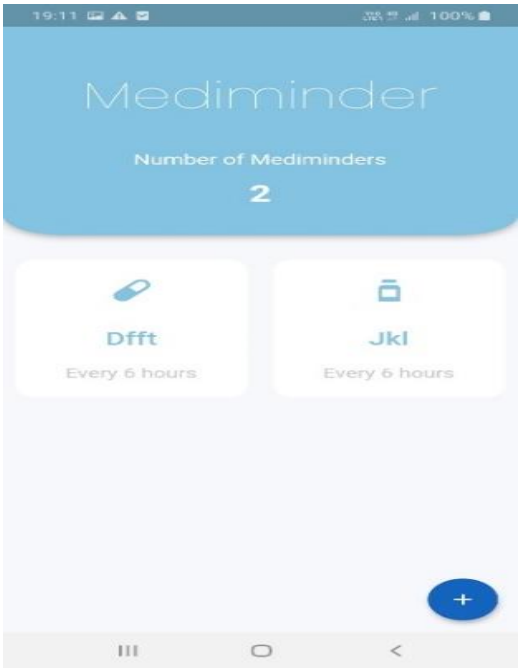


Fig. 6. Reminder Page

- In the reminder feature, all the medicines that are added or inserted by the user till date are displayed here.


Fig. 7. Medicine Details

- Clicking on any saved medicine reminder, will direct user to this page, where all the details will be shown and if user wants to delete that reminder, he/she can delete it from this page.

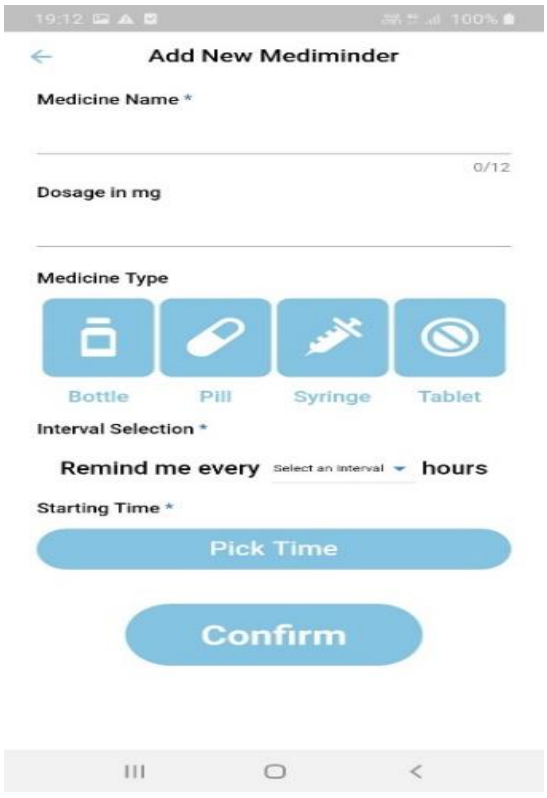


Fig. 8. Add New Medicine

- When user wants to add new medicine, this page's details have to be filled up.

- Name of the medicine which is compulsion, dosage and type are optional, interval based on picking time is mandatory and then by confirming, medicine reminder is added.

*4.3.4 Advisor Page*

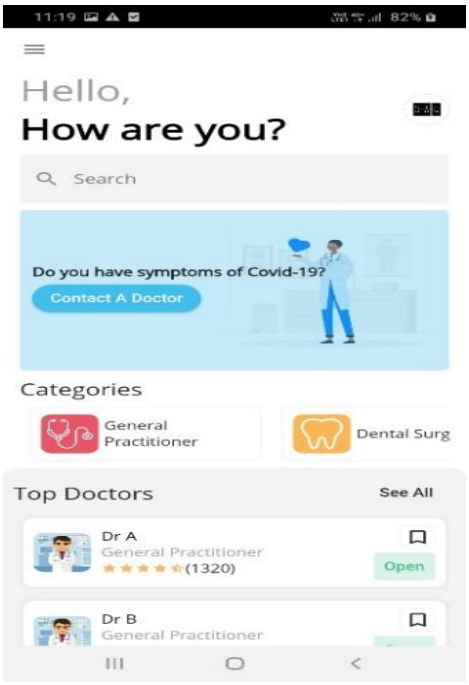


Fig. 9. Advicer Page

- This is Advisor's home page, where categories are shown which has to be selected to view available doctors in that specific category, also top doctors will also be listed below.

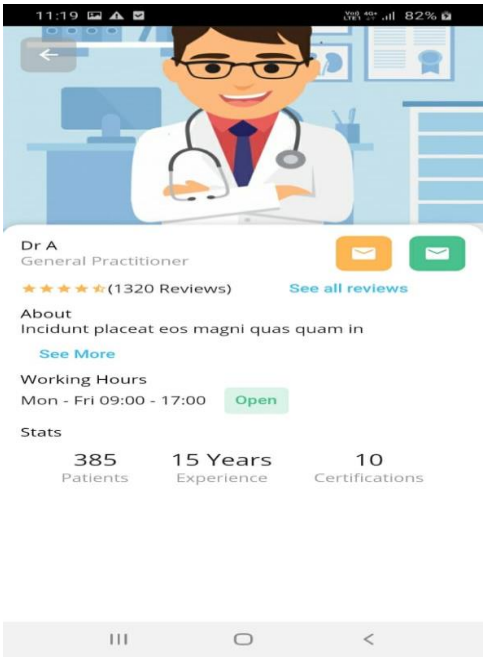


Fig. 10. Available Doctors

- On selecting any doctor, this page will be displayed where all the details/info of the doctors will be shown to the user including name od hospital, address, contact, timings of availability etc.

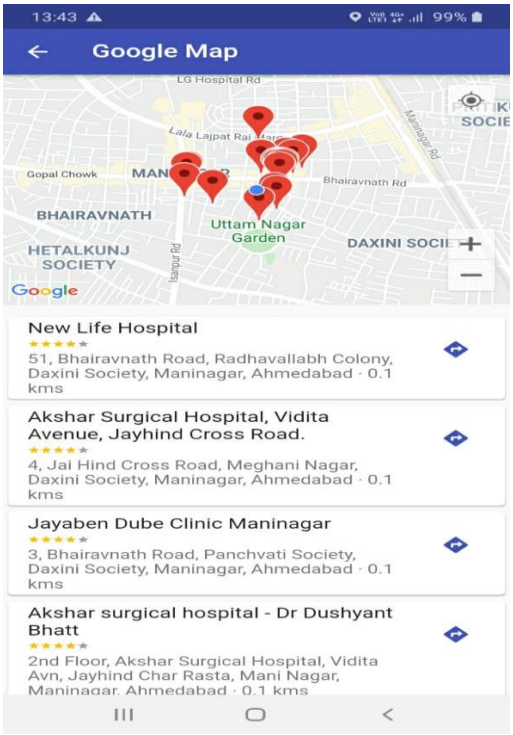


Fig. 11. Google Map

- This the Map feature which is directed from “Finder” option of home page. In this, users live location will be automatically considered and nearby hospitals will be listed.

## 5. Benefits For Society

1. This Application will be very helpful for Aged Peoples for remind the schedule. Doctor set the schedule of regular medicine.
2. It is useful for peoples to find the Specialist of any health problem. Find the timings for meet with doctor.
3. This Application is perfectly useful for Society for caring the health, remind the schedule of medicine etc.

## 6. Drawbacks

1. Recently, there are many applications for health care, but those applications provide only limited features like advisor or order medicine online or reminder. We overcome this problem and try to add all features for healthcare in one application and make it easier for User especially Senior Citizens.

## 7. Conclusion

This android application can be used by all but specially can be useful to aged people or those who are advised to take medicines on daily routine. So, the effort of remembering the schedule can be overcome. Also, people can consult doctor through the app.

### Future Work

1. A chatbot will be provided through which if user has any query or for enquiry can connect to us.
2. In future, we add online counselling in app so, counsellor and counselee can easily interact with each other through the app.
3. We will add more features related to the health so, app will be guide or give any fitness or health related tips.
4. Video chat option will be provided by app so user can easily consult with doctor online at any place.

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# Modification in Air Handler Unit for Healthcare Facility with Various Mode of Operating in Same Zone

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**Abstract**

The increase in quality of air that humans breathe is most important thing in healthcare because the most disease spread in hospitals are viral & bacterial. This virus can spread by contact of surface or through contaminated air from one human to many people till the strength of virus stays affective. When one breathe, particles present in lungs can spread epidemic disease like corona if one is a contaminated patient. When a person sneeze droplets are swept by the air motion and fall due to gravity, at the same time if there is a return terminal placed in ceiling will resist the fall by the drag force and may move in the direction of resultant force. This droplets evaporated to become droplet nuclei. Motion of air and motion of droplet concentration creates the turbulence force. Droplets lands on a surface and dry to become desiccated a layer formation on floor as well as it can eject dry particles into the air. Dilution range of this contaminated air from breathing mode is done till 1-2 meters. Operation Theater is the room in hospital which remains close all the time thus it is very much important to maintain the correct temperature and humidity at same time. Thus, to provide accurate temperature a modification in equipment is required to provide overcooled air from Air Handler which needs to reheat for balancing the relative humidity with quality air.

*Keywords*: 100% Fresh Air /Multipurpose Air Handlers, Reheat, Effectiveness.

**Nomenclature**

| | |
|---|---|
| *OT* | Operation Theatre |
| *CFM* | Quantity of air |
| *FPM* | Velocity of air |
| *ACPH* | Change of air in one hour |
| *AHU* | Air handling Unit which controls the quantity of air |
| *TFA* | Treated fresh air unit dedicated for conditioning the fresh air |
| *UV* | Ultraviolet light kills the germs & virus |

## 1. Introduction

Now a days after corona virus human race are getting aware of contamination through the medium of air. For Operation Theater it is very much important to maintain the desirable parameters for reducing such contamination. The Relative Humidity ranges listed are the minimum or maximum allowable at any point within the design range of temperature is permissible.

### *1.1. Quality of Air required for Operating Rooms*

Pressure of the room is kept positive so that the body which is opened in the room may not affect by the blend of other air which is blended from all over the hospital thus the corridor on both the sides are kept negative so the blended air from other zones do not enter in the operating zones. There must be two different corridors for material movement as ones the equipment used is to be taken outward towards CSSD is said to be a dirty corridor, after the sterilization of the equipment it can be taken in reuse to be brought from the sterile corridor because this movement reduce the risk of contamination by avoiding surface spread. Both the passages must be design with negative pressure. Minimum Air change per hour must be 20 design temperature must lay between 68-75 deg. Fahrenheit which is 20-24 deg. Celsius with 40-60 Relative Humidity.[1]

Filtration level in Air handlers [2]:

- Combination Filter (10+5 Microns-EU4+EU5)

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•Fine Filter (3 Microns-EU7)

Filtration level to be fitted at Terminal:

- Micro glass fibre Filter (0.3 Microns-H14)

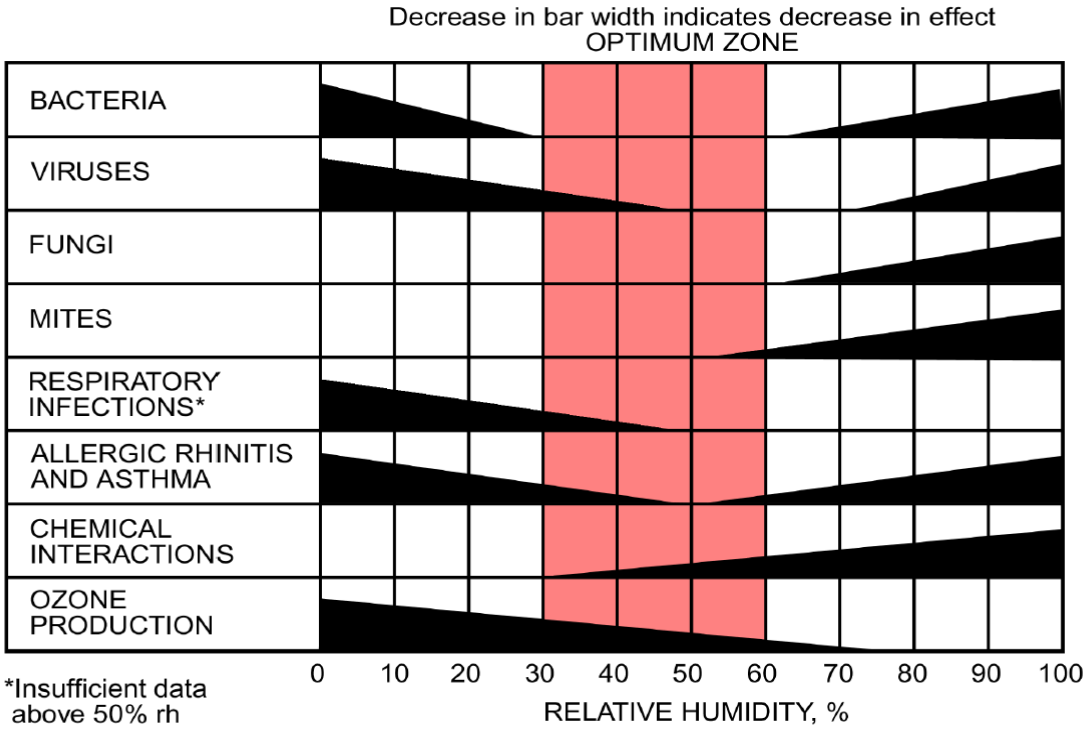


Fig. 1. Illustration of Graph of Relative Humidity in effective zone.[3]

*1.2. Reheat concept to support the Fresh Air Unit to get accuracy in conditioning*

During SARS it is studied that the inactivation of the corona virus family starts between the ambient RH of the room between 40-60%, further if it crosses the minimum or maximum limit the virus remains virulent and infectious.[4]
Reheat the concept of reheat is used to obtain the desirable Relative Humidity, when we reheat the air there will be a raise in temperature too. Thus, we need to overcool the air in such a way that after cooling with the curve of saturation there will be drop in temperature then by adding proper sensible heat to a dry air we can achieve the desirable conditions which is required for the room (OT).[5]
In this covid-19 situation the requirement has been generated for operating room with 100% fresh air. Fresh air is outside air which is passed from 3 level of filtration, UV lamp and a heating section. There will be a section of UV lamp just beneath the coils which will prevent the formation of mold & Biofilm on the surface of coil.

## 2. Condition of working in new proposed system

*2.1. Working of system*

The use of EC Fans is done wherever we want to decrease the power consumption and increase the efficiency of the equipment as there is no mechanical drives interferes between the shaft and rotor. This is the design of the Air Handlers which contains the above 3 system.

The lower Tier is dedicatedly used for providing Fresh Air with 2 layers of filtration, while the upper tier is a dedicated exhaust fan with filtration so that the exhaust air is also filtered this both the unit is connected by a damper E which needs to be control

from operation theatre.

The next thing observed is to control the system with dependent matrix so that it can balance the air handler on multiple operable manner by providing two-way Pressure independent dynamic balancing valve located on the manifold of Air Handler. This AHU is prepared for the multipurpose thus the requirement of it will also change as per its usage, let's say for 100% fresh air we will require 50.4 GPM flow of water through the coil and if we are recirculating the air with 20% Fresh Air then it will require 16.8 GPM flow. Thus, PIBCV must function properly.

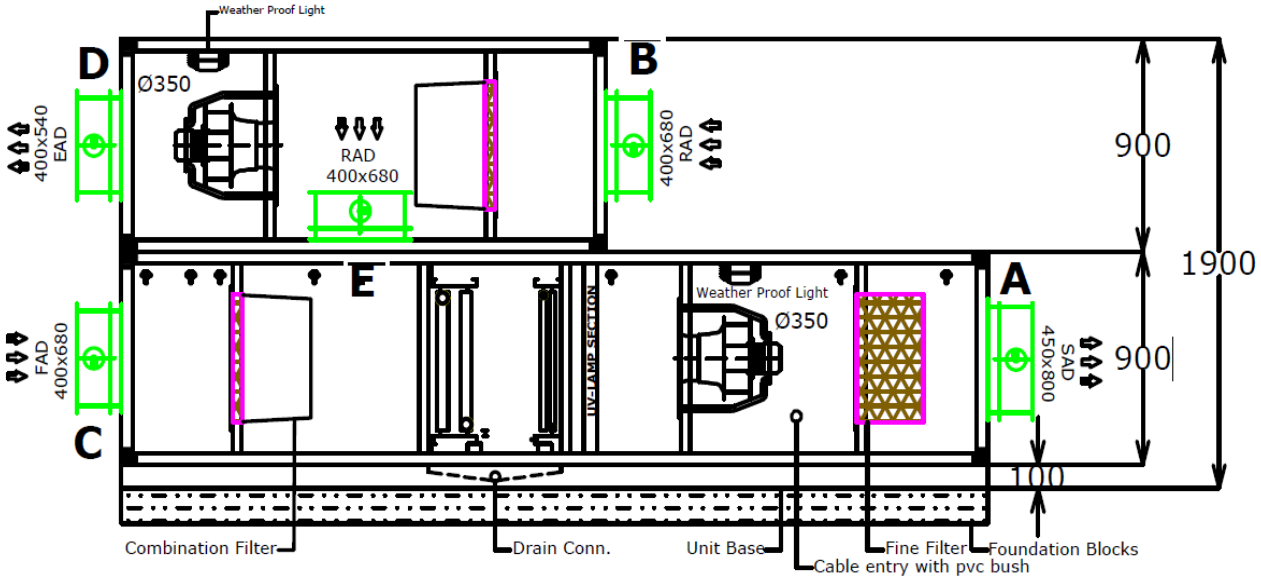


Fig. 2. Diagram for the movement of air flow and the location of Volume control dampers to control the system.

Table 1. Condition of Operating Dampers

| Sr. No. | Case | Condition | Status of Opposed blade 100% Leak proof damper | Damper No | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. | Case 1 | In this case Air Handler will run at 100% Fresh Air | 100% Open<br>Closed | A | B | C | D | E |
| 2. | Case 2 | Recirculation of Air with 20% Fresh Air and Positive pressure | 100% Open<br>20% Open<br>Close | A | B | C<br>D | | E |
| 3. | Case 3 | Fumigation | 100% Open<br>Closed | A | B | C | D | E |

Table 2. Some Reheat value to achieve OT requirements

| OT Requirements | Space Dew Point | Chilled Liquid Temp | Coil Face Temp | Reheat Temperature |
|---|---|---|---|---|
| 16° C & 50% RH | 5.0° C | 1.1° C | 3.88° C | 7.7° C |
| 16° C & 60% RH | 7.77° C | 3.88° C | 6.66° C | 10.55° C |
| 18° C & 50% RH | 7.22° C | 3.33° C | 6.11° C | 7.7° C |
| 18° C & 60% RH | 10.0° C | 6.0° C | 8.8° C | 10.55° C |
| 20° C & 50% RH | 9.4° C | 6.0° C | 8.33° C | 18.0° C |
| 20° C & 60% RH | 12.2° C | 9.0° C | 11.11° C | 13.0° C |
| 22° C & 50% RH | 11.1° C | 7.2° C | 10° C | 16.0° C |
| 22° C & 60% RH | 13.8° C | 10.0° C | 12.77° C | 16.0° C |

## 3. Study of different Drawbacks in Existing System

### *3.1. Desiccant wheel system*

Existing system in India for operation Room is AHU with desiccant wheel. Desiccant wheel is just a Heat Recovery wheel coated with silica gel. Purpose of desiccant is to remove humidity by absorbing the moisture present in the return air. It is also used as an enthalpy wheel as well as for dehumidification. There is a counter flow of air that comes in contact with this desiccant wheel, which is rotating continuously at low RPM, thus it will absorb the temperature from the air leaving for exhaust and pass it to the fresh air for supply thus it will decrease the initial delta T. [6]

In our country there is so much issues of area provided by Architect to fit in AHU with HRW, so ones it is assembled it will not accessible until it breaks down and service provider needs to take a day or two to repair the issue. As he needs to disassemble this unit again. The original use of this machine is a walkthrough machine kept on the terrace for fresh air to get plenty of space to walk with in.

We can achieve the RH by using this system but the mold formation on HRW needs to be clean on regular basis which is not possible as there is not shut down for operating rooms. Fouling is also one of the process in which the by-product with pure air starts formation of biofilm contamination which indirectly increase the power consumption of the entire system which is not considered during the time of calculation.

As per **California Society** for Healthcare Engineering 0.006” (0.1524mm) of fouling thickness can reduce the efficiency loss of 16%, 0.012” (0.3048mm) of fouling thickness can reduce the efficiency loss of 20%, 0.024” (0.6096mm) of fouling thickness can reduce the efficiency loss of 27%, 0.036” (0.9144mm) of fouling thickness can reduce the efficiency loss of 33%, 0.064” (1.625mm) of fouling thickness can reduce the efficiency loss of 50% and the major problem is this reduction cannot be count so we cannot control the handlers properly.[2]

Degradation of silicon due to continuous use of OT Air handlers the continuous degradation in system may leads to total choke up of the system which ruins and pressurize the mechanical system it can create a heavy damage or total loss of the system. This system has open boundary thus there is an imaginary boundary between Return Air and Fresh Air.

## 4. Conclusion

a) No mold formation inside the Air handlers.
b) We can achieve desirable condition if the system is designed accordingly.
c) Power consumption will reduce when we will be recirculating as we have proposed EC Fans.
d) In case of total fresh air power consumption will increase but the quality of air will justify the value of life.
e) During Fumigation there will be no supply and return will exhaust all air directly.
f) While using treated fresh air unit Air Handler will exhaust all the return air as we have kept filter in return connection we can utilize this air in other corridor as a secondary system, passing it from UV Light section [7]

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# Modified Virtual Carrier Sensing Mechanism For Wireless Ad Hoc Network

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**Abstract**

Medium Access protocols for wireless networks and wireless Ad hoc networks are interesting research issue. There are various issues in designing an efficient MAC protocols, e.g., Bandwidth efficiency, fairness, effective energy utilization. Fairness is one of them. When multiple stations are competing for a single channel, some stations may grab the channel again and again and others wait. This leads to unfairness problem. Unfairness results in different throughput for different flows, i.e., some flows get more throughput, and some get very less. It is desirable that MAC protocols should fairly allocate the channel to competing stations. We have reviewed many research papers in the field of MAC layer protocols. It is found that less attention is given to the issue of fairness. In this thesis, we have focused on fairness problem with reference to 802.11 MAC standards. We have simulated MAC 802.11 with and without virtual carrier sensing (RTS-CTS handshake) and with conservative CTS reply. Two types of topologies are considered: regular as well as random. Various performance metrics like aggregate throughput, Jain's fairness index is used in case of regular and random topologies. In case of regular topologies, it came to notice that virtual carrier sensing mechanism increases fairness in network. In case of random topology, Virtual carrier sensing mechanism increases fairness in the random topology also, but conservative CTS scheme results in reduction in fairness.

*Keywords*: MAC Protocols, Ad hoc networks, 802.11, RTS, CTS.

## 1. Introduction

This section introduces wireless ad hoc networks and IEEE 802.11 standard. We discuss 802.11 MAC layer protocol with carrier sensing mechanisms.

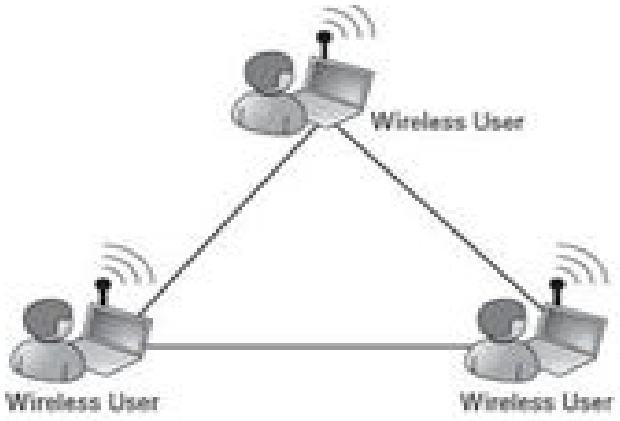


Fig. 1. Wireless Ad hoc Networks

Wireless ad-hoc network is more popular in nowadays. There are two categories of wireless networks. One has a wired backbone network. The boundary nodes and the extended connections between mobile users which are wireless channels. Second has more than one hop wireless channels in the connection. An independent network can be formed using two or more nodes. Ad-hoc networks are also known as infrastructure-less networks because in that fixed infrastructure is not required. When two nodes are within transmission range of each other they are known as one hop neighbours. [1] With the support of intermediate nodes Multihop ad-hoc networks are ones in which the nodes can talk to nodes more than one hop away. Ad-hoc networks are formed two or more by several wireless nodes and cooperate with each other. The intermediate nodes are called relaying nodes. Ad-hoc networks have advantages of being self-organizing in nature and easy to deploy. But all these come at some cost. They have similar challenges of wireless networks as they are type of wireless network, bandwidth optimization etc.

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## 2. Literature Survey

### a) Issues in designing MAC protocols for ad hoc networks:

1) **Bandwidth efficiency** is the ratio of the bandwidth used for actual data communication to the total bandwidth. It is used to maximize MAC protocol for ad-hoc networks.
2) **Quality of service** provision is important for time-critical applications. The MAC protocol should consider the limitation of ad-hoc networks.
3) **Synchronization** can be attained by interchange of control packets.
4) **Fairness** is the important criteria where each and every flow in the network should get effective channel utilization.
5) **Hidden and Exposed terminal problem;** we have discussed these problems in the previous chapter. So interference related issues can be resolved by MAC layer protocol. For this efficient carrier sensing mechanism is required. In wireless network nodes have limited power. So efficient energy consumption is essential.

### b) Interference aware protocols:

1) **Large Interference range:** Most of the interference in Virtual carrier sensing can be eliminate from the other nodes but both receiver and transmitter can also interfere to receiver nodes those who are out of transmission range. This problem arises because of large interference range. Whereas, in WLANs probability of this situation is very less when in case of ad-hoc networks nodes are spread in large area. If distance is larger than the 0.56* then RTS-CTS cannot be work well [2]. While in our work, study of simulation says that RTS-CTS is very useful in our topologies. As shown in Fig. 1, general path loss of a signal is modelled by two-way ground model [3] which is having distance between transmitter and receiver. So, from the equation (1) calculate power of signal at receiver that is Pr Here, transmission power is Pt.

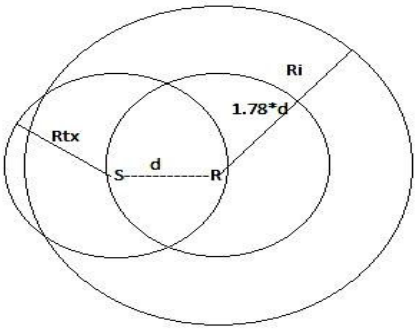


Fig. 2. Interference Range

$$P_r = P_t G_t G_r (h_{t2} h_{r2} / d^4) \quad (1)$$

$G_t$ and $G_r$ are the antenna advantages for transmitter and receiver respectively. ht and hr are the heights of antenna of transmitter and receiver. d is the distance between transmitter and receiver. r is distance of interfering node.

Signal at the receiver is considered valid if Signal to noise ratio is above certain threshold. SNR ratio is given as equation (2).

$$SNR = P_r / P_i \quad (2)$$

$$SNR = (r/d)^4 >= T_{SNR} \quad (3)$$

Where $T_{SNR}$ is the SNR threshold

$$r = 4\sqrt{TSNR} * d \quad (4)$$

2) **Conservative CTS reply:** Conservative CTS reply [4] is kind of modified virtual carrier sensing mechanism. Main purpose of this scheme is to combat with large interference range. Thus, it reduces collisions occurs due to interference. Idea is like node replies with CTS only when power of RTS (which is received) is larger than certain threshold. Node will not reply to RTS even if it is idle. In [10], this threshold can be equal to the power of packet of node which is 0.56*transmission range (where interference range is equal to transmission range) away from transmitter. This power value can be denoted by CTS Reply Threshold. This scheme reduces effective transmission range but decreases interference. This idea can be very use full in dense network where distance between transmitter and receiver is less. Practically the CTS Reply Threshold value can be adjusted to get optimal throughput.

3) **An Interference-Aware Busy Tone based MAC Protocol:** In [11] authors have suggested interference aware busy tone based MAC Protocol against hidden and exposed terminal problems. They figure out that these two problems are due to interference among the nodes. For solution of hidden terminal problem, some details of ongoing receiving sessions should know to all the hidden nodes. A sine wave is sent as a busy tone by receiver, when all the hidden nodes of receiver will be reported. This technique might be useful for getting solution of the hidden terminal problems. It is required that the exposed nodes know the interference range of the ongoing receiving node for the solution of the exposed terminal problem. With the help of using this protocol, to find the solution for exposed terminal problem, the dropped packets from MAC layer decrease expressively and the spatial reuse is improved. The performance of this protocol goes up substantially compared to the original 802.11 MAC protocol.

**c) Miscellaneous MAC Protocols:**

1) **An Adaptive Contention Window Control based protocol:** Here [12], a novel contention-based protocol is used to increase fairness and throughput together with the use of network collision and based on that array information, the contention window is optimized. Most of research give high priority to the nodes which cannot complete the transmission successfully. By providing better fairness, CW values should be increased then and then transmission originate. As it gives the chance to others for accessing the channel so that we can have high fairness and by this we can getting good results as an improvement in fairness. In the given method, the network status priority is given to older ones back off range comparing to new one. With the decision in this situation, sudden reaction of elimination will affect network changes. For saving new variables and extra computations for all five additional operations which are used to selection of next CW size will occupy extra space for memory. In order to this method, the total cost is cheaper than the cost used for estimating number of nodes. The fairness, network overhead load and throughput will be result after simulation which is added by the new algorithm.

2) **An Adaptive RTS-CTS Control Mechanism for IEEE 802.11 MAC Protocol:** RTS-CTS in terms of carrier sensing, transmission and interference ranges in IEEE 802.11 DCF, MAC protocol is specifically different. As a part of result, performance of throughput in Constant bit rate (CBR), UDP and TCP type traffic flows will be observed and based on that new RTS-CTS control mechanism will be proposed. Each and every terminal will keep counting the number of events for "Waiting for CTS timeout". If data packet is sent by node, it will check the value first. If threshold occurs by the given value, RTS-CTS are turned off. So, every node decides on its own whether to use RTS-CTS or not dynamically according to its current situation. Results show that the scheme has improved performance in both UDP and TCP traffic [13].

**d) Power Controlled Multiple Access Protocols for Wireless Networks:**

1) **Power controlled multiple access wireless MAC protocol (PCMA):** The collision avoidance framework (CSMA/CA) is power controlled multiple access wireless MAC protocol to remove HN and EN problem. In ad hoc networks, transmission power is managed without base nodes. In ad hoc networks, it allows simultaneous transmissions with help of source destination pairs which is tightly packed into the networks. In this mechanism, sender first sends request-power-to-send (RPTS) to receiver and Receiver will respond with Acceptable-power-to-send (APTS) that is used to determine minimum power value that is required for successful reception of packet. After successful handshake consisting RPTS and APTS sender and receiver will exchange data and acknowledgment packets. In this mechanism a busy tone is sent by receiver while it is receiving the data packet from sender. So, it needs one channel for busy tone. Simulation results show that this scheme has better performance in reducing packet corruption as compared to 802.11.
2) **Power Controlled Dual Channel (PCDC) Medium Access Protocol for Wireless Ad Hoc Networks:** In reference [12], the technique shows to handle 802.11 MAC and route request packets is done with proper selection of next hop which may effect to MAC layer. First of all, for this efficient connection between MAC layer and network layer is essential. In (Power Controlled Dual Channel) PCDC, network layer performance is affected by MAC layer by controlling the power used to transmit the route request (RREQ) packets. By a given destination, node will broadcast packets to inquire the next hop and controlling the transmission power of a RREQ packet, the MAC layer effectively controls the set of candidate next-hop nodes.

This protocol allows for interference-limited simultaneous transmissions to take place in the neighbourhood of a receiving node. This mechanism allows MAC layer to indirectly influence the routing problems by controlling

power of route discovery packets such as RREQ. Simulation study shows that this scheme has many advantages over 802.11 in terms of channel utilization, end-to-end delay and throughput.

e) **GPSR (Greedy parameter stateless routing):** Greedy parameter stateless routing protocol (GPSR) is based on strategy of choosing greedy approach for packet forwarding. Specifically, if a node knows its neighbors' positions, the locally optimal choice of next hop is the neighbor geographically closest to the packet's destination. This Greedy approach fails when a node doesn't find any neighbor node within range. But when greedy forwarding is not possible, perimeter routing is used. When Greedy approach fails it will send packet by perimeter approach. Fig. 3 shows the greedy approach for forwarding packet. As shown node S will send packet to node X and X will send to Y as Y is next neighbor of X. Similarly, Y approaches to D via greedy forwarding.

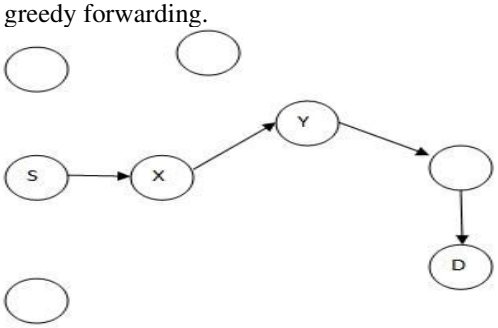


Fig. 3. Greedy Approach for forwarding Packet

## 3. Proposed Scheme to Check Fairness issues

### a) Who calls whom (i.e. relationships among functions):

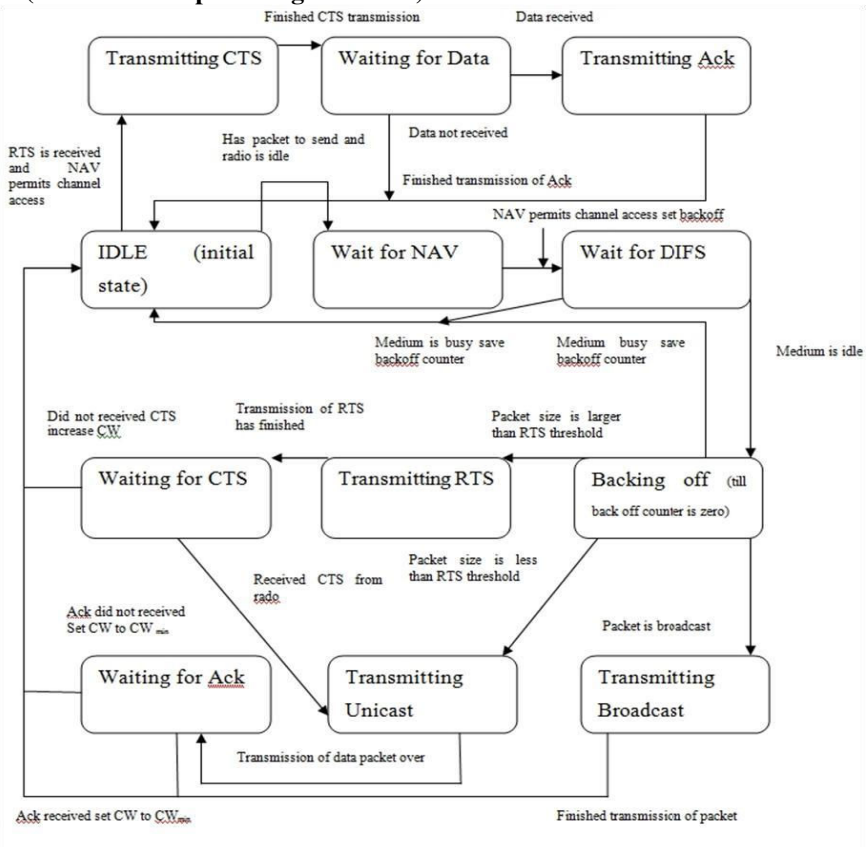


Fig. 4. Shows the state transition diagram/flow chart for IEEE 802.11 MAC layer Protocol

b) **Conservative CTS in MAC 802.11:** RTS-CTS cannot function well if distance between transmitter and receiver is larger than the certain distance like d*0.56[Xu]. In this mechanism the main idea is node will send CTS control packet to RTS only when the receiving power of RTS is above certain Threshold say CTS reply Threshold. Modified recvRTS (Packet *) function in MAC 802.11 for conservative CTS reply,

```
Procedure recvRTS (packet)
{
Access RTS farm received;
If (transmission_state is not equal to MAC Idle)
Then
Discard (packet, MAC_Busy);
End if
Else
If (power of received RTS is greater than CTS_reply_Threshold) Then
SendCTS ();
End if
Else
Discard (packet, MAC_Busy);
Stop defer timer; Resume transmission;
}
```

## 4. Analysis and Implementation

**a) Network Simulator 2 (NS-2):** NS-2 [14] is a discrete-event simulator whose implementation was started by 1989 with the development of the Real Network Simulator. NS-2 works with two languages. OTcl described the main characteristic of the scenario. Using C++ we can implement kernel of ns-2. Protocol vice folder is created for easy understating. For example, all the files related to implementation of protocol are stored in a folder named ADOV. So if any user wants to access any software which is already developed can be easily get it from the scenario by OTcl. Yet if any new protocol want to test then it we need to update C++ files.

**b) Implementation Methodology and Performance Metrics:** We have considered per stream/flow fairness to measure fairness. Jain's fairness index [6] is used as fairness index. So topologies have to be chosen in which more than one flow should be present. Basically, we want to check the role of virtual carrier sensing in fairness issue. So we first we select two topologies cross and grid. Cross topology is having two competing flows and grid topology is having five competing flows. In these regular topologies, distance between source and destination varies from 130m to 250m, where 250m is transmission range of any node. We have performance metrics like fairness index, aggregate throughput. We measured these performance metrics for both topologies with and without virtual carrier sensing to find its effect. We have implemented Conservative CTS reply [15] mechanism, a one kind of modified virtual carrier sensing mechanism for IEEE MAC 802.11 as discussed in previous chapter. Random topology of area 1km by 1km having 150 nodes is used. We believe that Conservative CTS reply mechanism is very useful when network is dense. We have done comparison of three MAC 802.11 standard like with and without virtual carrier sensing and Conservative CTS reply virtual carrier sensing mechanism on all three performance metrics.

Table 1. Simulation Parameters for grid and cross topologies

| Parameter | Value |
|---|---|
| Transmitter range | 250 m |
| Number of nodes | 9(Cross) and 25(Grid) |
| Traffic type | TCP |
| Routing Protocol | AODV |
| Application | FTP |
| Packet size | 1500 Bytes |
| Total simulation Time | 100 Sec |
| Channel type | Channel / Wireless Channel |
| Propagation model | Two Ray Ground |
| MAC protocol Type | Mac/802_11 with and without |
| Max packet in queue | 50 |
| Inter nodal distance | 130-170-210-250 |
| Seed | 10 |

Table 2. Simulation Parameters for random topology

| Parameter | Value |
|---|---|
| Transmitter range | 250 m |
| Simulation time | 400 Sec |
| Number of nodes | 150 |
| Area | 1000 m X 1000 m |
| Routing Protocol | AODV, GPSR |
| Traffic type | TCP |
| Channel type | Channel / Wireless Channel |
| Application | FTP |
| Packet size | 1500 Bytes |
| Propagation model | Two Ray Ground |
| MAC protocol Type | Mac/802_11 with and without VCS and CCR |
| Max packet in queue | 50 |
| Seed | 10-100 |

**c) Result Analysis:**

**1) Analysis of Regular Topology**

**a. Aggregate throughput Analysis for regular topologies:** From results as shown in Fig. 5 and Fig 6 it is observed that virtual carrier sensing mechanism creates some overhead in networks. 802.11 Without RTS-CTS gives better Throughput than 802.11 with RTS-CTS. This is because, when RTS-CTS packets are used, every data packet is preceded by transmission of a pair of RTS-CTS. This situation happens in regular topologies where distance between transmitter and receiver remains fixed.

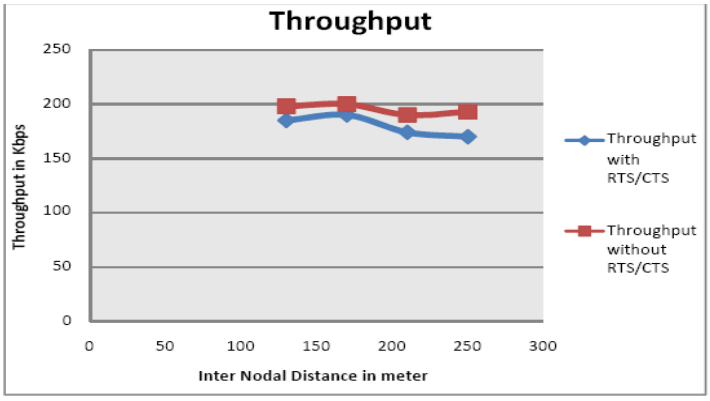


Fig. 5. Inter Nodal distance v/s Throughput (Cross topology)

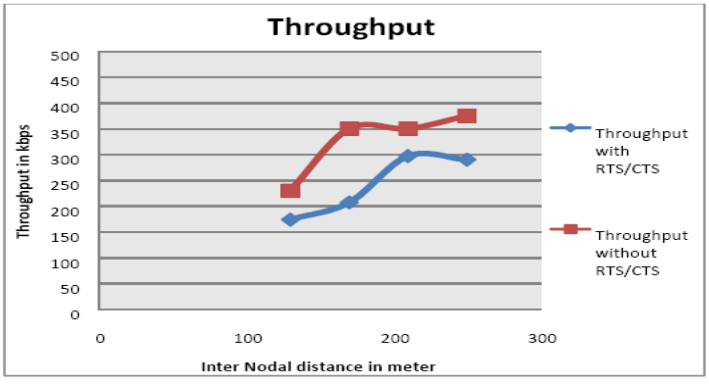


Fig. 6. Inter Nodal distance v/s Throughput (Grid topology)

**b. Fairness index analysis for regular topologies:** Graphs of Fairness v/s. Inter nodal distance are shown in figure 7 and 8. From both the graphs, it is concluded that in case of 802.11 without RTS-CTS, Fairness drastically reduces as inter nodal distance increases from 210m to 250m. Below we have explained this downfall. Consider the scenario shown in figure 9. Inter nodal distance is 250m. Carrier sensing range is 550m. Distance between node 1 and node 6 is 353m as per Pythagoras rule. They are out of each other's transmission range. In effect they are hidden from each other. So their packets will collide at node 2 and only one will get chance. So thus it is affecting the fairness. In case of RTS-CTS node 2 will send CTS to node 6 then node 1 will hear that and will defer from transmitting further data. When Inter nodal distance is fewer, node 2 and node 6 will hear each other's transmission and so defer from transmitting simultaneously. Thus RTS-CTS handshake is useful for larger distance for achieving fairness.

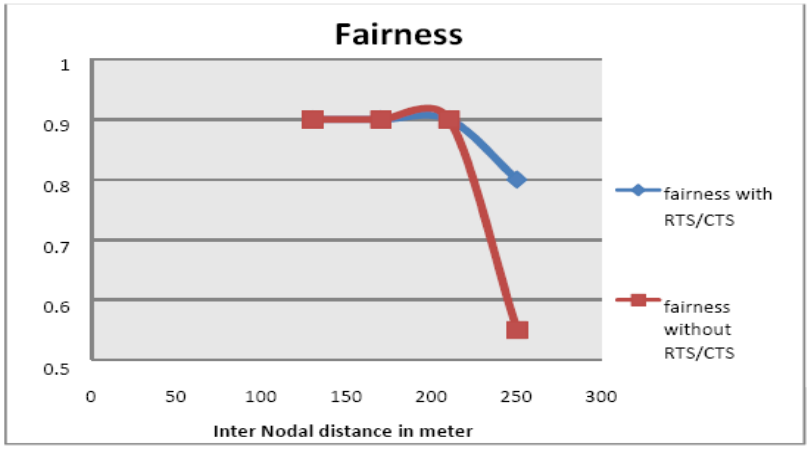


Fig. 7. Inter Nodal distance v/s Fairness (Cross topology)

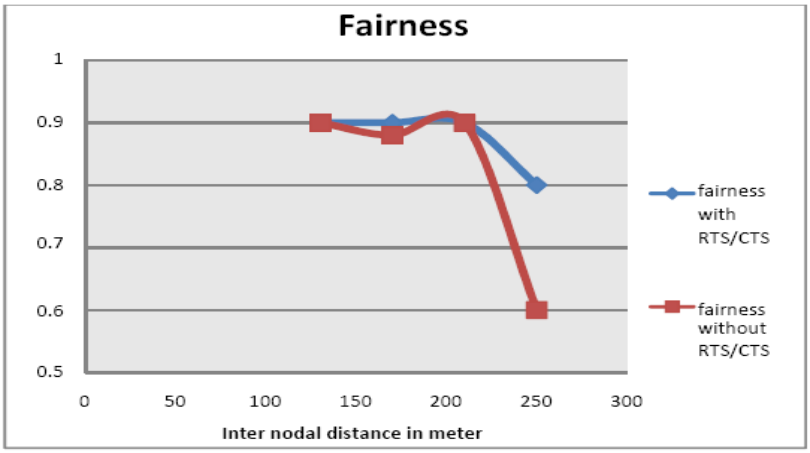


Fig. 8. Inter Nodal distance v/s Fairness (Grid topology)

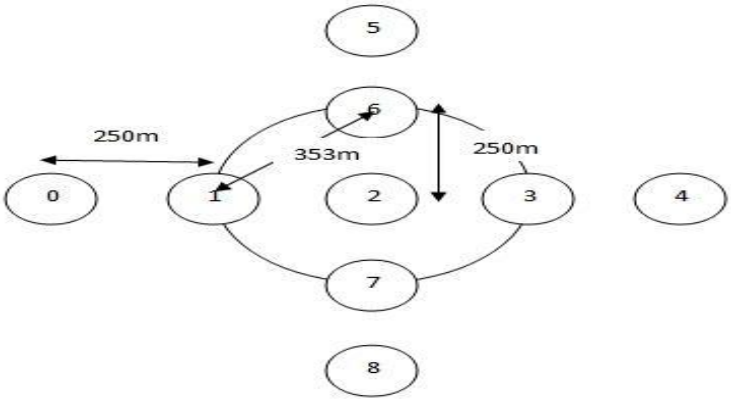


Fig. 9. Analysis of fairness

**2) Analysis of Random Topology**

**c. Aggregate throughput analysis for random topology:** In Figure 10, we have shown graphs of aggregate throughput for 802.11 without RTS/CTS, with RTS/CTS for random topology. From the results as shown in Fig.10, it is observed that virtual carrier sensing mechanism has better performance in case of aggregate throughput unlike regular topologies where RTSCTS mechanism creates some overhead in network. But in dense topology like this RTS-CTS has better performance.

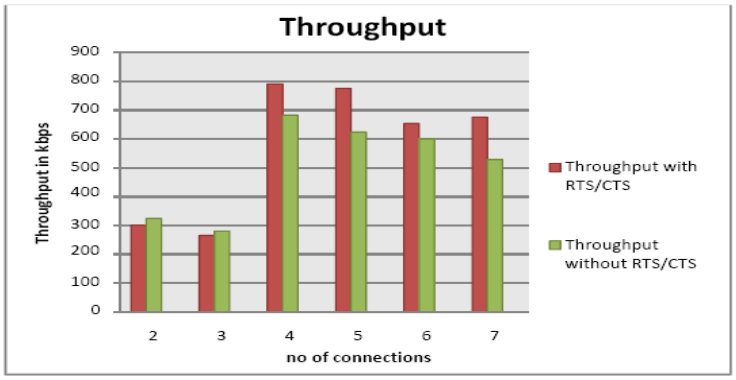


Fig. 10. No of connections v/s Aggregate Throughput

From the results of fairness index shown in Fig. 11, it is observed that virtual carrier sensing mechanism has vital role in fairness issue as it provides better fairness as compared to without virtual carrier sensing mechanism. We have simulated random topology for various routing protocols like AODV, DSR, and DSDV. But all three protocols failed due to the nature of CCR scheme (i.e. sending CTS to nodes having distance 0.56 * d). In GPSR routing protocol, every node selects nearest neighbor in its path to destination. So, GPSR seems suitable for use with CCR MAC layer protocol. We have simulated CCR with GPSR as routing protocol. Results of Fig. 12 and 13 are generated this way.


Fig. 11. No of connections v/s Fairness

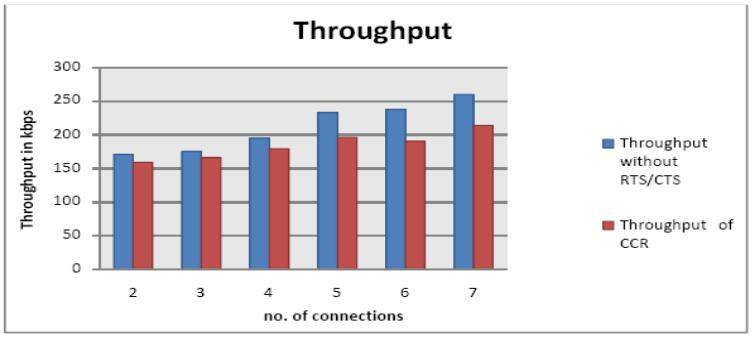


Fig. 12. No. of connections v/s Fairness

Fig. 12 shows comparison between aggregate throughput without RTS-CTS and aggregate throughput of modified virtual carrier sensing mechanism that is conservative CTS reply. Fig. 13 shows comparison between Fairness without RTS-CTS and conservative CTS reply.

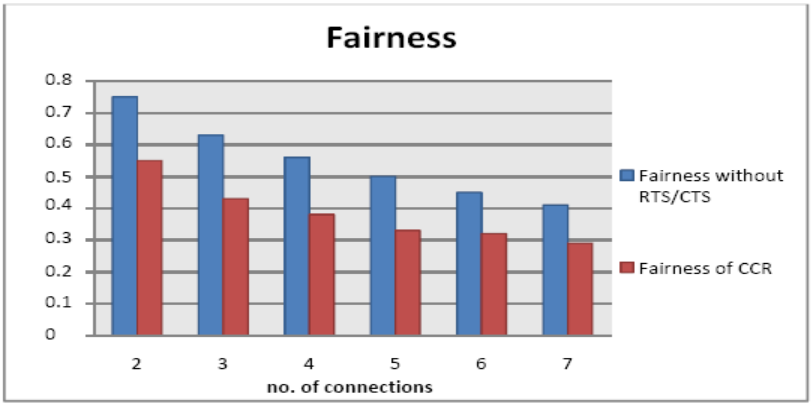


Fig. 13 No. of connections v/s Fairness

## 5. Conclusion and Futute Work

In IEEE 802.11 based Multihop ad hoc networks, fair channel allocation is the serious problem. We made comparison between three MAC standards 1) with virtual carrier sensing 2) without virtual carrier sensing 3) CCR. Form the results we can say conclude following points: Virtual carrier sensing increases overhead in regular topologies like grid and cross. But it is very useful in achieving fairness. It increases fairness about 20% in above stated topologies. In Multihop random topologies virtual carrier sensing mechanism is found very useful as it increases throughput as well as fairness. Fairness is increased about 7 -8%. In dense environment it is found useful. In Multihop random topologies CCR scheme is not much useful as it results in reduction in fairness and throughput.

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# Plant Height Estimation Using Sar Imaging

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**Abstract**

This paper deals with measuring the height of the plant using the SAR Images. Most of the research in these field are using the use optical images and radar images. SAR Images remove the problem of the optical images which capture only cloudless and well illuminated areas to produce quality data. SAR Images can observe the earth surfaces through all weather conditions and its signal can penetrate through a thick vegetation cover. SAR Images can also capture clear images at night-time also. Therefore, SAR Images are most suitable for the mapping of vegetation cover and measuring the height of the plants an algorithm is being developed that will calculate the height of the plants through SAR Images. The mapping of Plant height today through manual process is a tedious job. Through the Sar images we would like to be able to calculate the height of plants. Plant height can help in taking the inventories of the crops which can further help in deriving various other attributes. Various research work has showed that SAR Images provide useful and beneficial information about growth of plant. They help in agricultural monitoring and reliable mapping of vegetation.

*Keywords*: Image Processing, Satellite Image Processing, Sar Images, Plant, Height Estimation

## 1. Introduction

### *1.1 Satellite Image Processing*

Satellite Image Processing is a significant field in research and innovative work and comprises of the pictures of earth and satellites taken by the artificial satellites. Firstly, the photos are taken in digital type and later are handled by the computers to get the information. The satellite images is broadly used to design the foundations or to screen the natural conditions or to distinguish the reactions of impending calamities. We plan to Use the Satellite Image Processing to map the vegetation. Mapping vegetation through distantly sensed pictures includes different considerations, processes, and techniques. Satellite image processing assumes an indispensable part for exploration and advancements in Astronomy, Remote Sensing, GIS, Agriculture Monitoring, Disaster Management, and numerous different fields of study. Satellite pictures are in digital form and then various other processes are carried out on it to get the information extracted out of it. Variations in the scene attributes are represented to as variations in image brightness. A specific part of scene reflecting more energy will show up as bright while an alternate piece of the very scene that reflecting less energy will seem dark. Digital Image comprises of discrete picture components called pixels. Each pixel is a number spoken to as DN (Digital Number), that portrays the average radiance of relatively small area inside the scene.

### *1.2 Sar Images*

SAR monitors the surface day and night, through most climate conditions, and therefore the signal can enter the vegetation shade. There are various existing SAR datasets from previous and current airborne and satellite missions. A constraint of optical satellite distant detecting is that it relies upon cloudless, all around enlightened territories to make quality information. this is often particularly risky for gathering information during nighttime, around storms, and in thickly forested regions. Synthetic Aperture Radar (SAR) is a solution for a big number of those impediments. Synthetic Aperture Radar (SAR) images are often obtained from satellites like ERS, JERS and RADARSAT. Optical sensors like Landsat's Operational Land Imager (OLI) and Sentinel-2's Multispectral Instrument (MSI) gather the data within the near-infrared, short-wave and visible infrared portions of the spectrum. Radar sensors utilize longer wavelengths at the centimeter to meter scale, which provides it special properties, just like the power to determine through clouds (view spectrum to the right). The various wavelengths of SAR are often mentioned as bands, with letter designations like X, C, L, and P. According to the wavelengths of the band would they be able to penetrate the surface of any plant or forest canopy. So, the higher the wavelength the better the chances of penetrating the canopy.

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Table 1. Bands of Various Wavelengths

| Band | Frequency | Wavelength | Typical Application |
|---|---|---|---|
| **Ka** | **27 – 40 GHz** | **1.1 – 0.8 cm** | **Rarely used for SAR (airport surveillance)** |
| **K** | **18 – 27 GHz** | **1.7 – 1.1 cm** | **Rarely used ($H_2O$ absorption)** |
| **Ku** | **12 – 18 GHz** | **2.4 – 1.7 cm** | **Rarely used for SAR (satellite altimetry)** |
| **X** | **8 – 12 GHz** | **3.8 – 2.4 cm** | **High resolution SAR (urban monitoring, ice and snow, little penetration into vegetation cover; fast coherence decay in vegetated areas)** |
| **C** | **4 – 8 GHz** | **7.5 – 3.8 cm** | **SAR Workhorse (global mapping; change detection; monitoring of areas with low to moderate penetration; higher coherence); ice, ocean maritime navigation** |
| **S** | **2 – 4 GHz** | **15 – 7.5 cm** | **Little but increasing use for SAR-based Earth observation; agriculture monitoring (NISAR will carry an S-band channel; expends C-band applications to higher vegetation density)** |
| **L** | **1 – 2 GHz** | **30 – 15 cm** | **Medium resolution SAR (geophysical monitoring; biomass and vegetation mapping; high penetration, InSAR)** |

## 2. Case Study of Various Research Papers

In one of the papers, we studied shows the multifaceted effect of the effective spatial baseline, through the vertical (interferometric) wavenumber, on the inversion of forest height from Polarimetric Interferometric SAR (Pol-InSAR) data. At First the vertical wavenumber relating forest height to the interferometric (volume) coherence is introduced. By the review of the forest height inversion from Pol-InSAR data the effect of the vertical wavenumber on the inversion performance is calculated. The selection of forest height inversion performance with vertical wavenumbers is discussed. The effect of the acquisition geometry and terrain slopes on the vertical wavenumber and their consideration in the inversion methodology is addressed. The individual effects discussed are shown by means of airborne repeat pass Pol-InSAR acquisitions in L- and P-band acquired over various forest. The achieved forest height inversion performance is validated against reference height data derived from airborne LIDAR acquisitions.[1] In another paper we studied the satellites TanDEM-X and TerraSAR-X platforms form together the first spaceborne single-pass polarimetric interferometer in space. It allows the acquisition of spaceborne (Pol-InSAR) data without the disturbing effect of temporal decorrelation. It also aims to assess the potential of such data for forest applications. For this, single- and dual-pol data acquired over a boreal, a temperate, and a tropical site were investigated on X-band penetration and polarization diversity of the interferometric coherence measurements. Pol-InSAR forest height inversion schemes have been implemented for the single- and dual-pol cases and cross validated against LIDAR reference measurements for all sites. The singlepol inversion depends on an external ground digital terrain model (DTM) and performed better for all sites with correlation coefficients $r^2$ between 0.80 and 0.98. Therefore, its performance varied with forest structure and season: The best result was achieved for the summer acquisition of the boreal test site and for the winter acquisition of the temperate test site. For the tropical test site only, a weak correlation could be established.[2]. The third paper deals with the retrieval of agricultural crop height from space by using multipolarization Synthetic Aperture Radar (SAR) images. Coherent and incoherent crop height estimation methods are discussed with a unique TanDEM-X dataset acquired over rice cultivation areas. The TanDEM-X mission helps the tracking of crop height through InSAR, PolInSAR and the inversion of radiative transfer-based backscattering model. The paper evaluates the three techniques simultaneously with a data set acquired in September 2014 and 2015 over rice fields in Turkey during their reproductive stage. The detail report of the absolute height accuracy and the limitations of the approaches are provided. The PolInSAR and morphological backscattering model results showed good results with low RMSEs (12 and 13 cm) compared to the differential InSAR result having RMSE of 18 cm. [3] In the fourth paper they train Sentinel-1 data against ground measurements with machine learning techniques (Multiple Linear Regression (MLR), Support Vector Regression (SVR) and Random Forest (RF)) to estimate rice height and dry biomass. The study has been done on multitemporal Sentinel-1 dataset acquired from May to September 2017 over the Camargue region, southern France. The ground measurements were done in the same time to collect rice height and dry biomass over 11 rice fields. The images were processed to produce a radar stack in C-band including dual-polarization VV (Vertical receive and Vertical transmit) and VH (Vertical receive and Horizontal transmit) data. Their observation was that non-parametric methods (SVR and RF) had a better performance over the parametric MLR method for rice biophysical parameter retrievals. The accuracy of rice height estimation showed that rice height retrieval was strongly correlated to the in-situation rice height from dual-polarization, in which Random Forest yielded the best performance with correlation

coefficientR2=0.92 and the root mean square error (RMSE)16% (7.9 cm).[4] In another paper the study objective was to establish and validate a methodology by which forest canopy height can be estimated from SAR and optical remote sensing data using machine learning models i.e., Random Forest (RF) and Symbolic Regression (SR).[5] In another paper Sentinel-1 Synthetic Aperture Radar (SAR) imagery was utilized to investigate the performance of the sensor backscatter image on crop monitoring. Multi-temporal C-band VV and VH polarized SAR images were acquired simultaneously by in-situ measurements. [6] In another paper Using polarimetric SAR (PolSAR) data, plant morphology dependent electromagnetic scattering models can be used to approximate the backscattering behaviors of the crops. The accuracy of the proposed approach is tested with ground measured biophysical parameters on rice fields in two different bands (X and C) and several channel combinations.[7]

### 3. Proposed Method for Plant Height Estimation

After going through all the papers, we decided the best way to measure the height of plants is through using a combination of SAR backscatter power and INSAR coherence. This approach is referred as SAR/INSAR Estimation of Forest Stand Height. The Sar backscatter method is normally used to measure the FSH values below 10m while the values above measurements are taken through interferometric coherence. As the number of scatterers increase within a SAR resolution cell, so does the reflected power. This trend is moderated because of lessening of signals as they pass through a forested canopy and is directly related to the saturation effect seen in backscatter to biomass relationships. When two SAR observations are made the angle can be determined very precisely through trigonometric calculations and can be used for measuring the topography of the Earth through a process called Interferometric SAR, or InSAR. If the measure of InSAR height can be adapted to the bare ground, and if the topography of that ground can be determined through other means, then we can estimate the vegetation height by the difference between the InSAR-measured height and ground surface Digital Elevation Model (DEM).[8]

➔ Relationship of Backscatter to Forest Stand Height

The backscatter power, after correcting for topographic and other geometric effects, is written as

$$\gamma^0 = A\left(1 - e^{-Bh_v^C}\right)$$

where γ0 is the terrain-corrected form of radar cross section, hv is the vegetation height, and the coefficients A, B, and C are determined in the FSH algorithm using a least-squares fit between the backscatter power and the vegetation height provided by the ground validation and/or overlap data between scenes.

➔ Relationship of Interferometric Coherence to Forest Stand Height

The interferometric correlation γ is defined as

$$\gamma = \frac{\left\langle E_1 E_2^* \right\rangle}{\sqrt{\left\langle |E_1|^2 \right\rangle \left\langle |E_2|^2 \right\rangle}},$$

where E1 and E2 are the complex values of radar cross sections observed by the SAR satellite and delivered as SLCs, the brackets indicate averaging over multiple looks, and * indicates a complex conjugation.

In the FSH algorithm, the combination of volume and temporal correlation (or coherence), |γv&t| =|γvol|γtemp|, is related to the vegetation height hv by the empirical equation:

$$|\gamma_{v\&t}| = S_{scene} \cdot sinc\left(\frac{h_v}{C_{scene}}\right),$$

where the coefficients of Sscene and Cscene are scene wide coefficients (i.e., have only one value for the entire radar scene) determined using a least-squares fit to the ground validation data and/or overlap regions between neighboring interferograms.

Once the coefficients for the empirical relationship between hv and |γv&t| have been established, it is a simple matter to invert the relationship (using a lookup table or otherwise) to determine FSH over an extended region.

## 4. Methodology

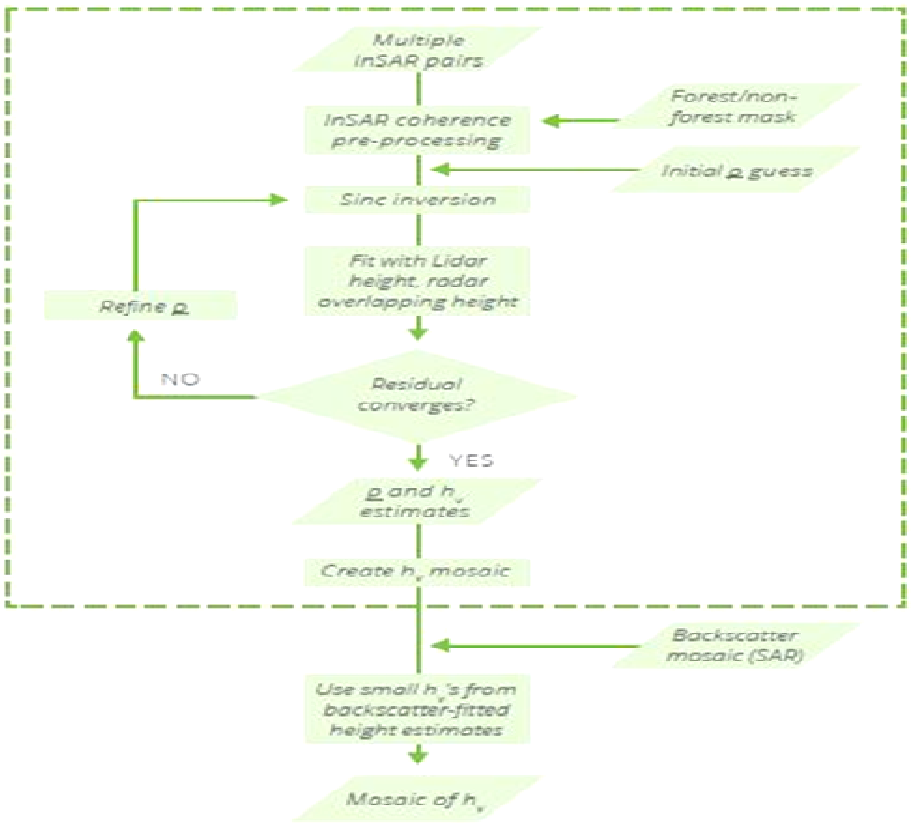


Fig. 1. Block Diagram for processing FSH (FOREST STANDARD HEIGHT)

In the above figure, parallelograms point to inputs and outputs of the algorithm. Rectangles depict steps in the processing, and a diamond depicts to a point of evaluation. In the figure, the variable hv refers to the value of FSH, and ρ = [Sscene Cscene] are the set of two values per scene that parameterize the model that relates temporal decorrelation to the vegetation height.[8]

## 5. Result and Discussion

To measure the height of the plants we choose the study area extends over an 83 km x 71 km region in central Maine, where the Howland Research Forest and the Penobscot Experimental Forest are located. The area selected is shown in below figure.

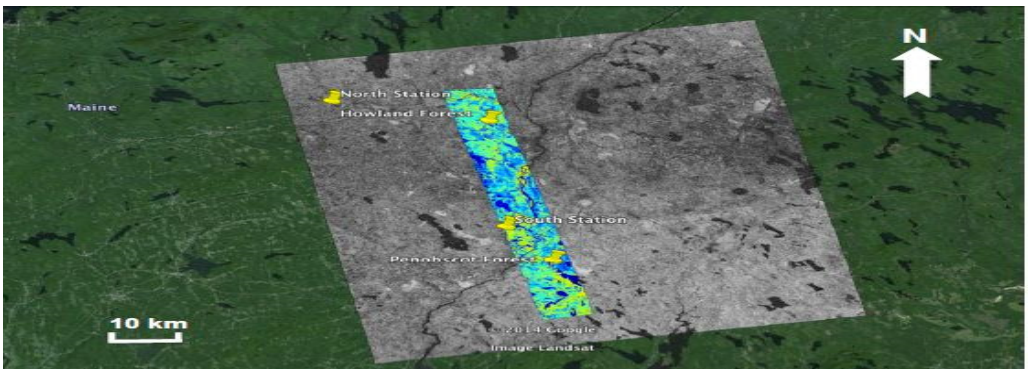


Fig. 2. Howland and Penobscot Forest Region

The following files are required to carry out the Forest Height Measurement of the forest: -

1) flag_file – It contains all the flags and corresponding full file names and associated file information (dates, scene location (frame#, orbit#), polarization), e.g.
   001 890_120_20070727_HV_20070911_HV 070727 070911 890 120 HV
2) ref_file - reference tree height data (Lidar or field inventory) in raster format.
3) mask_file - landcover mask that excludes all water areas and areas of human disturbance (urban, agriculture).
4) link_file - a text file that lists all the edge scene pairs. Each line consists of the two numbers that correspond to the flag numbers for those two scenes.
5) file_directory - the root directory that consists of the individual scenes-directories.

Then we run the foreststandardheight script to map the height of trees. The above files are to be imported to this foreststandardheight script.
We get the following output after running the script.

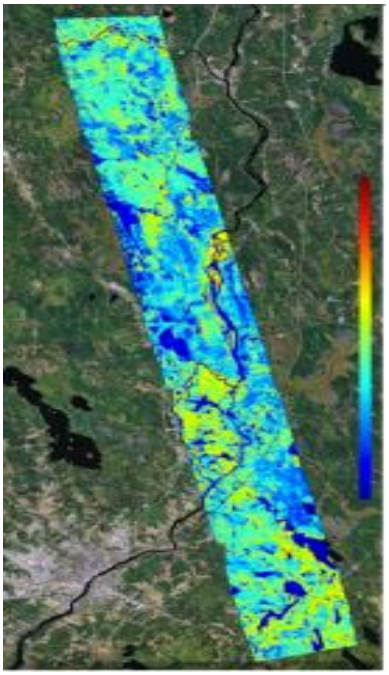

Fig 3. Output Image

The mapping starts from blue to red with blue depicting 0m and red depicting 45m.
We get the Sscene as 0.63 and Cscene as 9.95 with RMSE of 3.9 m and R of 58%.

## 6. Conclusion

Most of the papers that we studied in this field were measuring the height of plants. While we plan to implement the algorithm that can be applied to all the plants. The measurement of forest structural characteristics is important for a various reason like Monitoring, Reporting, and Verification (MRV) protocols in resource management. Plant height can be used as an indicator of the age of a forest stand, plant and animal habitats, and the amount of Ground Biomass (GB) held in the forest stand. A difficulty with airborne measurements, is that these measurements work well for tens- to hundreds-of-hectares-level, they are difficult to scale beyond that.

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# PLC Based Automated Drainage Water Monitoring and Control System

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**Abstract**

For Disposal of the waste the preliminary way is the drainage system but during the cleaning and changing the drainage line many humans' lives are at trouble. To tackle this burning issue of saving human life I came with this idea of implementing the automatic industrial drainage system. The main purpose of the concept is to replace the labour work and cleaning the drainage by automated system. To solve this primary real-world issue, I have planned and designed this project so that it can give an efficient way to control the dumping of wastages and regular service of the filtration, bifurcation of gaseous materials so that the toxic and non-toxic gas can be easily separated form one other and they are treated separately and one can frequently monitor the dumping process very easily. The PLC is the main controlling unit, and supervisory control and data collection techniques track the drainage level. The automated monitoring and control system of the drainage water pump consists of solenoid valves, gas exhausters, pressure valves, level sensors. The gas sensor is a system in the drainage pipe region that senses the presence of gases. There was a separation of the toxic and non-toxic gases, by using the exhauster for gas. In order to check the water level and the level of pressure produced within the pipe, the pressure sensor and the level sensor are triggered. The pressure valve opens when the pressure reaches the specified cap. The compressor works with minimal pressure if the water level is high. In factories, hospitals, etc. This industrial drainage technique is used. The gas sensor is a device that detects, sometimes as part of a safety system, the presence of gases in the drainage pipe area.

*Keywords*: drainage system, PLC based drainage piplines, Automated drainage system.

## 1. Introduction

Automatic Drainage Water Monitoring and Control System is to solve real-time issues, using PLC and SCADA. With the continued growth of factories, due to the growing sewage problems from environmental factories, the question of sewage water must be urgently resolved. The waste and gases produced from the factories are very damaging to humans and to the PLC and SCADA technique of environment.ng. The PLC is the main control unit and the drainage level is controlled by supervisory control and data acquisition methods (SCADA). It is the perfect program to envision the system's service. We used compressors, exhausters, gas sensors, IR sensors, stepper motors, filter plates and pressure valves in this system. This project could bring a revolution in this industrial era where everything needs to be automated to cut of the overall production cost. The maintaining cost would be not that expensive to it can be a perfect fit in both large- and small-scale factories.

### *1.1 Purpose of work*

In today's world, while automation plays a very important role in industrial and commercial applications, it is still a difficult challenge. Drainage pipes are used for waste disposal, but sadly, when cleaning the blockages in the drainage pipes, there can often be a loss of human life. To solve this issue and save people's lives. Open loop simulations have been carried out on MATLAB software and objective is to minimize reactive power flow from source with the help of proper triggering of thyristor switches in TCR. "I am introducing a "Drainage Monitoring and Control System" design. We are planning our project to use an effective way to manage waste disposal and blockage clearance on a regular basis. We also routinely track the disposal in a regular manner.

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*1.2 Hardware Description*

PLC based automated drainage water monitoring and control System consists of a Compressor system, gas exhauster, Valve for friction, stepper motor, level sensors. In factories, hospitals, etc., the system is used. Gas sensor is an instrument that senses the presence of gases in the sensor. The field of the drainage shaft, also as part of a protection. The gases that were harmful and non-toxic were divided. The gases were released using the gas exhauster being exhausted. The sensor for pressure and the sensor for level simultaneously activated to monitor the water level and the pressure that was produced within the pipe. When the strain of the pressure valve surpassed a certain amount pressure valve opens. If the level of water is high, the compressor would operate running.

## 2. Design Procedure for Automatic Drainage Water Monitoring and Control System

*2.1 PLC MODULE*

The Programmable Logic Controller (PLC) is a digital computer used by companies to automate various electro-mechanical processes.

> Schneider TM200C16R

- Digital Inputs:16
- Digital Outputs:16
- CPU: XS6 SOOMHz
- RAM: DDR2 512MB
- Storage: 4 MB
- DAC:16 bits,2 channels,-10v to ÷10v
- Support Language: Ladder Programming
- Operation Power:24 VDC,1A Min

*2.2 Power Supply*

The power supply is primarily used to decrease the AC supply voltage to 230 V 50Hz to 24Volts operated DC. The PLC stocks 24V. Two types of switched mode power supply and linear operated power supply are primarily used to supply power. We have used SNIPS in our system for the supply voltage. The transformer, rectifier, filter and controlled IC are power supplies with blocks that have ideal controlled DC voltage.

*2.3 Level Sensor*

The primary function of the level sensor is to detect the level of water that flows. Four level sensors are being used in this process. Each level sensor is made up of two respective proximity sensors. At a distance of 20mm each, the two proximity sensors are mounted. This sensor senses the level of water on the level sensor and the water pump is turned ON accordingly.
Proximity Sensor Specifications:

- Type:-metal target of inductive meaning
- Supply:- 24V dc-24V dc
- Diameter:- 8mm diameter
- Range sensing:-2mmm distance sensing
- Length:-50mm
- Output:-PNP NO 3 cables

*2.4 Pressure Sensor*

The pressure sensor will be used to take note of the air density inside the drainage system because if the gas level inside the drainage will reach through its threshold then there would be a possibility of major blast. So, the pressure sensor plays a very vital role in this project. Water pressure sensors are often used to measure the **water** level in a tank, or the rate of change in that level (as shown in the **figure t**o the right). The sensor is **att**a**ch**ed to the top of an open-ended tube **im**mer**s**ed in the container. The sensor is fitted to the top of an open-ended tube submerged within the container. As the water level rises, the air above the water in the tube is compressed, increasing the pressure on the sensor. An analogue-to-digital convertor (ADC) is used to

convert the signal from the sensor into a digital value.

Specifications:

- Input / output resistance:- 2500
- Supply current:- 2.5 mA
- Output noise:- 1.0 µV p-p
- Pressure overload:- 3X

Fig. 1. Pressure Switch

*2.5 BLOCK DIAGRAM*

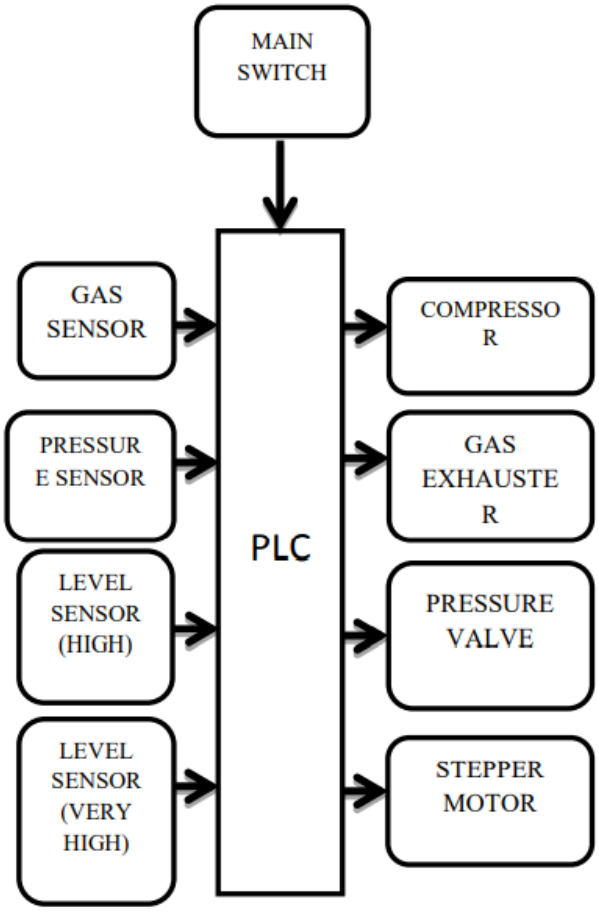


Fig. 2. Block Diagram

2.6 GAS Sensor

A simple-to-use Carbon Monoxide (CO) sensor will also be available, suitable for detecting concentrations of CO in the air. COgas concentrations ranging from 20 to 2000ppm can be detected by the MQ-7. This sensor has a good response time and high sensitivity. An analogue resistance is the sensor's output. It has strong carbon monoxide exposure in a wide range and has benefits such as long lifetime, low cost and simple drive circuit. Other than that there will be sensor to detect the gas pressure inside the drainage system.

Specification:- 5.0 V

Heater Voltage:- Max 24 V

Circuit Voltage:- Variable

Road resistance:- 833 mW

*2.7 Compressor*

The air compressor in the water molecule in the drainage system raises the pressure that some of the moisture fall out. Also, the water vapour condenses into liquid and more moisture comes out as the air is cooled back down to room temperature. At the bottom of the pipe, this water accumulates. Usually, compressors have one or more separators, each fluidly linked to each compressor stage. In order to separate liquid from a compressed substance, such as air, these separators are given so that the fluid is significantly gaseous. As such, liquid pools in each separator, which must be regularly removed in order to avoid reduced separator efficiency.

Specification:-

- Air environment:- Saliferous atmosphere
- Gas Temperature inlet:- 0- 20ºC
- Gas Temperature outlet:- < 45°C

*2.8 Gas Exhauster*

The gas exhauster is used for exhaustion of the gas so they can be separated easily on the bases of the toxicity level. And to do so the rpm of the exhaust should be very high it should be nearly 5000 to 6000 rpm.

*2.9 Steeper Motor*

When the compressor is in maximum pressure, Sledges present in the drainage water can be removed by filtration process. Aluminium or the metal plates are the two plates which are placed which are in the filtration process. The plates are arranged in the opposite order. The controlling action of the plates is done with the help of the stepper motor.

*2.10 Controlling Method of Drainage System*

The PLC automatic drainage monitoring and control system consists of a level sensor for monitoring, and hooter, filtering plates are the equipment used for handle. Pumps with water. In urban and rural parts, this method is used. The level sensor is a system used to detect the water level in drainage pipes with a minimum flow rate of 19L/min (approximately 5%) and a maximum flow rate of 114L/min. In this device, when the water level is less than 20 percent, the water pumps are turned on due to the presence of barriers in the shape of solid debris that may allow the drainage piping to block. To check the water level generated within the pipe, the level sensors are triggered simultaneously.

*2.10.1 The Controlling Of this System Involves Two Condition*

- First case: Due to the discontinuous water level rate (less than 20 percent), the obstacles found will be sensed and the water pumps will be turned on to clear the obstacles and bring the water flow back to usual (60 percent -80 percent of the total drainage water flow).

- Second case: In order to remove the barrier, the water pumps are required to turn on and apply the water forcibly. But the water flow velocity is impaired in the case of heavy particles that prevent themselves from going on (reduces). This can occur in the event of pipeline choking due to long-term accumulation of other content at one site.

### 3. Simulation

When the power supply unit is typically in close condition, the mc switch comes on and the stepper motor rotates as well. The water level sensor will be used in this project to control the compressor valve. With the aid of the program described above, the simulated performance of this project is seen. The sensor detects the appropriate parameters when the power is on, and the output is provided to the PLC package.

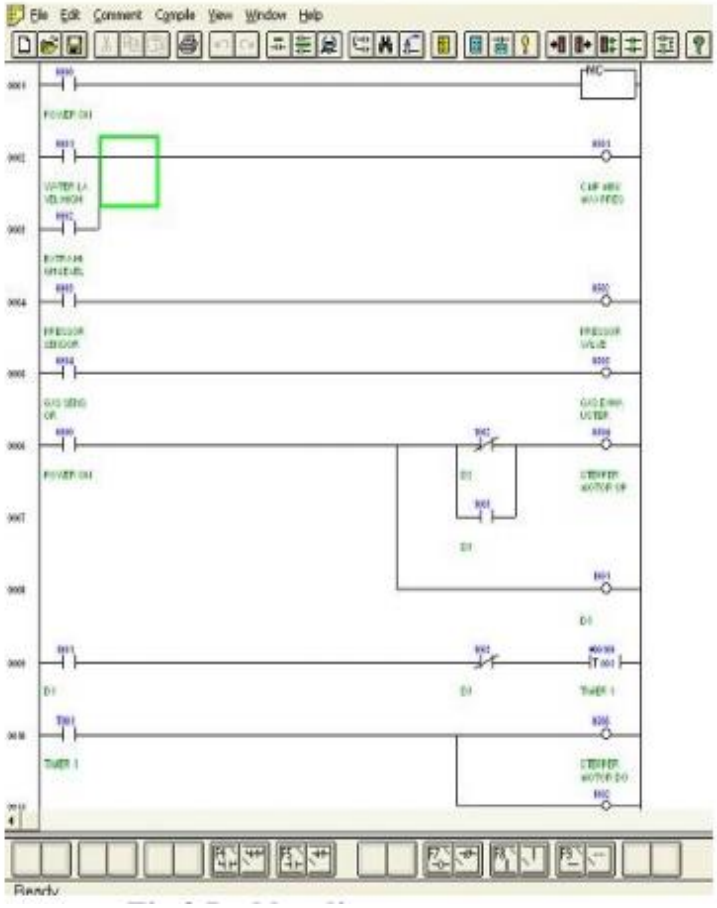


Fig. 3. Simulation

With the sensor operation, the ON and OFF operations are managed and each and every parameter is controlled in the required state. The stepper motor is often turned on when the power is switched on and the relevant operation is carried out using the stepper motor. The medium level water sensor initially gets the signal usually near then the signal delivered to the compressor then works in minimum pressure. The high-level water sensor then gets the signal usually near to the signal to the maximum pressure provided in the compressor to operate. The pressure sensor usually closes the signal and the signal is given to open the pressure valve. If the waste water pressure reaches a certain pressure valve, it can work. The gas sensor usually shuts the signal and opens the signal produced by the gas exhauster. It's a situation where the tank is open or not open. Based on the usually near signal to the Stepper engine, the filtering plates are worked. The heart of the proposed system is powered by attached stepper motor plates. The operation is comparable to the MCB (miniature circuit breaker) executing each switch are operator.

## 4. Future Work

Sensor networks are known as the IoT paradigm's primary enablers. However, it is increasingly difficult to identify common specifications for the WSN nodes and platforms because of the expanding variety of applications. In the future, this project will discuss all phases of the realistic implementation of an Underground Drainage Monitoring System (UDMS) through IoT applications for metropolitan cities via the automated Internet of Things for Underground Drainage. As a guide to direction, a real life, challenging application will be chosen. Platform structure, accessibility and reusability, optimization of sensor nodes, optimization of connectivity, error recovery from communications and node activity, high service efficiency at all stages, stability of the application server and interfacing with IoT applications will be considered facets of the sensor network platform. This project will lead the specification, optimization, and creation of sensor network platforms for the extension of IOT to other IoT application domains.

## 5. Conclusion

In the distribution system for drainage wastewater control, the Siemens PLC controller was used by the stepper motor, compressor, gas exhauster, pressure valve and liquid level, flow and other analog variables to achieve automated sewage wastewater treatment control. Through this project, runoff from factories is handled to meet the national pollution standards, with reliable service, low cost and good result. By this process, runoff wastewater control is treated to irrigate trees, clean toilets, etc. Not only to fix the issue of water scarcity in manufacturing, but also to produce good economic and environmental benefits.

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# Prediction and Monitoring on Secure Edge-cloud Integrated Privacy Preserving Heath Protecting System

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**Abstract**

Edge-based privacy preserving cryptosystem is identified as the upcoming amenities of cloud-based secure remote healthcare monitoring systems. Usually, the cloud-based healthcare system will directly collect the remote patient data through a sensor layer and provide the continuous monitoring and diagnosis through various prediction processes made by the decision support system. These sensing and processing of real-time patient's medical data without compromising its privacy and security become daunting issues in the traditional healthcare services. Therefore, the proposed research incorporates the security mechanism in the patient-centric edge-cloud-based healthcare system architecture. More precisely, an edge level privacy preserving additive homomorphic encryption is proposed for secure data processing and filtering non-sensitive data in the edge layer. In addition, response time and network capacity usage are minimized in the proposed healthcare system due to effective filtering and offloading mechanisms adapted in the edge level. Next, an adaptive weighted probabilistic classifier model is proposed in the cloud layer for onboard disease prediction and rehabilitation of remote patients. It will improve the disease prediction time and prediction accuracy while comparing to traditional classifier models. Finally, security and performance analysis of the proposed Secure Edge-Cloud-based Healthcare System (SECHS) was demonstrated with respect to empirical evaluation of Parkinson disease dataset.

*Keywords*: Cloud-based healthcare, Edge level security, energy consumption.

## 1. Introduction

Cloud-based healthcare service became more popular due to centralized Electronic Healthcare Record (EHR) and uninterrupted service facility to patients remotely. Emerging tele-healthcare industry needs to maintain the security and privacy due to the growing nature of Healthcare 4.0 which has a significant impact on access mechanisms of patient data from common storage repositories [1]. The doctor can make investigations on patients' health conditions based on the sequence of records stored in the cloud which gives the actual deviation in medical parameters. Due to this fact, the data stored in the cloud server will not have access to all medical data uploaded by multiple users which may be accidentally disclosed [3]. This situation will open the door of prying eyes to launch various levels of security attacks such as data privacy, integrity and confidentiality in healthcare systems. To provide security, an attribute-based encryption scheme has been exploited to make access control on electronic healthcare records where the patient can decrypt the data using appropriate access policy [4]. Now-a-days, the edge-based healthcare services were employed for cost effective data processing and network resource provisioning on edge computing framework through data offloading and real-time processing respectively. Here, computational offloading at edge level can minimize the energy consumption, communication and computational delay between edge and cloud server [5]. In order to share the data to the end-user, more prevailing access control schemes are needed to improve the undesirable situation in the edge computing platform. More specifically some security threats like side channel attacks, virtualization vulnerabilities, networks eavesdropping, and denial of service attacks are tightly associated with cloud data service [9]. Therefore, the healthcare data need to be encrypted locally before offloading and sharing among the peerto-peer edge and cloud nodes. Moreover, the distortions of the signal due to the communication line and end-devices could be easily distinguished from the distortion of voice due to Parkinson disease. It can be identified by the low-volume voice having monotone quality of speech with unfortunate silences between words and extensive pauses prior to initiating speech. To fill this research gap, an effective privacy preserving encryption scheme is introduced at edge and cloud server level. First objective of this research is to develop effective privacy preserving additive homomorphic encryption techniques and also energy aware live data offloading scheme at edge computing level. In addition, blockchain technology helps to protect the information exchange between the cloud server and hospital network without any delay and information leakage. It promises to provide secure data storage and sharing among the medical stakeholders and remote patients with flexible data interoperability and payment modes [13]. It attains privacy of the data due to maintenance of cryptographic hash function of previous block, timestamp and transaction data. But it is limited to data index extraction overhead and cost effectiveness data

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processing transaction overhead on real-time smart contracts exploited in the healthcare system [14]. Apart from security, proposed research includes the implementation of adaptive classifier models in the edge-cloud-based healthcare system. Existing healthcare system exploited the reasoning-based privacy-aware decision support system for disease prediction and preservation of patient sensitive data [15]. These approaches are more complex and increase the response time of the system and obtain a very smaller fault alarm rate. To overcome these issues, the proposed research incorporates the privacy preserving additive homomorphic encryption and offloading mechanism to enhance the security and optimize the communication capacity and energy at edge level. Along with this encryption, the proposed research incorporates the adaptive weighted probabilistic classifier model at cloud server level for enhancing onboard disease prediction and rehabilitation monitoring process.

## 2. Related works

### *2.1. Security in cloud based smart healthcare system*

According to recent research studies in healthcare systems, various security mechanisms were adopted in both edge and cloud level as given in Fig. 1. At edge level, security techniques are applied in the context of cryptography, machine learning and computational intelligence approach [17]. Here, the cryptography approach includes the advanced encryption standard, secure sockets layer, access control, blockchain, cipher-text policy attribute-based encryption, decoy, Deffie-Hellman and Shibboleth security schemes. Next, the machine learning approach consists of deep learning, j48 decision and real-time machine security schemes. Finally, the computational intelligence approach contains various security schemes such as evolutionary game, fog-fisver and f-iov. Also, a lightweight selective encryption scheme was developed based on a machine learning approach to further protect the patient data privacy [18]. A Canetti-Krawczyk security model is enforced in edge/fog level to establish secure communication between edge and cloud computing without leakage of any patient data identity [19]. Therefore, to bring rapid advancement in hyperphysical systems, a novel logarithmic encryption scheme was designed and verified for handling security, privacy and trust related issues in real environments [20]. To establish secure routing from source to destination, a trust detection-based secured routing scheme is established under a malicious environment for the sake of improving the success probability of routing in cyber physical systems [21]. he security and efficiency of search operations and also provides privacy protection over the encrypted data [22].

In cloud level, encryption cannot be a successful scheme until the search result falls into a precise time period. Therefore, a novel time-aware searchable encryption scheme is designed with designated medical cloud servers to provide more security and efficiency than the existing schemes [24]. A homomorphic encryption scheme was introduced to manage largescale sensor data with high level privacy preserving anomaly detection service in cloud-based electronic health records [25], A systematic review on various homomorphic encryption techniques such as fully, multiplicative, XOR, additive, and critical infrastructure homomorphic schemes were done to extend the healthcare application over big data and cloud environments. These techniques are used to manage and analyze the massive amount of heterogeneous medical data to further improve the quality of healthcare service [26]. According to literature study, some prominent schemes such as key policy attribute-based encryption, trust, multi-tenant, multi-authority, fine-grain, revocation mechanism, trace mechanism, proxy re-encryption and hierarchical encryption were analyzed for ensuring security and privacy in cloud [27]. n and permutation phases in healthcare systems for protecting the patients' privacy without compromising the robustness and efficiency of image encryption [28]. less public-key encryption along with authorized equality test scheme before outsourcing to smart healthcare service [29]. In order to improve the storage efficiency and data transfer safety between stakeholders, a cipher block chaining-advanced encryption standard is exploited along with Huffman coding and discrete wavelet transform [30]. A light-weight attribute-based encryption was proposed to impose low overhead on proxy service based architecture with fine grained user revocation and access control capability over the mobile cloud assisted cyber-physical systems [31].

Finally, an identity-based encryption scheme has been identified as a practical solution for one way security against the selected identity and cipher text attacks in random oracle model [32]. As per recent survey, all the above discussed security techniques are used to overcome various levels of threats such as audio steganography, botnet, denial of service, phishing, flooding request, malware injection and target shared memory attacks involved in both edge and cloud environment [33]. the proposed research focuses on privacy preserving additive homomorphic encryption development to ensure secure data transfer and offloading computation at edge level. There are different types of classifier models are used for real-time disease prediction and rehabilitation monitoring over edge and cloud computing platforms. In order to make early diagnosis of Parkinson disease, a comparative analysis was made using Naive Bayes, kernel-based support vector machine, random forest and boosted tree classifier models [34]. As a result, kernel-based support vector machine classifiers were observed as best performers in terms of prediction accuracy, sensitivity and specificity metrics. The modified k-NN classifier model has been applied in cancer disease prediction and diagnosis in the context of smallest and largest modification scenarios [35].

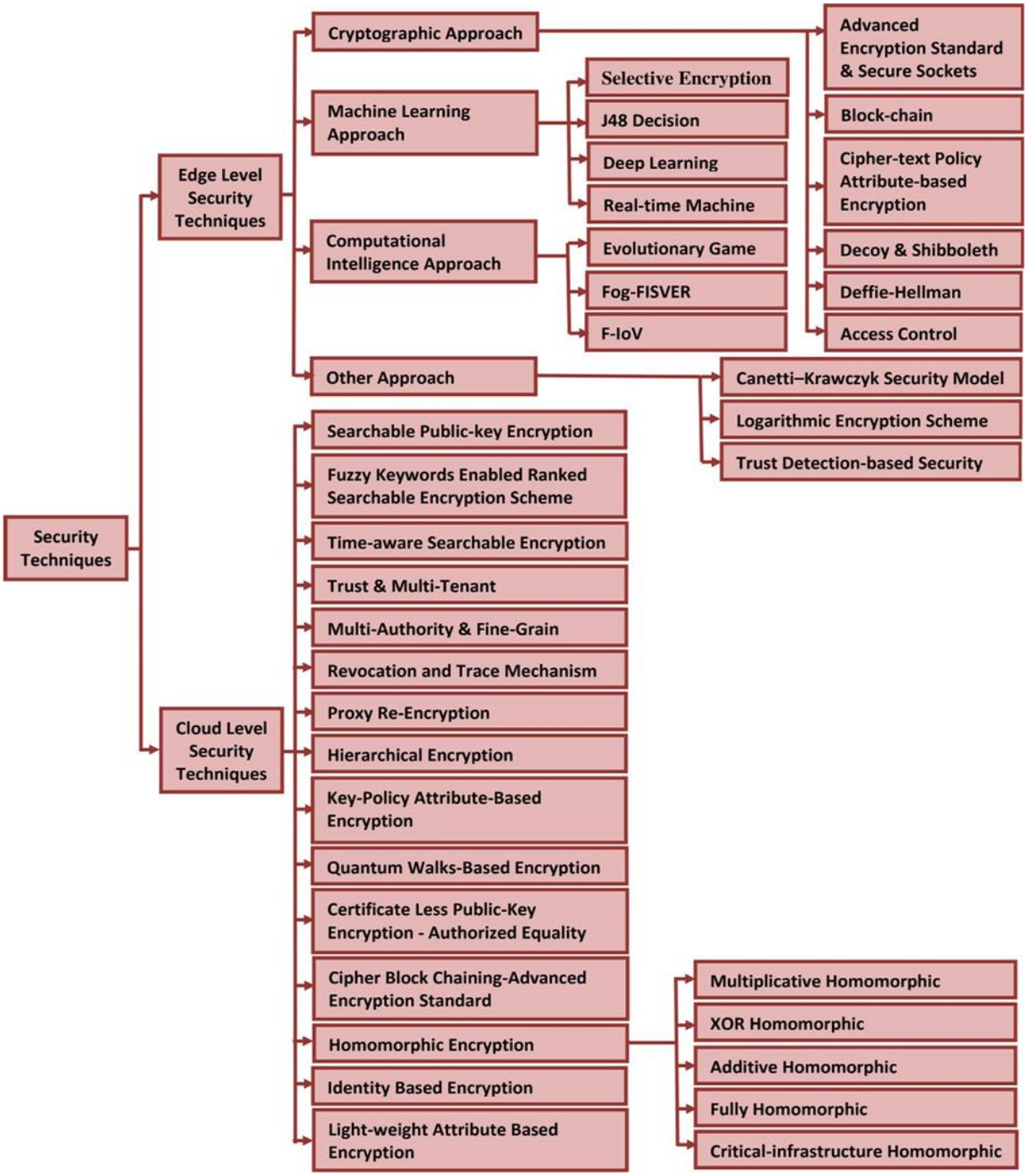


Fig. 1. Taxonomy of security techniques.

A fuzzy based k-NN classifier model was proposed to design an efficient diagnosis system for improving the performance of Parkinson disease detection [36]. Sometimes, the sensitivity of the k value may degrade the performance of the classifier in case of less sample size with traditional outliers. Therefore, a generalized mean distance-based k-NN classifier model was employed by estimating categorical nested and multi-generalized mean distances [37]. The accuracy of the classifier model will vary with respect to the types of feature extraction and optimization techniques. Since the voice and video data used for classifier training has its own pros and cons, the prediction accuracy of the model does not have much significant difference due to voice or video data exploitation. Therefore, the proposed research work shows the focus on developing adaptive weighted probabilistic classifier models for robust disease prediction and rehabilitation of remote patients with economical cost [40]. Comparison of healthcare system architectures can also be found in the layered architecture context, very few research studies are present in the healthcare system with respect to two-, three- and four-layer representation. The complete layered architectural comparison and analysis of healthcare systems are made in terms of security, interoperability and performance attributes as shown in Table 1.

A cloud-based framework is designed with two-layer healthcare architecture for Parkinson disease monitoring and diagnosis from remote place [38]. this architecture does not make any prediction of disease and diagnosis over the patient data. An edge computing based smart healthcare system was introduced to optimize the healthcare operations and service flows with a simple data accessibility scheme. [41]. In order to provide interoperability among the healthcare systems, a semantic based healthcare interoperability framework is explored to provide secure information exchange [42]. While comparing the architecture of all the healthcare systems, the proposed secure edge cloud-based healthcare system provides better security, interoperability and performance measurement attributes.

## 3. Author Artwork

**Next Proposed secure edge-cloud-based healthcare system**

A layered architecture of secure edge-cloud-based healthcare system is proposed with edge level secure data filtering and offloading mechanism as presented in Fig. 2. y smart phone it will sense the voice parameter and share the data to the edge layer. In case of video data, it will sense the patient data by using video surveillance cameras located at different locations through patient identification and tracking mechanisms. In edge level, the proposed architecture incorporates a microcontroller device called Raspberry Pi complete kit to enforce security and data offloading mechanism. This edge level device can optimize the response time and communication capacity usage between edge and cloud computing layers. In addition, the edge computing layer provides the computing and storage capability to collectively integrate all the medical data required for real-time disease prediction, diagnosis and rehabilitation monitoring over edge-cloud-based healthcare systems. the data privacy and integrity is assured for all the healthcare services running on cloud-based virtual machine platforms. It provides the elasticity feature to the healthcare system by dynamically scaling up and scaling down virtual resources based on the number of on-demand user access available in the healthcare system. A continuous monitoring and assessment of Parkinson disease related parameters will identify the deviations happening in the patient's health condition during rehabilitation processes. Based on the improvements observed during the rehabilitation process, the health status and Tele medicine prescription will be automatically disclosed to the patient and caretaker.

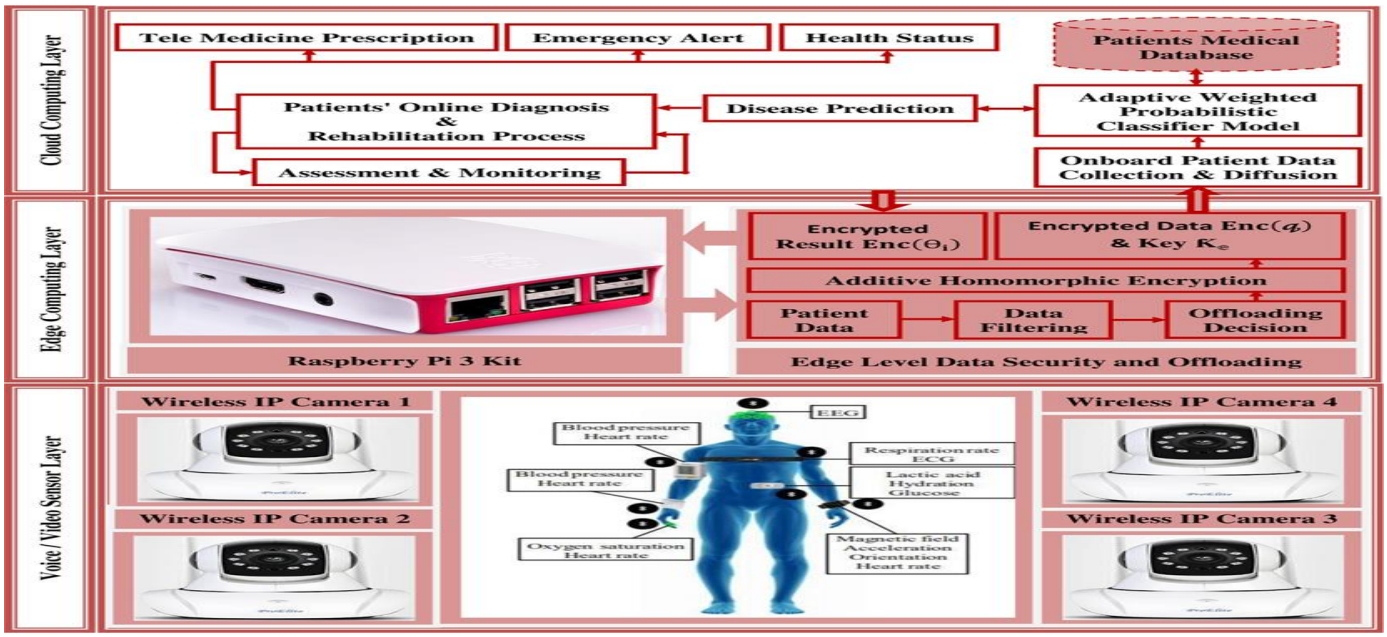


Fig. 2. Secure Edge-Cloud-based Healthcare System Architecture

The healthcare service provisioning from cloud layer has effective storage and processing capability for real-time disease prediction and rehabilitation process by exploiting the proposed adaptive weighted probabilistic classifier model. After receiving the patient's data requests from various geographic regions, the proposed classifier will be exploited by the healthcare system for quick prediction and response generation to concern.

At cloud layer CLayer, there are n number of live data request were received to process in the classifier service which in turn parallelize the data processing task to m number of virtual machines VM. A classifier service hosted at each VM can have a maximum and minimum bound of data processing capability for processing the corresponding maximum and minimum amount

of data tasks respectively. Now, the objective of research is to minimize the cost of VM provisioning initiated for data processing at classifier service hosted in CLayer.

## 4. Results and discussion

The proposed SECHS performance is measured by comparing with existing healthcare systems such as Smart Architecture for in Home Healthcare (SAHH) and IoT-based Healthcare Smart Homes (IHSH) in terms of network capacity and response time. Results obtained during the experimentations are given in Table 1. More clear from the tabulated observation, the proposed SECHS model takes only less network capacity of 130 (kbps) while comparing to existing SAHH and IHSH systems which takes maximum network capacity of 350 (kbps). Since the proposed SECHS filters all the unwanted features of patient data, it minimizes the network capacity utilization in the edge level itself. Therefore, the proposed SECHS offloads only sensitive patient data to cloud nodes for initiating the disease severity prediction and rehabilitation assessment by continuous monitoring. As a result, the proposed SECHS takes very less response time (80 s) while compared to existing SAHH (120 s) and IHSH (170 s) systems.

Table-1. Performance measure of healthcare systems

| Healthcare Systems | Network Capacity (Kbps) | Response Time (Seconds) |
|---|---|---|
| IHSH | 350 | 170 |
| SAHH | 350 | 120 |
| Proposed SECHS | 130 | 80 |

The proposed additive homomorphic encryption scheme can provide more security in both edge and cloud platforms without any collusion attack. In case of eavesdropping attack, all the schemes have defending capability due the assumption of secure transmission of data among the stakeholders. Even then, the proposed scheme has more security feature capability due to the exploitation of privacy preserving secure communication protocol in the healthcare system. Finally, the proposed additive homomorphic encryption scheme provides the identity authentication feature in the privacy preserving communication protocol. Therefore, the proposed scheme can defend against the replaying attack, where the existing scheme does not involve any patient's identity feature to defend against the replaying attack. Since the proposed additive homomorphic encryption scheme introduces an identitybased authentication mechanism with added timestamp features can make significant improvement in the privacy preserving access control part. The healthcare system not only verifies the cipher-text during data transmission but also verifies the freshly generated timestamp in each transmission. In order to improve the diagnosis level, all the hospitals continue to have diverse trait vectors at different times. After receiving the patient data, originality of the timestamp associated with data is verified by comparing the timestamp present in the encrypted data to ensure protection against replaying attacks. Therefore, the proposed scheme involves the timestamp during the patient's identification and provides resistance against the replaying attack.

## 5. Conclusion and future enhancement

At the end of this research, a layered architecture of secure edge-cloud based healthcare system is presented for real-time disease prediction with diagnosis and rehabilitation facility. The proposed system incorporates privacy preserving additive homomorphic encryption to ensure the data security at the edge computing layer. Also minimizes the response time and network capacity between the edge and cloud layers by using effective filtering and offloading mechanisms. All the patient data requests from different geographic locations were processed in a cloud layer using the proposed adaptive weighted probabilistic classifier model. The cost of resource provisioning at the cloud layer is minimized due to optimal resource usage of the proposed adaptive weighted probabilistic model during the processing of patient data tasks. To validate the performance of proposed secure edge-cloud-based healthcare systems, a comparative analysis is made with existing systems in terms of prediction time, prediction accuracy, response time and capacity usage. According to obtained results, it can be concluded more evidently that the proposed healthcare system significantly outperforms all the existing systems compared during experimental evaluation. However, some important challenges like edge-to-edge secure object tracking and transmission protocol must be dealt in future research. In addition, blockchain enabled security features can be applied in the cloud layer for effective privacy preservation of patients' electronic healthcare records.

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# Rainwater Harvesting at Primary School Campus – Case study, Analysis and Design

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**Abstract**

At the rate of increasing population in India it will be too difficult to provide the fresh water for the people who live in country. By the day by day our water source is decreasing. India is very fast growing in population in 50 years from 1951 (62.44 million) to 2001 (286.08 million). From this growing population water demand is not met and water is required in big amount. Only 2.5% of earth's water is freshwater and almost three quarter of it is frozen in the ice caps. In today's world, big quantity of water is wasted; often demand is growing faster than the supply provided by nature. In India, usually this growing problem is not taken sincerely because of its availability; but in insufficiency it becomes our most precious resource. Therefore, by knowing the importance of water to our lives we are trying to find ways to meet the increasing demand and the rainwater harvesting technique is adopted. The technical aspects of this paper are rainwater harvesting collected from rooftop which is considered to be catchment areas from the roof of the primary school campus. First of all, we collect required data like catchment areas & hydrological rainfall data. Collected water from catchment was calculated & analysis, and the tank capacity with suitable design is being considered. Volume of tank has been calculated with most appropriate method of estimation. Optimum location of tank on the basis of hydrological analysis and GIS analysis was done in the school.

*Keywords*: catchment area; rain water harvesting; drainage pipes; resorvior; rain water harvesting at primary school campus

## 1. Introduction

For the rain water harvesting project we have consider one primary school named "Sheth Amulakh Vidyalaya" and detailed analysis and design of RWH system in that. The school has wide playground and sufficient roof (Tarec) to provide rainwater harvesting in the school. If there is more perception (rainfall) then water is logged in ground and that become problematic for the school. We are planning to provide roof water harvesting & artificial ground recharge method in the school. In the ground we provide artificial ground water recharge method, so the water is going to ground water & provide rain water harvesting in roof to collect that water and use after.

### *1.1. RWH system and its components & function*

Rainwater Harvesting is a simple technique of catching and holding rainwater where its falls. Either we can store it in tanks, or we can use it to recharge groundwater depending upon the situation.

### *1.2. COMPONENTS OF RAINWATER HARVESTING SYSTEM*

A rainwater harvesting system comprises of components for - transporting rainwater from pipes its filtration, and tanks for storage of harvested water. The major components of a RWH system: -

1. Catchment Area
2. Coarse Mesh
3. Conduits
5. First-flushing
6. Filters
7. Storage facility
8. Recharge structures

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## 2. Study area & data collection

### *2.1 Study area*

As discussed earlier in the section of introduction – importance of rainwater harvesting we clearly came to know the all the advantages which we can draw out by implementing this small but highly efficient technique in the campus. Thus, to increase the potential, benefits of this system and draw maximum advantages from it, we need to have large rooftop areas which will be going to act as catchment areas. More the catchment areas more will be the surface runoff and thus more will be the amount of harvested water.
And for the ground we design the ground water recharge technique by recharge pit method by which we can get the water by the any recharge well (i.e., bore well) method. Given below a satellite picture, fig no.1, showing buildings considered for rainwater harvesting system at primary school.

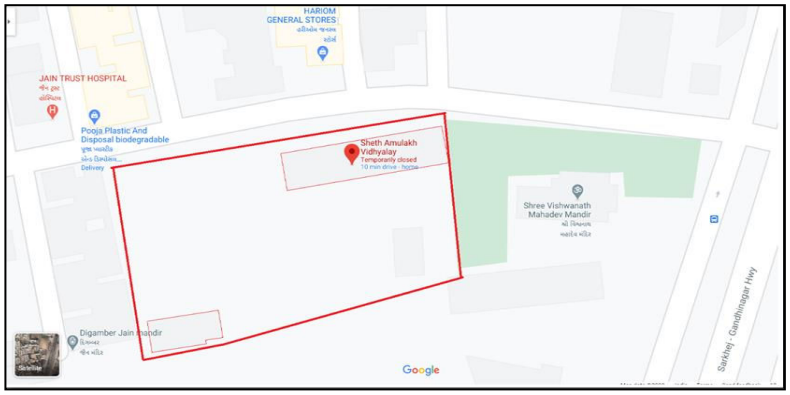



Fig.1. School campus for RWH

### *2.2 Data collection*

#### *2.2.1 Rainfall data collection*

The average monthly rainfall data are taken from the online sight of worldweather.com. the Ahmedabad has uniform average rainfall throughout the city in all locations. Now from the given chart we can get the rainfall data.
Total rainfall from the given chart = **753 mm**

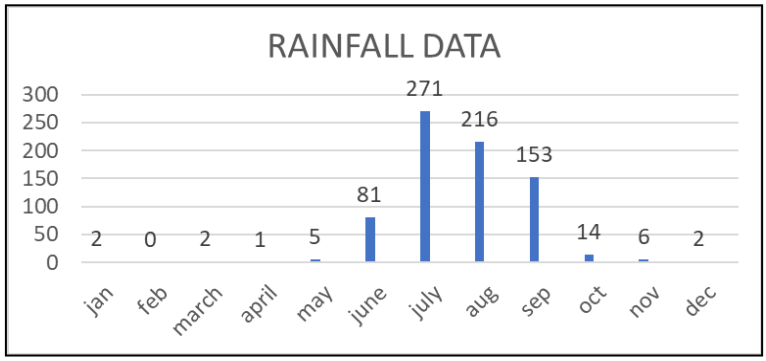



Fig. 2. Rainfall data

#### *2.2.2 Determination of catchment area*

The rooftop surface area is nothing but the catchment area which receives rainfall. Catchment areas of the different block measured. This measurement was done manually with the help of “reinforced fiber tape” which is the simplest technique known as “tape survey”. Before using the tape, tape was checked for any zero error and also length of the tape was also carefully checked for its accuracy. Given below the table no. 2 for calculated the rooftop areas of two block.

Table 1. Roof top area

| Serial no. | Building block | Catchment area |
|---|---|---|
| 1 | Block -A | 361.86 m2 |
| 2 | Block -B | 93.57 m2 |

Catchment area is determined by the use of (Google Earth)

## 3. Methodology

*3.1. Hydrological analysis:*

On the basis of Mr. H. Darcy's formula which governing the rate of flow (i.e., the discharge) through the soils,

$$Q \propto \frac{H}{L} . A$$

Here, H/L = head loss or hydraulic gradient (I),
K = co-efficient of permeability
A = cross section of soil

Hence finally, annual rainwater harvesting potential is given by,
V = K * I * A
Where, V= volume of water that can be harvested annually in $m^3$
I = intensity of rainfall

Similarly, based on the above principle, water harvesting potential of the catchment area was calculated. The formula for calculation for harvesting potential or volume of water received or runoff produced or harvesting capacity is given as: -

Harvesting potential / volume of water received ($m^3$) =

**Area of catchment ($m^2$) * amount of rainfall (mm) * runoff coefficient**

Runoff coefficient for any catchment is the ratio of the volume of water that runs off a surface to the volume of rainfall that falls on the surface. Runoff coefficient varies from 0.5 to 1.0. Given below the table showing the value of runoff coefficient with respect to types of surface areas: -

Table 2. Runoff coefficient value

| Sr. | Types of area | Value of K<br>Flat land 0-5% slope | Rolling land 5-10% slope | Hilly land 10-30% slope |
|---|---|---|---|---|
| 1 | Urban area | 0.55 | 0.65 | - |
| 2 | Single family residence | 0.3 | | |
| 3 | Cultivated areas | 0.5 | 0.6 | 0.72 |
| 4 | Pastures | 0.30 | 0.36 | 0.42 |
| 5 | Wooden land / forested areas | 0.3 | 0.35 | 0.5 |

Source: Table 7.31, Chapter Hydrology and runoff computation, Irrigation Engineering & Hydraulic Structure, by Garg, S.K.

*3.2. Annual rainwater harvesting potential*

Area of block $A_1$ =361.86$m^2$
Area of block A2 = 93.57 $m^2$
Total area = $A_1 + A_2$ = 455.43 $m^2$
Run off coefficient = 0.8
Water supply, S = R x A x Cr
=0.2 x 455.43 x 0.6
=1200 litres/year

Table 3. Rainfall potential for blocks

| BLOCK | K | I 1 | I 2 | Area (m2) | Volume Annual | Volume Monsoon |
|---|---|---|---|---|---|---|
| A 1 | 0.85 | 0.2 | 0.271 | 361.86 | 61.52 | 83.36 |
| A 2 | 0.85 | 0.2 | 0.271 | 93.57 | 15.90 | 21.55 |

Total Annual = 77.43 m3
Total in monsoon = 104.91 m3

*3.3. Discharge calculation*

For the calculation of drainage pipes diameter, first we need to calculate discharge Q,
Q= C * I * A

Discharge from block, $Q_1 = C * I_1 * A_1$
= 0.85 x (14 / 1000 x 60 x 60) x 361.86
= 0.0012 $m^3/s$
Discharge from block, $Q_2 = C * I_2 * A_2$
= 0.85 x (14 / 1000 x 60 x 60) x 93.57
= 0.0003 $m^3/s$
Total discharge Q= 0.0015 $m^3/s$

*3.4. Calculation for number of rainwater pipes to be installed:*

Let's consider rainwater pipes to be provided are diameter 100 mm,

$Q = C * I * A = n * \pi/4 * d^2 * v$
Where, n = minimum no. of pipes
d = diameter of rainwater pipes
v = velocity of rain water it is taken as 0.1 m/s for 0-2 % slope of ground

no of pipes are calculated as,

$n = Q / (0.785d^2 \times v)$
$n1 = 0.0012/0.785(0.05)^2 \times 0.1$
=2 pipes
$n2 = 0.0003/0.785(0.05)^2 \times 0.1$
= 1 pipe
So, therefor 2 pipes are for A1 and 1 pipe are required for A2 block.

*3.5. Optimistic determination of size & types of tank*

Now from the rainfall data we can determine the discharge of every month.
Here by the table, we can see that in every month how many rainfall and water is available for us and we can harvest that water by the storage tank.

Table 4. Volume of water stored in diff. month

| month | rainfall(mm) | volume of water stored (m3) | volume of water stored (l) |
|---|---|---|---|
| Jan | 2 | 0.91086 | 910.86 |
| feb | 0 | 0 | 0 |
| march | 2 | 0.91086 | 910.86 |
| April | 1 | 0.45543 | 455.43 |
| may | 5 | 2.27715 | 2277.15 |
| June | 81 | 36.88983 | 36889.83 |
| July | 271 | 123.42153 | 123421.53 |
| Aug. | 216 | 98.37288 | 98372.88 |
| sep | 153 | 69.68079 | 69680.79 |
| oct | 14 | 6.37602 | 6376.02 |
| nov | 6 | 2.73258 | 2732.58 |
| Dec. | 2 | 0.91086 | 910.86 |
| **total** | **753 mm** | **342.93879 m3** | **3,42,938.79 liter** |

Total water harvested in block B= 70.46 m3
But if we design according yearly that become unusable that's why we design the tank on monthly basis
During maximum rainfall in month of july-aug the water harvested from b block = (0.487*93.57) = 45.57 m3
Height of tank = 2 m
Area of base= 22.78 m2
Provide 6 m radius tank
Water can be stored = 56. 55 m3
So, design is safe
And for the block A water is stored in underground water tank
From the block A total (361.86*0.753) =272.48 m3 water is stored through the year.

*3.6. Recharge pit for the ground water conservation:*

For the designing the recharge pit
Dig the pit of size 1.2 to 1.5 m.
Depth 2.5 to 3 m
Fill with 40 mm metal
20 mm metal
15% coarse sand

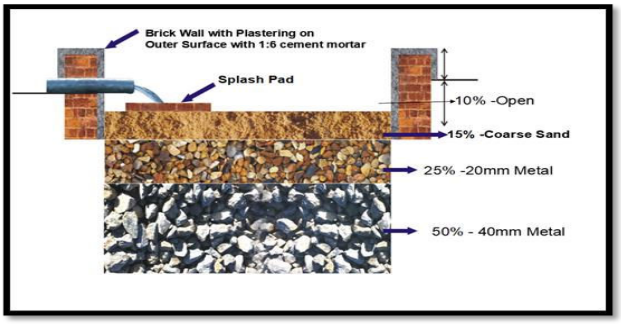



Fig. 3. Recharge pit cross section

Water which stored by recharge pit method that can be recovered by the boring method. Boring is the method in which water from the ground surface is use whenever we need. As you can see by this fig.4. we can get the water from the recharge pit by the boring and we can use that water for the other purpose.

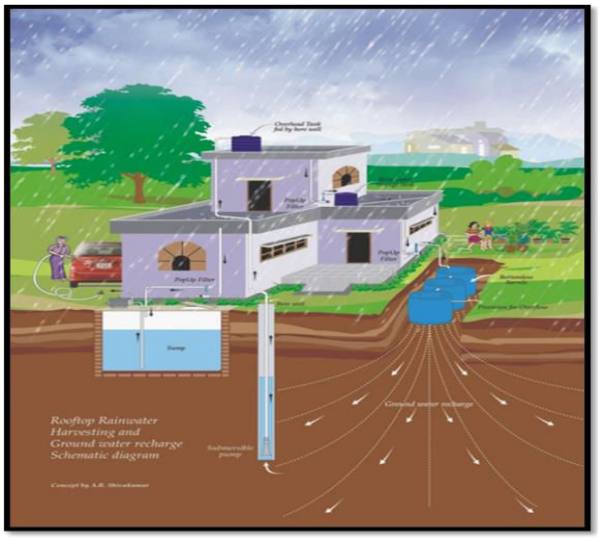
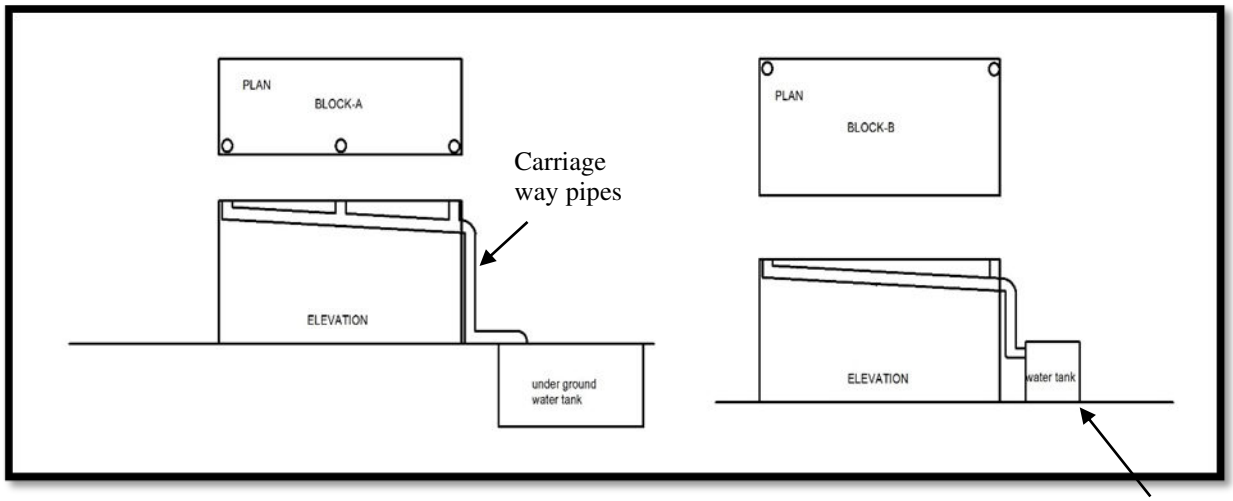
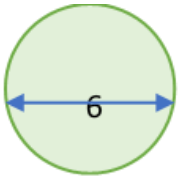



Fig. 4. Boring method

*3.7. Prototype:*

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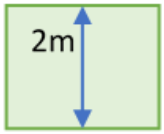


Fig. 5. Size of water tank

## 4. Conclusion

- Implementation of rainwater harvesting is essential to fulfill the increasing water consumption by various sources likes vegetation, washing etc.
- As here in the campus itself it is observed that there are many problems due to water logging like spreading of diseases, salinity, dampness of nearby walls etc. So many a time when water logging occur it is removed by pumping technique.
- Thus, to reduce this effort and again and again investment in pumping, effective method of recharging is used such that water is harvested and used for future generation.
- Also, it would prove to be cost effective and beneficial. If cost-benefit ratio will be analysed then it can be said that there are number of benefits with this system over its initial investment so, prove to be economical.

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# Survey on Secure Telesurgery Systems for Healthcare 4.0: A Comparative Analysis

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**Abstract**

Telesurgery has proven a huge caliber in delivering real-time healthcare monitoring and services from far location over the Internet, i.e., a wireless communication channel with quality-of-service and experience. It has revolutionized traditional healthcare services with high accuracy and precision. Various research have been done in the field of telesurgery, which considers the security as well as network parameters. But, as per the literature, there exists no article which reviews the existing and well developed telesurgery systems. Motivated from this, we present a comparative analysis of the existing telesurgery systems by considering the parameters like blockchain, latency, reliability, intelligence, and implementation.

*Keywords*: Telesurgery, Security, Blockchain, Privacy, Healthcare 4.0, Telemedicine

## 1. Introduction

In the past few years, wireless systems have put a great impact on various application domains such as industry 4.0, augmented reality, virtual reality, agriculture, healthcare 4.0, and autonomous vehicles. The most evolved domain concerning wireless technology is healthcare 4.0 [1]. This transfigures the conventional healthcare system to the smart/intelligent healthcare system. In conventional healthcare systems, the patient needs to visit a nearby healthcare centre or healthcare professional, which is quite expensive and time-consuming. In this particular case, the life of a patient who needs emergency services on stake. Anyhow, conventional healthcare systems are not perfectly suitable for critically ill patients. This arises the need for intelligent healthcare services, which permit doctors to scrutinize the patients from their distant places and deliver real-time healthcare solutions via electronic devices (haptic, sensor, and actuator devices) without visiting physically at their sites. It is also called healthcare telepresence or telemedicine. Telemedicine systems are highly influential systems, which consist of bilateral audio-visual devices, medical-surgical robots, and ultra-high-speed wireless communication systems.

Advances in healthcare services are of utmost importance for all healthcare centres across the globe. But the associated cost does not allow all healthcare centres to digitize their services for better efficacy. Despite such few cases, the telemedicine field has widely been opted by many healthcare organizations, which observe the life span enhancement of patients, especially in the case of critically ill patients. Telemedicine allows healthcare experts (such as doctors) to examine the patients remotely without physically visiting their sites, which saves a lot of money as well as time for both patients and doctors. The question is, for all visualization problems (i.e., a doctor can advise medicines just by seeing the patient), telemedicine is perfectly working, but for critical observation or examination, how it helps doctors. Advances in hardware and software technologies, i.e., the artificial intelligence (AI) algorithms [2] introduce robots for patient examinations. Doctors or healthcare experts or caregivers control the robot at the patient side, which senses the patient illness and sends data to the corresponding doctor. Robotic telemedicine can widely be used for training purposes, i.e., training a new team of doctors by the expert present at the remote location.

The widely used telemedicine systems are teleradiology, patient monitoring, rehabilitation care, etc. Telemedicine systems are classified as on-line or off-line systems. The prime characteristic that decides the telemedicine system is either on-line or off-line is communication network latency. In the case of off-line systems, a store and forward approach have been followed as the patients are non-critical. But, in the on-line scenario, the patient needs emergency real-time services, i.e., blood pressure monitoring, heart-rate monitoring, pulse monitoring, etc. (well suitable for critically ill patients). A system is real-time, that is ok, but there is a need for an interactive system, which requires an ultra-responsive communication network and an intelligent robot. Figure 1 shows the various off-line and on-line modes of the telemedicine systems. This paper highlights the telesurgery field of the telemedicine system, which permits healthcare professionals to perform real-time minimal surgical procedures remotely via a surgical robot is at the patient end. Telesurgical procedures happen over the high-speed wireless communication channel,

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otherwise, the robot cannot be controlled by doctors with real-time operations [3]. The first surgical robot called "Medrobotics" was developed by Flex Robotic Systems in 1991 for minimal stereotactic brain surgery. Then, many companies around the world started working on developing surgical robots. Figure 2 shows the timeline of the surgical robots developed by the companies since 1992.

Telesurgery is a complex master-slave system, which consists of a human-system interface (HSI) [4] at the doctor/ surgeon's (master side) end and robot or robotic arm at the patient end (slave side). The robot at the patient end listens and follows the instructions or gestures passed by the doctor at the master end, that is why the patient side is called a slave. The HSI at the master end comprises haptic devices, a video monitor [5], and audio devices (microphone and headphones). Telesurgery opens the door for collaboration for many specialists around the world. But, because of the following reasons, the telesurgery systems are not fully succeeded, which does not gain much popularity in their early days of evolution.

- The delay in communication network makes the telesurgery system unacceptable, which reduces its success ratio.
- The entire communication is on a wireless channel, i.e., the Internet, which is open that raises the concern about its security, privacy, and trust.
- The reliability of the system is also of utmost importance for gaining trust and popularity, but the traditional wireless channels, i.e., 2G, 3G, and 4G are not highly reliable.
- Availability of network systems is another issue that needs to be tackled before the telesurgery system is installed.

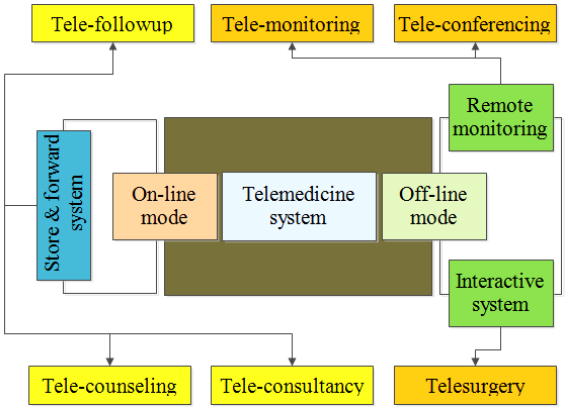


Fig. 1. Various telemedicine modes.

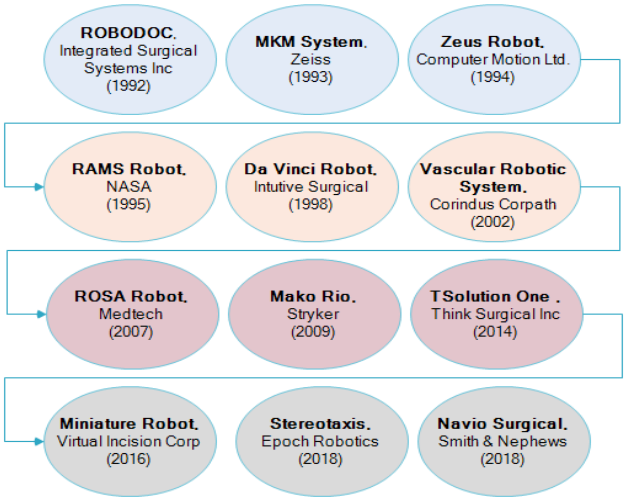


Fig. 2. Innovations in surgical robots

To mitigate the aforementioned issues, many researchers around the world have given their solutions. Some have used the Tactile Internet for ultra-reliable low-latency communication with a latency of <1ms and reliability of 99.999%. But they neglected the security perspective of the telesurgery system. Later, the authors have used cryptographic techniques and blockchain technology to maintain the security, privacy, and trust issues in telesurgical systems to improve their acceptability. So, this paper presents the survey on existing telesurgical systems and presents its comparative study. This study gives the idea to the researchers working in the field of telesurgery systems over security and communication issues.

### *1.1. Motivation*

Below mentioned is the motivation of the study.

- Telesurgery is one of the widely adopted fields in pandemic times, where the physical presence or traveling of surgeons from a far location is quite risky. Thus, the preferred solution is telemedicine, especially telesurgery (with robotic arms at the patient end).
- The traditional technologies and communication systems do not allow doctors to perform highly critical real-time surgical procedures remotely, as the chances of errors are high. This can put the life of the patient at stake. Thus, there is a need for a highly sensitive, accurate, and intelligent telesurgical system.
- As per the literature many such systems exist, which guides the researchers who are working in this domain for social causes. But, as per the literature, there exists no survey, which gives a detailed comparison of such systems for their better understanding and clarity with their pros and cons. Thus, this motivates me to write the survey on telesurgery procedures.

### *1.2. Structure*

The remaining paper is structured as follows. Section 2 described the related work summary of the existing telesurgery systems. Section 3 presents the comparative analysis (in tabular form) of the traditional systems. Finally, Section 4 concludes the paper.

## 2. Related Works

Many surveys [6-10] were conducted by researchers across the globe in the field of telesurgery systems concerning security and privacy issues. Gupta *et al.* [6] presented an ultra-reliable Tactile Internet-assisted telesurgery system for remote surgeries in healthcare 4.0. They classified the telesurgery robots on year-wise in tabular format along with their merits and demerits. They also proposed a Tactile Internet-enabled telesurgery system and compared it against the traditional system. Finally, the authors verified their proposed system by presenting the case study on the world's first telestenting surgery performed by a team of doctors from Gujarat, India. Their proposed system is more concerned about the latency and reliability issues and minimal focused on its security. Then, the authors in [7] presented a blockchain-based telesurgery system to secure surgical procedures in a healthcare 4.0 environment. They introduced the novel concept of blockchain for the first time in securing telesurgery commands and procedures. They proposed a private blockchain-based integrated telesurgery architecture to increase trust, security, and privacy. Although it is good, they have not given any implementation information and may possess interoperability issues.

Later, Gupta *et al.* in [8] overcome the interoperability issues of [7] by introducing the concept of a public blockchain, i.e., Ethereum by proposing an Ethereum smart contract-based telesurgery system in healthcare 4.0 called *HaBiTs*. They have implemented the overall scenario in Remix IDE by designing smart contracts in solidity language. Despite security issues, they have focused on latency issues also by incorporating the fifth generation (5G) communication network as a channel. *HaBiTs* is not intelligent that can predict the need for telesurgery required by a patient and malicious commands given by the surgeons. To fill this gap, later Gupta *et al.* in [9] proposed a blockchain-assisted intelligent telesurgery framework for healthcare 4.0 systems. Upon receiving the request, BITS classifies them as malicious or non-malicious. They addressed the issues of security, latency, and intelligence in their system. But, there may be a scenario where the urgency in medicine requirement and due to heavy traffic doctors will not get the same. Then, the patient may not survive in such a situation. To incorporate such demands, Gupta *et al.* in [10] proposed a blockchain and drone-based telesurgery system to make telesurgery successful. They have used the XGBoost algorithm for disease criticality, i.e., whether the surgery is required. They have also used drones for medicine delivery on an urgent basis. The latency achieved by BATS is extraordinarily low as it uses the communication channel as 6G networks.

## 3. Comparative Analysis

This section presents the comparative analysis of existing telesurgery frameworks such as Tactile internet-based [6], *HaBiTs* [7], *AaYusH* [8], *BITS* [9], and *BATS* [10]. Table 1 shows the comparative study on the aforementioned frameworks by considering parameters like blockchain, latency, reliability, intelligence, and implementation.

Table 1. Comparative analysis of existing telesurgery systems.

| Author | Objective | Latency | Reliability | Blockchain | Intelligence | Implementation | Limitations |
|---|---|---|---|---|---|---|---|
| [6] | Proposed an ultra-reliable and low latency Tactile Internet-based telesurgery framework for healthcare 4.0 | <1ms | 99.999% | No | No | No | No security concern |
| [7] | Presented a blockchain-based secure and trusted telesurgery system *HaBiTs* | <10ms | Very low | Yes | No | No | High latency<br>Low interoperability |
| [8] | Given an Ethereum blockchain-based secure and efficient telesurgery system *AaYusH* | <5ms | 99.999% | Yes | No | Yes | No intelligence |
| [9] | Proposed a blockchain and AI-based novel and enhanced telesurgery system called *BITS* | <1ms | 99.99999% | Yes | Yes | Yes | No disease classification |
| [10] | Designed an AI and blockchain-integrated drone-based telesurgery system for healthcare 4.0 environment. | <1ms | 99.99999% | Yes | Yes | Yes | Security at data sensing not provided. |

## 4. Conclusion

In this paper, we present the comparative analysis of the existing telesurgery systems in a healthcare 4.0 environment based on various parameters like blockchain, latency, reliability, intelligence, and implementation. The first part of the paper discusses the historical background of the telesurgery system and highlights the research gaps in the existing telesurgery systems, then we present the comparative analysis table by considering the aforementioned parameters. In the future, the novel telesurgery infrastructure will be proposed to overcome the issues in the state-of-the-art systems.

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# Solar Desalination System with Nanoparticles: A Review

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**Abstract**

In certain parts of the world fresh water has always been scares natural resource. The global phenomenon of urbanization over population has led to the global surge in water requirement. The percentage of freshwater in the world is only 1% compared to Ocean glaciers or groundwater etc. The ocean water has high saline content; hence it needs to be desaline first (Panchal & Patel, 2017). In this article we have pointed out distinct factors and parameters which alter the productivity and performance of the Solar still as well. There are different methods are used to verify the saline water which can be done either in a traditional way or applying modern purification Technology. Apart from this many desalination techniques are merged with renewable sources as well. However solar desalination technique is impressive mode of approach owing to it does not need any extra moving parts and electricity. So desalination technique is one of the impressive methods used at the remote located zones. A lot of investigations and research have been carried out and much more are ongoing. In solar distillation system, the major disadvantage is that it has lower effectiveness, so optimization of certain parameters is required to enhance the productivity of the system. The recent researches are based on the concept of Nanotechnology By considering the all factors which are affecting the productivity of solar still, many researchers have modified the solar still with the help of nanoparticles and phase change material.

*Keywords:* Distillation techniques, Active Solar Still, Hybrid Nano particle, Cooling Technique

## 1. Introduction

Water is considered as basic requirements of all living beings in earth. On earth the percentage of water is such that only 3% of water is fresh and rest 97% water is not fit for drinking purpose because of salty in nature. Out of fresh water 69% water is in the form of glaciers, 30% water is under grounded and only 1% water is available in rivers ponds and lakes. In recent years, many people across the of world 2.7 billion people are suffering from water scarcity and 2.4 billion people are suffering from diseases such as cholera, and typhoid due to impure drinking water. So, nations are facing drinking water problems now a day. Many technologies are implemented like Reverse Osmosis (RO) filters but not everyone can afford it, mostly in urban areas due to high electric bills.

Solar stills can obtain fresh water from saline water also. Solar stills can be used around countries which are facing shortage of drinking water, urban areas which cannot afford purifiers for them and the areas near to equator can utilize the solar energy to purify water. Solar stills consist of a container in which impure/saline water is filled as shown in Figure.1. The bottom layer of container is coated with a black absorber lining so that it absorbs maximum upcoming solar radiation.

The top of container is covered with a glass sloping cover. The sloping cover for solar still is chosen in such a manner that it should have the property of transmitting maximum sun radiation falling on it to black absorber lining. The still is designed in such a way that maximum amount of solar radiation is trapped inside it. Heat loss can be reduced by insulation. Solar Still include another container to collect the fresh water dripping from glass slope cover.

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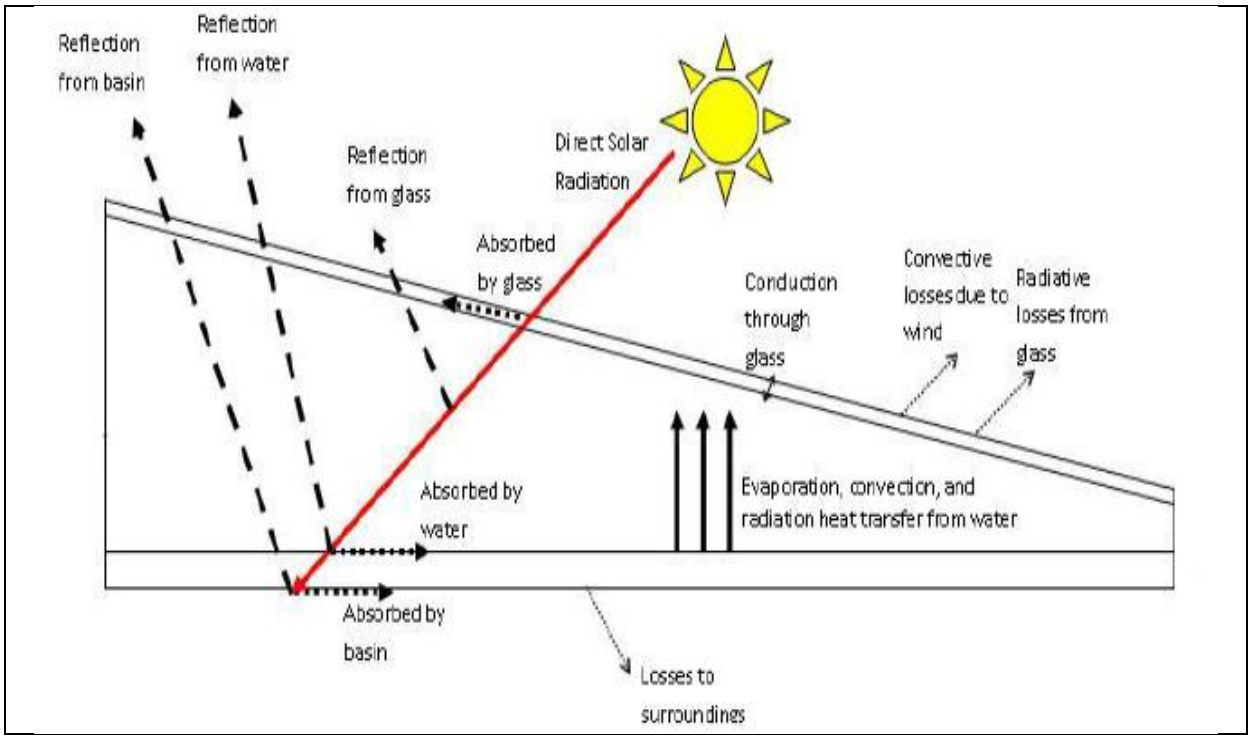


Fig. 1. Principle of Solar Water Distillation System

Solar still mainly works on principle of transferring the solar radiation into heat. The main principle is that converting solar radiation into heat. To begin with, saline water is pumped into container. When the solar radiation is passed through glass sloping cover and transmitted to black absorber lining. It helps to enhance the saline water temperature in such a way that evaporation of saline water takes place. The pure water vapor condenses in the glass sloping cover and then falls into empty new container. That water can be used for drinking purpose.

The solar still can be classified as passive and active solar still. Passive type solar still works in normal weather condition. They do not use any secondary source to increase productivity. As they operate in normal weather conditions the productivity of the passive type solar stills are low as compared to active type solar stills. Active type solar stills are used to increase the productivity of solar still by using extra thermal energy with the help of collector.[10]

There are main two distillation methods used primarily around the globe for desalination. Thermal distillation and membrane distillation. Thermal distillation technologies are mostly used in the Middle East, primarily because the region's petroleum reserves keep energy costs low. It includes three major, large-scale thermal processes. Multistage flash distillation (MSF), multi-effect distillation (MED), and vapor compression distillation (VCD). Another thermal method, solar distillation, is generally used for very small production rates. These systems treat the feed water by using a pressure gradient to force-feed the water through membranes. In addition to this, there are three major membrane procedures, which are electrodialysis (ED), electrodialysis reversal (EDR), and reverse osmosis (RO).

Nowadays, many researchers are trying to enhance the productivity of the solar still by using application of nano particles, phase change material and heat storage medium. Productivity can be increased by enhancing the temperature of water which tend to increase the evaporation rate or decreasing the temperature of the condensing glass cover which enhance the condensation rate. (Murugan et al.) [9]

## 2. Analysis of Different Researchers on Productivity of Solar Still

A.E. Kabeel et al. [4] experimented research on corrugated wick solar still by using copper oxide and providing vacuum. The performance of CrWSS with internal reflectors, integrated with external condenser and using different types of nanomaterial is investigated and compared with the convectional still. It has been observed that the productivity of CrWSS with reflectors

when providing a vacuum was enhanced to about 180% higher than the CSS. The productivity enhanced, when using CuO, by 285%.

Sahota et al. [5] carried out investigation on passive double solar still in order to find the effect of aluminum oxide on yield of solar still. After experimentation; it was found that productivity of still increased with increasing concentration of aluminum oxide concentrations. During sunshine hours, metallic nanoparticles absorb more solar radiation which increases the convective heat coefficient within the chamber.

S.W.Sharshir et al. [6] conducted a research on single slop solar still with four different modifications. The modifications include using flake graphite nanoparticles (FGN), phase change material (PCM), and film cooling. They also found that the enhancement of productivity of the still increased 73.8% compared to conventional still and also found that as depth of water decreased from 2 cm to 0.5 cm, productivity increases by around 13%.

Bhupendra Gupta et al. [7] experimented analysis on two different single solar still with 5cm and 10cm depth of water and sidewall one still painted with black and other painted with white by using copper oxide nanofluid. From the experiment, it has been concluded that yield of modified still is 22.4% higher than traditional solar still at 5cm water depth whereas, 30% higher at 10cm water depth. Moreover, white painted side wall diminishes heat loss to environment.

Madhu & Essaki [8] enhanced the production of potable water by experimenting PV panel submerged inside the solar still using three different nano materials namely $Al_2O_3$, $TiO_2$ and MgO at a constant concentration of 0.1%. From the study, it was found that yield from solar still with PV and with the use of nano fluids is found to be 8, 3.8 and 3.6 kg/m2 for $Al_2O_3$, MgO, $TiO_2$ respectively.

Murugan et al. [9] conducted an experiment with two different metallic nanoparticles on the productivity of single slop solar still. To increase the productivity angle of transparent glass kept at 30 degree, which is near to the latitude of the site. It was found that addition of nanoparticles in water enhances its thermal conductivity which tend to increases the temperature of the water as a result, rate of evaporation becomes higher and productivity increased by 26.36% and 34.61%.

Rees Alexa et al. [10] compared the efficiency and output of double slope solar still with and without the Nano fluid. The still was a double slope basin type solar still with black paint coating on the inside and external reflecting mirrors, to enhance the yield. The results depicted a positive outcome of a 15% increase in the rate of distillate collected with the use of nano fluids. The solar still was tried out without the nanofluid and had a total yield of 19.4litres from the 97litres supplied and the yield increased to 33.9litres with the addition of the nanofluid.

Reza Safaei et al. [11] performed an experiment on stepped solar slope solar still by using graphene oxide as nanofluid and paraffin an nano-PCM in order to enhance solar efficiency and yield as well. Researchers focused on using graphene oxide (GO) at different concentrations with phase-change materials (PCMs), to improve the productivity of a solar still. From experiment, it has been found that during day time, a part of solar energy is stored in PCM. After that it released stored energy when the sun sets. The productivity was found at maximum concentration of nanoparticles.

Ruchir Parikh et al. [12] compared and enhanced the yield of solar still by varying the depth of the basin fluid with the help of the combination of titanium oxide nanoparticles and black die. From the experiment, it has been found that at 20% TiO nanoparticles with black die increase 10% productivity and at 40% concentration its offer 20% productivity of solar still and 11-18% and 18-23% increase in the yield of solar still compared to the conventional solar still consequently.

R. Elavarasi et al. [13] enhanced the production of fresh water from conventional basin type still using nano as a silicon oil with black paint coating. Results of the study depicted that productivity increases by 5-25% by nano-pcm and temperature of solar still increases by 5-35%

Anil Gupta et al. [14] accomplished experiment on double solar still which was filled with aluminum and granite at different depth water in to analysis the performance of solar still. During experiment, it was observed that as the depth of water decrease, productivity of water increase. Maximum efficiency was obtained when water is filled with granite, which was 45.47% greater than convectional still and 5.62% higher than the still filled with aluminum.

O. Mahian et al. [15] used two sizes of nanoparticles with different volume fractions by using heat exchanger which was composed with two flat plate collector in series. Their result showed that productivity of solar still can be increased by two times however heat exchanger in the solar still cannot beneficial for inlet temperature.

Chaichan and Kazem [16] improved the production of fresh water from conventional basin still using nano enhanced PCM the bottom of basin. Their results illustrated that PCM ended the potable water production during sunset and enhanced to about 61% than solar still without PCM. Also, the potable water production enhanced by 10% than solar still without PCM.

The main aim of the present study is to enhance the fresh water productivity from the solar still and its performance by using hybrid nanoparticles of three different material namely, $Al_2O_3$, CuO, $FeO_2$ and with the use of cooling techniques.

Table 1. Depiction of Solar Still with Nano Fluids by Different Investigator

| Author, Location | Nano particles | Modification | Max. increase in the yield |
|---|---|---|---|
| Kabeel et al. (2015) Egypt [4] | CuO and $AL_2O_3$ | Internal reflectors with providing vacuum<br>External condenser<br>Corrugated wick solar still with (0.5 m2 base area) | Approximately 285% by using CuO<br><br>Approximately 255% by using $Al_2O_3$ |
| Sahota & Tiwari (2016) India [5] | $Al_2O_3$ | Double slop solar still having (2×1 m2) area | 12% using aluminum oxide |
| Shashir & Kabeel et al. (2016) China [6] | FGN | Using FGN (Modification A)<br><br>PCM+FGN (Modification B)<br><br>FGN + Film cooling (Modification C)<br><br>FGN+PCM+film cooling (Modification D) | 50.25% with Modification(A)<br><br>65.00% with Modification(B)<br><br>56.15% with Modification(C)<br><br>73.8% with Modification (D) |
| Murugan & Elumalai (2017) [9] | $Al_2O_3$ and CuO | Inner side of wall is painted black<br>Single slop still having (0.5×0.5m2) area | 26.36% using aluminum oxide<br>34.61% using copper oxide |
| Rees Alexa & keloth (2018) Oman [10] | $Al_2O_3$ | Using external reflecting mirror<br>Double slop solar still | 15% using aluminum oxide |
| Safai,Goshayeshi & Issa(2019) Vietnam [11] | Go | Phase change material with graphene Oxide<br>Stepped solar still | 2.5 kg water / 0.4m2 |
| Thakur, Agrawal, Kandelwal, Satydev India [28] | $Al_2O_3$ | Nano material mixed with the Black paint and coated on the inner surface | 17.44 % productivity yield increase in simple SS with nano fluid |
| Kabeel et al Egypt [29] | CuO and $AL_2O_3$ | nanoparticles with providing vacuum. In Single slope | 133.64% using cuprous oxide with a vacuum.<br><br>125.0% using aluminum oxide with a vacuum. |

| | | | |
|---|---|---|---|
| Ruchir Parikh et al. India (2021) [12] | TiO | $TiO_2$ nanomaterial with black die | Increased by 11–18% and 20–23% in productivity with 20% and 40% mixture. |

## 3. Conclusion

- Thermal conductivity and heat transfer coefficient enhanced by inclusion of nano-sized particles in the saline water hence it help to increase evaporation rate.
- As increase the concentration of nanoparticles in the base fluid rise the temperature difference between basin liner and inner glass surface increasing the productivity of solar still.
- The productivity of solar still influenced by using external modification such as external or internal mirrors and film cooling.
- Heat loss in the solar still can be reduced by white painted side walls, which tend to increase condensation rate
- In the case, when high wind speed decreases the temperature of glass cover which, in turn, increases the temperature difference between glass cover and water. Likewise, it too increases the concentration rate of evaporation. This outcome is significantly attained by usage of Nano fluid. It demonstrations the great impact on the yield of the still. Nano fluid has provided the prospect to develop the productivity and effectiveness by taking the benefits of the belongings of Nano fluid and several investigators have exposed the same.
- Productivity of the solar still is directly depend on the volume of nanoparticles concentration.
- As the depth water decreases in container of solar still, capacity of producing fresh water increases.
- Phase change materials worked as a heat storage material after the sunshine period and enhance the daytime yield of solar still.
- The productivity of solar still is mainly depend on the evaporation rate, which can be increased by using PCM and Condensation rate can be increased by film cooling.

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# Web-application for Trading Books

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**Abstract**

The web has evolved exponentially since its birth. It has become a global environment for most of services available today which can be classified as short-term, large or quality oriented. It has found its application in both daily life users and big enterprise corporations. A web-application has potential to change the way an organization work by automatizing certain tasks. It can be made using various scripting and programming language by integrating various tools also. It is highly interactive, robust with capacity to support millions of transactions.

*Keywords*: web-application (Chaffee, 2021); scripting (Wall, 2007); programming (Bebbington, 2014).

## Introduction

Books have important application in every aspect of life. They help to take and maintain notes, impart knowledge and store legit information. But, many a times in schools and colleges students use books for only few months and discard them at low rates which leads them to be out of circulation.

### *1.1 Concept*

Simple and effective solution can be a web-application (Wall, 2007) where students can sell their unused or not required old books. Pushing forward the motto of book affordability and reuse, buyer gets the material at affordable rates while seller gets rid of them. Also, if a book has limited supply in the market and/or is rare, if available with any can be mutually shared/bought by the needy. By this paper can be saved and books on large scale books can be appointed for good use.

### *1.2 Working*

The whole system works in pre-defined steps which have precise task. The steps can be classified into following:

a. Sign-Up: A new user visiting the application for the very first time will have to register himself in order to use it.

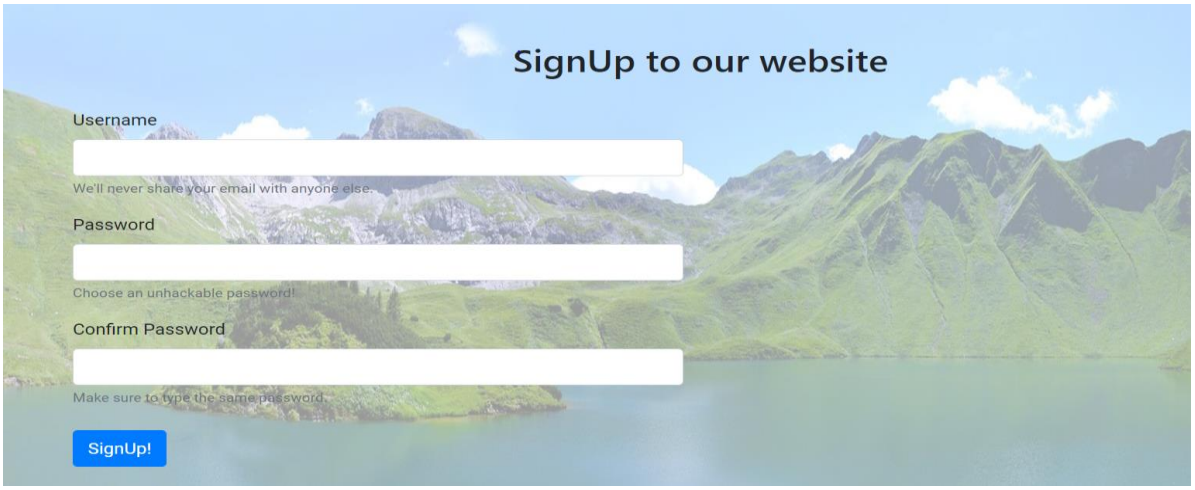


Fig. 1. Sign-up Page

*Nirali Kapadia
*E-mail Address:* nirali.kapadia@git.org.in

b. Log-in: The credentials used for signing-up will be used in this step to start the session for carrying out various activities.

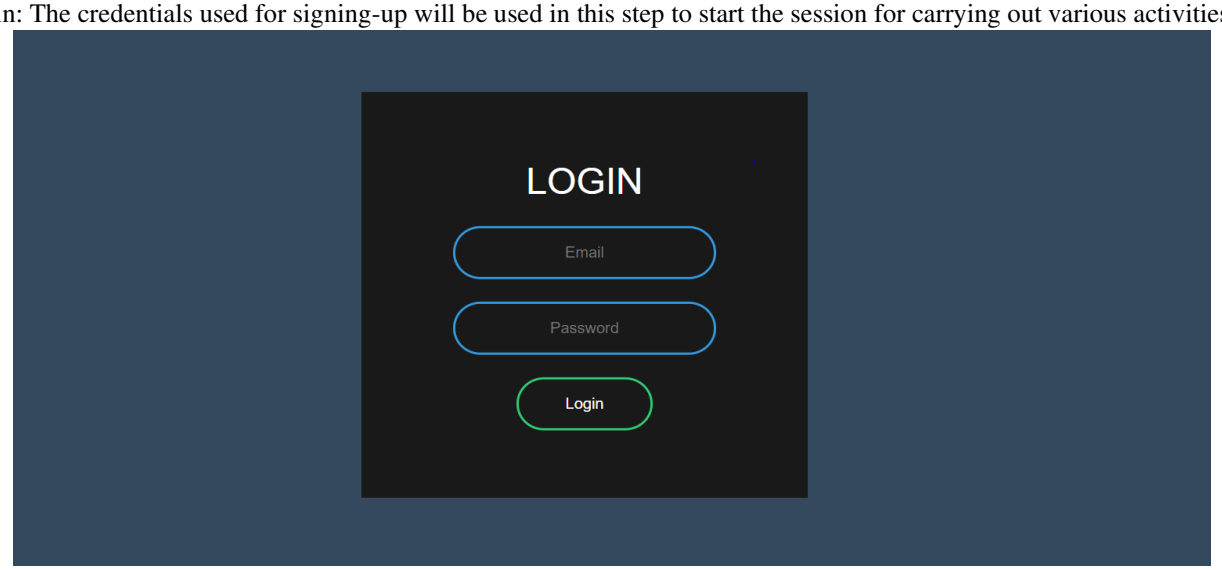


Fig. 2. Login Page

c. Activities: Various tasks can be done according to the role of the user. Every role has a definite task which he can perform for by using the system.
   1. Selling Books
   2. Buying Books
   3. Reading/Publishing Books Payment

*2.1 Roles in System*

a. Selling Books: A user can simply click the tab of selling books. A form will be made available where user can fill the information regarding attributes of a particular book. They can be as follows:
   - Seller First Name
   - Seller Last Name
   - Book Full Name
   - Publisher Name
   - Author Name
   - Edition
   - Book preview
   - Category/Genre

b. Buying Books:
   - User can surf from the list of books that are available in the system for selling.
   - Another approach can be the case when user wants a particular book, in this method he can search from the search bar which has query used to filter and match the input string with the data available in the database. If conditions match, output is given or else a message displays unavailability of item.

c. Reading/Publishing Blogs: To foster the trend and creativity of writers and also pleasure to readers, a feature of blogs has been added in the application. It can be accessed only by registered user.

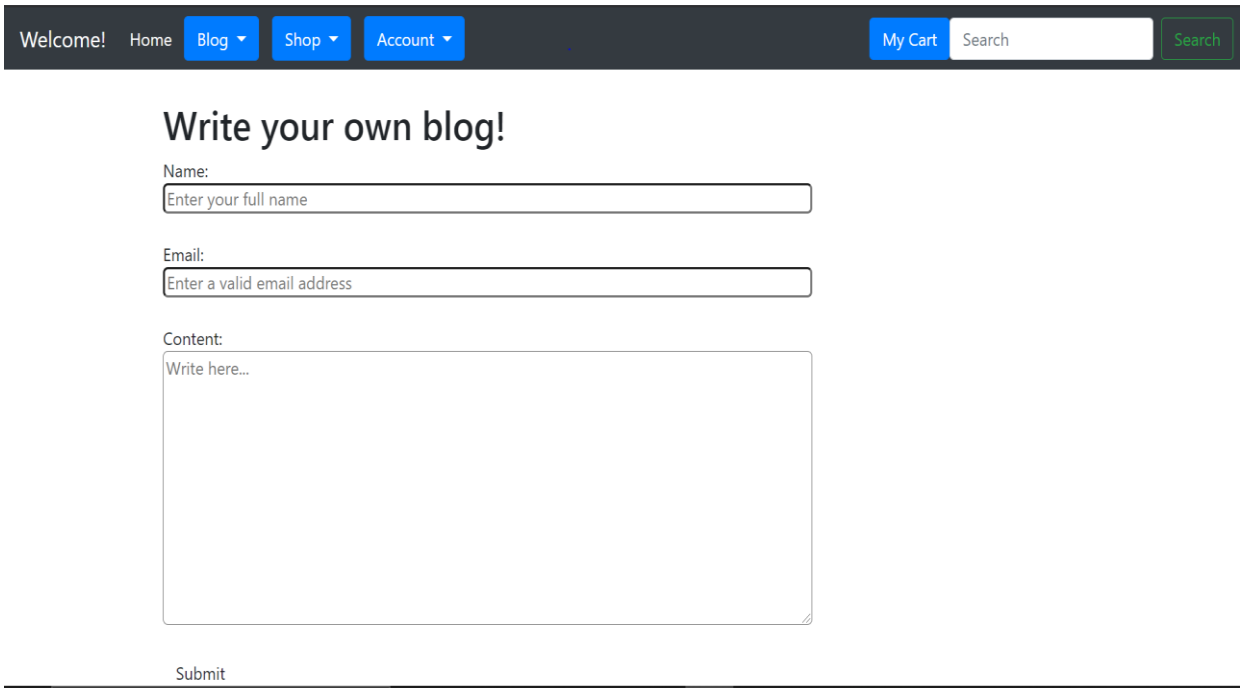


Fig. 3. Home Page

*2.2 Data in System*

The web-application uses PHP scripting language (Manual, 2009) at the back-end. Using phpMyAdmin functionality of it which can be accessed by XAMPP Server (SourceForge, 2015), Database has been created in MySQL (Corporation, 2020). All the required information can be stored in different tables like log-in, sign-up, cart and many others. Queries can be used to read, update and delete data from various tables. As the system has been designed for small and local schools and colleges, the data will be stored on dedicated servers of the institute only. It will not be shared with anyone. Also, there will not be any pre-rolled advertisements and banners on any of the web pages.

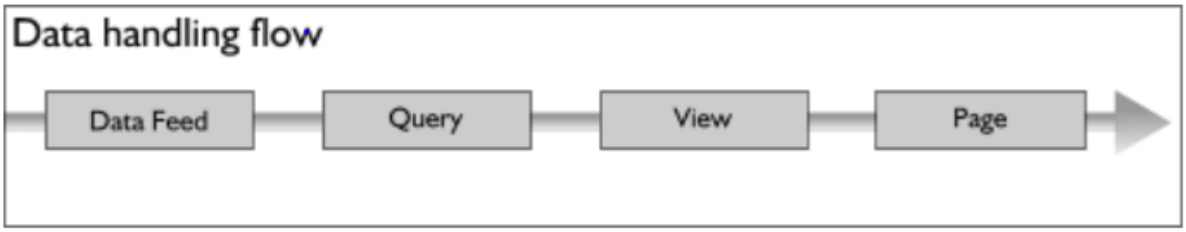


Fig. 4. Data flow

*3.0 User Account Management*

In order for client to access all the features and functionality of any web-application, it is important to manage all the information and help user maintain his account properly. For this system it will show name, transaction history, contact info and other data. It can be broadly classified into following:

a. Adding User: When a new user comes to use the system, a unique account has to be created by him according to the rules and fields of the system.
b. Profile Making: Every task initiated by the user will require a look-ahead of his profile. Like for instance in this system, his username, semester, field of study might be checked to make his user experience better.
c. Profile Editing: this is an iterative step where user can change fields. He can change his email address, contact details and some other information in future.

User Data Declaration: in the era of data breaches, it is important for the system maker to declare what data of the users will be known and used by them. Here, details like email address, phone number, username and some activity of the user will be stored in the system database. Its total usage will be transparent and declared to the user.

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