

# Conference on “Technologies for Future Cities”

January 8-9, 2019



## Conference Proceedings

Organized by  
**MES's PILLAI COLLEGE OF ENGINEERING  
NEW - PANVEL**

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**Mahatma Education Society's  
Pillai College of Engineering**



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on  
Technologies for Future Cities  
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**Organized by  
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## Preface

I am happy to present the Proceedings of the conference on “Technologies for Future Cities 2019 (CTFC 2019)” that was held at Pillai College of Engineering, New Panvel, Navi Mumbai during Jan.08-09, 2019 ([www.futurecities.mes.ac.in](http://www.futurecities.mes.ac.in)) The conference covered various aspects of the expected problems and their solutions for future cities. The conference consisted of plenary talks by eminent speakers (both from India and abroad), scientific paper presentations and panel discussions. In all, about 250 scientists and engineers attended the conference. The conference was inaugurated by world renowned technologist Dr Srinivasan Ramani (ex-TIFR, Mumbai) and Dr Rakesh Kumar, Director NEERI, Nagpur delivered the keynote address. Dr K. M. Vasudevan Pillai (CEO, Mahatma Education Society, Mumbai) and Dr Sandeep M. Joshi (Principal, Pillai College of Engineering) welcomed the participants and the dignitaries and gave introductory remarks. The plenary talks were delivered by experts from national laboratories, IITs and the industry. The list of speakers includes Dr. Patrik Lamson Hall (NYU Stern Urbanization, New York), Dr Dhiren Patel (Director, VJTI, Mumbai), Prof. B Menezes (IIT, Bombay), Prof. M V Rane (IIT, Bombay), Dr Priam Pillai (Pillai College of Engineering, Navi Mumbai), Dr M Sasikumar (Director C-DAC, Mumbai), Dr B. Satyanarayana (TIFR, Mumbai) and Dr P Shrivastava (Padeco India Pvt. Ltd, Mumbai). The most interesting part of the conference was Panel Discussion which was moderated by Dr Srinivasan Ramani. In addition to some plenary speakers, the panellist included Dr S K Ukrande (Dean, Science and Technology, Mumbai University), Dr S M Khot (Principal FrCRIT, Vashi), Mr G. Udayabhaskar (Head, Corporate Environment, Reliance Industries) and Mr V Venu Gopal (Chief Planner, NAINA, CIDCO).

The conference covered all relevant topics connected to “Technologies for Future Cities” and consisted of five tracks, namely, (i) Software solutions for future cities, (ii) Hardware solutions for future cities, (iii) Systems for future cities, (iv) Materials for future cities and (v) Policies and Governance for future cities. In all, we had received 159 contributed papers. Based on the peer review process, 110 of them were accepted for presentation at the conference. 70 papers were presented in oral sessions and 20 were presented in poster sessions. Depending on the grading given by the referees and the chairmen of respective sessions, 50 of the presented papers have been accepted for publication in the conference proceedings. These papers have been uploaded on SSRN website. Center of Excellence for Future Cities at Pillai College of Engineering was inaugurated during this Conference.

I am very much grateful to the management of Mahatma Education Society, the esteemed members of the international and National Advisory Committees for their advice and guidance. I would like to thank Computer Society of India (Mumbai Chapter), National Environment Engineering Research Institute, Nagpur and Builders’ Association of India for being knowledge partners to the conference and our sponsors Boron Rubbers, E-Keeda, Shroff Publishers, Jaydee Electronics and GATE Academy. I would also like to thank all the referees, track coordinators and track chairs of various sessions who helped us in maintaining high standard of the conference. We have also applied for funding from All India Council for Technical Education (AICTE) under AQIS scheme “Grant for Organizing Conference – GOC” in year 2018-2019 and approval of the same is awaited. The conference organization owes its success to the efforts of our colleagues in the organizing committee, and many other individuals, especially the staff of Pillai College of Engineering, and other institutes of Mahatma Education Society. In particular, I express gratitude to Dr P S Goyal, Dr. Onkar Sahasrabudhe, Dr Avinash R. Vaidya and Dr Mahendra Khandkar who were members of the core committee. I also thank SSRN for publishing the proceedings of the conference on their website.

I wish to acknowledge untiring efforts put in by Prof. Ameet Mehta and Dr Avinash R. Vaidya as co-editors of this proceeding.

Dr. Sandeep M. Joshi

Convener CTFC 2019 and Principal, Pillai College of Engineering, New Panvel-410206, India  
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# IOT BASED PORTABLE SMART LOCK

Payel Thakur, Ayush Shetty, Manthan Parvadia\*, Onkar Pokharkar, Shubham Shinde  
(PCE, New Panvel, India, Affiliated to University of Mumbai).

**Abstract:**

Security has been playing a key role in many of our places like home, offices, institution, suitcases, etc. In order to avoid intrusion from unauthorized person into these places a portable smart lock is proposed. Biometric systems and facial recognition have overtime served as robust security mechanisms in various domains. Fingerprint is most widely used form of biometric identification. Project builds an IOT based portable smart lock which can be opened through various means such as biometric fingerprint and facial recognition via mobile application using Wi-Fi or Bluetooth module. Database will be used to store the records of authorized person to unlock the lock. When an unauthorized person tries to unlock the lock a push message will be send to the owner of the lock and subsequently log of the same will be saved in the database .This database will be stored on web-server. Hence the lock will be unique combination of various aforementioned security features providing solution to problem of security.

**Keywords:**

Facial recognition, fingerprint, bluetooth, portable, database, security

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## I. INTRODUCTION

In this modern world crime has become ultra modern too! In this current time a lot of incident occurs like robbery, stealing unwanted entrance happens abruptly. So the security does matters in this daily life. People always remain busy in their day to day work also wants to ensure their safety of their beloved things. Sometimes they forget to look after their necessary things like keys, wallet, credit cards etc[1].

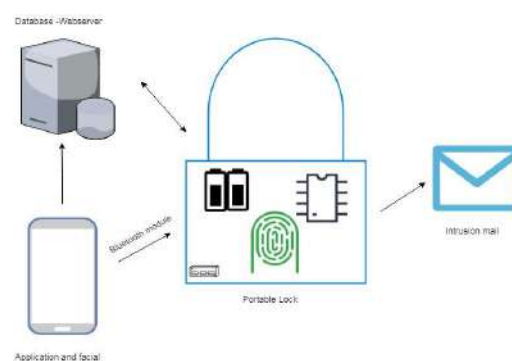
The technology of keys and locks remained the same for the last century while everything else is evolving exponentially. So why not use current technologies and apply it with old ones to build something new and innovative [2].

Recently, the Internet was enhanced, and everything was connected to it (phones, televisions, laptops, tablets, cars and so on...). This was done because we wanted to make systems "smarter", in other term "more productive". Why not do the same thing with Locks? Enhancing the locks mechanism by connecting them to the internet, making them more robust and productive. Today, the number of mobile device users including smartphone users has rapidly been increasing worldwide, and various convenient and useful smartphone applications have been developed. Now smartphones are not only used to send and receive phone calls, send text messages, and perform mobile banking operations, but they also are used to control various other devices in our real everyday lives. Through a mobile operating system and internal applications, we can remotely control a variety of external devices such as TVs, projectors, computers, cars, etc[2].

Biometrics are automated methods of recognizing a person based on a physiological or behavioral characteristic. Among the features measured are; face, fingerprint, hand geometry, iris, retinal, signature, and voice. Biometric technologies are becoming the foundation of an extensive array of highly secure identification and personal verification solutions. As the level of security breaches and transaction fraud increases, the need for highly secure identification and personal verification technologies is becoming apparent.

In this paper, a new system is designed which would be a combination of two biometric factors (face and fingerprint) which would be integrated in a single system. The user can unlock the lock either through fingerprint present on the lock or face detection via mobile application. The system would be integrated in such a way that the lock can be carried any time anywhere thus increasing its application areas and making it portable.

## II. METHODOLOGY



**Fig. 1** System Architecture

## A. System Architecture

### i. Server:

The server provides two things:

- Database: It stores the log of entry and intrusion detection.
- Web server: It manages the database and communicates with other components request/response.

### ii. Mobile Application:

Android mobile application is developed to allow users to register to use the system and access the features of the system. The owner can authenticate other users to use the system and its features. Android library is used for face recognition. The application communicates with the lock via bluetooth to unlock the lock using signals. The application can access logs too.

### iii. The lock:

The lock is portable and can be carried anywhere anytime. The lock consists of following components in it:

- Fingerprint scanner: The fingerprint scanner scans the print of the user placed on the fingerprint scanner with the fingerprints stored in the database.
- Arduino uno: It is used as micro controller. Controls other components by sending control signals. Controls bluetooth and wifi capabilities.
- Battery: 9V-12V batteries are used to provide power supply to the fingerprint scanner.
- Usb port: usb port is used for charging the batteries.

### iv. Email/Msg:

When an unauthorized person tries to unlock the lock using fingerprint or facial recognition a email/msg is send to the owner and log is maintained of the same.

## B. Features

### i) Multiway unlocking system:

The system can be unlocked either by facial recognition or fingerprint whichever is convenient for the user at that moment.

### ii) Intrusion detection system:

The system sends an email/msg to the owner if the lock is tried to be unlocked by unauthorized user.

### iii) Logs:

The system keeps recordings of the log by maintaining the history of lock/unlock operations.

### iv) Availability:

Android application features can be availed and accessed anywhere anytime and authenticate other users to access the lock.

## C. System Methodology

### i) Registration:

User registers himself using the android mobile application. Logins himself and registers face image and fingerprint which are to be recognized as

authentic. The owner can register other users as well and store face images and fingerprint which are to be recognized as authentic.

### ii) Operation:

User unlocks the lock either using facial recognition or fingerprint scanner. If the user is authorized the lock unlocks otherwise after predetermined attempts intrusion mail/msg is send to the owner.

## III. EXPERIMENTATION

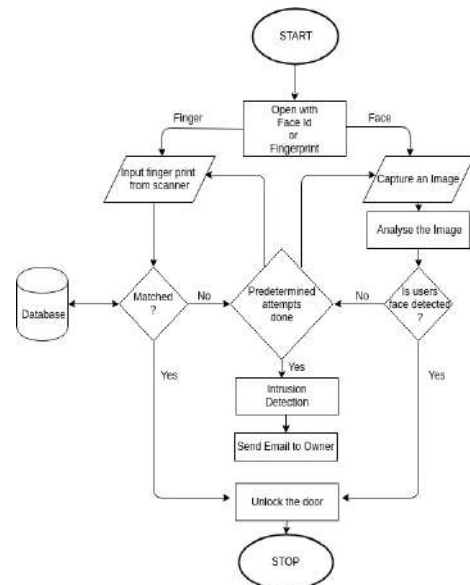


Fig. 2 System working flowchart

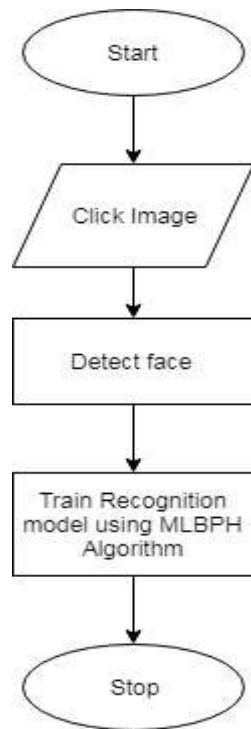
Step 1: Start

### METHOD 1:

- Step 2: User // who will try to enter biometric details
- Step 3: Finger Print //user will put the finger on fingerprint scanner
- Step 4: Fingerprint scanning // System will match the input with existing fingerprint in the database
- Step 5: if match found the lock is unlocked
- Step 6: Else go to step 8.
- Step 7: Entry in register // users check in time is entered in register.

### METHOD 2:

- Step 2: User // who will try to enter his details
- Step 3: Face Id //user will scan his face on the camera.
- Step 4: Face Recognition // System will try to Recognize the authentic person
- Step 5: if match found the lock is unlocked
- Step 6: Else go to step 8.
- Step 7: Entry in register // users check in time is entered in register.
- Step 8: If any of the step 3 of method 1 or 2 has been attempted for five times unsuccessfully then go to Step 9
- Step 9: Intrusion will be detected.
- Step 10: Email/message will be forwarded to owner.



**Fig. 3** Facial recognition model training flowchart



**Fig. 4** MLBPH operator [3]

Step 1: Capture face image.

Step 2: Use Haar Cascades Classifier with AdaBoost algorithm for Face Detection.

Step 3: If face is detected at Step 2 proceed to Step 4 else terminate.

Step 4: Divide the face image into several blocks.

Step 5: At each block calculate median of all gray values and replace the center value with the median.

Step 6: Consider the center value as threshold of window and compare all other values with it.

Step 7: Calculate Histogram for each block.

Step 8: Concatenate the entire block MLPBH.

Step 9: Compare the MLBPH of current image with MLBPH of saved image.

Step 10: If match found goto Step 11 else terminate.

Step 11: Face recognized successfully.

#### IV. RESULT AND DISCUSSION

A database of 200 different people with 6 images of each person would be created. Each person's different characteristic images would be selected as test images for training. The experiment will be performed ten times and average of the experiment will be noted.

**Table 1** Expected result after training

Characteristics	Correct times	Wrong times	Recognition rate
Illumination change	1167	33	97.25%
Attitude change	1186	14	98.83%
Face proportion change	1111	89	92.60%

The above table shows expected recognition rate when trained with MLBPH algorithm when following characteristics are taken into consideration.

#### V. CONCLUSION

The main advantages of using this system are:

- The lock is portable can be carried anywhere.
- No issue of power failure since battery is used.
- No manual errors.
- MLBPH algorithm used for face recognition overcomes the recognition rate disadvantages of LBPH.
- Combination of fingerprint authentication and facial recognition overcomes each others disadvantages providing absolute solution to problem of security.

The solution proposed in this paper is a combination of two biometric factors (facial recognition and fingerprint) in both the system overcomes the disadvantages of each other. All notification and data updates across the system are real time since the components of the system are synchronized. The system would be integrated in such a way that the lock can be carried any time anywhere thus increasing its application areas and making it portable. Hence the system is effective yet simple to use solution for security.

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## REGRESSION BASED ICT MODEL FOR CROP YIELD ESTIMATION

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(PCE, Panvel, India, Affiliated to University of Mumbai)

### **Abstract:**

*Farming and agriculture is the primary occupation in a nation like India. It has always proved to be important that we work towards constructing projects and systems that subsequently help in making a social reform where it is needed the most. Hence, it comes as no surprise that not only the government but also prominent science project centres have always paid a lot of attention and never hesitated from taking initiatives and efforts in assisting build different projects that help in development and progress in the same field. We also aim in building a project that draws an estimation about which crop is yielded at which rate in which district of Maharashtra. There are a number of algorithms that have proven to be helpful in finding out the estimation. We have taken use of Multiple Regression algorithm, which helped us to compute the yield estimation. The foremost goal of our project is to facilitate farmers and cultivators with an estimation system that helps them approximate the yield of crops and ultimately leads to a better and smarter farming structure for farm level.*

### **Keywords:**

*Yield Estimation, Information and Communication Technology, Multiple Regression Algorithm, Machine Learning*

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### **I. INTRODUCTION**

For years, agriculture has been the major source of sustenance and nourishment. The foremost goal of our project is to facilitate farmers and cultivators with an estimation system that helps them approximate the yield of crops and ultimately leads to a better and smarter farming structure for farm level. A number of factors affect agricultural yield such as climate, environmental changes and land availability. Hence, with every changing season, development rate and changes in the ecosystem, the cultivation figures change as well. As a result, it is important to come up with a system that helps in approximation and estimation.

A number of government assisted organizations take keen interest in supporting and helping projects that have a potential in making the lives of farmers easier and suggesting smarter ways of work. The proposed solution aims to integrate data from different heterogeneous sources, such as satellite based meteorological data, sensor data directly obtained from the farm, various other data obtained from archives of government departments in order to develop a time series model. No such attempt has been done reported in India for any crop so far, although a few simulation studies have been attempted by scientists in meteorological and agriculture departments. Our project, too, is being made with an aim of better farming in India. This

will prove to be of a great aid in systematic and strategic agriculture thus a step forward in making farming in this country more tactical.

### **II. METHODOLOGY**

We, at a student level, can take help from resources made available by the government, in realizing the project. Extracting database from various trusted government websites [6], we have circled down to around 5 districts of the Maharashtra state which will be our aim places regarding which we will calculate the estimation. There are a number of algorithms that have proven to be helpful in finding out the evaluation. We aim at making use of Multiple Regression algorithm which will help compute the yield estimation. The input for our project would be the database and records of the yield figures from the past (say) 20 years, each according to different districts. We can have access to these databases from renowned websites such as data.gov.in which provide databases, statistics and figures. Applying the mentioned algorithms to the database figures, we can calculate the estimated rate at which the crops of the given state can be yielded in the current or coming years.

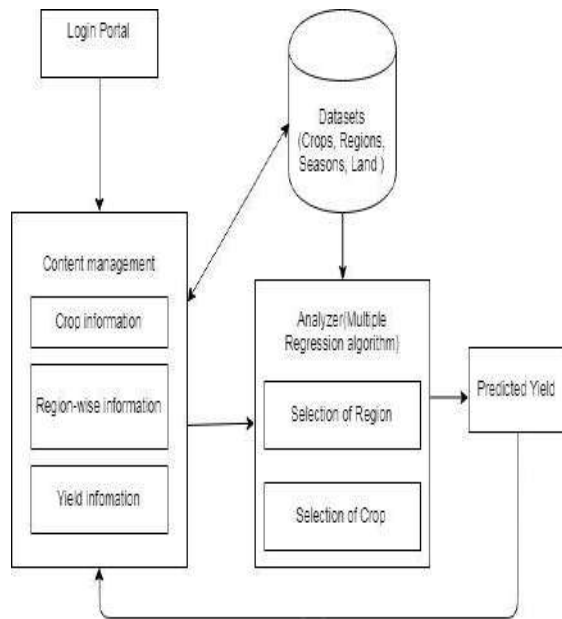


Fig.1:- Proposed Estimation System Architecture

### III. ALGORITHM

#### A. Data Set Collection

The first stage or the first task was to find the required data sets. We needed the information of the previous years' yield. We needed the required data for different parts of Maharashtra for different crops. With the help of sources such as Data.gov, we obtained the data sets for the past 20 years for 5 districts of Maharashtra for 5 different crops. Statistics of crop are shown in table 1.

Table 1:- Crop Production Statistics

Crop Production Statistics					
State/Crop/District	Year	Season	Area (Hectare)	Production (Tonnes)	Yield (Tonnes/Hectare)
Maharashtra					
Wheat					
1.KOLHAPUR	1997-98	Rabi	6300	10100	1.60
	1998-99	Rabi	7300	13400	1.84
	1999-00	Rabi	7600	15200	2.00
	2000-01	Rabi	8400	15000	1.79
	2001-02	Rabi	8500	16600	1.95
	2002-03	Rabi	8500	15200	1.79
	2003-04	Rabi	8600	17400	2.02
	2004-05	Rabi	9200	19400	2.11
	2005-06	Rabi	9900	20100	2.03
	2006-07	Rabi	9300	19400	2.09
	2007-08	Rabi	105	251	2.39
	2008-09	Rabi	9600	23800	2.48
	2009-10	Rabi	7900	18000	2.28
	2010-11	Rabi	8600	22800	2.65
	2011-12	Rabi	8500	21100	2.48
	2012-13	Rabi	9100	20000	2.20
	2013-14	Rabi	16600	41700	2.51
	2014-15	Rabi	6800	15100	2.22
	1997-98	Rabi	73600	95100	1.29
	1998-99	Rabi	83900	112200	1.34
2.NASHIK	1999-00	Rabi	85700	122600	1.43
	2000-01	Rabi	39400	44500	1.13
	2001-02	Rabi	36800	48900	1.33
	2002-03	Rabi	36900	49500	1.41
	2003-04	Rabi	35500	41300	1.16
	2004-05	Rabi	55600	81300	1.46
	2005-06	Rabi	70600	116600	1.65
	2006-07	Rabi	84100	137700	1.64
	2007-08	Rabi	790	1490	1.89
	2008-09	Rabi	71900	115900	1.61
	2009-10	Rabi	73000	117800	1.62
	2010-11	Rabi	75300	143700	1.91

Fig.2:- Sample Data set (Wheat)

Crop Production Statistics					
State/Crop/District	Year	Season	Area (Hectare)	Production (Tonnes)	Yield (Tonnes/Hectare)
Maharashtra					
Rice					
1.KOLHAPUR	1997-98	Kharif	1100	246100	223.73
	1998-99	Kharif	106000	289100	2.73
	1999-00	Kharif	103200	261900	2.54
	2000-01	Kharif	106300	232800	2.19
	2001-02	Kharif	105900	289400	2.73
	2002-03	Kharif	105600	233200	2.21
	2003-04	Kharif	106200	246100	2.32
	2004-05	Kharif	110500	279100	2.53
	2005-06	Kharif	108300	246100	2.27
	2006-07	Kharif	109800	284800	2.59
	2007-08	Kharif	111900	336200	3.00
	2008-09	Kharif	113800	285200	2.51
	2009-10	Kharif	112700	291800	2.59
	2010-11	Kharif	111500	321600	2.88
	2011-12	Kharif	104300	278900	2.67
	2012-13	Kharif	107800	282200	2.62
	2013-14	Kharif	108800	339600	3.12
	2014-15	Kharif	110900	335200	3.02

Fig.3:- Sample Data set (Rice)

#### B. Implementation of Multiple Regression

The second task was to apply the suitable algorithm to the data set. We had a number of options such as Naive Bayes, Linear Regression and Multiple Linear Regression. The algorithm, which we have applied, is Multiple Linear Regression. This is because we have a number of parameters to be taken under consideration. These parameters include production, area, soil pH, rainfall and temperature. To extract a result based on all these parameters along with the data sets obtained, we applied Multiple Linear Regression algorithm which gives us an astoundingly accurate and efficient result thus improving the performance of the project.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	x1	x2	y										
2	9300	19100	1.60										
3	7300	13400	1.64										
4	7900	15300	2.00										
5	9400	15900	1.70										
6	9500	16500	1.35										
7	9200	15200	1.70										
8	9800	17400	2.02										
9	9200	16400	2.11										
10	9800	20100	2.03										
11	9200	18400	2.00										
12	9200	25100	2.34										
13	9300	23900	2.48										
14	7900	18800	2.28										
15	9500	22900	2.63										
16	9500	21100	2.48										
17	9100	23900	2.21										
18	10000	41700	2.51										
19	9300	15100	2.23										
20	9000	11500											
21													
22													
23													
24													

Fig.4:- Estimated Yield

#### IV. RESULTS AND DISCUSSION

Applying the multiple regression algorithm to the database figures, we calculated the estimated rate at which the crops of the given state can be yielded in the current or coming years. This is done by using a sliding window non-linear regression technique to predict based on different factors affecting agricultural production such as area, production, yield etc. As shown in fig. 4, we have calculated the estimated crop yield for Nashik district of wheat crop for the year 2018 taking the data of past 20 years. The result is 2.012 tonnes per hectare. The objective of work is to help the farmer by applying predictive analytics on data from previous years.

#### V. CONCLUSION

The primary goal and motive of the project is to provide the farmers a rather easier and more strategic way of farming which provides better results to not only the farmers but to the entire country. With the growing population rate of the nation, the economic issues are ever rising which is subsequently going to lead to issues in feeding the entire population. Hence, it is very important that we constantly come up with ideas that lead to smarter farming. Our project aims at serving the exact purpose. With the help of our project, the farming sector will know the estimated yield count and as per that they can plan and prepare.

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# PROPOSED IMPLEMENTATION ON ELECTRICITY USAGE PREDICATIONS ANALYSIS FOR TOWN USAGE APPLICATION

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## Abstract:

Proposed system is working on a prediction model here we are trying to address a typical problem of whole world which is going to come up that is the usage of electrical usage. Here we are using a UCI data set for the initial processing. Uncertain probabilistic data is accepted and converted in certain predicated vales by use of aggregation. Data science logic is used for estimating future power prediction and to have actual estimated requirement of electrical power analysis. Regression analysis is one of the methods which can be worked out. Linear regression is one way for implementing this model. Here we have tried to concentrate on the home electrical usage in a town.

## Keywords:

Regression, Probabilistic data, Electrical usage Data mining, data Science.

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## I. INTRODUCTION

Now-a –day the global situation is that how to save electrical power usage. This in turn give rise to the analysis of known values which is available, from which the required usage for some number of minute, Hours day, month, years can easily have predicated using best possible methodology. Saving power is nothing generating, also it will help in knowing the usage depending on the rise in population. [2]

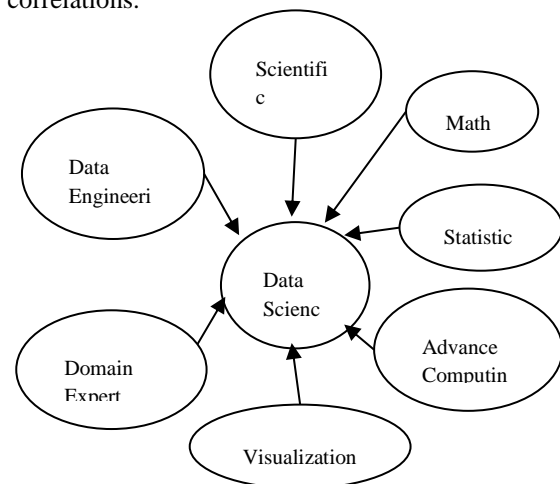
Proposed intelligent system does the analysis of previously available data This system can be broken into various components namely i) Data mining ii) Computing iii) Statistics iv) Analytics Models etc.

Here to work on with we have used the methodology of Data science. A combination of mathematics, statistics, programming, the context of the problem being solved, ingenious ways of capturing data that may not be being captured right now plus the ability to look at things differently and of course the significant and necessary activity of cleansing, preparing and aligning the data.[4]

Data Analysis: Analysis is really a heuristic activity, where scanning through all the data the analyst gains some insight. Analytics is about applying a mechanical or algorithmic process to derive the insights, for example, running through

various data sets looking for meaningful correlations between them. [10]

Data Mining: This term was most widely used in the late 90's and early 00's when a business consolidated all of its data into an Enterprise Data Warehouse. All of that data was brought together to discover previously unknown trends, anomalies, and correlations.



**Fig: 1 Basic of Data Science [3]**

## II. METHODOLOGY USE OF DATA BASE

This data set is measurements of power consumption in one household with a one-minute sampling rate over a period of almost four years. Dataset consists

of **2075259** measurements. Database has 9 attributes: Date, Time, Global\_active\_power, Global\_reactive\_power, Voltage, Global\_Intensity, Sub\_metering\_1, (Kitchen) Sub\_metering\_2, (Hall) Sub\_metering\_3. (Bedroom) for a small home

<http://archive.ics.uci.edu/ml> [6]

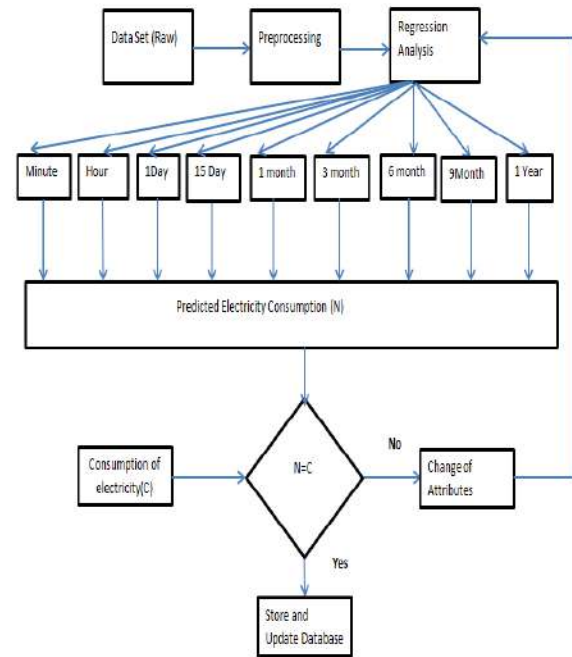
Attribute Information:

1. *Date*: date in format dd/mm/yyyy
2. *Time*: time in format hh:mm:ss
3. *Global\_active\_power*: household global active power (in kilowatt)
4. *Global\_reactive\_power*: household global reactive power (in kilowatt)
5. *Voltage*: voltage (volt)
6. *Global\_Intensity*: household global intensity (ampere)
7. *Sub\_metering\_1*: energy sub\_metering\_1 (in watt-hour of active energy). It corresponds to the kitchen, containing mainly dishwasher, an oven, and microwave
8. *Sub\_metering\_2*: energy Sub\_metering\_2 (in watt-hour of active energy). It corresponds to a laundry room, containing a washing machine, tumble drier, a refrigerator and light.
9. *Sub\_metering\_3*: energy Sub\_metering\_3 (in watt-hour of active energy). It corresponds to an electric water heater and an air conditioner

### III. EXPERIMENTATION

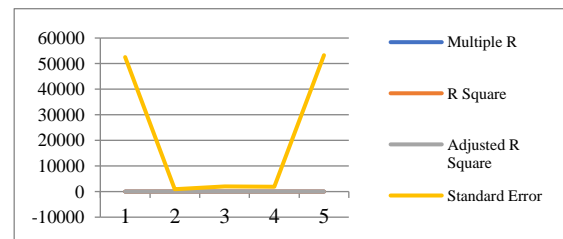
Working of the proposed model contains different steps of working logic:

- 1 Initial raw data is collected
- 2 According to the required data, proper filtering is being worked out.
- 3 Regression analysis is applied in this step.
- 4 Comparison with the actual available (electricity) and used data (electricity)
- 5 Store the data for training if newly found also update the same in data sets
- 6 if no then produce error return to regression by changing the attributes go back to an analysis
- 7 Continue till you get proper results
- 8 End.



**Fig 2:** Flow chart of implementation method [8] [11]

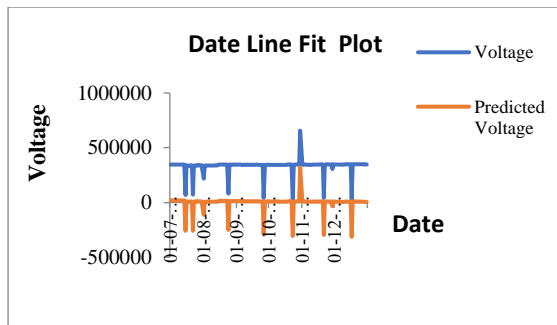
### IV. RESULTS AND DISCUSSION



**Fig 3:** Regression analysis of 6months electrical usage

**Table1:** Regression statistics of 6 months' usage

Regression Statistics					
Multi ple R	0.04432 7	0.48521 7	0.24285 5	0.52082 5	0.04206 3
R Squar e	0.00196 5	0.23543 6	0.05897 9	0.27125 9	0.00176 9
Adjus ted R Squar e	- 0.03245	0.20907 1	0.02653	0.24613	- 0.03265
Stand ard Error	52501.5 5	927.444 7	2060.21 5	1898.53 4	53286.9 3



**Fig 4:** usage of electrical for a period of 6mths v/s predicated usage

Table 2: Monthly Data of Electricity for 1 full year [8]

Mon th Data	Sub_m etering _1	Sub_met ering_2	Sub_met ering_3	Voltage
1/1/ 7	10905 9.1	82915	350559	117102 23
1/2/ 7	43949	64500	258693	936842 8
1/3/ 7	58184	102940	286430	104781 86
1/4/ 7	40864	37899	188372	931059 6
1/5/ 7	75737	71724	224130	101590 81
1/6/ 7	56011	68856	169923	932689 5
1/7/ 7	33864	54528	145253	972771 5
1/8/ 7	35763	47323	217236	102342 25
1/9/ 7	55415	65290	223233	100407 05
1/10 /7	42221	83742	258700	103472 93
1/11 /7	50886	69502	287224	100567 37
1/12 /7	72454	82713	351856	104680 41
SU M	67440 7.1	831932	2961609	1.21E+ 08

Table 3:-Regression statistics  
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.063960501
R Square	0.004090946
Adjusted R	
Square	-0.001441882
Standard	
Error	62192.73945
Observations	182

A regression equation containing only one predictor variable is called Simple regression equation. Two variables are fixed in it one is predictor variable and other one is a response variable. [11]

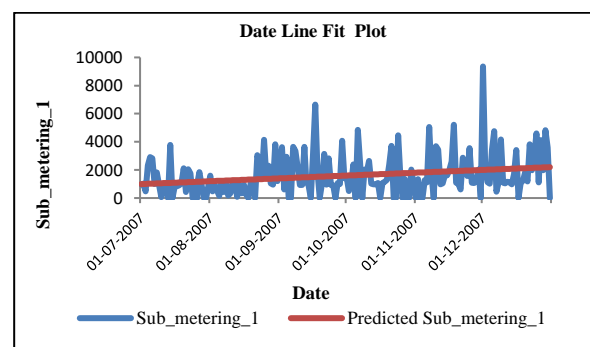
$$YI = \beta_0 + \beta_1 X_1 \quad (1)$$

$$YI - \beta_0 - \beta_1 X_i = 0 \quad (2)$$

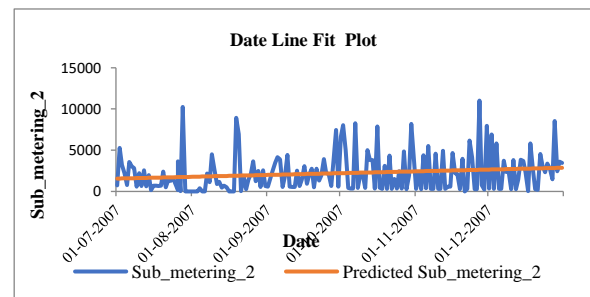
$$\sum_{i=1}^n [(Y_i - \beta_0 - \beta_1 X_i) = 0] \quad (3)$$

$$\delta Q / \delta \beta_0 = 0 \quad (4)$$

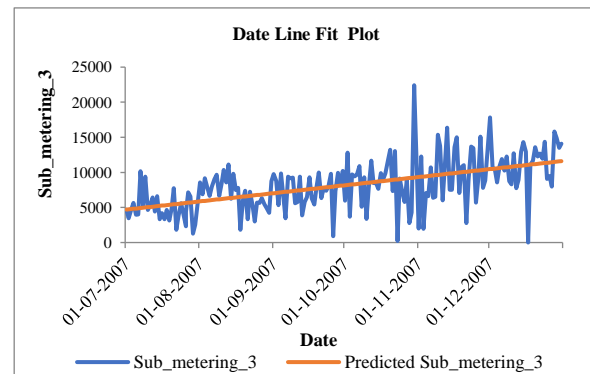
$$\delta Q / \delta \beta_1 = 0 \quad (5)$$



**Fig 5:** predicated V/s Sub\_meter\_1 usage of electrical



**Fig 6:** predicated V/s Sub\_meter\_2 usage of electrical



**Fig 7:** predicated V/s Sub\_meter\_3 usages of electrical

Table 3: Residual output predicted of sub\_meter\_3

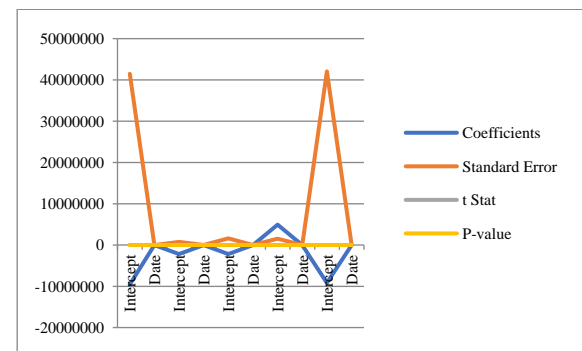


V/S Residual (some sample of 181 observations)

Residual output		
Observation	Predicted Sub_metering_3	Residuals
1	4692.327418	-2.327417906
2	4730.055821	-1285.055821
3	4767.784225	-72.78422461
4	4805.512628	826.487372
5	4843.241031	-870.2410313
6	4880.969435	-875.9694347
7	4918.697838	5258.302162
8	4956.426241	320.5737586
9	4994.154645	4391.845355
94	8238.797333	-4546.797333
95	8276.525736	1433.474264
96	8314.25414	1110.74586
97	8351.982543	1314.017457
98	8389.710946	2496.289054
99	8427.43935	-3345.43935
100	8465.167753	824.8322468
150	10389.31632	-1571.316324
151	10427.04473	3173.955272
152	10464.77313	7382.226869
153	10502.50153	133.4984658
154	10540.22994	-112.2299376
155	10577.95834	-2016.958341
156	10615.68674	303.3132557
157	10653.41515	1254.584852
158	10691.14355	-428.143551
159	10728.87195	1554.128046
160	10766.60036	-2038.600358
170	11143.88439	535.1156088
171	11181.61279	2410.387205
172	11219.3412	1031.658802
173	11257.0696	1415.930399
174	11294.798	667.2019954
175	11332.52641	3017.473592
176	11370.25481	-2286.254811
177	11407.98321	-1927.983215
178	11445.71162	-3485.711618
179	11483.44002	4339.559979
180	11521.16842	3384.831575
181	11558.89683	1926.103172
182	11596.62523	2474.374769

Table 4: Coefficients, standard data error values

		Coefficients	Standard Error	t Stat	P-value
Voltage	Intercept	-9572343.7	41442823	-0.230977115	0.8189544
	value	251.9074	1054.2565	0.238943187	0.8128302
Sub_metering_1	Intercept	-2186574.7	732091.26	-2.986751474	0.0056839
	value	55.653226	18.623537	2.988327373	0.0056616
Sub_metering_2	Intercept	-2190957	1626259.5	-1.347237028	0.1883372
	Value	55.774194	41.370121	1.348175749	0.1880386
Sub_metering_3	Intercept	-4930807	1498634.4	-3.29020017	0.0026326
	Value	-125.25565	38.123488	-3.285524256	0.0026646
Total consumption Of Electricity	Intercept	-9195360.6	42062773	-0.218610425	0.8284847



**Fig 8:** t-stat, p- value, coefficients, standard error  
The predication analysis using the proposed model is for six months. The method used for this analysis is from the raw data which was available from a

standardized data set of UCI repository. [6] Initially a pre-processing of the data is required which helps in getting near to the expected calculations. We have concentrated in the area of the home usage of electricity in which sub\_meter\_1 is said to be usage in Kitchen, sub\_meter\_2 is said to be in bed room and Sub\_meter\_3 is said to be in Hall respectively. A common work out for the UCL data base is calculated for various set of timing. A brief work is represented in this paper which includes the data for six months of data. The entire data set is of 15 years from which we have use six months in this paper. Regression analysis is the key which is used for the process. Multiple regression analysis concept has helped in calculating the graphs which are plotted, using various parameters has help in getting some conclusion of usage in electrical usage and it future requirements respectively. Here we are trying to predict the required electrical usage depending on the current usage, by applying different parameters we get some actual and predicated values of the usage electricity. Fig 3 is the graph which represents regression analysis for six months. Table 1 is the calculation of the above graph. Fig 4 represents the actual usage v/s predicated usage. Table 2 represents the full year pre-processed data. Using various parameter, we have calculated the expected and the actual usage of electricity. Also using the same individual area such as kitchen, Hall and Bedroom are being calculated which helps in getting to the final conclusions. A sample data of sub\_meter\_3 with 181 observations for residual output predication is been calculated in Table 4. The main focus of the model is to predicate future electrical requirements which will give rise for investment in this sector in terms of finance, generation availability, natural resource eg. Hydro, solar, nuclear respectively. Depending upon the above generation means and modes of availability, every question is to be answered. Similarly various graphs for parameter is being worked out mainly figs 4,5,6,7. Etc. fig 8 represents the different test carried on the data t-stat, p-value, coefficients, standard error respectively.

## V. CONCLUSIONS

The paper has tried to focus on the electrical usage in a specified town. The major conclusion which can be drawn are

- i) What is the usage of electrical?
- ii) What will be the requirement of future electricity?

- iii) How much will be expected requirement depending on various parameters, in real time?
- iv) What is the generating capacity of electricity?
- v) Predication from the actual usage to expected rise in requirement is all.

We have tried to calculate using standardized data mining techniques and data science approach.

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# GENERATIVE CHAT BOT IMPLEMENTATION USING DEEP RECURRENT NEURAL NETWORKS AND NATURAL LANGUAGE UNDERSTANDING

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## Abstract:

*There has been not much development in the area of neural conversational models/dialogue systems till the recent times. Neural networks are gaining much more importance once again due to the exponentially decreasing cost of memory and cheap cloud services which has made it possible to do such huge computations with ease. In this paper, we present an architecture of recurrent neural network called as Sequence to Sequence model which is unlike traditional dialogue systems built until now. The architecture aims at building the neural network without using components like Named Entity Recognition (NER) and huge lines of code with conditional statements to be written to get decent performance. It actually consists of two neural networks, encoder-decoder. The encoder encodes input sequence of tokens into a neural machine readable form and decoder decodes the sequence output from encoder. The architecture is complemented with the attention mechanism which allows to pay attention to certain parts of the input sequence which are more important in generating output sequence. In this paper, we also show that using the Bidirectional Long Short Term Memory (LSTM) cells instead of regular RNN cells or GRU's, increases the performance in terms of model convergence and performance. Using this approach we aim to deliver a conversational model with performance same as the current one with very less overhead. We have selected an open domain as the target as it is necessary to get dialogues of a particular domain to get optimum performance from the model.*

## Keywords:

*Recurrent Neural Network, Long Short Term Memory, Attention Mechanism, Beam Search, BLEU Score, Deep Learning, Bidirectional RNN, Chatbot, Generative bots, Natural Language Understanding*

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## I. INTRODUCTION

There have been numerous applications/domains where there has been remarkable progress using neural networks. Neural networks have been here since 1960s but were not given much importance due to the computational and memory requirements. They got the deserved publicity recently when the prices of memory decreased remarkably and GPUs were invented. The applications of the neural networks span across multiple domains like text, computer vision, finance, operations, etc.

Neural networks are not just used for classification and regression, they can be structured to solve many problems that trivial machine learning algorithms cannot solve like compression, recommendation engines, etc. A very different application of neural network is mapping a query to response which can be voice or text that led to remarkable progress in a new field called Natural Language Understanding (NLU) [1], [2].

Sequence to sequence models give dialogue systems huge push in terms of recent developments. Previously it was considered a very much saturated topic and the only development done was using rule/retrieval based systems. Mapping the queries to responses and predicting the next sequence given the past ones using the Recurrent Neural Networks (RNNs) have been helping various applications of text generation, language translations, dialogue systems [1], [3].

In this work, we are presenting an architecture for dialogue systems which can learn through queries and responses. Even for the long sequences, it works by paying attention to the important parts of the sequence while ignoring the rest. We have experimented with the architecture using open domain Cornell movie script corpus and single domain Ubuntu support channel chat corpus. Though not every reply from the model is making sense, but sometimes it is able to output natural replies.

## II. RELATED WORK

Our approach is based on the sequence to sequence model which is proposed recently to map a sequence to another sequence. DNNs work only with labelled and fixed size vector data; and many problems are such that the length of sequences is not known a-priori like speech recognition, translation using machines. Authors have solved this using a variant of Recurrent Neural Networks (RNNs) called as Sequence to Sequence model [1]. We have taken inputs from a similar piece of work which, emphasized on neural conversational modelling. In contrast with the traditional conversational bots which required handcrafted/manually formed rules and are often restricted to domains, the seq2seq model is an end-to-end solution as it does not require hand-crafted rules [2].

Our work is also inspired by the recent development in neural translation using attention mechanism to learn long sequences and they improved the performance of English-

German and English-French translation. Their model generates a word with the help of information stored in the relevant parts of the sentence instead of searching the entire sentence [4].

The vanishing and exploding gradient problem in neural networks is well known. It is more prominent in RNNS, as it is required to keep temporal dependencies over long sequences it becomes more important to deal with the vanishing gradient. An early research work tells us that using Long short Term Memory (LSTM) cells solved this problem[5].

There have been many examples of conversational modelling/dialogue systems but the blend of rule based and generative model is used by Haptik, inc and they have shared the insights of their architecture from which we have taken inputs[6].

Our work is different from the researchers that have pursued this problem in terms of architecture and the type of cells used in RNNs. We provide end to end solution to the problem which outputs responses to the given queries based on some context from the attention mechanism.

### III. METHODOLOGY

#### Data Selection & Pre-processing

##### A. Selection:

The data we have selected are from two corpuses. First one is a multi-domain dataset which is created from raw scripts of approximately 600 movies. Second one is a single domain dataset with chat logs from Ubuntu's technical support channels. We will be gauging the performance of the model with both the datasets.

##### B. Pre-processing:

The input and output sequences are the sentences, these sentences can have as many words as possible. The input given to any of the neural network or computational model is an array of constant length, thus the input and output sequences need to be arrays of constant lengths. The approach selected to deal with this is as follows: Encoding a sentence/sequence by words and not by character.

$T_x$ : Number of maximum words in an input sentence

$T_y$ : Number of maximum words in an output sentence

First of all, the sentences which have less than or equal to  $T_x$  steps/words are selected. Similarly for the output sentences which have less than or equal to  $T_y$  steps/words are filtered. The sequence which has less than  $T_x/T_y$  words is padded with '<pad>' padding token till the size becomes  $T_x/T_y$ .

The input given to the model is one hot encoded sequence of words in a sentence. The input array size for example is: (1,00,000, 15, 7000). Here, 1,00,000 is number of input sequences, 15 is the  $T_x$  and 7000 is the size of vocabulary selected. This is a very huge array with huge computations to be computed by the model.

The number of unique words in a corpus is huge and spans over millions. Due to which if we select all the words in a given corpus the size of input array will be multiples of what we have seen before. The memory and computational restrictions limits us from doing so and thus, we have to select a vocabulary size for the model.

Separate dictionaries are formed for words in input and output sequences. The dictionaries map the word to a number, for each word selected in the vocabulary. Inverse mapping is also done to get the predicted sequence from the output of the model.

While encoding a sentence, if a word encountered is not in the vocabulary then that word is replaced by '<unk>' token.

#### Encoder-Decoder Bidirectional Long Short Term Memory Sequence to Sequence model with Attention Mechanism

##### A. Long Short-Term Memory (LSTM) cell:

The Recurrent Neural Network (RNN) is a neural network that depicts the Temporal lobe of a human brain.

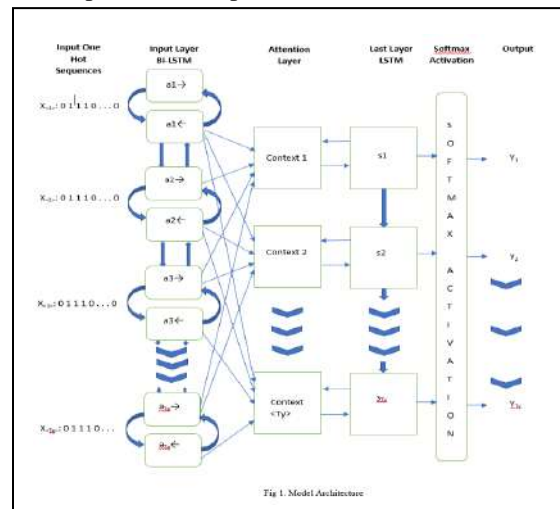


Fig. 1-Model Architecture

The temporal lobe keeps a track of events happening over time, RNN cells do the same by keeping a track of temporal sequences and that is how it is able to learn sequences. There are various cells used in RNN like regular RNN, Gated Recurrent Units (GRU) with forget and output gates, Long Short Term Memory (LSTM) with update, forget and output gates. In this architecture we will be using LSTM cells as they prove to be very useful in sequential learning due to the gates.

##### B. Bidirectional LSTM cell:

This is a variant of LSTM cell which, makes use of two LSTM cells that are interacting with each other to provide the necessary activation outputs. The two LSTM cells consists of Forward and Backward LSTM cells, the two cells learn the training sequence literally from forward and backward. This gives a better understanding of the



sequences and the model is able to learn and predict much better results.

#### C. Encoder-Decoder Sequence to Sequence Model:

This model is unlike any other neural network which provides output for every input given. The seq2seq architecture presents encoder and decoders where, the encoder reads all the inputs given and then the decoder tries to decode the outputs given by the encoder. The encoder and decoder model are two separate neural networks.

#### D. Attention Mechanism:

The input sequence can span very long like more than 20-30 words in a sentence. Now, the output might not be dependent on all the 30 words but only some parts of the sequence, paying attention to those parts which are required is important. Attention mechanism takes inputs the activation outputs from the input layer LSTM cells and also the output from output layer LSTM cells and gives out a context for every step of output sequence. This allows the model to learn quickly the output for a given input which in turn increases recall and accuracy.

#### E. Fully Connected Network:

The fully connected network is as per the figure shown above.

The notations in the network are as follows:

$X<Tx>$ : One hot input sequence for each of the steps of input

$a<Tx> \rightarrow$ : Forward activations from the forward LSTM cells for each input steps

$a<Tx> \leftarrow$ : Backward activations from the backward LSTM cells for each input steps

Context  $<Ty>$ : The context computed from the activation units for each of the output steps

$s<Ty>$ : The activation given by the LSTM cells of the last layer

$Y<Ty>$ : The output from the softmax activation layer for each of the output steps

Here, the step means one input or output unit from the training input or target sequences.

In the architecture there are two LSTMs, the first one is first layer of the model, bidirectional LSTM which takes input the one hot encoded sequences,  $(X_1, X_2, \dots, X<Tx>)$  and goes through  $T_x$  time steps.

The second LSTM is simple forward LSTM which is the last layer of the model and takes input the contexts (Context1, Context 2... Context  $<Ty>$ ) computed from the attention units and goes through  $T_y$  time steps. Between both the layers there is an attention layer for each output units of the model. There are as many attention units as the steps in output sequence I.e.,  $T_y$ . The attention units take into consideration the weights from both of the LSTM layers ( $a<Tx> \rightarrow$ ,  $a<Tx> \leftarrow$ ,  $s<Ty>$ ) to compute the contexts.

## IV. EXPERIMENTATION/MODEL TRAINING DETAILS

The Bi-LSTM models are computationally intensive as it is required to change the values of all the 3 gates for both the forward and backward LSTM cells. Due to which we restricted the number of training sequences to 25,000 and the vocabulary size to 7002 words with ' $<unk>$ ' and ' $<pad>$ ' as the two extra tokens. The 7002 words selected were for both encoder and decoder models. Each of the training input/output sequences were padded to be of size 11 tokens. We have used 2 GPUs for training the model and also experimented with 50GB memory instance but the time difference in for training using both was 40-45%. The details are as follows:

1. We used the RMSprop stochastic gradient descent optimizer as it is well suited for RNN's, also checked with Adam optimizer but using RMSprop the model was converging faster.
2. The batch size used is 256 as it was helping the model to converge quickly, also experimented using larger sizes like 512 but 256 proved to be more useful.
3. Training the model almost took 48-72 hours for 25,000 training instances.

## V. RESULTS AND DISCUSSION

The result is divided into 3 parts. We have selected sequences with 11/15 tokens or less for training. The performance of the model will be gauged using accuracy and a score called as Bilingual Evaluation Understudy (BLEU) score.

### I. ACCURACY:

We have calculated accuracy for all the tokens separately for all the data instances on which it is trained. The accuracy for the last epoch/iteration of the training is as below

The closed domain corpus with 25,000 training instances selected, the model is trained for almost 72 hours. The open domain data with 15,000 training instances selected, the model is trained for almost 48 hours:

Table 1:- Ubuntu Chat corpus accuracy

Ubuntu chat corpus	
Token Number	Accuracy
1	75.86
2	76.71
3	77.38
4	79.02
5	80.69
6	84.05
7	86.57
8	89.8
9	92.75
10	95.77

11	98.19
Overall Accuracy/Loss	85.16/7.99

Table 2:- Cornell Movie corpus accuracy

Cornell Movie script corpus	
Token Number	Accuracy
1	88.46
2	89.58
3	90.15
4	90.84
5	91.8
6	91.93
7	92.87
8	93.18
9	94.04
10	94.73
11	95.81
12	96.37
13	97.23
14	98.37
15	99.37
Overall Accuracy/Loss	93.64/4.22

Training Examples: We can see that the model is able to learn from the training examples accurately.

Example 1: Input source: does anyone know how to convert .flv files to mp3?

Original output: try using super for windows

Predicted Output: try using super for windows

Example 2: Input source: is there an option to downgrade certain package after installation?

Original output: use synaptic to force version

Predicted output: use synaptic to force version

The output for some of the test instances is proper like following:

Example 1: Input source: someone interested in a free shell account

Original output: ?

Predicted output: ?

Example 2: Input source: whats the command to search apt-get ?

Original output: sudo apt-cache search

Predicted output: search apt-cache remove

Example 3: Input source: ciao

Original output: list

Predicted output: !list

But the output of the test data for open domain data gives less sensible results due to the data being open domain.

Also, the model is able to understand the context of the input sequence:

Example 1: Input source: when is the next release of ubuntu

Original output: karmic koala

Predicted output: #ubuntu-release-party partition

Example 2: Input source: ubuntu is the best os in the world

Original output: howto install dc++ help

Predicted output: thanks

Example 3: Input source: how do i run a program with wine

Original output: i tried it wont work

Predicted output: wine apt-g

## II. BLEU SCORE:

Generally a human evaluator is used for evaluating the output from machine translation model. Understudy means a person who can act as backup another which is what BLEU score does, it acts as a backup in place of human evaluator[7].

Following are the sequences from the model for test input sequences. We can see that the model can understand the context of the input sequences and produces the output properly. The sequence of the output tokens is a bit jumbled but it will become more and more accurate with increased size of training instances and also with more training –

Example 1: Input source: just use xchat for irc ?

Original output: what program can be used to open .bin files ?

Predicted Output: to .bin ? can program what open used other

Score:

1-gram: 0.000000

2-gram: 0.471714

3-gram: 0.583675

4-gram: 0.645203

Example 2: Input source: can i install kde also even though i already have gnome?

Original output: be able to choose at logon or something?

Predicted output: logon or choose at able something? Be

Score:

1-gram: 0.875000

2-gram: 0.500000

3-gram: 0.632878

4-gram: 0.707107

Example 3: Input source: how do i check memory size?

Original output: i forget the command on terminal to check it

Predicted output: to command on forget the i terminal it

Score:

1-gram: 0.100000

2-gram: 0.316228

3-gram: 0.467735

4-gram: 0.562341

The scores are not that great as the model was just trained on 25,000 sequences. Ideally it should be more than 100,000.

III. ATTENTION MECHNISM:

The attention mechanism used in the model is visualised below. It depicts, how the responses are dependent on some and not all the parts of the input sequences.

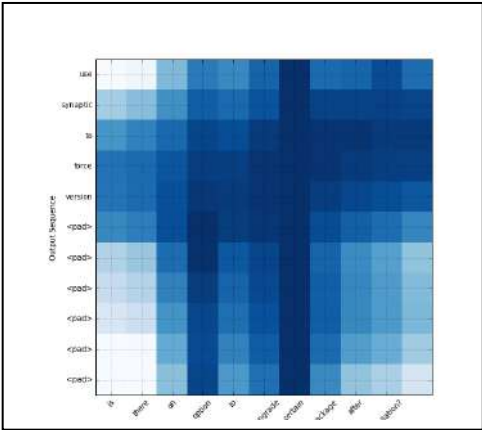


Fig. 2-Attention Mechanism Weights

IV. CONCLUSION

In this work by experimenting with different corpuses, we show that the architecture learns from huge corpus of the data and even sometimes produces natural responses for unseen sequences. Of course there were limitations on the amount of data that can be trained which, can be increased to whatever size the hardware supports. The model cannot be readily deployed into production as it still requires many modifications like use of word embedding, to output more sensible and realistic sequences. But, we want to emphasize on performance of the model which is without any rules and is comparable to the current retrieval based systems. Following are the improvements that can be done to the existing model proposed:

Beam Search- In the given problem we are finding the best possible sequence to the given input sequence. Beam search is such an algorithm that makes use of conditional probability to find each token in the output sequence given the input token. It uses a parameter beam width (B) to find the most likely number of words which is set by parameter B.

Example: Input- "This is a good place"

Output- "Indeed it is a great place"

If  $B = 3$ , then  $P(Y_1|'This')$ : 'Indeed', 'it', 'is' are going to be the top 3 words.

But the important issue here is, beam search is again going to take quadratic time for computation. The proposed architecture already takes time because of the attention mechanism. Including beam search will require heavy hardware.

Word Embedding: Embedding is a way of representing words in such a way that the analogies among words are

found out. The analogies are the latent features which associate words similar to each other with high values like associating all the names, gender, places, etc. The model that can be used to find embedding is Word2Vec skip-gram model which gives out word representation that are useful to find surrounding words in a sequence[8].

Named Entity Recognition: The named entities in the data unnecessarily introduce bias in the model. There are techniques, models to find the named entities in a corpus. These named entities can be replaced with a token like we have used a token for padding. This can result in better performance of the sequence to sequence model.

The above techniques can be readily introduced for more accurate results from the sequence to sequence models. The only downside is heavy time and space complexities.

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I am a Computer Science Engineering graduate from Pillai's Institute of Information Technology and currently pursuing Master of Technology in Data Sciences from NMIMS. The field of Natural Language Processing has given rise to Natural Language Understanding using Deep Learning models from Google like Word2Vec, Sequence to Sequence models. In this work we are presenting before you a new architecture using Recurring Neural Networks.



## ANALYSIS OF ADVANCED VOLATILE THREATS USING MEMORY FORENSICS

Priya B Gadgil (KJSCE, Mumbai University), Sangeeta Nagpure (KJSCE, Mumbai University)

### **Abstract:**

*Malwares has always been one of the greatest threat actors for the organizations with their digital information infrastructure. Malware is any malicious program, file or executable whose prime purpose is to gain an unauthorized access or cause harm to the computer or the network system. It has always been a subject of concern for computer experts or even the users as the harm due to different types of malwares is increasing exponentially. Malware can be in any form i.e. virus, computer worm, Trojan, phishing frauds, etc. These threats actors are constantly evolving with a new and sophisticated ways to avoid a detection and successfully perform the attacks. The rising power and ambitions were specially seen during year 2017 and the current year that is 2018. It was observed that during year 2017, almost 230000 malware samples were produced daily and around 4000 ransomware attacks threatened the organizations [1]. Year 2017 also saw a sharp increase in the amount of fileless malware attacks, which grew by approximately 50% in 2017.*

*File less malwares poses a threat to organizations and a big challenge for the information security professionals, mainly due to its use of different non-executable file formats for infection. Therefore, it becomes very difficult to detect such threats. These threats also pose challenge for detection due to its ability to execute its malicious logic exclusively in memory. This paper analyses in detail the file less malwares along with the similar volatile threats. As a solution, a tool has been proposed which can be useful in detecting such threat factors.*

### **Keywords:**

*File less Malwares, Living off the land attacks, memory forensics*

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## V. INTRODUCTION

A file less attack, also known as a zero-day attack or zero footprint attack or macro attack get its name by not leaving files on a disk. Instead of the traditional method of executing malicious logic on the disk of the machine it stays memory resident. Such type of malwares doesn't need to install malicious software to infect a victim's machine. Majority of the times it takes advantage of existing vulnerabilities on a machine. It exists in a computer's RAM and uses common system tools to execute an attack by injecting malicious code in normally safe and trusted process such as javaw.exe or iexplorer.exe. These attacks can gain control of victim machine without downloading any malicious files, hence the name is

given file less malwares. File less attacks are also referred as memory based or "living off the land" attacks. An attacker can bypass the traditional security checking on the machine. In this approach, an attacker can easily infiltrate and carry out objective by taking advantage of vulnerable software that typical end user would use daily.

Once the target is compromised, such attacks normally load their malicious payloads into already running system processes, where they can operate themselves hiding behind the legitimate processes. If the file less attacks are performing their activities through the RAM, then it leaves no artefacts for the post process forensic analysis. However, there are some advanced methods which attempts to achieve

the persistence by writing files to hidden directories or by modifying the operating system registry.

### WHY MEMORY FORENSICS

Traditional malware analysis and investigation is highly depending upon detecting malicious executives on the disk, and disk forensics to uncover the malicious activity behind the attack. But recent trade in similar attacks showed that the attack vectors are shifted towards more offensive techniques which avoids writing anything on the disk and resides only in the memory.

Another reason is many malware families in general moved to the techniques like API hooking or code injection to be stealthy or file less. With this feature they are achieving the goals like spying on sensitive information or passwords typed by the user before they are being encrypted using TLS.

A sample memory image is chosen to demonstrate how memory forensics can be useful in digging the traces of the malware. In the example, we will be analysing to get enough Indicators of Compromises (IOC's). Using the tool 'Volatility' following analysis was performed on the memory image. For the analysis the tool used is the open source tool Volatility. Volatility is the tool that is widely used by the researcher and even medium size organizations for the memory forensics.

## VI. METHODOLOGY

### D. Analysis Flow

Analysis of the such malwares can be carry out in six process.

1. Analyse the rogue process
2. Analyse process DLL's and handles
3. Review network artefacts
4. Look for the evidence of the code injection
5. Check for the signs of the rootkit
6. Dump suspicious processes and drivers (for the further analysis)

## VII. PROPOSED TOOL & EXPERIMENTATION

From many years, cyber forensic experts are trying to do the automation in the field of cyber forensics. This will help in reducing the manual intervention and will increase the proficiency. There are open source sandboxes available for the malware analysis but very less work is done in the field of automation of memory forensics. In the proposed tool named FMD (Fileless Malware Detection) the tool Volatility (open source tool for memory forensics). The work is done to help the investigator who is not necessarily malware expert. FMD is a GUI based tool to perform complex and tedious memory forensics with some steps automated so that the investigator can focus on the generated output and collect the Initial IOC's for further analysis.

### Sample Analysis using the tool

1. Tool initially validate the investigators identity by verifying the credentials.

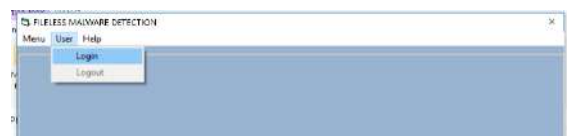


Figure 1: Authenticate login

2. In next step, after the successful login user can choose one of the two options:
  - a. Take an Image: If memory image of the machine is required to capture user can use this option to capture the memory of the machine.
  - b. Do Analysis: When user needs to do analysis of already captured RAM.
3. For the Analysis of the memory image, user needs to select the path of the memory image in the system.



Figure 2: Path for the memory capture stored needs to be select

- After selecting the path of the memory image tool allows us to run the volatility plugins with the single click as follow

It is important to note that as soon as user select the option of Analyse it automatically runs the **imageinfo** command and extract suggested profiles by the volatility for the user.

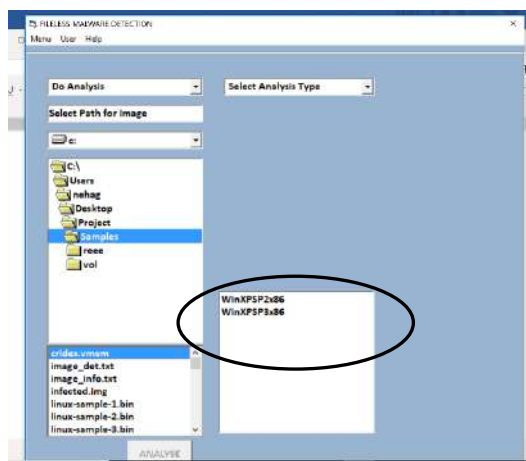


Figure 3: Automatic detects the probable profiles for further analysis

- With selection of the desired profile user can go ahead with the further analysis. All the plugins can be used with single click.
- It also provides us the option for taking Dump. This option is useful in extraction of suspicious processes and other elements from the memory depends upon the plugin used.

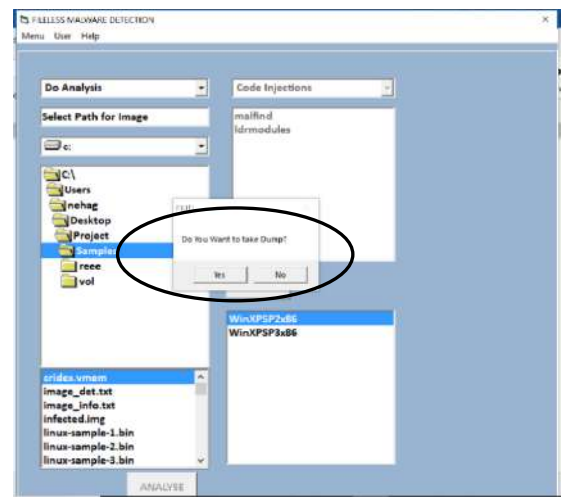


Figure 4: Option to extract the suspicious processes

## VIII. RESULTS AND DISCUSSION

In above example, the sample is checked for the probable code injection. If we see the results of the command, we get the following result:

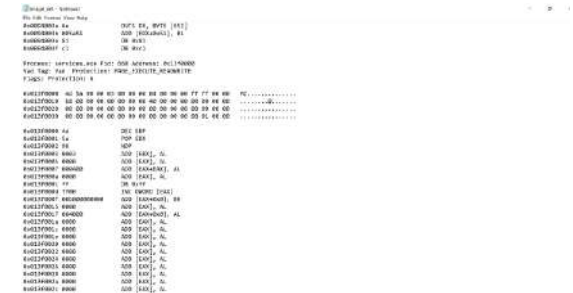


Figure 5: Output generated for code injection test

The code injection has been found in several processes of the machine.

- We can verify the results from checking the dumped process in the Virus Total which is the malware database.



Figure 6: Verification of the maliciousness with Virus Total

The results for the above designed tool can be highlighted using the time aspect. The efficiency of the tool has been calculated over the time taken for

execution of volatile tool instructions manually verses time taken for execution of volatile tool instructions using the designed tool.

T1= Time taken to execute instruction 'pslist' manually

T2=Time taken to execute instruction 'pslist' using tool

Ten random samples have been chosen to calculate the efficiency. T1 is calculated by taking average of executing ten samples.

So,

$$T1=t11+t12+t13+t14+t15+t16+t17+t18+t19+t110$$

$$T2=t21+t22+t23+t24+t25+t26+t27+t28+t29+t210$$

The calculated timings for T1 are as follows

(In seconds): 10, 15, 20, 12, 20, 12, 17, 15, 14, 13

$$T1 = (10+15+20+12+20+12+17+15+14+13)/10$$

$$= 14.8 \text{ Seconds}$$

14.8 seconds is the average time for the command pslist where we need to also write profile of the memory capture.

The calculated timings for T2 are as follows (In seconds): 5, 6, 8, 10, 9, 8, 10, 8, 7, 9

$$T2 = (5+6+8+10+9+8+10+8+7+9)/10$$

$$= 80/10$$

$$= 8 \text{ seconds}$$

The above calculations were done by picking ten random samples and for the pslist command which dig out all the processes information from the memory.

Time efficiency can be vary depending upon the type of investigation and size of memory capture.

Similar calculations were done for the command 'malfind' which is used to find the code injection. In case of 'malfind' significant.

Average Time	With Tool Volatility	With FMD Tool
<b>pslist command</b>	<b>14.8 seconds</b>	<b>8 seconds</b>
<b>Malfind command</b>	<b>24 seconds</b>	<b>12 seconds</b>

**Figure 7: FMD tool Validation**

## IX. CONCLUSIONS

The tool FMD will provide GUI based partially automated Memory Forensics tool. This tool can even take care of advance malware attacks such as file less malwares and similar advanced volatile threats. It also allows investigator to analyse the live memory by capturing the memory image of the machine.

## X. FUTURE SCOPE

Although FMD will take all necessary actions for the malware analysis there is still scope for the automation. The tool can be completely automated with the help of web- based GUI and connecting it with an available online malware solution. Tool can be a complete incident response tool with some machine learning algorithms. Organizations face hundreds of threats each day. So, it would be impossible for threat researcher to analyse and categorize the threats especially in case of advanced volatile threats like fileless malwares.

Further development of the FMD which combines the machine learning would provide great solution which will even identify patters and behaviour of the malware.

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## PROPOSED AUTOMATED PLANT WATERING SYSTEM USING IOT

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### **Abstract:**

*In daily operations related to farming or gardening watering is the most important cultural practice and the most labour-intensive task. Manual process of watering requires two important aspects to be considered: when and how much to water. In order to replace manual activities and making gardener's work easier, the project builds an IOT device that can initiate the watering of the plant system automatically whenever the moisture content in the pot drops below a threshold value, which will help the plants to reach their fullest potential as well as conserving water. This type of system can be implemented on projects like green building concepts, roof farming, gardening etc. Using sprinklers or drip emitters, or a combination of both, we will design a system that is ideal for every plant in our yard. For implementation of automatic plant watering system, Arduino and sensors such as moisture, soil fertility, temperature and water level sensors will be used. The system will have a distributed wireless network of soil-moisture and temperature sensors placed in the root zone of the plants. In addition, a gateway unit will handle sensor information, trigger actuators, and transmits data to a mobile application. The system is planned to be powered by photovoltaic panels and will have a duplex communication link based on a cellular-Internet interface that allowed for data inspection and irrigation scheduling to be programmed through a application. It reports its current state as well as remind the user to add water to the tank. All these notifications will be made available to the user through mobile application. Because of its energy autonomy and low cost, the system will have the potential to be used in water limited geographically isolated areas. This system will ensure quality gardening with conservation of water.*

### **Keywords:**

Sensors, Arduino UNO, GSM Module, Mobile Application, IOT

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## I. INTRODUCTION

Plants are essential part of human life. They maintain ecological balances as well as they provide various resources to human being. To maintain the issue related to plant conservation is major concern in one's life. If user fails to plant the water on a regular basis, there is chance of plant to reduce its soil fertility, and wastage of water. Also, excess watering leads to soil damage. In order to control and monitor there is a need of automated plant watering system. This system automatically water the plant based on the sensor readings or includes a mobile application with values ON and OFF to control water motor. This work presents a low cost sustainable automatic plant watering system with sensors measuring humidity, fertility and temperature of the environment and the moisture of the plant. The soil fertility sensor keeps track of the fertility of the soil. Watering the plant is one of the main issues in plant and garden management. The system supports water management decision, used

for monitoring the whole system using GSM module, which provide the networking capability to the system.

## II. LITERATURE SURVEY

**A. Wireless Sensor Network and GPRS Module:** In 2014, a system was developed having distributed wireless network of soil moisture and temperature sensor implemented using Zigbee technology. Along with that a gateway unit handled sensor information, triggered actuators and transmitted data to web the application. The system had duplex communication link and was powered by photovoltaic panels. The system was designed for agricultural practices [1].

**B. GSM Activated system:** Using GSM technology, the system is designed in such a way that along with basic functionalities, it enables user to control the system through Short Message Service (SMS). The user responds to the system by sending ON/OFF messages. Main control is given to user. The system is semi-automated [2].



**C. Mobile Application:** A mobile application is designed for elder people. Arduino provides an interface between the analog sensor, database and android application. MySQL database is used and PHP establishes connection between Arduino and database. HTTP protocol is used to send data to PHP server [3]. The system helps is proper monitoring and easy control of system.

**D. Automation along with Web Application:** In 2016, Drasti along with her team members describes a prototype which uses ATmega328 microcontroller. There are two functional components – moisture sensor and motor/pump. If the moisture content drops below a threshold value, the plant is supplied with desired amount of water. Twice a day, the microcontroller is programmed to supply water. The user is notified using buzzer in this system. The result is scalable, supporting technology [4]. In another existing work data is stored in Arduino IDE software and simultaneously sent to the web browser through Ethernet [5].

### 2.1 Summary of Related Work

	Paper	Advantages and Disadvantages
1.	Wireless Sensor Network and GPRS Module (Joaquin Gutierrez, 2014)	Energy Autonomy and low cost, potential to be used in isolated areas.
2.	GSM Activated System (N.S Ishak, 2015)	Provides SMS service, No android applications, not fully automated
3.	Watering system using mobile application (Kritin Lekjareon, 2016)	Android Application, Easy to use GUI, User Controlled. Not Fully automated.
4.	Automated Plant watering systems (Drashti Divani, 2016)	Humidity sensor is used instead of moisture sensor.

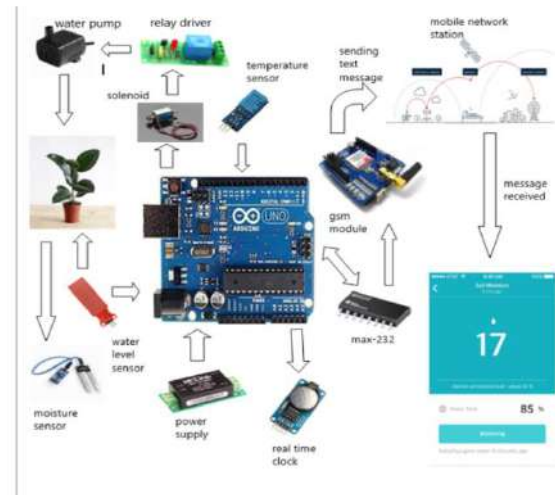
## III. PROPOSED WORK

In daily operations related to farming or gardening watering are the most important cultural practice and the most labor-intensive task. In order to replace manual activities and making gardener's work

easier, the project builds an IoT device that can initiate the watering of the plant system automatically whenever the moisture content in the pot drops below a threshold value, which will help the plants to grow easily and reach to its full growth as well as conserve water.

### 3.1 System Architecture

The system architecture is given in Figure 1. Each block is described in this Section.



**Fig. 1** Automated Plant watering system architecture

**A. Description:** The first part is to take the data from different sensors that are placed inside the pots. The data collected from these sensors are sent to the system and based on the sensor details the system will perform the required operations. The automatic plant watering system comprises four main components namely an Arduino UNO, a motor driver circuit, a GSM module, and a sensor circuit.

**B. Arduino UNO:** Arduino UNO is the central unit of this system which processes all the data received from sensors and also all the other modules are connected to the Arduino UNO. The analog signals that are received from the moisture sensor are converted into the digital signal through ADC. There is a predefined threshold value for the moisture content of the soil, if the readings of the moisture sensor go below from the threshold value a warning message will be sent to the user.

**C. Sensor Circuit:** This module consists of three different types of sensors temperature sensor moisture sensors and a water level sensor all these sensors are placed inside the pot in such a way that

all the details related to plants such as the moisture content of the soil and the water and the temperature can be taken precisely.

**D. GSM module:** The GSM module plays a important role in keep on updating the user about the plants details this module consist of WI-FI modem so that the system will always remain online and keep sending all the updates of the plants also if there is no internet available the system will send the text message to the user and by replying to the message user can control the water supply to the plants. Through this module user keep on touch with the system and with help of the mobile application provided to user the user can turn off or on the pump.

**E. Android application:** An Android application is installed in the user mobile so that user can keep track of all the plant details. The application shows information such as moisture content of the soil, water level and the soil fertility of each of the pots and also shows warning to the user if the moisture content of the soil goes down a particular level. The application also keeps reminding the user to change the sensors after a particular period of the time (Approx 2 months for moisture sensor). The user can also set time for watering the plants. There is a additional functionality in our application that allows the user to go hand free use of application through voice recognition.

**F. Motor-driven Circuit:** This module deals with watering the plants, when the user receives the warning message from the system and if the user replied to receive message the water pump will turn on. This module has a Relay driver which is used to control the pump output.

#### IV. REQUIREMENT ANALYSIS

The implementation detail is given in this section.

##### a. Software

Arduino IDE is used to provide the backend functionality to the system , a serial communication is established between arduino module and other components via a void setup() function and direction are given to different pins. Gsminit() function is included to initialize the GSM module. The gsm module provides the base to transmit and receive message from the user. Android Studio is used to create an mobile application that will provide the graphical user interface to manually control the working of the system and provide the user with the live details of various sensor readings included in the system.

##### b. Hardware

Arduino UNO is the main component of our system; all the other sensors and modules are connected to the arduino to provide a serial communication among each other and real time data to the user. Soil moisture sensor is connected to the analog pin of the arduino to provide the moisture reading of the plant and accordingly the arduino is programmed to perform an action based on the readings. Temperature and humidity sensor (DHT 11) is used to measure surrounding air temperature. A 5V water pump is used to pump the water from the water container. A SG 90 micro servo motor is used to provide a rotatory movement to the water pipe allowing to supply water at different angles. A L293D (IC1) motor driven IC is used to run the water pump. A 1.5 m water pipe is attached to the water pump to supply the water to the plant based on the soil moisture sensor readings. A wireless sensor module/gsm module is used to provide the network connectivity between arduino and end user. Any android supported device is required to access the mobile application that will grant the end user to control the system. All the external connections are provided through the breadboard and 12V power supply is to given to the arduino to monitor the whole system.

#### ACKNOWLEDGMENT

It is our privilege to express our sincerest regards to our supervisor Prof. Gayatri Hegde for the valuable inputs, able guidance, encouragement, whole-hearted cooperation and constructive criticism throughout the duration of this work. We deeply express our sincere thanks our Head of the Department Dr. Sharvari Govilkar and our Principal Dr. Sandeep M. Joshi for encouraging and allowing us to presenting this work.

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## DETECTION OF FAKE AND CLONED PROFILES IN ONLINE SOCIAL NETWORKS

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### **Abstract:**

*Online Social Network (OSN) is a platform to build social relations with others who share similar personal or career interests or real-life connections. OSNs allow users to share their views, likes, comments, opinions, photos, videos etc with other users in the network. As the popularity of OSNs are increasing day by day, the threats related to them are also increasing. Fake and Cloned profiles have become a severe security issue in social networks. Profile Cloning is an act of identity theft of existing user's profile credentials to create duplicate profiles. This cloned profile is misused for defaming legitimate profile owner. They even launch phishing attacks, harvest sensitive user information, stalking or spread viruses to other users. Fake profiles are created to carry out malicious activities and online social crimes. So, a detection method has been proposed which can effectively detect cloned and fake profiles in Online Social Networks.*

### **Keywords:**

*Online Social Network (OSN), Fake Profiles, Profile Cloning*

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### **I. INTRODUCTION**

Today Online Social Networks (OSN) such as Facebook, Twitter, LinkedIn are used by millions of people to build connections with others who share similar likes and interests. The growth and popularity of social networks have created a new world of interconnection and communication. As the popularity of Social Networks are increasing day by day, the threats related to privacy and security of users are also increasing. OSN users readily expose their details like name, photos, phone number, email address, date of birth, home address etc. This information if put into wrong hands cause severe risks.

In Profile Cloning attack, the attacker steals the profile credentials of existing users to create duplicate profiles. Further these cloned profiles are misused for defaming the original profile owners. There are two types of Profile Cloning namely Same Site and Cross Site Profile Cloning.

If user credentials are taken from one Social Network and a duplicate profile is also created on the same Network then it is called same-site profile cloning. By using this cloned profile, the attacker may send friend requests to all the friends of legitimate user. Many users accept the friend request, if the request is from a person whom they know and is already in the friend list, without getting suspicious. Then the attacker can misuse the profile

for any type of attack and friends therefore fall prey to the attack.

In cross-site profile cloning an attacker uses the user credentials from one Social Network and creates a duplicate profile in some Social Network in which the user is not a part. The attacker tries to get as much information as possible from the user's original profile so that it will look like original profile in the target OSN.

The registration process in OSNs are very easy in order to attract large number of users. As a result, fake profile creation has also become easier. The attacker creates fake profile and try to establish connection with the victim. By accepting the friend request, the victim fall prey to attacker by exposing all his identity.

### **II. RELATED WORK**

As the users of Social Networks are increasing in an alarm rate, the crimes and malicious activities related to it are also increasing. Many researchers have proposed various methods to detect and prevent these types of attacks.

Georgios Kontaxis et al [1] have proposed a methodology for detecting cloned profiles in LinkedIn site. This method can be employed by users to check whether they have become victims to

such an attack. Here they have used simple string-matching algorithm to compare the profiles. Piotr Brodka et al [2] have proposed two novel methods of profile cloning detection in Facebook. The first method is based on the similarity between the attributes of victim's and suspicious profiles and the second method is based on the similarity of relationships in the network. They have used cosine similarity to compare various profile attributes. Aditi Gupta et al [3] have focused on detecting fake accounts on Facebook. User activities and their interaction with other users on Facebook are considered to detect fake profiles

From the above works we can conclude that, most of the works are based on simple string-matching algorithm for similarity measure. But this cannot overcome wrongly typed data or purposefully injected mistakes. And they have used one single similarity measure to compare different types of attributes. So, a more powerful method has been proposed to detect fake and cloned profiles. Here different similarity measures are used to compare different types of attributes. And also, Network similarity is taken into consideration where network relationships like mutual friends, followers or following ratio etc are considered.

### III. METHODOLOGY

Profile Cloning and Fake Profile generation have become a very serious threat in Online Social Networks where the attacker use these profiles for various unethical purposes affecting a person's or organization's reputation. These profiles can also be used for other types of attacks like spamming, phishing, cyberbullying etc. So, a Fake and Clone Profile Detection Method is very much important to detect this type of profiles and to remove them from OSN so that it does not cause any adverse effects to users of OSN.

#### E. Architecture

The proposed system helps to detect clone and fake profiles by undergoing different phases. The architecture is as shown in Fig 1.

It consists of 4 phases

- Identification Phase
- Profile Matcher Phase
- Similarity Measurement Phase
- Verification Phase

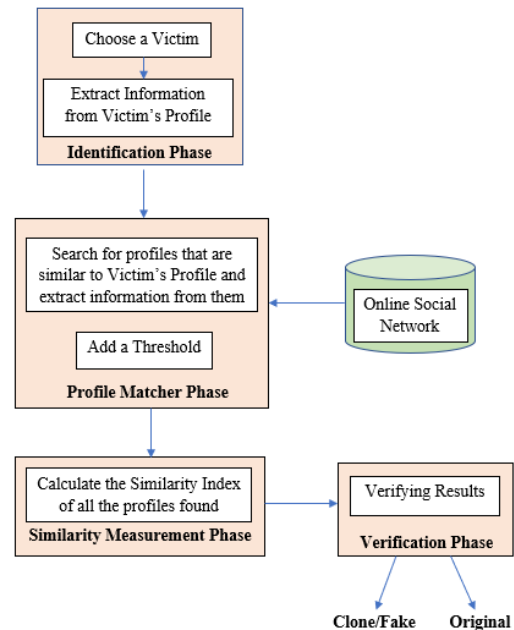


Fig. 1:- Proposed Architecture

#### 1. Identification Phase

In this phase, the user who doubts that his/ her profile has been cloned is chosen as a victim. The information like Name, Gender, Location, Birthdate etc are extracted from user's profile and are termed as User Identifying Information and passed on to Profile Matcher Phase.

#### 2. Profile Matcher Phase

In this phase, a query search is performed on online search engines to search for profiles with the same name as that of victim. Here name is considered as primary attribute. If the search results returned are many, we need to add attributes to query search in an increment basis in order to get minimum number of results. Then we extract User Identifying information from these resulted profiles.

Example:

If we search for profiles using name attribute, we may get thousands of search results. But if we combine name with location, the query search results count gradually decreases. So, we have to select the attributes for query search in such a way that we get reduced number of profiles for next phase and at the same time we have to be careful that we don't miss any of the cloned or fake profiles.

#### 3. Similarity Measurement Phase

The Profiles found in previous phase are compared with Victim's Profile and a Similarity Index is

calculated. After calculating the Similarity Index, it is compared with a predefined Threshold value. If the Similarity Index is greater than the Threshold value, then this profile is marked as a possible clone or fake and will be forwarded for verification in the next step. Threshold value is a crucial parameter and must be set correctly to minimize false positive and maximize true positive classification.

Here two types of similarities are considered

Attribute Similarity

Network Similarity

In attribute similarity measure, similarity between attributes of victim's profile and other profiles which are similar to that of victim are considered. Network similarity is based on similarity of relationship networks. Here parameters like Mutual friends in Facebook or followers and following ids in Twitter etc can be considered

The attributes like Username, First Name, Last Name, Email, Education, Gender, Birthdate, Work etc are easily accessible in OSN. So, they can be used for attribute similarity measure. For each attribute there must be a defined similarity measure because each of them can be compared differently [2].

### Cosine Similarity

It is used to measure of similarity of cosine of the angle between two non-zero vectors. Two vectors have a cosine similarity of 1 if they are with the same orientation, have a similarity of 0 if they are at 90° and -1 if they are diametrically opposed, independent of their magnitude. Cosine similarity formula is given by

$$\cos(\theta) = \frac{\sum_{i=1}^n A_i B_i}{\sqrt{\sum_{i=1}^n A_i^2} \sqrt{\sum_{i=1}^n B_i^2}}$$

Example:

Consider two profiles Profile A and Profile B. Cosine Similarity to compare "First Name" and "Last Name" of these profiles is as follows

A= Barack Obama

B= Barack Hussein Obama

	A	B
Barack	1	1
Hussein	0	1
Obama	1	1

$$\cos(\theta) = \frac{(1*1) + (0*1) + (1*1)}{(\sqrt{(1*1) + (0*0) + (1*1)}) (\sqrt{(1*1) + (1*1) + (1*1)})}$$

$$= \frac{2}{2} = 0.819$$

$$\sqrt{2} \sqrt{3}$$

The similarity between two names are 0.819

### n-gram similarity

It is used to find similarity between two strings by splitting the strings into unigrams, bigrams, trigrams etc. n-gram similarity is used to compare attributes in which the order of words should also be taken into consideration.

Example:

To compare profiles X and Y with "work" attribute using n-gram similarity will be as shown below

X = Solutions Infotech pvt Ltd

Y = Infotech Solutions pvt Ltd

Using bigrams, it can be split as

X= Solutions Infotech | Infotech pvt | pvt Ltd

Y= Infotech Solutions | Solutions pvt | pvt Ltd

n-gram similarity =

$\frac{\text{No. of n-grams common between X and Y}}{\text{Highest number of n-grams among X and Y}}$

$$= \frac{1}{3} = 0.33$$

Here, the similarity is 0.33

If here Cosine Similarity was used, it would have given 100% similarity match as Cosine Similarity does not take order of words into consideration. But the two company names are different as one is in Mumbai and the other in Delhi. So, in this type of conditions n-gram similarity is used where the order of strings matters.

### Exact String Matching

String Matching checks whether the string values are equal. Similarity is set to '1.0' if values are equal and '0.0' if not [2]

Example 3:

Gender1 = Male

Gender2= Female

Similarity= 0.0

After calculating each of the attribute's similarity, overall attribute similarity is calculated using the formula [2]

$$S_{att}(P_c, P_v) = \frac{\sum_{i=1}^n E_i(P_c, P_v)}{n}$$

where

S<sub>att</sub>- Attribute Similarity

P<sub>c</sub> - Profile of clone

P<sub>v</sub> - Profile of victim

n - Number of different attributes compared

$E_i(P_c, P_v)$  - Function returning the similarity of ith attributes of  $P_c$  and  $P_v$ .  $E_i \in [0;1]$

### Verification Phase

The last step is to verify the results and the user verifies it manually. He or she knows which profile is his original profile and which one is a clone or fake. A very important parameter is to set the Threshold, because with too many alarms it would be very difficult to check all the profiles manually for clones or fakes.

## IV. EXPERIMENTATION

Data extraction from Facebook and Twitter accounts are explained below.

### Data Extraction from Facebook account

Facebook Graph API can be used to extract data from Facebook. The Graph API is the basic way to get data from and put data into Facebook's platform. It is a low-level HTTP-based API that can be used to query data, post new data, upload photos etc. programmatically.

#### Graph API Explorer

It is a low-level tool used to extract, search, query, add and remove data. In order to query Facebook, we need an Access Token. The extraction of various data like First Name, Last Name, Gender, Birthdate, Home town, Education, Work etc using Graph API Explorer is as shown in Fig 2

### Data Extraction from Twitter account

In order to extract data from Twitter, we need to create a Twitter application by going to apps.twitter.com and click on create new app. Now, we get hold of the access keys and tokens to use this twitter application to gather data. We totally get 4 keys called consumer key, consumer secret, access token and access token secret to extract data from Twitter. The rest API of Twitter provides functionality to collect various kinds of data. We can access data specific to a user or public tweets or we can even get the follower and following information of users who have authenticated our app or of any particular user whose such data is public. To use Twitter API, we need to use a python wrapper called Twython. The data that can be extracted from Twitter profile using Twitter API are Name, Username, Birth Date, Location, Number of Tweets made by user, Tweets content. Fig 3 shows tweets

content extracted from Twitter account using Twitter API in json format.

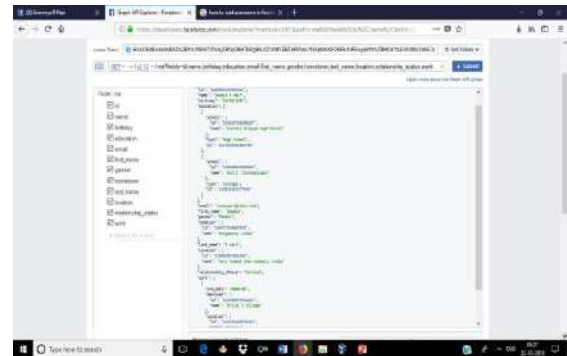


Fig 2:- Extraction of data from Facebook using Graph API Explorer



Fig 3:- Tweets content extracted from Twitter account using Twitter API in json format

Using the about mentioned methods we can extract data from Facebook and Twitter. Then using query search engine, we can search for profiles that are similar to victim's profile. Attribute Similarity and Network Similarity measures can be applied on suspicious profiles and can be verified as fake or cloned.

## V. CONCLUSION

As the popularity of online social networking is increasing, users are facing difficulty in protecting their data stored on social networking services. And this data can be acquired easily using various methods and fake or cloned profiles can be created instantly. These types of profiles can be used to harm the legitimate users both in virtual and real life. So, a detection method has been proposed to detect cloned and fake profiles based on similarity of profile attributes and network similarity. In attribute similarity, the attributes of victim's profile and profiles similar to victim are compared for similarity measurement. In network similarity, similarity is measured based on network relationships.

But although detecting fake or cloned identities can stop greater extent of crimes, prevention is better than cure. Therefore, it is worth to teach OSN users how to safeguard their personal and private information in the social networking sites.

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## PRIVATE DIGITAL ASSISTANT FOR ALZHEIMER'S PATIENTS

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**Abstract:**

*Alzheimer's is a progressive disease in which a person experiences memory loss in varying stages of severity. Currently, there is no cure for Alzheimer's; palliative care is available for the patients. A solution to help Alzheimer's patients for scene recognition is proposed here. The scenes may include classrooms, offices, homes, etc. We use Convolutional Neural Networks in order to achieve our proposed goal.*

**Keywords:**

*Alzheimer, Digital Assistant, Scene Recognition*

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### I. INTRODUCTION

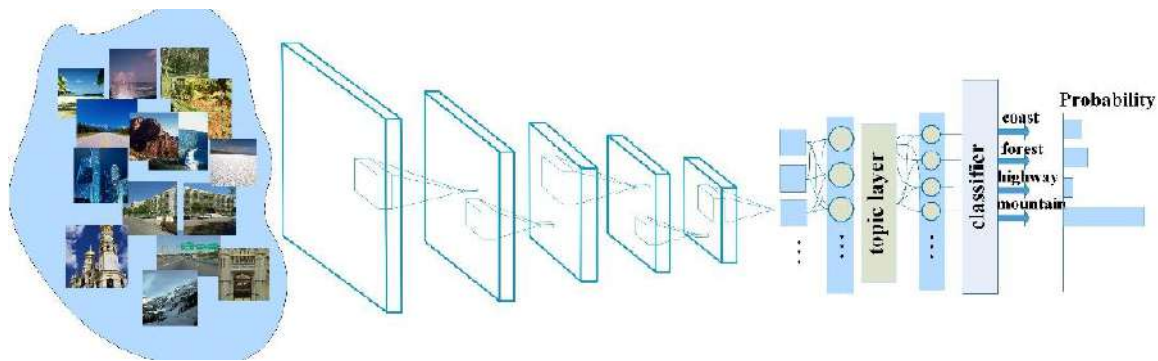
Alzheimer's is a type of dementia that causes problems with memory, thinking and behavior. Symptoms usually develop slowly and get worse over time, becoming severe enough to interfere with daily tasks [1]. Alzheimer's disease is one of the leading causes of deaths in the world. Alzheimer's patients require constant assistance for carrying out their day-to-day activities. The constant assistance is mainly in the form of help provided by the patient's family, friends or a caretaker. In some situations, there is a possibility that human assistance is not readily available and the patient is in potential danger of self-harm. The Alzheimer's patient tends to become a social as well as an economic burden on the caretakers. There is a huge potential in using digital services to reduce the burden on humans involved in taking care of the patient.

Because of the progressive nature of this disease, it is seen that the degradation in cognitive abilities start with scene recognition and poor judgement in

location familiarity [2]. The nature of this disease gives us insights on why some patients become confused in familiar environments before getting lost. This is why we have proposed a digital solution consisting of a scene recognition model, aided by Reverse Geocoding using Google Maps API [3]. Main features of this system include sending timely alerts and notifications to the patients to provide with assistance in scene recognition and location mapping. The system will send detailed and timely reports to the caretakers. It will also provide reminders regarding medicine and appropriate meal timings.

The model is based on the concept of Convolutional Neural Networks. The proposed system will be deployed as a mobile application. The system can be implemented using various techniques, but the choice of Convolution Neural Networks is optimal as our data consists of images.

Our paper provides insights about the problems faced by Alzheimer's patients and our proposed digital solution for the same.



**Figure 1: Convolutional Neural Network**

Source: [4]

Convolutional Neural Network is a multilayered Neural Network architecture. First layer captures the environment and further networks have various levels of feature extraction and sampling.

## II. METHODOLOGY

### A. Scene Recognition Model:

**Collection of Datasets:** The dataset used contains images classified into various scenes. The dataset is acquired from MIT Indoor Scene Recognition Dataset [5]. Being an uncurated dataset it needs to be divided into a training and testing dataset. This makes the dataset ready for training.

**Training and checking optimal architecture:** The dataset will be trained on models based on different CNN architectures such as VGG, Inception, AlexNet, etc. The model is chosen on the basis of most suitable architecture and which provides the best validation accuracy.

**Preparing the model for deployment:** Once the model is trained, the optimal model's architecture and weights will be saved and a protocol buffer file will be created for deployment on the android platform.

### B. Creating Deliverable:

**Deploying the model:** Prepared model will be deployed on an android application using Tensorflow Inference class.

**Location-Scene mapping:** The application will get the latitude and longitude coordinates from GPS and use Google Maps API for reverse geocoding. The scene recognized by the model is then mapped to the location found.

**Database entries and alerts:** Entries like the Location-Scene mapping, user preferences (like

medicine and meal timings), etc. are made in the database. Based on these the user is notified about daily activities and caretakers are alerted about irregular behaviour.

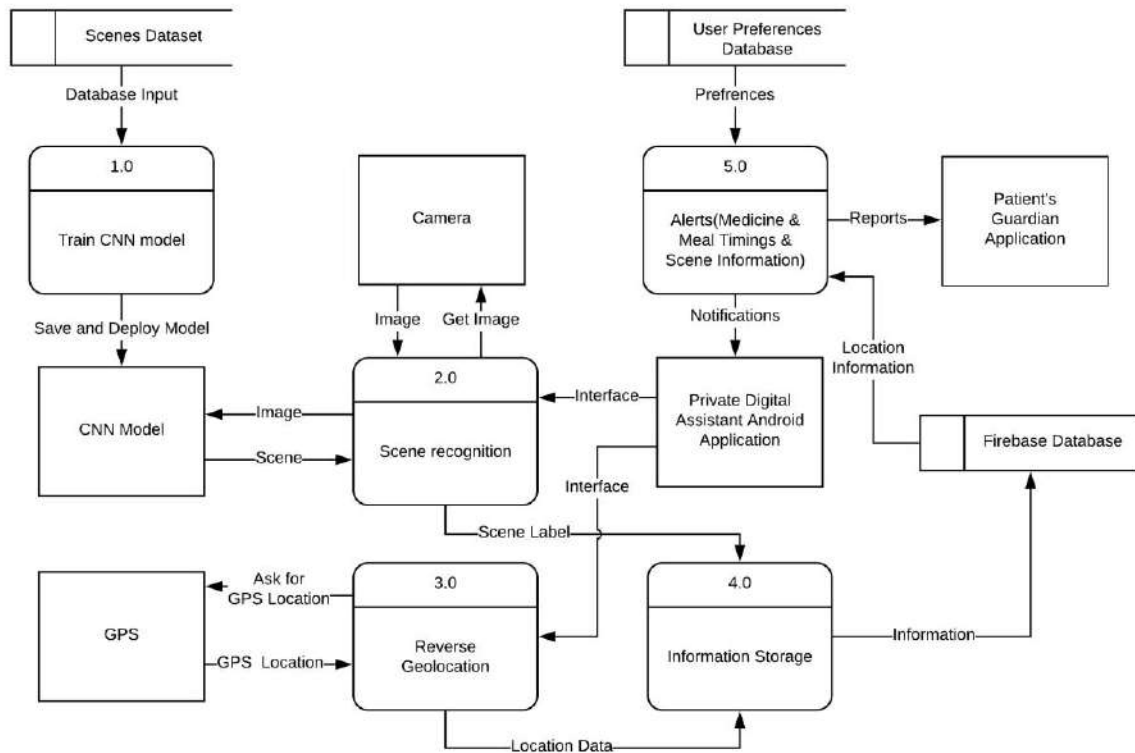
## III. REVIEW OF WORK DONE BY VARIOUS RESEARCHERS

1. Scene recognition with CNNs: objects, scales and dataset bias [6]

Luis Herranz, Shuqiang Jiang, Xiangyang Li Key Laboratory of Intelligent Information Processing of Chinese Academy of Sciences (CAS) Institute of Computer Technology, CAS, Beijing, 100190, China. This paper compares different types of CNN architecture models like VGG and AlexNet on datasets like Places-205 and MIT Indoor Scenes. The paper presents hybrid parallel architecture where object recognition and global scene features follow two distinct yet complementary neural pathways which are later integrated to accurately recognize the visual scene. We studied this paper and chose VGG and InceptionNet architectures for our scene classification problem.

2. Dissociation between recognition of familiar scenes and of faces in patients with very mild Alzheimer disease: An event-related potential study [5]

Pei-Ju Cheng, Ming-Chyi Pai have used Event-related potentials (ERPs) to find the difference between recognition of faces and scenes



## 2: Data Flow Diagram

in patients having mild Alzheimer's disease. It was found that different parts of the neural region are responsible for early visual processing of faces and scenes. This causes patients to get confused before getting lost in a familiar location or environment.

## IV. PROPOSED MODEL

The proposed system is an Android application with built-in capabilities for scene recognition. The application uses the scene recognition model developed in Tensorflow framework and deployed on Android using Tensorflow Inference libraries. Thus the application can do scene recognition without the need of any network connection and allow low latency real time recognition. The scene recognition module will recognise the scenes and the labels will be mapped with the device location using GPS coordinates to create a memory base. The application will also contain modules to provide features like timely medicine and meal alerts to the patient using the application. Further, notifying the caretakers in case of any irregular activity like unresponded alert message or significant random location change will be added.

Figure 2 shows the typical prototype of the system under consideration.

## V. DATA FLOW DIAGRAM

The scene recognition CNN model will first be trained on the dataset of images. Then it will be deployed on an android application. The digital assistant, i.e the android application will take input about the patient's daily medicine and meal routine. The application will predict the scene using images from phone's camera and use reverse geocoding on GPS coordinates obtained from the device. Further, the scene information and location information will be mapped to the firebase database for storage and the current scene or place identification information will be provided to the patient. There will also be reminders to the patient regarding his or her meal and medicine timings and any irregular behaviour by the patient regarding responding to reminders will be reported to the caretaker.

## VI. CONCLUSION

A new technique was proposed to help patients with Alzheimer's disease by providing them with a Digital Assistant. This technique is compliant in terms of accuracy and sensitivity. Furthermore, our method signifies its effectiveness when compared with the other machine learning approaches. If this project idea gets implemented successfully, we are



hopeful that the assistant will be helpful to all the needy sections of the society.

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## DEPRESSION DETECTION AND PREVENTION SYSTEM BY ANALYSING TWEET

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**Abstract:**

*Social media platforms like Twitter which is a microblogging tool enable its users to express their feelings, emotions and opinions through short text messages. Detecting the emotions in a text can help one identify anxiety and depression of an individual. Depression is a mental health problem which can happen to anyone, at any age. There is a lack of systematic and efficient methods to identify the psychological state of an individual. With more than 58 millions tweets generated daily, Twitter can be used in order to detect the sign of depression in a faster way. Recent studies have demonstrated that Twitter can be used to prevent one from taking an extreme step. Our Proposed depression detection and prevention system can detect any depression related words or phrases from Tweets and also classify the type of depression, if detected. This system is proposed in order to diagnose depression and prevent it. Proposed system is using Support vector machine and Naïve Bayes classifier. This hybrid approach works well not only with shorter snippets but also with longer snippets.*

**Keywords:**

*Natural Language Processing, Machine learning, Twitter Analysis*

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### I. INTRODUCTION

With the advent of digitalization social media has become a most preferred medium for communication. Being active on various social media sites has become a sort of addiction and trend amongst teenagers. Online Social networks serve as a source through which people follow their interests and is an informal medium to share emotions. It has been observed that many users share their moments through such platforms. People who have less interaction with friends and family find social media more familiar than the closed ones, to share and open up their feelings. 37% of the world's population, a whopping 2.8 billion people use social media. As per World Health Organization (WHO), 450 million people across the world suffers from mental disturbance and thus an efficient technique is required to automatically identify unusual or abnormal behaviour of a person, which would serve as an indicator for early detection of mental illness, if any [1]. The intermix of online life and offline life has made it possible to social networking sites to be used for behavioural analysis. Online experiences can affect an individuals well being and many other aspects of his life. With data being generated in humongous quantity every second through various

social media platform like Facebook, Twitter, etc, a lot of relevant information is available for behaviour analysis. Twitter being one of the most visited social networking site, an average of 58 millions tweets are generated per day on twitter [2]. The tweets are public which makes it possible to analyse them. It has gained popularity due to less parental presence as compared to other social networking sites such as facebook. These tweets created by the user are less than 140 characters. It is impossible and impractical to manually identify depression or suicide related messages from each and every tweet posted. This generates the idea to create an application that is useful to our community. Depression is most common in age group of 18-25 years and more than 37% of twitter users are between the ages of 18 and 29.

In this research we have proposed a system that analyses the tweets of an individual over a span of time to check for any change in behaviour depicting any unusualness. With the use of computerized systems to track depression, it will help the authorities to monitor and control probable extreme cases. The rest of this paper is organized as follows: Section 2 describes the related work. Section 3 presents proposed system and Finally, results are

summarized and concluded in section 4.

## II. RELATED WORK

Everyone today is busy with day to day chores, amidst this people who are mentally stressed or disturbed about a particular thing and they can't confront anyone directly leads to mental illness. The lack of personal communication may encourage that person to express his/ her emotions through social media platforms. This eventually leads him to a depressed state. To reduce this, and to have a healthy state of mind such system is needed.

Sida Wang and Christopher D. Manning [3] did a comprehensive research on opinion classification using variants of Naïve Bayes (NB) and Support Vector Machine (SVM). They concluded that the inclusion of word bigram features gives consistent gains on sentiment analysis tasks and Naïve Bayes outperforms SVM on shorter sentences, while opposite result holds true for longer sentences. However, combination of both methods performed better on sentence of any length.

Kasturi Varathan and Nurhafizah Talib [4] implemented a system to detect suicide related tweets. Their system monitor profiles from database entries and classify their new tweets using bag of words model.

Xi Ouyang, Pan Zhou, Cheng Hua Li and Lijun Liu [5] used deep learning for sentiment analysis. They used Convolutional Neural Network (CNN) along with word vector library. Word vectors improved performance of CNN but overall accuracy didn't cross 50%.

Patricia Cavazos-Rehg, Melissa Krauss, Shaina Sowles, Sarah Connolly, Carlos Rosas, Meghana Bharadwaj and Laura Bierut [6] did a study on depression related tweets to examine use of social media for mental health. It used Diagnostic and Statistical Manual (DSM) for mental disorders. They found that two-third of the dataset revealed one or more symptoms of depression. Their study also included demographic factors of an individual.

Deepali Joshi, Nikhil Supekar, Rashi Chauhan and Manasi Patwardhan [7] modelled and detected change in user's behaviour through social media using cluster analysis. Their research talks about use of K-means clustering for sentiment analysis. They modelled change in behaviour using vector space.

Mandar Deshpande and Vignesh Rao [8] did a comparative analysis of Naïve Bayes and SVM for depression detection on tweets. Their research concluded in Naïve Bayes classifier to be more accurate than SVM.

Smita Yadav, Ankita Kundu, Kalyani Kanase and Priyanka Tandale [9] implemented a prototype for tracking changes in human behaviour. Their prototype classifies tweets into positive, neutral and negative categories. Feature extraction is used for predicting polarity of tweet. System is designed to classify user's tweet using Naïve Bayes classifier and send alert if necessary.

**Table 2.1** Comparative Analysis of Existing Systems

Paper	Technique Used	Advantages	Drawbacks
2014 [4]	Keyword based Sentiment analysis	Easy to monitor particular person.	Does simply pattern matching and is less effective.
2015 [5]	Sentiment analysis Using CNN	Works well with large amount of data and is better than other neural networks (RNN etc).	Less accurate than NBSVM. Training time high.
2016 [6]	Web scraping, Indexing	Can differentiate between trivial and non-trivial tweets and consider demographic details.	Less effective than personal diagnosis.
2017 [7]	Semantic analysis, Clustering	Tries early detection of mental illness using vector space model.	Considers only the magnitude rather than scale of the behaviour change vector.
2017 [8]	Multi-nomial Naive Bayes and SVM	Works well with long as well as short snippets and does conditional classification	Does not classify depression into its types.

2017 [9]	Naive Bayes, Data dictionary	Automatic language processing to identify tendency of extreme step.	Pre- processing of tweets doesn't involve emoticon handling.
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Considering the shortcomings of all the above analysed papers we propose a system which would incorporate classification of tweets, determining the type of depression (major or maniac), emoticon handling, considering the scale along with the magnitude of the tweets, alerting various organizations such as AASRA, The mind research organization etc to help the victim take a step towards positivity.

### III. PROPOSED SYSTEM

We propose a system which will scrap the twitter tweets and will classify the tweets using SVM and Naive Bayes taking into account the emoticons and plot a graph of the classified tweets over a period of time. Depending upon these graphs an analysis will be made which will help us to classify the depression into two major categories Major depression and Bipolar depression. The symptoms of Major disorder include weight loss, insomnia, loss of interest, unable to make decisions for more than 2 weeks. We will take into account the past 2 weeks tweets of an user and plot it on a graph, if the graph is left skewed then it can be classified as major depression. For Bipolar disorder the person is at times extremely high on energy and at times very low. There is a sudden change in mood. In this case, if the graph is sinusoidal over a period of time then it is Bipolar disorder. Now, for further help our system alerts the NGO such as AASRA, The mind research org. Etc, as well as concerned parents via an email and shows our analysis. For further diagnosis a questionnaire is embedded on our website which would accurately determine the type of depression the person is going through and would help the person seek help. Psychologist can also use our system to find information about a particular patient. Also, the person must be a registered user to see his complete analysis. Our system would track his improvement once he starts showing positive behavior.

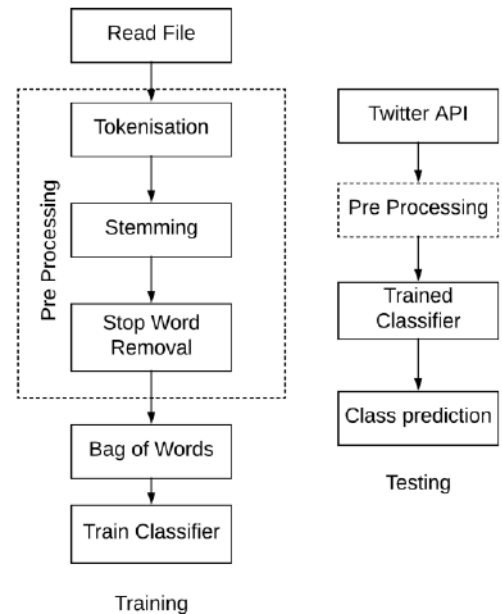


Fig. 1 Proposed Framework

#### 3.1 Training Phase

Training phase includes the following phases.

**Data Set:** In training phase, we use the labeled Dataset from kaggle and pass it for Pre-Processing.

**Pre-Processing:** This step is used to remove noise from the data and involves cleaning and simplifying the data by the following ways:

1. Conversion from Uppercase to Lowercase
2. Apostrophe Lookup
3. Punctuation Handling
4. Removal of URLs
5. Removal of usernames and topic names starting with '@' and '#' respectively
6. Stop word removal
7. Lemmatization

#### □ Feature Extraction:

The feature extraction method, extracts the aspect (adjective) from the improved dataset. This adjective is used to determine the polarity of a sentence. Unigram model extracts the adjective and segregates it. The preceding and successive word occurring with the adjective is rejected in the

sentences. Example "art Subtle" through unigram model, only Subtle is extracted from the sentence.

#### Classification using hybrid model :

Naïve Bayes classifier is better used for instances where snippet to be analysed is short in length. Whereas SVM performs better for full length snippets. Naïve Bayes and SVM contradicts each other on aspect of length. When combined together the hybrid model NB-SVM performs well regardless of snippet length. Therefore, for strong baseline hybrid method seems appropriate.

#### 2 SVM with NB features (NBSVM):

NB has simplicity and SVM has accuracy. Hybrid approach introduces improved performance as compared to traditional NB. SVM classifier doesn't handle textual data. Classifying features such as keywords are converted into numerical format. NB is able to handle textual data, therefore use NB as vectorizer (convert keywords into numerical format) and then use SVM for classification. NB calculates posterior probability of a particular word being in a particular category by using following formula.

$$\Pr(C|W) = \frac{\Pr(W|C) \cdot \Pr(C)}{\Pr(W)} \quad (3.1)$$

Where,

$Pr$  = Probability

$C$  = Category

$W$  = Word

Overall probability for an input snippet to be of particular category can be then calculated as shown in equation(3.2):

$$\Pr(C_i | S) = \frac{\Pr(C_i | w_i)}{n} \quad (3.2)$$

Where,

$C_i$  = particular category

$S$  = input snippet

$w_i$  = words in  $S$

$n$  = number of words in  $S$

Using Term Frequency-Inverse Document Frequency with NB as shown above we obtain vectors. SVM now works on training vectors belonging to different classes. It's task is to separate training set with hyperplane. We Scikit-learn SVM model in our research.

#### 3.2 Testing Phase

Classification problems are significantly solved using Supervised learning at runtime.

CSV file of tweets split in training and test sets are read using pandas library. Model is trained on train.csv that contains labelled tweets. We use test.csv file to test our model and calculate accuracy using F1 score.

F1 score formula:

It is the harmonic mean of precision and recall.

$$f = \frac{2}{\frac{1}{Recall} + \frac{1}{Precision}} \quad (3.3)$$

Where,

$f$  = F1 score

$Recall$  = proportion of tweets correctly classified considering the false positives.

$Precision$  = proportion of tweets correctly classified considering the false negatives.

#### 3.3 Expected Results

Our system's main aim is to detect depressive tweets. Moreover the system can also detect the type of depression. It is expected that the system correctly identifies the negative posts when it is negative and positive posts when it is positive. Naive bayes - support vector machine based classifier which theoretically gives 85% accuracy for sentiment analysis classification task.

For evaluating the classifier's performance we use F1 score which is the harmonic mean of precision and recall. Precision and Recall tells us what proportion of tweets we classified positive are actually positive. If one number is really small between precision and recall, the F1 score raises a flag and is more closer to the smaller number giving the model an appropriate score.

#### IV. CONCLUSIONS

Social networks have become an integral part of everyday life. Data can be collected from social networking sites to identify an individual's



behavioural patterns and well being. Psychological and emotional states of an user like happiness, anxiety, sadness can be predicted by analyzing sentiments of the posts in social media. The proposed system describes a technique to detect the depression status of a twitter user and also to classify the type of depression. It would serve as an indicator for detecting depression by analysing the tweets over a period of time. This system uses a Twitter API to collect the tweets posted by a twitter user. The system processes the collected tweets using Natural Language Processing and classifies them accordingly. This system provides a questionnaire to accurately determine the type of depression one has and severity of it. This system is useful for concerned parents as well as NGO's and psychiatrists to keep track of patient's behavior.





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## A SURVEY OF IMAGE CLASSIFICATION AND TECHNIQUES FOR IMPROVING CLASSIFICATION PERFORMANCE

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### **Abstract:**

*In image analysis classification of land used image is an important application. There are various algorithms used for classification of data some algorithms are rule based and some algorithms are learning based. We may get good classification but some pixels are always misclassified or unclassified. The major reason for misclassification is mixed pixel. The composition of the various objects in a single pixel makes identification of genuine class more difficult. Subpixel algorithms give the better idea about the respective class of such pixels. The subpixel mapping method is varies depending on the type of image. In Panchromatic or multispectral images the data set is very less as compared to the hyperspectral image. A hyperspectral image contains contiguous bands. Each band is very narrow with few nanometer bandwidths. More than a hundred such bands are available in the hyperspectral image. This huge data set is very difficult for the typical neural network to process. The feedforward neural network is not able to reach the local minima whereas the back propagation neural network needs a lot of time to converge to a minimum value. Radial basis function neural network has some advantages over other but it gives poor performance on hyperspectral imaging. The convolutional neural network is going to resolve the huge data problem. It has a 3-dimensional vector in which we can take multiple kernels to operate on interested data. This kernel gives us depth which is nothing but the more information of the same pixel. So here we can save a lot of information as compared to other neural networks. But in the convolutional neural network after the pooling layer, our data is in a 3D form which we need to convert again in 1D by flattening.*

### **Keywords:**

*Convolutional Neural Network(CNN), Spectral Unmixing, Hyperspectral, Subpixel*

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### **I. INTRODUCTION**

Remote sensing techniques are the most popular methods nowadays to collect information without physical contact. Earth surface analysis is easier through remote sensing. Panchromatic images can collect most of the information of the interested area. The good spatial resolution images will give a better idea of the earth surface. But only spatial resolution will not enough to do analysis because of the presence of clouds and haze. Spectral information is also used to collect data from the surface. Radiometric resolution is also important in satellite imaging. More the bits per pixel more will be the grey levels. But there is difficult to get all this resolution at a time. Somewhere we need to compromise in resolution. There is another problem in satellite imaging called mixed pixel. In course

resolution mixed pixel problem is common. While doing an analysis of such images then the accuracy of the images decreases because of the mixed pixel. The subpixel sharpening and subpixel mapping are the techniques introduced by Atkinson in 1997. Subpixel mapping improves the accuracy of the image by soft classification. Mixed pixel is nothing but a single pixel contains many objects. In such situation classification of that pixel in a single pixel is very difficult. In the satellite image, there are many objects. The pixel having information more than one class where we need to handle data very carefully otherwise this situation leads towards misclassification of data. The algorithm is given by Atkinson which resolves most of such cases by dividing a pixel into subpixel. Then those subpixels are mapped to respective classes. A lot of research is going in such directions but the algorithms do not



perform well in all directions.[5] Some algorithm gives good classification accuracy but fails in the convergence criterion. In this paper, we provide an overview of existing techniques for unmixing. Objectives of paper are given in section 2. Section 3 describes the various methods available for subpixel unmixing and comparison among them. Section 4 describes the Convolution Neural Network method for unmixing hyperspectral data. Section 5 concludes with the future scope.

## II. OBJECTIVES

In Remote sensing, the data is received at the sensor not only from the targeted area but also from the path radiance. The path radiance is nothing but an error in the reflected value due to scattering phenomena. The first objective of this survey paper is to study methods to remove the path radiance from the image. The second objective of this survey paper is to understand techniques to remove haze and clouds from the image. The third objective is to learn how to improve the accuracy of classification by using subpixel mapping. Experimentation

## III. METHODOLOGY

The panchromatic images give good spatial resolution but this data does not give enough idea about the mixed pixel. The multispectral images will give certain spectral information. The multispectral resolution adds the more information in overall classification result. Still, these bands are less in numbers due to that, all the spectral responses will not be recorded. Hyperspectral images are providing maximum information of images because there are more than 100 spectral narrow bands available. In subpixel mapping, those bands will give detail information about the mixed pixel. Such a huge information is more suitable for mixed pixel classification. CNN is used to handle such kind of data as CNN has multiple kernels. This multiple kernel gives depth to the neural network. With this multiple kernels, the multiple bands present in the a hyperspectral image can be easily studied.

### F. Path Radiance

Scattering is an important factor to reduce the reflectance. Rayleigh scattering is occurred due to the gas molecules present in the images. Rayleigh scattering will be assumed to be homogeneous in all the images. Due to Rayleigh scattering, the reflectance values are increasing homogeneously. So by identifying the histogram of each band we will get an idea about the path radiance or offset. By

subtracting that offset value from each pixel Path radiance can be removed. Path radiance subtraction also called as dark object subtraction.[11]

$$R = \frac{(L_S - L_P) \times \pi d^2}{E \cos \theta T}$$

In the above equation,  $L_S$  is Total radiance received at the sensor,  $L_P$  is path radiance,  $E$  is solar spectral irradiation,  $d$  astronomical distance between earth and sun,  $\theta$  is solar elevation angle [11].

## G. Removal of haze and clouds

Haze optimization transform is giving better result in the cloudy and hazy image. Scatter plot of blue wavelength Vs Red wavelength will give an idea about Haze vector. Haze vector tells us about haze and cloud content in the particular image. After subtracting Haze vector from respective pixel we get the haze free image.[11]

## H. Sub Pixel Mapping

In subpixel mapping there is a lot of work has been done. The various algorithm includes back propagation neural network method, some are based on a modified version of backpropagation i.e. observation model. Also, some methods are based on the neural network with a predicted coefficient and few are based on radial basis function neural network. The subpixel sharpening and subpixel mapping methods with wavelet multiresolution analysis enhance the resolution of soft classification by using multiresolution decomposition. The image is decomposed at a different scale and process the approximations, vertical, horizontal and diagonal information. Each data is separately given to the NN and the highest probability is calculated from two classes.[2]

The basic problem of the regression model is eliminated by updating the weighted of the neuron links. Here nonlinear sigmoid function is used as an activation function which improves the quality of learning. In this paper, certain problems related to Backpropagation have been addressed like local and slow convergence speed. Here weight is adjusted by adjusting the learning rate and momentum coefficient. The local subpixel mapping model can be obtained by finding the relationship between fractions in the local window and the spatial distribution.[3] Liangpei discussed two methods in his paper. In the first method, the subpixel assigns to class with the maximum output value. This method works better if the data set is small with few classes. The second method keeps the records of the

fractions of the different classes. Those fractions values are then weighted in respect to a sum of the output in the selected subpixel set. The modified BPNN method improves the accuracy as compared to BPNN. Modified BPNN algorithm is giving a good result for only synthetic images [3].

Xiaodong Li and Yun Du works on fraction images generated through soft classification. They estimate in each pixel the area proportion of each class. Those images are taken as input for sub pixel mapping model to resolve the mixed pixel problem.

Qunming Wang, Wenzhong Shi and Peter M. Atkinson in the there paper discussed radial basis function. With the help of the basis function, the relation between the subpixel within the coarse resolution and the surrounding course resolution are quantized. Then the coefficient indication the contributions from neighboring course pixel are calculated. To predict the subpixel soft classification the basis function values are weighted by the coefficient. In the given paper, two major problems from subpixel mapping are addressed. The first problem is an identification of a total number of subpixels and second is about class label prediction of those subpixels. Super-resolution methods are more effective in RBF interpolation which gives point prediction. Soft class values are estimated by using RBF interpolation and Hard class values are estimated by class allocation. [5], [9].

#### IV. CNN

CNN introduces in 1998 by Yann LeCun. There is various kind of spatial neural networks for processing data that is known as a grid topology. this can be a one dimensional time series data or grid of samples over time series data or something like 2 dimensional image data a grid of pixel in space.[6]

##### A. CNN has 3 features that reduce the number of parameters in NN

###### ii. A sparse interaction between layers

In typical NN every neuron in one layer is connected with every neuron in the next layer. This means a large number of parameter networks needs to learn which cause many problems in learning. i.e. to learn a lot of parameters we need more training data and convergence time also increases and we may end with an overfitted model. CNN can reduce the number of the parameter throughout the indirect interaction.

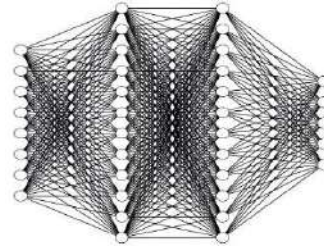


Fig. 1 A) Typical Neural Network

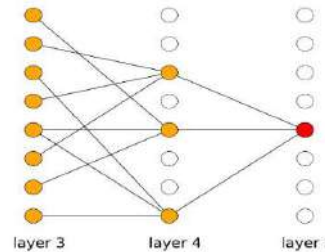


Fig. 2 B) Convolution Neural Network

###### iii. Parameter sharing

Parameter sharing further reduces the learning parameter as sparse interaction. It is important that CNN have spatial features interaction. An image after passing through convolution layer gives rise to a volume. A section of a volume taken through a depth representation features of a same part of the image. Furthermore, each feature in the same depth layer is generated by the same filter that convolves the image. Feature map is created for the same set of shared parameter. This drastically reduces the number of the parameter to learn to run typical ANN.

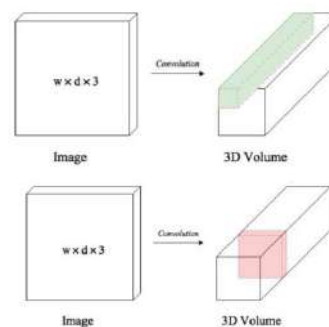


Fig. 2 Parameter Sharing

###### iv. Equivariant Representation

A function  $f$  is said to be equivariant to another function  $g$  if  $f(g(x))=g(f(x))$  for e.g. convolution is equivalent to translation operation that means if an image is convolving first and then translating is equivariant to translating first then convolving.



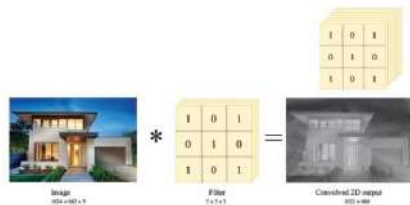
**Fig. 3** Convolution and Translation

The convolution layer gives the edges however smiler edges may occur in the entire image. So make sense to represent them with the same parameter.

## B. Types of layers in CNN

### i. Convolution Layer

Convolution layer is the first layer in CNN in which we convolve the data or image using kernel or filter. Convolution operation involves taking elementwise a product of the filter in the image and then summing those values for every sliding action. Percentage of the area of g filter that overlaps the input at a time  $T$  overall time  $t$ . This is a single dimension convolution operation. For the multidimensional input we required multidimensional kernel.



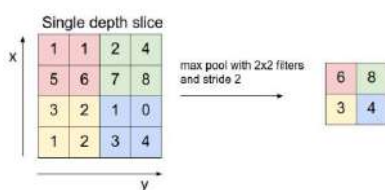
**Fig. 4** Multiple Kernels

### ii. Activation Layer

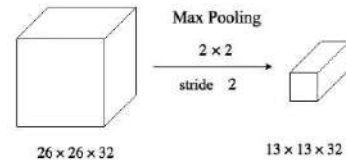
In CNN nonlinear activation the function is preferred because of there is no any learning if we used a linear activation function. Relu activation function is used in CNN but to avoid dying Relu problem preferably Leaky Relu is activation fiction is used.

### iii. Pooling Layer

Pooling involves a down sampling of the features. So that we need to learn less parameter during training. There are two hyper parameters are mention in pooling layer. Depth of the image remains unchanged after pooling layer. Pooling reduces the chances of over fitting as there are less parameters. In pooling we reduces the 25 % of number of features this is significant decaying in number of parameters.



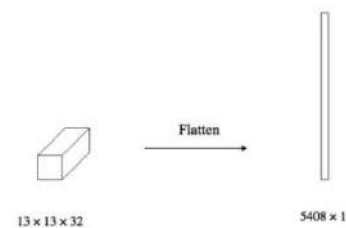
**Fig. 5** a)Down sampling with Stride of 2 [10]



**Fig. 5** b)Max Pooling

### iv. Fully Connected Layer

The fully connected layer is the simplest method to learn nonlinear combination features. Convolution layer provides meaningful, low dimensional and invariant feature space and the fully connected layer is learning a possibly nonlinear function in that space. The output of the pooling layer is 3D feature map and fully connected layer remains a 1D feature vector.



**Fig. 6** Flattening

Convolution, Activation, and pooling layer may occur many times before Fully connected layer and hence the depth of the filter is an increase. So, by flatterring a 3D layer is converted into 1D vector. Here the output of fully connected layer is applying at the softmax activation to the last layer of neurons.

## V. SUMMARY

In subpixel unmixing, the most important is an availability of data. If we have only spatial information then its very difficult to separate the mixed pixel. The subpixel is not well distinguished from the neighborhood which results in reduced in the accuracy. The subpixel to be classified correctly the probability must be more than half within two adjacent classes. We observe that the classification accuracy of feed forward neural network, Back Propagation neural network and radial basis function neural network is less. These neural networks cannot be able to handle a large dataset.

### A. Future Scope

Furthermore, network performance can be increased by adding information to the training dataset. This additional information makes uses of physical characteristics of objects. Specific spectral bands are combined to form a discriminative index. For example, the normalized difference vegetation index discriminates vegetation from non-vegetation. Further research could also address the effects of increasing the number of training samples subject to a wider range of weather conditions. This possibly enhances segmentation performance when training a network using a training dataset subject to multiple weather conditions.

## B. Summary

Convolutional neural networks are capable of generalizing HS images under varying lighting, weather and seasonal conditions. In this application, neural network design is a segmentation accuracy is controlled by network weight arrangement. A wavelet-based method is giving the simple solution for unmixing the subpixel but at a certain scale. Backpropagation which is a special case of feedforward neural network which will address the problems related to weight adjustment but still, time requires to converge the network is large. Radial basis function gives better classification as a basis function is Gaussian-based which is influencing more near to the center and influence decreases as we move away from the center.

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REVIEW ON METHODOLOGIES OF OBJECT DETECTION

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**Abstract:**  
This project is an application of Convolutional Neural Network (CNN) and Recurrent Neural Network (RNN) in the field of object detection and classification. CNN's are best applicable in image and video recognition. The system proposed in this project involves training the network over images and processing the input video frames for testing. The model will be trained over images of potholes, road signs and pedestrians. The dataset of images for potholes is created, as there is no specific dataset available. The dataset of images for road signs and pedestrians is created by collecting images from various sources and formatting them. The model will be trained over these datasets and tested on a real time video. This is a prototype which can be implemented in automated cars and can be used by car drivers as an Android application, which detects the objects and alerts the user through a voice message.

**Keywords:**  
Real time monitoring, Pothole detection, Pedestrian detection, Road sign detection, Automated Car.  
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**Accepted on:** 24/12/2018  
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I. INTRODUCTION

This project is an application of Convolutional Neural Network and Recurrent neural network in the field of object detection. Convolutional Neural Networks are very similar to ordinary neural networks. They are made up of neurons that have learnable weights of biases. A neural network is defined as a computing system that is biologically inspired programming paradigm which enables a computer to learn from observational data. Convolutional Neural Network architectures assume that input is in form of images, which allows us to encode certain properties into architecture. These properties can then make the forward function more efficient to implement and vastly reduce the number of parameters in the network. This project will demonstrate the use of CNN to detect and monitor Potholes, pedestrians and road signs. As there are no standardized traffic signs and symbols yet in India, we aim at creating our own datasets for traffic signs. Our network will be trained on these datasets. With this, it will be able to detect the signs, potholes and pedestrians dynamically through video. As these objects are detected the algorithm will give an alert in the form of speech. This all will be incorporated into a mobile application. This is an extension of a previously implemented project which was specifically for road signs. In this project, we will be improving the accuracy of road sign detection as well as adding new features for detecting potholes and pedestrians.

Neuron and Neural Network:

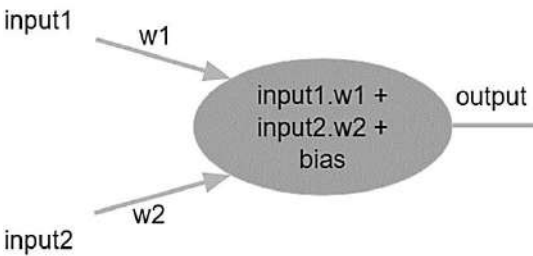


Fig 1.1 Neuron in a neural network

An artificial neuron is inspired by the biological neuron. It is a basic component of neural network, which takes input and performs dot product of the inputs with their corresponding weights. There is also a bias which is added to this product of shifting the activation function to its left or right. Set of neurons form a layer. Set of layers form a neural network. There are three basic layers input layer, hidden layer, and output layer.

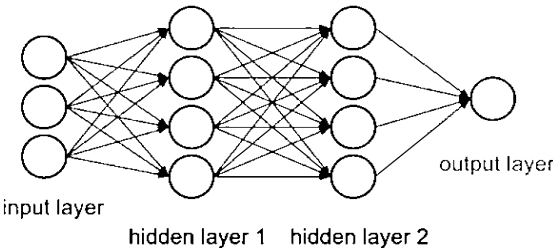


Fig 1.2: Neural Network

A. Literature Review

The first paper was on Pothole Detection System using Machine Learning on Android. This paper investigates an application of mobile sensors for detection of potholes on roads. Another paper was Pothole Detection Using Android Smartphone with a Video. This paper gives an idea about an accelerometer detects potholes by recognizing certain signal patterns. Another paper was on Deep learning traffic sign detection, recognition and augmentation. This paper presents a new real-time approach for fast and accurate framework for traffic sign recognition. Another paper was on Texture and Pothole Detection for Mobility Assistant for the Visually Impaired (MAVI).This thesis address Pothole detection and its area estimation using image segmentation and spectral clustering with the help of SVM on top of it. Understanding of Object Detection Based on CNN Family and YOLO.This paper exhibits one of the best CNN representatives You Only Look Once (YOLO).Another paper was on Designing Neural Network for Image Categorization. This paper explores the scope of Neural Networks in the field of Image Categorization.

II. METHODOLOGY

The whole model will be based on developing a CNN-RNN framework. In this classifier model, the input will be given to CNN and its output will be fed to RNN. RNN is associated with memorizing the network. CNN along with RNN will classify the detected object into following labels:

- 1.Pothole
- 2.Pedestrian
- 3. Road Sign

Before the image is fed to CNN it will undergo image pre-processing steps. The input image will be cropped and will segment out only the object. This image will be then passed to CNN. The whole work will be carried out in TensorFlow. The keras library will be used for CNN and RNN. For now, around 3000 images are used for training and about 1000 for testing as per the hardware constraints.

C. Approach

The frame initially captures the real-time images and applies convolution using a 3x3 filter. The diagrammatic representation is:

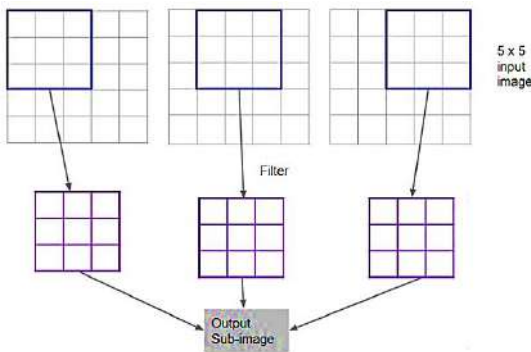


Fig 2.1: Sliding a Filter across the image

The CNN is able to generate a classifier at the end of training and testing.The classifier can be of the pothole, pedestrian as well as road signs.This model will work efficiently when it is trained on set of good quality images. But the CNN on its own is incapable of memorizing the classified images i.e. every time the model needs to classify an image, it must be trained beforehand which is a tedious job. Here RNN will be used for memorizing the weights of classifier. LSTM (Long Short Term Memory) variant of RNN will be used for making the model remember for longer durations.

D. Recurrent Neural Network

RNN uses the output of hidden state produced by previous input and current input to producecurrentoutput (uses its memory).

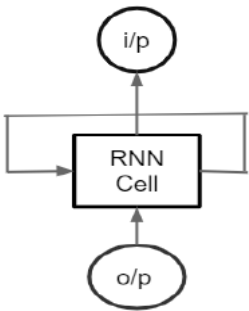


Fig 2.2 RNN model

E. Activation Functions

Activation functions are used to activate a specific neuron in the neural network.Which node or neuron must be activated by the model so that it fits the prediction accurately is done by the activation function.Sigmoid is a primary activation function used here.Another activation function used was ReLu.ReLu(Rectified Linear unit) function on its own tends to leave many nodes inactive or unvisited for a large amount of time.ReLu activation function was used after sigmoid.The mathematical representation of these is as follows:

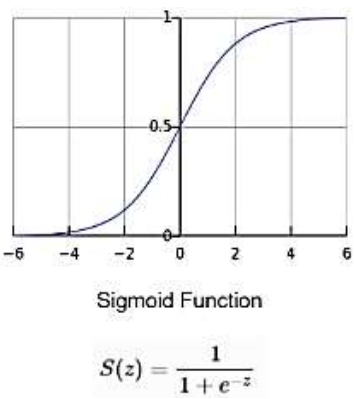


Fig 2.3: Sigmoid Function



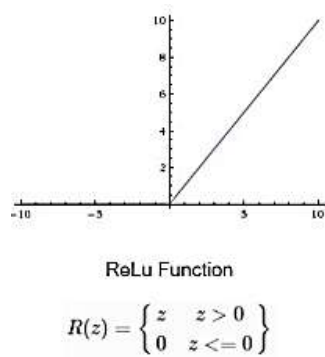


Fig 2.4: ReLu Function

Approach Diagram

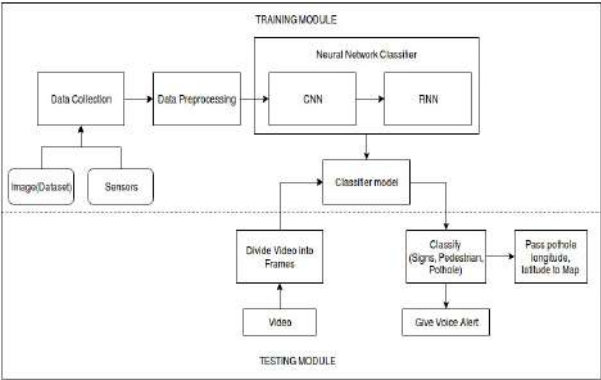


Fig 2.5Approach Diagram

III. EXPERIMENTATION

The implementation has been started and for now the CNN RNN model is being worked upon. Initially, the CNN RNN algorithm was tested for about 25000 images. But the capacity of the system was not enough to handle such large processing. The system stopped at about 4000 images after 3/10 epochs. Thereafter 3000 images were used for training and testing. The system’s performance was satisfying this time. All the 3000 images were processed by the system, the overall accuracy is about 80 %. This dataset has both negative and positive images of potholes i.e. images having potholes and images not having potholes. As, in the first attempt even though the accuracy was 80% the system was not able to classify the potholes. Then the images were segregated into two folders positive and negative. This enabled the system to classify the pothole more smoothly.

IV. RESULTS AND DISCUSSION

We have built a classifier model using convolutional neural network and recurrent neural network and trained it over the dataset that was created by us, the output from the CNN was fed to the RNN, this is due to the fact that CNN works on the mechanism of forward feeding and is unable to store the previously trained datasets. RNN will basically help to store trained datasets and save the time that otherwise would be required for training the dataset again and again.

RNN uses the output of hidden state produced by previous input and current input to produce current output. This will further result in a Classifier model which will classify the objects in images as potholes, pedestrians, road signs. In the case of potholes, if suppose there is a new pothole the record is added to the server database and if the problem of the pothole is solved the record is deleted.The location of potholes will be plotted on the map for the users to be aware of the number of potholes present on the route. The expected detection is given:



Fig 4.1Output Specification

Hardware details

OS	Windows, Linux
Recommended Laptop	TensorBook
PC Specification	8GB RAM, Intel UHD graphic
Processor	Minimum i5
Mobile OS	Android (5.0)

Table 1.1 Hardware details of system

Software details

Programming Language	Python, Java
Python version	3.5
Environment	Jupyter Notebook
Libraries	Keras
Framework	Tensorflow

Table 1.2 Software details of system

V. CONCLUSIONS

Thus, our project comprises of application of CNN and RNN, which we have used for detection of objects. Moreover, in the case of potholes, our system maps the coordinate of potholes and if new coordinates are found they will be added to the server database.Then user will be able to plot the location of potholes.

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## THORACIC DISEASES PREDICTION ALGORITHM FROM CHEST X-RAY IMAGES USING MACHINE LEARNING TECHNIQUES

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### **Abstract:**

*Examining Chest X-Ray (CXR) is a time consuming process. In some cases, medical experts had overlooked the diseases in their first examinations on CXR, and when the images were reexamined, the disease signs are detected. Radiologists have to spend time diagnosing these chest X-ray images to find any potential lung diseases. Diagnosing X-ray require careful observation and knowledge of anatomical, physiology and pathological principles. The work involves machine learning techniques applied for automated prediction of seven thoracic diseases namely Pneumonia, Fibrosis, Hernia, Edema, Emphysema, Cardiomegaly and Pneumothorax from chest X-ray images. Computerized image segmentation and feature analysis helps in assisting the doctors in treatment and diagnosis of diseases more accurately.*

### **Keywords:**

*Thoracic diseases, independent binary classifier, SIFT(Scale invariant feature transform), Visual bag of words, Logistic Regression, SVM(Support Vector Machines).*

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## I. INTRODUCTION

Radiologists have to spend time diagnosing the chest X-ray images to find any potential lung diseases. Examining chest X-ray is one of the most frequent and cost effective medical imaging examination. Diagnosing x-rays require careful observation and knowledge of anatomical, physiology, and pathological principles. Developing automated system for such could make a huge impact to the patients, who don't have access to expert radiologists.

To make it a bit simpler and efficient, the approach includes machine learning techniques applied in building independent binary classifier for each of the seven diseases i.e. Pneumonia, Fibrosis, Hernia, Edema, Emphysema, Cardiomegaly and Pneumothorax. Preprocessing of gray scale image is done by resizing and cropping it. SIFT (Scale-invariant feature transform) a computer vision algorithm when applied on pre-processed image detects feature descriptors in the image. Visual bag of words is constructed from feature descriptors obtained from the images. Computed visual bag of words is used as a feature vector for machine learning techniques like Logistic regression and SVM.

## II. RELATED WORK

Various research papers were taken into consideration. Some were solely based on image processing techniques while other papers involved use of artificial neural networks for prediction of diseases from chest X-Rays.

Emon Kumar Dey, Hossain Muhammad Muctadir [1] et al. presents a method for abnormal mass tissue detection on digital x-ray. It adopted the template matching technique for detecting mass tissue. This work adopted DCT (Discrete Cosine Transform) based template matching which has decreased the matching time.

Zurina Muda, Noraidah Sahari [2] et al. have shared an experience on segmenting the lung shape on CXR image. The segmentation process starts by detecting the lung edge using canny edge detection filters. To improve the edge detection, Euler number method is applied. Later, morphology method is used to make the lung edge better so that the final output of lung region can be generated. Zhiyun Xue, Serna Candemir [3] et al. paper was solely based on detection of foreign objects i.e. buttons. The work is based on image processing techniques. Two methods for extraction of button objects from chest X-Rays were applied. One is based on the circular Hough transform, the other is the Viola-Jones object

detector.

Jie Chen [4] et al. proposed a new framework to augment the dataset dramatically. Using the augmented dataset to train a CNN model for the thorax disease diagnosis, they improved the model performance significantly. Their future work is to combine millions of images without labels collected from local hospital to improve the performance of the CNN models.

Shubhangi Khobragade [5] et al. developed automated system for the detection of lung diseases specifically for Tuberculosis, pneumonia and lung cancer using chest radiographs. From the results, it is observed that image preprocessing techniques like histogram equalization, image segmentation gives good results for the chest radiographs. Pattern recognition technique such as feed forward artificial neural network is giving good results.

Abhishek Sharma, Daniel Raju [6] et al. have identified the lung region by rib cage boundary identification. Otsu thresholding is used to segregate the pneumonia cloud from the healthy lung in the lung area, still working on other methods that can be adopted for thresholding the CXR images can yield better results.

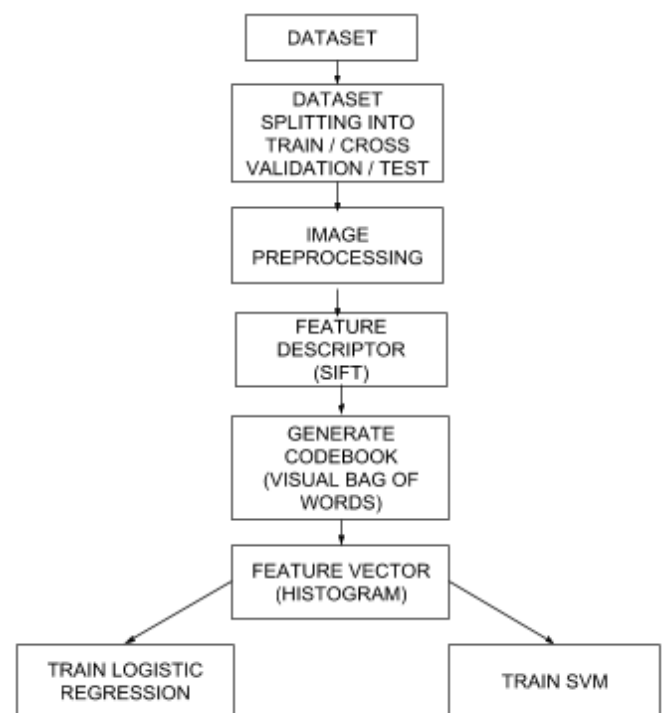
Xiaosong Wang [7] et al. attempted to build a "machine-human annotated" comprehensive chest X-ray database that presents the realistic clinical and methodological challenges of handling at least tens of thousands of patients. They conducted extensive quantitative performance benchmarking on eight common thoracic pathology classification and weakly-supervised localization using ChestX-ray8 database. The main goal is to initiate future efforts by promoting public datasets in this important domain. Building truly large-scale, fully-automated high precision medical diagnosis systems remains a strenuous task. ChestX-ray8 can enable the data-hungry deep neural network paradigms to create clinically meaningful applications, including common disease pattern mining, disease correlation analysis, automated radiological report generation, etc.

Yuan-Hao Chan, Yong-Zhi Zeng [8] proposed the method to segment the lung in the abnormal region through multiple overlapping blocks. The abnormal region is found by texture transformed from computing multiple overlapping blocks. Finally, this method effectively analyses lung diseases of the area in the chest X-ray image and improves the possible

diagnosis of the missing problem of the pneumothorax area. The study presents a novel framework for automatic pneumothorax detection in CXRs. The texture analysis is based on intensity and gradient for pneumothorax detection.

### III. CASE STUDY

The work involves focussing mainly on feature extraction techniques like Scale Invariant Feature Transform, classification machine learning algorithms like Logistic Regression, Support Vector Machines and Computer Vision algorithm like Visual bag of words to help in prediction of lung diseases from chest X-Rays.



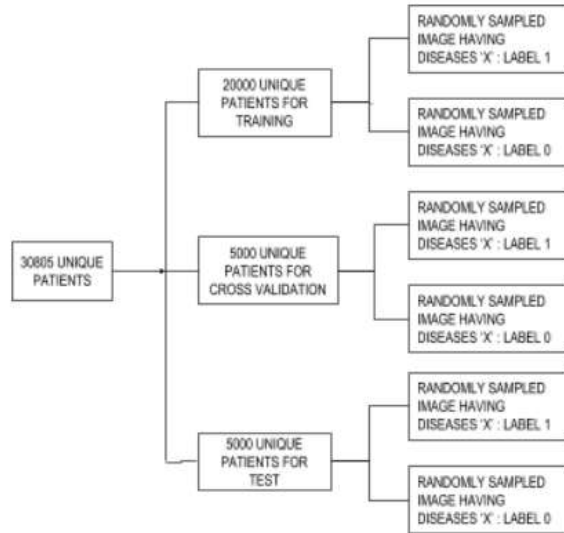
**Fig. 1** Proposed system architecture

Dataset used is published by National Institutes of Health (NIH) Clinical Center consisting of 100,000 plus frontal-view X-ray images of 32,717 unique patients comprising of 14 lung diseases. Each image has multi-label images which are gray scale of size 1024 x 1024 in resolution.

Data split and preprocessing pipeline (refer figure no. 2) is performed where data pipeline is used to split data, pre-process it. Each image will be pre-processed by resizing image from 1024 x 1024 to 224 x 224 in resolution to speed up the computation. Rescaling is followed by cropping to make lungs in the image focal, resulting in image of size 180 x 200. Contrast of image will be increased by applying

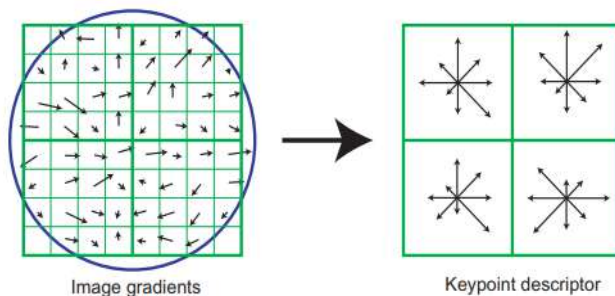


histogram equalizer. The images will be split for Training, Cross-validation and Test-set. Since, each disease will be having independent binary classifier; separate dataset will be generated for each of the disease classifier. Images will be randomly sampled for randomly sampled patients.

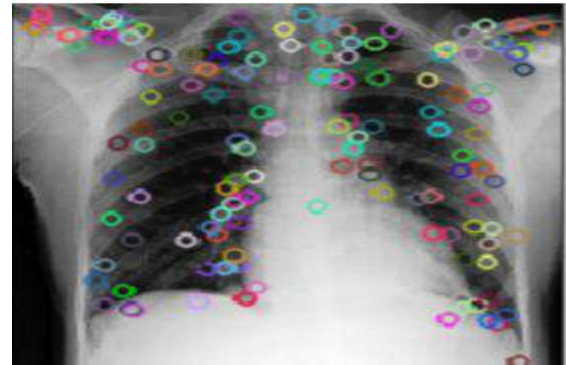


**Fig. 2** Data splitting for differentiating the lung diseases.

For extracting features, SIFT is applied to capture local information in the image. SIFT is a computer vision algorithm used to detect and describe local features in images. SIFT finds the key points within an image and then calculates descriptor vector (refer figure no. 3) for each keypoint. Image is convolved with Gaussian filters at different scale, and then the difference of successive Gaussian blurred images is computed. Keypoints are the maxima or minima of the Difference of Gaussian (DoG) that occurs at multiple scales. Orientation is computed for each keypoints (refer figure no. 4) based on local image gradient directions. Using orientation, descriptor vector is computed for each keypoint.

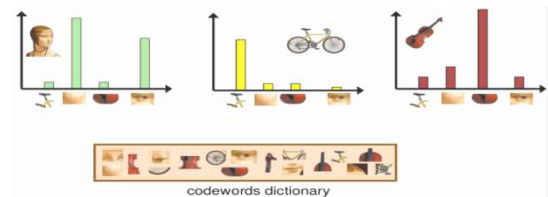


**Fig. 3** Descriptor Vector [12]



**Fig. 4** Keypoint Localization

Bag of Visual Words (Codebook) helps in constructing a large vocabulary of visual words. Features are extracted using SIFT, then codebook will be generated, followed by histogram. K-means clustering is applied to extracted features from all image to generate codebook. Each extracted feature is mapped to one of the closest centroid. Resulting histogram of for each image helps in counting the number of features for each of the visual code words (refer figure no. 5). Histogram is used as feature vector for training models.



**Fig. 5** Codeword Dictionary [11]

For classification, Logistic regression and SVM are the machine learning algorithms that will be applied on visual bag of words feature vector to predict whether a chest X-ray is normal or infected with any of the diseases specified.

#### IV. EXPERIMENTATION

The work is implemented by pre-processing image into gray scale images then resizing and cropping them so that the region of interest can be properly identified to carry out further work. SIFT computer vision algorithm will be applied on pre-processed image to detect feature descriptors in the image. Visual bag of words will be constructed from feature descriptors obtained from the images. Computed visual bag of words will be used as a feature vector for Logistic regression and SVM. Each model's output will be a binary label for prediction of each

diseases namely Pneumonia, Fibrosis, Hernia, Edema, Emphysema, Cardiomegaly, Pneumothorax.

## V. DISCUSSION

Dataset contains 112, 120 frontal-view X-ray images of 30,805 unique patients, with each image labeled with up to 14 lung diseases. Each image is a gray scale image with 1024 x 1024 in resolution.

Metrics used to evaluate models performance are accuracy, precision, recall, and ROC (Receiver Operating Characteristic) curve. Number of cluster centroids for each of the classifier is determined using accuracy and recall. With more importance to recall, because of medical domain.






## VI. SUMMARY

Logistic regression is performed similar to SVM. By developing classifiers using traditional machine learning techniques of extracting features using computer vision technique, reasonable performance is achieved.

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# ASSIST CRIME PREVENTION USING MACHINE LEARNING

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## Abstract:

*Crime rate is increasing significantly over the years. Crime prevention is the attempt to reduce and deter the crimes and the criminals. The government must go beyond law enforcement and criminal justice to tackle the risk factors that cause crime because it is more cost effective and leads to greater social benefits. The data driven method is used which is based on the broken windows theory, having an enormous impact on the working of the police department. The theory links disorder and incivility within a community to subsequent occurrences of serious crimes. Predictive policing is used by the law enforcement stakeholders for taking proactive measures against crimes. This will help the police departments to efficiently focus their resources on the potential crime hotspots. The model is built to predict the crime rate based on demographic and economic information of particular localities using decision trees, linear classification, regression and spatial analysis.*

## Keywords:

*Crime, Broken Windows Theory, Decision Trees, Classification, Regression, Spatial Analysis*

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## I. INTRODUCTION

Crimes are increasing day by day which means that there should be measures to avoid them. Crime prevention refers to recognizing that a crime risk exists and taking some corrective action to eliminate or reduce that risk. Using machine learning approach we will assist the local authorities in preventing crime and to take the necessary actions against crime.

There are numerous types of crimes taking place at different locations. Some areas have crimes occurring frequently whereas there are some places where occurrence of crime is negligible. Therefore potential crime hotspot areas require much more security than those areas where crime rate is comparatively less. For example, Crimes like chain snatching occur mostly at lonely places so that criminals could escape easily from that location. Detecting the crime hotspot areas helps the police officials to decide what kind of security strength will be required for that particular place.

The system is based on the broken windows theory. Broken windows theory is an academic theory proposed by James Q. Wilson and George Kelling in 1982 that used broken windows as a metaphor for disorder within neighbourhoods. Their theory links disorder and incivility

within a community to subsequent occurrences of serious crime [12].

## II. METHODOLOGY

### A. Preprocessing

Pre-processing is the process of cleaning and preparing the text for classification.

Algorithm for Pre-processing module:

1. Accept the data set in .csv (comma separated value) format.
2. Remove corrupt data.
3. Impute missing data.

The communities-crime-full.csv dataset is used. The dataset consists of the crime records of the communities within the United States. The dataset is for per-capita crime rates around the country. Our task is to build models to predict the crime rate based on demographic and economic information about the particular locality.

The data is given in the file “communities-crime-full.csv”. It includes data fields with missing values (indicated by “?”), which have to be removed.

Table 1:- Dataset before cleaning

	A	B	C	D	E	F
1	state	county	communit	communit	fold	populatio
2		8 ?	?	Lakewood	1	0.19
3		53 ?	?	Tukwilacit	1	0
4		24 ?	?	Aberdeen	1	0
5		34	5	81440 Willingbo	1	0.04
6		42	95	6096 Bethleher	1	0.01
7		6 ?	?	SouthPas	1	0.02
8		44	7	41500 Lincolntov	1	0.01
9		6 ?	?	Selmacity	1	0.01
10		21 ?	?	Henderso	1	0.03

Table 2: Dataset after cleaning

	A	B	C	D	E	F
1	state	communit	fold	populatio	househol	racepctbl
2		1 Alabaster	7	0.01	0.61	0.21
3		1 Alexander	10	0.01	0.41	0.55
4		1 Anniston	3	0.03	0.34	0.86
5		1 Athenscity	8	0.01	0.38	0.35
6		1 Auburncity	1	0.04	0.37	0.32
7		1 Bessemer	6	0.04	0.44	1
8		1 Birmingham	2	0.41	0.37	1
9		1 Cullmanci	1	0.01	0.3	0
10		1 Daphnecit	7	0	0.39	0.31

## B. Processing

### 1. Decision tree

The goal is to create a model that predicts the value of a target variable by learning simple decision rules inferred from the data features. We will use the clean dataset to predict whether the crime rate in a locality is greater than 0.1 per capita or not. A new field “highCrime” is created which is true if the crime rate per capita (ViolentCrimesPerPop) is greater than 0.1, and false otherwise.

### 2. Cross Validation

Cross-validation is a statistical method which has a single parameter called k that refers to the number of groups that a given data sample is to be split into. Algorithm for Cross Validation is:

1. Shuffle the dataset randomly.
2. Split the dataset into k groups
3. For each unique group:
  - a. Take the group as a hold out or test dataset
  - b. Take the remaining groups as training data.
    - c. Fit a model on the training set and evaluate it on the test set.
    - d. Retain the evaluation score and discard the model
  - e. Summarize the skill of the model using the sample of model evaluation scores

We will apply cross-validation (cross\_val\_score) to do 10-fold cross-validation to estimate the out-of-training accuracy of decision tree learning. We will find out what are the 10-fold cross-validation accuracy, precision and recall.

### 3. Classification

In machine learning, classification is the problem of identifying to which set of categories a new observation belongs, on the basis of a training set of data containing observations whose category membership is known.

### Linear SVM

A Support Vector Machine (SVM) is a discriminative classifier formally defined by a separating hyperplane. The LinearSVC is used to make a linear Support Vector Machine model learn to predict highCrime.

- i. The 10-fold cross-validation accuracy, precision, and recall for this method is found.
- ii. The 10 most predictive features are identified.
- iii. The results are the compared with results from decision trees.

### Gaussian Naive Bayes

Bayes' Theorem provides a way that we can calculate the probability of a hypothesis given our prior knowledge.

The GaussianNB is used to make a Naive Bayes classifier learn to predict highCrime.

- i. The 10-fold cross-validation accuracy, precision, and recall for this method is found.
- ii. The 10 most predictive features are identified.
- iii. The results are the compared with results from decision trees.

### 4. Regression

Regression is used to predict continuous values. We perform regression analysis to understand which among the independent variables are related to the dependent variable. [11] Regression will be used for predicting the crime rate per capita (ViolentCrimesPerPop). The following errors are calculated:

1. RMSE(Root Mean Square Error)
2. MAE(Mean Absolute Error)
3. R<sup>2</sup>(R Square Error)

### Ridge Regression

Ridge Regression is a technique for analyzing multiple regression data that suffer from multicollinearity.

### SVM Regression

SVM constructs a hyperplane in multidimensional space to separate different classes. SVM generates optimal hyperplane in an iterative manner, which is used to minimize an error.

### Random Forest Regression

It is a meta estimator that fits a number of classifying decision trees on various sub-samples of the dataset and uses averaging to improve the predictive accuracy and control over-fitting.

### XGBoost Regression

XGBoost stands for eXtreme Gradient Boosting. It is an implementation of gradient boosted decision trees designed for speed and performance.

### KNN Regression

K nearest neighbors is a simple algorithm that stores all available cases and predict the numerical target based on a similarity measure.

### Lasso Regression

Lasso (Least Absolute Shrinkage and Selection Operator) penalizes the absolute size of the regression coefficients.

### Decision Tree Regression

Decision tree builds regression or classification models in the form of a tree structure with decision nodes. It breaks down a dataset into smaller and smaller subsets while at the same time an associated decision tree is incrementally developed.

Algorithm for predicting crime:

1. Taking input dataset which is .csv file (In our example we have US based dataset).
2. Perform cleaning and pre-processing. Save the cleaned file and use this for further analysis.
3. Based on various conditions, apply appropriate decision tree and infer the results.
4. Split the data into train and test by using cross validation.
5. Apply various Classification and Regression models. Analyze them using evaluation metrics and select one which gives best results.
6. Perform spatial analysis using GeoPanda.
7. Based on the results obtained we can identify the area of high crime and assist police.

### *5. Feature Extraction*

Determining a subset of the initial features is called feature selection. The selected features are expected

to contain the relevant information from the input data, so that the desired task can be performed by using this reduced representation instead of the complete initial data.

### **C. Spatial Analysis**

Spatial analysis is a type of geographical analysis which seeks to explain patterns of human behavior and its spatial expression in terms of mathematics and geometry, that is, locational analysis.

GeoPandas is the geospatial implementation of the big data oriented Python package called Pandas. GeoPandas enables the use of the Pandas data types for spatial operations on geometric types. The potential crime hotspots are plotted on the map which gives better visualization of results.

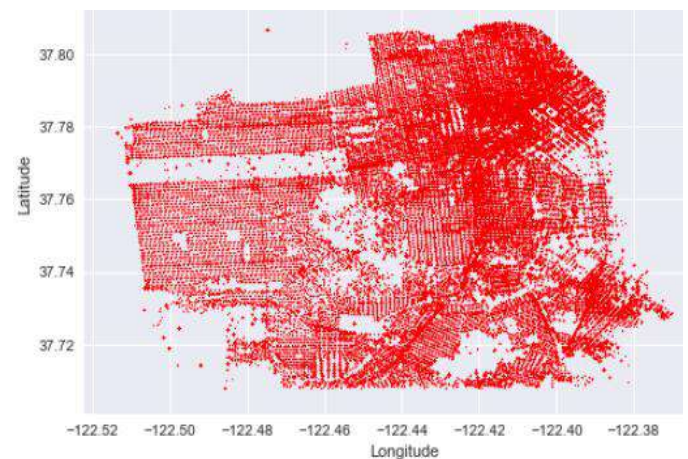


Fig. 1:- Plot of Crime Hotspots

### **III. Experimentation**

#### *System architecture*

The system architecture shows the overall flow of the System. There are 3 modules:

1. Preprocessing
2. Processing
3. Analyzing

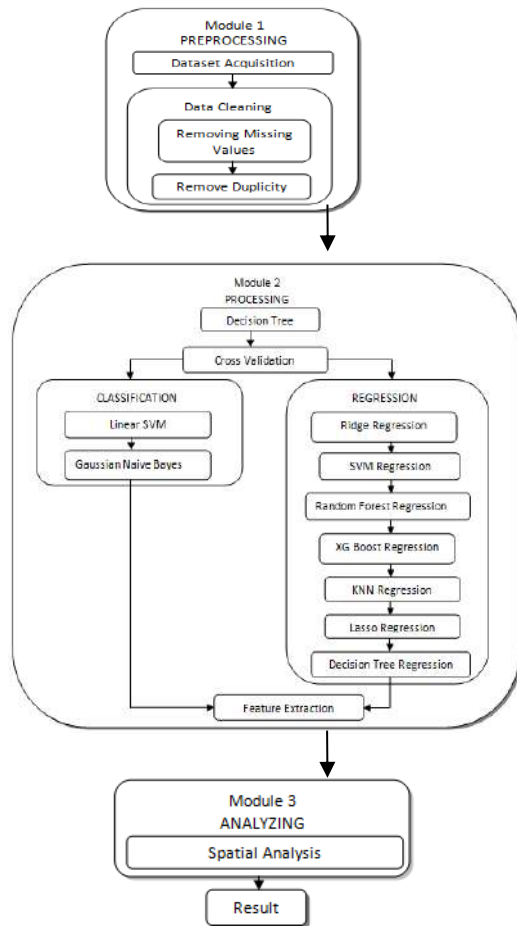


Fig. 2:- System architecture

#### IV. Results and Discussion

These systems are typically measured using accuracy, precision and recall.

Table 3: Prediction Outcomes

Condition Positive (P)	The number of real positive cases in the data
Condition Negative (N)	The number of real negative cases in the data
True Positive (TP)	Equivalent to hit
True Negative (TN)	Equivalent to correct rejection
False Positive (FP)	Equivalent to Type I error
False Negative (FN)	Equivalent to miss, Type II error

**Precision:** A measure of exactness, determines the fraction of relevant items retrieved out of all

items retrieved. Precision (P) It is given in Equation 2.

$$P = \frac{TP}{TP + FP} \quad \dots(2)$$

**Accuracy:** Accuracy is the proximity of measurement results to the true value; precision, the repeatability, or reproducibility of the measurement. Accuracy (A) is given in Equation 3.

$$A = \frac{TP + TN}{P + N} \quad \dots(3)$$

**Recall:** a measure of completeness, determines the fraction of relevant items retrieved out of all relevant items. Recall (R) is given in Equation 4.

$$R = \frac{TP}{TP + FN} \quad \dots(4)$$

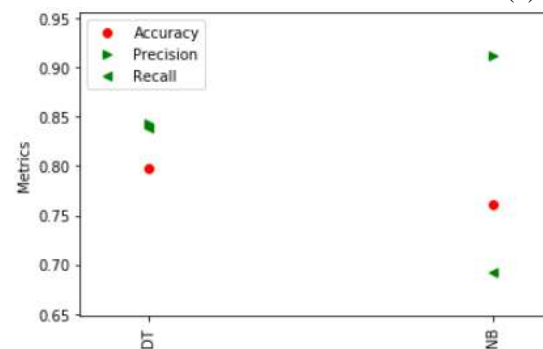


Fig. 3:- Plot of Accuracy, Precision and Recall

#### Applications

##### Technical applications

**Assist police department:** The Crime Prevention System will assist police department in maintaining law and order, as the model will give a pictographic view of crime hotspots based on the data set provided of that region.

**Crime Reports for newspapers:** This system can be used by news reporters or journalists to give a brief analysis about crime occurrences at a particular place stating about the type of crime and its frequency.

**Predicting crimes from news feeds:** Crime patterns can be analyzed and crimes can be predicted from news feeds. The news feeds for a particular time span can be collected like for 20 years and this news feeds corpus can be used to predict future events.

##### Social Applications

#### Combat drug addiction and other related crime:

This system will help to identify the predominant drug and other related crime hotspots and then the government can set up rehabilitation centres and camps. NGOs can also conduct awareness drives.

Urban planning: Once the crime hotspots are identified the government can take measures to redevelop those areas by implementing urban planning so as to improve the social neighbourhood of a person by which there is no or minimal indulgence in criminal or illegal activities. Bad urban planning can lead to an increase in crime rate.

Analyzing crime through social media: The tweets and social media posts can be analyzed for a certain timespan. From this corpus certain deductions can be made about the crime patterns and criminal instincts. By further enhancements on the model using Natural Language Processing, the crimes can be prevented from happening by assessment of social media posts.

### V. Conclusions

The system uses different Machine Learning approaches to assist in crime prevention by predicting whether a particular area is a potential crime hotspot or not. The community crimes dataset of the US is used this purpose. As the dataset collected consists of missing values, it has to be cleaned and pre-processed. Decision trees can then be used to make decision about a high crime area. The classification models are applied to the system and the topmost features can be predicted. Different regression models are applied aiming for the least error. The model with the least error will be the winning model. Accuracy, Precision and Recall are considered for evaluation of the system. Geospatial analysis can then be done to plot the potential crime hotspots across the longitudinal and latitudinal positions over a map. This plot will assist the police department in deciding which area requires greater attention and hence larger security forces could be deployed at that crime hotspot.

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## AGRO INSURANCE - A TOOL FOR S.C.H.E.M.E. MANAGEMENT

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(PCE, New Panvel, India, Affiliated to University of Mumbai).

### Abstract:

With the flourishing technology, science and internet services; the data related to the different agricultural schemes are now available on the internet 24\*7. Also, many agricultural mobile apps and websites are available nowadays from where the farmers can get information about the various agricultural government funding schemes. But, due to the inferior usability of these mobile apps and websites; the farmers in the different parts of the country are not able to take benefits of these government funding schemes which are provided to them. So, my motivation is to implement an easy to use mobile app and website for the benefit of the farmers of our country; so that they can get different data related to agricultural government funding schemes, funding schemes under Pradhan Mantri Fasal Bima Yojana, insurance claim forms of these funding schemes, operational guidelines of Pradhan Mantri Fasal Bima Yojana, address of Agricultural NGO's at the time when they need.

### Keywords:

Agriculture, Usability, Agricultural Government Funding Schemes, Insurance Claim Forms, Pradhan Mantri Fasal Bima Yojana, Operational Guidelines of Pradhan Mantri Fasal Bima Yojana.

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### I. INTRODUCTION

Agriculture is the power of Indian economy and almost 70% of Indians are primarily depend upon agriculture for their sustenance. Since ages, several advancements are taking place in the field of agriculture. ICT provides end users with the access and information about utilizing numerous ICT's viz: smart phones, computers, laptops, tablets, etc. Using ICT needs active as well as literate participation of the end user. Different digital services are offered by ICTs such as mobile apps, websites, etc. Users who do not know how to use the different ICT's and ICT services; find it very challenging to use them. However, the information delivered through different ICT's have usefulness and pertinence only if it is precise, unambiguous and localized. In India, many communities reside in provincial areas and are resting on agriculture for their existence. However, due to digital illiteracy, many farmers of our country are unaware concerning the different agricultural news and information, which are made available for them by the Government of our country. The major focus of this project is to implement a well efficient and usable mobile app and a website for the farmers of India. The mobile app and website will contribute our farmers with agricultural government funding schemes which are suitable for them according to their needs. This tool (Agro Insurance) also provides the users with the insurance claim forms of the schemes and operational guidelines of Pradhan

Mantri Fasal Bima Yojana (PMFBY) which will give information about PMFBY. The Agro Insurance tool can be accessed in three languages viz: Marathi, Hindi and English. The information of government schemes will be accessible in the form of text, audio as well as video. A help in the form of video will be provided in the website as well as in the app to the farmers for how to fill the insurance form and how to use the website and the app.[10]

### II. SERVICES

- The Agro Insurance tool provides information of agricultural Government funding schemes in the form of mobile app and as well as website to curtail the problem of digital divide.
- The tool also provides operational guidelines of Pradhan Mantri Fasal Bima Yojana (PMFBY) i.e. important instructions of PMFBY in the form of text, audio and video.
- Provides information of funding schemes, insurance claim form and instructions of PMFBY in the form of multimedia i.e. text, audio and video.
- Provides scheme recommendation based on the parameters filled in the "My Profile" form.
- Provides information of app and website in local languages (Marathi and Hindi) and also in English.
- Provides insurance claim forms for the government schemes.

- Allows the users with online filling of the insurance claim form.
- Providing videos on how to fill the insurance claim forms.
- Providing address and location of nearby agricultural NGO's and help centres.
- Providing a feedback form, which will help us in future to enhance the tool (App and Website).
- Providing weather forecast of different regions.
- Providing discussion forum, where the registered users can ask questions and solve each other's doubt.

### III. ARCHITECTURE OF THE PROPOSED SYSTEM

This diagram represents the architecture of the proposed system. The information system contains the different operational guidelines of PMFBY, agricultural government funding schemes and insurance claim forms of those schemes. Agricultural schemes, insurance claim forms or operational guidelines of PMFBY will be fetched from the information system as per the farmers need. The fetched information will be delivered to the farmers via mobile app and website. The services, which the proposed system will provide are: 1) Scheme Information, 2) Scheme Recommendation, 3) Operational guidelines of Pradhan Mantri Fasal Bima Yojana, 4) Insurance Claim Form, 5) E-Learning (Providing information of funding schemes, insurance claim form and instructions of PMFBY in the form of multimedia i.e. text, audio and video.) and 6) Multilingual support (English, Marathi and Hindi).[10]

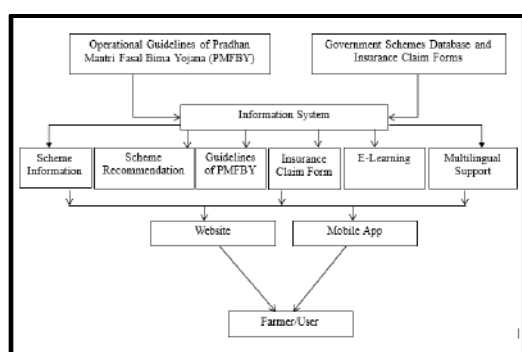


Fig 1: Architecture of Proposed System

### IV. SYSTEM METHODOLOGY OF THE PROPOSED SYSTEM

The Agro insurance tool consists of six steps as explained below:

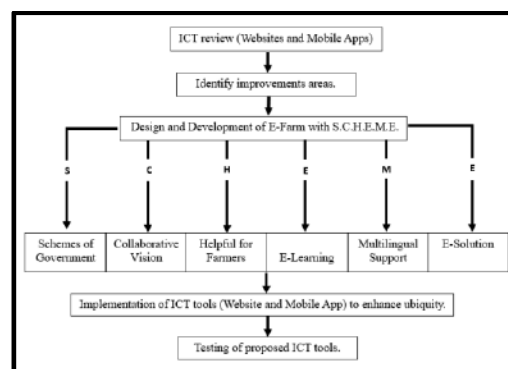


Fig 2: System Methodology

**Step 1:** The very first task is to analyse and inspect the different agricultural mobile apps and websites which provide Government funding schemes; using online evaluation tools and user collaboration.[10] Three ICT evaluation tools such as SEOptimer Tool, Qualidator Tool and Website Grader Tool were used to assess the agricultural websites.[10]

**Step 2:** The existing agricultural mobile apps and websites are scrutinized for improvements.

**Step 3:** The design and implementation of the Agro Insurance tool is initiated.

**Step 4:** The proposed system consists of the below S.C.H.E.M.E. services.[10]

**S:** Schemes approved by Indian Government i.e., provides the farmers of our country with agricultural government funding schemes which are approved by our Government).[10]

**C:** Collaborative Vision i.e., provides the farmers of our country with the government funding schemes through digital medium viz: mobile app and website.[10]

**H:** Helpful for agriculturists i.e., The mobile app and website, both will be very helpful for the farmers since they provide operational guidelines of PMFBY, agricultural insurance schemes, insurance claim forms, weather forecast, agricultural news and discussion forum; where the users of the app can solve each other's doubts.

**E:** E-Learning (The Agro Insurance tool will provide the users with operational guidelines of Pradhan Mantri Fasal Bima Yojana, agricultural government schemes and insurance claim forms of every scheme in the form of multimedia i.e., in text, audio and video).[10]

**M:** Multilingual support i.e., The mobile app and website will be available in two Indian local languages such as (Marathi and Hindi) and also in English language.[10]

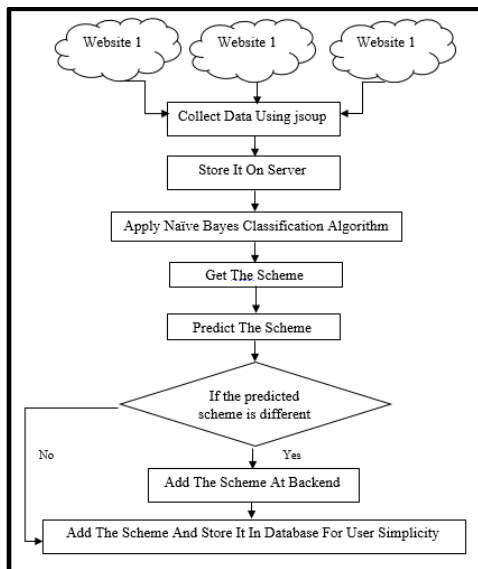
**E:** E-Solution (Information related to the different government schemes will be available any time on one click.[10]

**Step 5:** The Agro Insurance tool (mobile app and website) has been developed.

**Step 6:** After the proposed systems (mobile app and website) are developed, they are tested for usability by performing user interaction for any improvements and calculating the effectiveness and efficiency.[10]

## V. TECHNIQUES FOR SCHEME MANAGEMENT

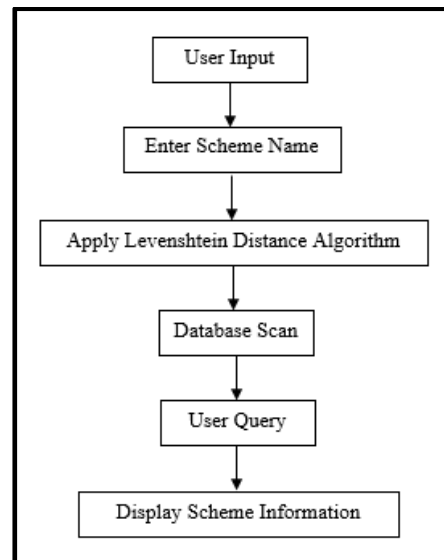
### A. Scheme Classification Process



**Fig 3:** Scheme Classification Process

The system methodology of this proposed system illustrates that there is a trained dataset which contains different agricultural schemes which are further stored in the server. Apart from having a trained dataset, the system also fetches new funding schemes from the web using the Jsoup Library. The newly fetched schemes are further categorized into several groups using the Naive Bayes Classifier Algorithm. Once the new schemes are categorized into different groups; they are then stored in the server with the previously trained dataset.[10]

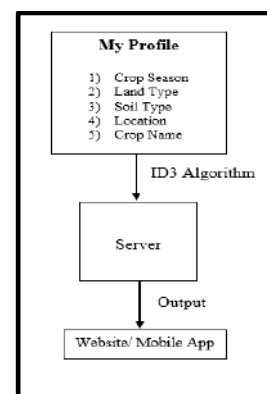
### B. Scheme Retrieval Process



**Fig 4:** Scheme Retrieval Process

In the scheme retrieval process, initially the user gives an input. The input will be a name of the scheme. After entering the name of the scheme, the proposed system will seek to find for the related scheme in the server by applying LevenshteinDistance Similarity Checker Algorithm. After applying the algorithm, an relevant scheme will be fetched; and displayed to the end user on the mobile app or on the website.

### C. Scheme Retrieval Process using ID3 Algorithm



**Fig 5:** Intelligent Retrieval of Schemes through Registration Form using ID3 Algorithm

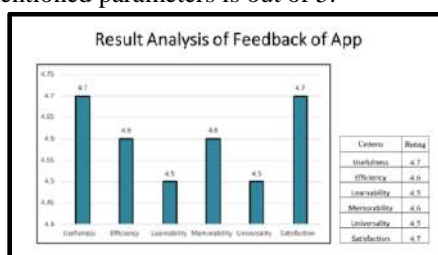
ID3 algorithm is used to fetch a suitable scheme from the server. The above diagram illustrates that a scheme recommendation form will be displayed, where the user will have to fill the details such as: 1) Crop Season, 2) Land Type, 3) Soil Type, 4) Location and 5) Crop's Name. On filling the above-mentioned details and submitting the form, the system will intelligently find the suitable scheme

from the server where different categories of schemes are stored. The ID3 algorithm will fetch the relevant agricultural scheme from the server according to the user's input. The fetched scheme will have all the information regarding that particular scheme and display it on the website or app.

## VI. RESULTS AND DISCUSSION

### A. Overall Result analysis of feedback of Agro Insurance Tool

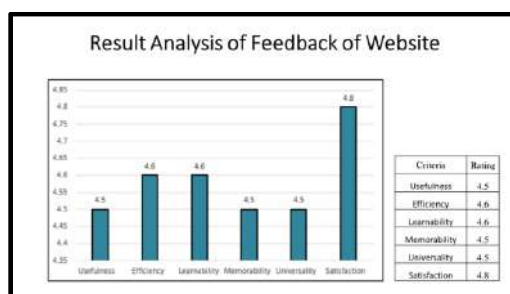
The fig 6 shows the analysis of feedback for Agro Insurance App. The overall rating for Usefulness is 4.7, Efficiency is 4.6, Learnability is 4.5, Memorability is 4.6, Universality is 4.5 and Satisfaction is 4.7. The rating achieved for the above-mentioned parameters is out of 5.



[1]

**Fig 6:**Feedback analysis of Agro Insurance App

The fig 7 shows the analysis of feedback for Agro Insurance Website. The overall rating for Usefulness is 4.5, Efficiency is 4.6, Learnability is 4.6, Memorability is 4.5, Universality is 4.5 and Satisfaction is 4.8. The rating achieved for the above-mentioned parameters is out of 5.



**Fig 7:** Feedback analysis of Agro Insurance Website

### B. Effectiveness of Agro Insurance Tool

Overall Effectiveness of Agro Insurance App	
Total Number of Users =	30
Total Number of Tasks Undertaken by 30 users =	960
Total Number of tasks completed successfully by the user =	860
Total Number of tasks not completed successfully =	100
Overall Effectiveness =	89.58%
Average Effectiveness =	89.58%

**Fig 8:**Effectiveness of Agro Insurance App

### Overall Effectiveness of Agro Insurance Website

Total Number of Users =	30
Total Number of Tasks Undertaken by 30 users =	870
Total Number of tasks completed successfully by the user =	810
Total Number of tasks not completed successfully =	60
Overall Effectiveness =	93.10%
Average Effectiveness =	93.10%

**Fig 9:**Effectiveness of Agro Insurance Website

### C. Time Based Efficiency of Agro Insurance Tool

Efficiency of App when language selected as "English"	0.00268
Efficiency of App when language selected as "Hindi"	0.00221
Efficiency of App when language selected as "Marathi"	0.00251
Average Efficiency of App (Goals per second)	0.00247

**Fig 10:**Time Based Efficiency of Agro Insurance App

Efficiency of Website when language selected as "English"	0.00300
Efficiency of Website when language selected as "Hindi"	0.0025
Efficiency of Website when language selected as "Marathi"	0.0025
Average Efficiency of App (Goals per second)	0.00267

**Fig 11:**Time Based Efficiency of Agro Insurance Website

## VII. CONCLUSIONS

1) With this research, it is observed that, tremendous information is available in the area of agriculture; which can help the farmers to increase the productivity of their produce. This agricultural information is delivered to the end users in the form of digital medium such as; mobile apps and/or websites.[10] Many agricultural mobile apps and websites are launched by our government for the use of our farmers.[10] But, due to the lack of education of the farmers and inferior quality of the mobile apps and websites, the farmers are not capable to use them and take benefits of these facilities.[10] So, the main aim of this research was to develop a versatile agricultural mobile app and website of same for the benefit of our farmers with a pleasant and increased quality which will provide them with the distinct agricultural government funding schemes and operational guidelines of Pradhan Mantri Fasal Bima Yojana (PMFBY) in the form of text, audio and as well as video. The mobile app and website will be available in three languages Marathi, Hindi and English. The Agro Insurance tool also provides scheme recommendation, insurance claim forms for different schemes and videos on how to fill those insurance forms. This tool also provides weather forecast of different regions and information of agricultural NGO's and help centres which will help the farmers to visit these NGO's at the time of any emergency and/or disaster. The Agro Insurance tool

also provides a discussion forum, where the registered users can ask questions and solve each other's doubt and feedback form which can help us in future to enhance the tool (App and Website).

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# PERFORMANCE ANALYSIS OF BUS ARRIVAL TIME PREDICTION USING MACHINE LEARNING BASED ENSEMBLE TECHNIQUE

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## Abstract:

*Bus transport is an important means of communication in a modern world of smart cities. These smart cities require intelligent transportation systems. Such systems need effective techniques to be developed to meet customer requirements. Machine learning is one of those techniques for developing mathematical models to predict based on given data. Such techniques can be used to detect the arrival time of a bus at a given bus stop based on the historical data of the bus. In this paper Random Forest, Lasso and Ridge regression are used to train and analyze the performance over standard dataset in comparison with ensemble of Random Forest, Lasso and Ridge regression. Performance of ensemble techniques is better as compared used to Lasso, Ridge Regression, XGBoosting, and Gradient Boosting.*

## Keywords:

*Random Forest, Lasso, Ridge Regression, Stacking, XGBoosting, Gradient Boosting*

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## 1 INTRODUCTION

Lot of developments are taking place to make our cities smart. These smart cities meet the requirements of the inhabitants in an optimal way. Bus transportation in smart cities needs to be effective so that people opt for it instead of private vehicles. Machine Learning (ML) is a fast growing branch of Artificial Intelligence which is useful in predicting various data based on the input factors. ML is used in areas such as stock exchange markets to predict whether the price of a share will fall or rise given the specific set of circumstances. This paper uses ML techniques to find when a bus will arrive at a particular stop, given the location of the bus, the source and destination of travel, the distance from the stop, the scheduled arrival time and the time at which the recording is made. New York City Metropolitan Transportation Authority (NYC MTA) is a New York city based transport service provider which provides bus services to the New York city. Here the data set for MTA bus route is taken. The expected arrival time of the bus is predicted based on the input parameters such as RecordedArrTime, DirectionRef, etc.

## 2 LITERATURE SURVEY

The main factors affecting bus arrival time in smart cities are traffic density, sequences or the bus time and the bus stop in the way followed by number of intersections, and any other factors.

Lovell D J et al. [2] proposed a way to know the speed of the moving bus by using the global position of the bus. S. I.J. Chien et al. [3] have devised a system that uses artificial neural networks to predict the time of arrival of the buses. This system shows higher accuracy on the trained paths. Dihua Sun et al. [4] proposed a system in which the route data is predicted by the system. For example if the bus is visiting two GPS locations in a sequence then the direction of the bus can be predicted. ShravanGaonkar et al. discussed a system called micro-blog [5] which predicts the bus arrival time with the use of social media. Sites such as Facebook, Blogger are used to share information of the users to get the accurate bus arrival time.

By looking at the historical data, authors observed the bus arrival time in cities is combination of two main parts: residuals and linear part. Simon Bernard et al. [6] have proven the relation between the distance traversed and bus arrival time. In this model, authors have considered the factor of intersection, traffic condition, departure time and dwell time. The bus arrival time prediction model is officially a linear model but authors had to estimate its parameters. Author still needs improvement in its accuracy by considering various other factors. This system has much complexity involved in it. The prediction factors consider various occasions, time of travel, etc. as the affecting factors for bus time



prediction. This system is needlessly complicated.

The system described above reviews the work of RFID based tagging. The system is divided into three parts: the IN-BUS module, the BUS-STATION module and the BASE-STATION module. The IN-BUS module is responsible for reading the tags. The BUS-STATION module consists of tags that are to be read by the bus module. The BASE-STATION module consists of the computational end of the system. Gabriel Agamennoni et al. [7] proposed an alert bus monitoring, identification and management method using RFID and sensing applications. A hypothetical model and interface algorithm use RFID and communication technologies, i.e. GIS, GPS (Global Positioning System) and GPRS are developed for a model. The algorithm at the server end is able to analyze information about the driver, the bus location and the status of the bus, and whether it is running as per the schedule. Thus, the designed module is able to improve the effectiveness of the campus bus system.

Feng Li et al. [8] discussed how to extract the principal road path from the maps. The automatic extraction of paths from the map images help in digitization of the maps. Biagioni James et al. developed a proprietary application called EasyTracker [9] to track the location of the bus based on the GPS coordinates.

M. A. Hannan et al. presented a new approach to integrate RFID (Radio Frequency Identification) and WSN (Wireless sensor network) [10]. In this literature the authors suggest that the RFID tags should be mounted in the bus stop. Here they suggest that the tags should be read with the help of WSN. WSN is used because WSN has a wider range as compared to the normal tags. Authors also suggest that the energy levels are optimized by the use of WSN. Integration of WSN with the RFID results into an intelligent bus tracking system. Depending on the monitoring data the administrator can determine whether the bus will arrive late, on time or early. This information is conveyed by the server to the wireless network and displayed in the bus stop.

Yidan Fan et al. discussed tracking of the bus in cities based on cell tower location [13]. This system requires tie up with the cell tower companies to track the area in which the bus is

travelling. As the system does not use GPS, the location of the bus provided is in the form of area of the location range and not the exact location. Pengfei Zhou et al. used participatory sensing [14] to detect the location of the bus and the arrival time. Participatory sensing is where the location of the bus is provided by the passengers travelling inside the bus.

Various literature use various techniques such as GPS, GPRS, RFID, etc. These techniques along with crowd sensing [15] produce cheaper implementations of the proposed system. Techniques such as crowd sensing encourage people in cities to participate in the process of gathering data about the bus's arrival time. Whereas, techniques such as traffic information management use real time traffic conditions to determine the arrival time of the bus. There is also a literature which discussed the determination of the location of the bus using cell tower positioning this technique uses the position of the cell towers and the data sent and received by the cell towers to determine whether the particular bus is travelling in the area of the located cell tower.

Luis G. Jaimes et al. discussed incentive techniques [17] to promote crowd sensing. Authors introduce the concept of reservation wage. Reservation wage is the minimum amount for which the user is ready to participate in the activity. This literature also discussed on rating the users on the basis of the number of contributions made to the system. An intensive survey [18] of the factors affecting the traffic conditions on the Indian city roads is carried out. This survey was sponsored by the government of India. This literature identifies as many as 17 factors affecting the traffic conditions on Indian roads. Gabriel B. Kalejaiye et al. [22] discussed a frugal way to get the location of the bus based on participatory sensing this method requires intensive participation by the passengers of the bus.

Table 2.1 Comparative study of techniques

Authors	Features	Future Scope
Lovell D J et al. 2001 [1]	Calculates the current speed of the bus and does not consider the bus arrival time.	Include the bus arrival time prediction
Steven I-JyChien et al. 2002 [2]	Highly accurate predictions on the trained paths and Time consuming	Bus breakdown management system not included
Dihua Sun et al. 2007 [3]	Route direction of the bus is predicted.	Bus breakdown system not implemented
Shravan Gaonkar et al. 2008 [4]	Involves people's participation in determination of path of the bus and does not include the tracking of the bus	GPS data could be used to track the bus in real time.
Amir Saffari, et al. 2009 [5]	Covers online implementation of random forest model	Not applied to bus arrival time prediction
Simon Bernard et al. 2009 [6]	Present a study on the RandomForest family of ensemble methods	Does not consider application of random forest.
Huan Xu et al. 2010 [7]	Discusses the robustness of lasso regression technique	Does not consider application to real world problem.
Gabriel Agamennoni et al. 2011 [8]	Digital maps help in finding the direction of the maps and does not discuss bus arrival and tracking systems	Bus arrival time and bus delay predictions could be included
Feng Li et al. 2011 [9]	Considers detailed information relating to a particular traffic route and system is too complicated to be implemented	GPS tracking can be used to track the real time position of the bus.
James Biagioni et al. 2011 [10]	Proprietary software does not include bus breakdown management system	Bus breakdown management system system.
M. A. Hanna et al. 2012 [11]	High accuracy in detection and implementation and Costly implementation	Simpler and cheaper technologies could be used to develop the system.
Paola Arce et al. 2012 [12]	Online facility to use ridge regression is applied.	Application to bus management is not discussed
Mohammed S. Alam et al. 2013 [13]	Random forest method is used to detect android malware	Stacking of random forest could be used
Yidan Fan et al. 2014 [14]	Lower power consumption and requires tie-up with network providers	GPS location tracking could be used

Pengfei Zhou et al. 2014 [15]	Cheaper implementation at server side and users have to invest their own data to contribute	Incentive techniques could be used to lure the users
Lei Wang et al. 2014 [16]	Has higher accuracy and does not consider the bus broken down system	Bus breakdown management system could be introduced
Jinrong He et al. 2014 [17]	Presenta nearest nonlinear subspace classifier that extends ridge regression classification method to kernel version	Bus time tracking is not discussed.
Luis G. Jaimes et al. 2015 [18]	Crowd sensing is a cheaper solution to bus arrival prediction problem and suffers heavily if the user decides not to cooperate with the system	Monetary benefits can be increased
B. Dhivyabharathi et al. 2016 [19]	Detailed survey about Indian traffic conditions and no application developed	An app should be developed
Tianqi Chen et al. 2016 [20]	Xgboost has poor performance as compared to ridge, random forest, etc	Ensemble method should be used to increase accuracy
Ferran Diego et al. 2016 [21]	Gradient boosting performs poorly as compared to other algorithms.	Ensemble method should be used
Muthukrishnan R, Rohini et al. 2016 [22]	Lasso regression does not perform well on its own	Performance needs to be enhanced
Gabriel B.Kalejaiye et al. 2017 [23]	Cheaper implementation and suffers if user decides not to participate	GPS data could be used to track the bus in real time.
Xiaobo Liu et al. 2017 [24]	Stacking algorithm can perform predictions on its own.	Results that are obtained are better if other algorithms are used

Based on survey as shown in Table 2.1 there is scope for future development. These future scope is taken into account in this implementation. Various literature discussed use the GPS coordinates but do not apply machine learning techniques to them. Machine Learning techniques

are applied to captured GPS coordinates. Other literature do not apply machine learning to the problem of bus arrival time prediction which is also addressed here. The technologies used in various literature are shown in Table 2

Table 2.2 Technologies used

Parameters	Participatory Sensing used	GPS Used	App developed	Cost Effective
Feng Li et al. 2011 [1]		✓	✓	
James Biagioniet al 2011 [10]		✓	✓	

M. A. Hanna et al. 2012 [11]		✓	✓	
Yidan Fan et al 2014 [14]			✓	
Pengfei Zhou et al. 2014 [15]	✓		✓	✓
Luis G. Jaimes et al. 2015 [18]	✓			✓
Gabriel B.Kalejaiye et al. 2017 [23]	✓		✓	✓
Proposed System		✓	✓	✓

Table 2.3 Parameters Used

Papers	Technique	Dataset	Metrics	# Parameters
Steven I-JyChien et al. 2002 [2]	ANN	New Jersey Transit Corporation	RMSE	Stop-to-stop distance, Number of intersections, Simulated travel time
Dihua Sun et al. 2007 [3]	Different Algorithm	Chongqing, China	MAPE	GPS Coordinates of bus
Feng Li et al. 2011 [9]	Statistical approach	Hong Kong City	MAE	Departure time, Work day, Bus location, # links, # intersections, passenger demand
Yidan Fan et al. 2014 [14]	Cell of origin (COO)	Beijing, China	MAPE	Cell tower location
Pengfei Zhou et al. 2014 [15]	Participatory sensing	Singapore public buses	Median Absolute Error	Cell tower signals, movement statuses, audio recordings
Proposed System	Machine Learning	New York City MTA	MAE, MSE, RMSE, MSLE, Median Absolute Error, R2	Source, Destination and Bus location coordinates, Distance from Stop, Recorded and Scheduled Arrival Time

Table 2.3 shows the evaluation parameters, techniques, data sets used by various authors. In the table RMSE stands for Root Mean Squared Error, MAPE stands for Mean Absolute Percentage Error, MAE stands for Mean Absolute Error. Symbol # is read as number of.

### 3 Methodology

The data that is used has to go through a data processing cycle as shown in the Figure 3.1.

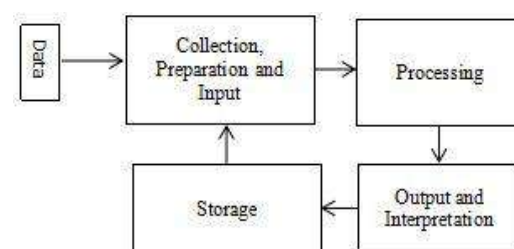


Figure 3.1 Data Processing Cycle

#### 3.1 Collection, Preparation and Input

Collection of data is the step where data is collected from various sources of data. Preparation is the step of converting data into one common format after combining the data of various formats. Input is the process of storing

data into a format that is processed by the computer. As database is available readily in a csv format, it is not required to prepare and input the data. The data is already in a format acceptable to the computer

### 3.2 Processing

Processing is the action of converting the data into data type that is readily accepted by the algorithm. This is done in various steps as below:

#### 3.2.1 Removing rows with more than 17 fields

It is observed that the given database has 17 fields normally, but some of the data have 18 fields. Such records were found out and discarded with the help of the following procedure.

- 1: Open "mta\_1706.csv" as file1 in read mode
- 2: Open "out.csv" as file2 in write mode
- 3: For each line in file  
Split values separated by comma
- 4: If number of fields is 17  
Write line to file1
- 5: Remove "mta\_1706.csv"
- 6: Rename 'out.csv' as 'mta\_1706.csv'

#### 3.2.2 Drop rows with empty data values

Dropna() is a method provided in pandas to drop the rows or columns containing empty values. Axis parameter decides whether to delete a row or a column. Axis with a value 0 assigned to it deletes a row and value 1 deletes a column. data.dropna(axis=0, how='any', thresh=None, subset=None, inplace=True)

#### 3.2.3 Converting recorded time, expected time in seconds

Algorithms can process only integer and float type values. It is needed to convert the datetime format values to integer type values denoting the second of the day.

- 1: Recordedsecond = ( RecordedAtTime.hour \* 3600 ) + ( RecordedAtTime.minute \* 60 ) + RecordedAtTime.second
- 2: ExpectedSecond = ExpectedArrivalTime \* 3600 + ExpectedArrivalTime \* 60 + ExpectedArrivalTime.second

#### 3.2.4 Converting Scheduled arrival time to valid datetime data type

Scheduled arrival time in the data set is not in valid datetime format. Therefore a procedure to convert scheduled arrival time to a valid datetime format is written. This changed format is stored in column NewScheduledArrivalTime.

- 1: list1=[]
- 2: for dt in ScheduledArrivalTime  
if int(dt[2])>23  
dt=str(int(dt[2])%24)+str(dt[2:])  
list1.append(dt)
- 3: NewScheduledArrivalTime = list1

- 4: list2=[]
- 5: for line in NewScheduledArrivalTime
- 6: csv\_row=line.split(":")
- 7: hour=csv\_row[0].strip().zfill(2)  
minute=csv\_row[1].strip().zfill(2)  
second=csv\_row[2].strip().zfill(2)  
str1=hour+":"+minute+":"+second
- 8: list2.append(str1)
- 9: NewScheduledArrivalTime = list2

#### 3.2.5 Converting NewScheduledArrivalTime in seconds

Since the scheduled arrival time is in datetime format, a procedure is written to convert it into seconds.

ScheduledSecond = NewScheduledArrivalTime.hour \* 3600 + NewScheduledArrivalTime.minute \* 60 + NewScheduledArrivalTime.second

### 3.3 Output and Interpretation

This step is concerned with output of the modified data being displayed on the screen. The screen shots below show the data snippet along with the data types of each field in the data frame.

In [2]: data

Out[2]:

	RecordedAtTime	DirectionRef	PublishedLineName
0	2017-06-01 00:03:34	0	B8
1	2017-06-01 00:03:43	1	S61 FE
2	2017-06-01 00:03:49	0	Bx10 E 206 S
3	2017-06-01 00:03:31	0	Q5 TEARD
4	2017-06-01 00:03:22	1	Bx1 RIVER

Figure 3.3.1 Data

In [3]: data1.dtypes

Out[3]:

DirectionRef	int64
OriginLat	float64
OriginLong	float64
DestinationLat	float64
DestinationLong	float64
VehicleLat	float64
VehicleLong	float64
DistanceFromStop	float64
Recordedsecond	int64
ExpectedSecond	int64
ScheduledSecond	int64
dtype:	object

Figure 3.3.2 Data Types

### 3.4 Storage

This step deals with the storage of the modified data back to the original file. As shown in the procedure snippet, the modified data is written back to the original file.

data.to\_csv('mta\_1706\_01.csv', index=False, header=True)



#### 4 Fitting Data Into Various Models

The following procedure snippets show the way in which the data is fit into the models.

##### 4.1 Random Forest

Random forest is an ensemble [5] learning method for regression. In this method a number of decision trees are created and the decision is made based on the numerous decision trees [6]. Random forest is best known for over fitting the training set [13]. The procedure to fit the data in training set is given below:

```
fromsklearn.ensemble import
RandomForestRegressor
model=RandomForestRegressor()
model.fit(x_train, y_train)
```

##### 4.2 Lasso Regression

Lasso regression performs both variable selection and regularization [7] so as to improve prediction accuracy and of the statistical model. Lasso regression was originally defined for least squares. It is also extended to a wide variety of statistical models including generalized linear models [22], generalized estimating equations, proportional hazards models, and M-estimators. The following is the procedure to fit lasso regression to training data set

```
fromsklearn import linear_model
model = linear_model.Lasso(alpha=0.1)
model.fit(x_train, y_train)
```

##### 4.3 Ridge Regression

Ridge Regression is a technique for analyzing multiple regression data that suffer from multicollinearity [12]. When multicollinearity occurs, least squares estimates are unbiased, but their variances are large so they may be far from the true value. By adding a degree of bias to the regression estimates [17], ridge regression reduces the standard errors. It is hoped that the net effect will be to give estimates that are more reliable. Example is given below:

```
fromsklearn.linear_model import Ridge
model = Ridge(alpha=1.0)
model.fit(x_train, y_train)
```

##### 4.4 Gradient Boosting

Gradient boosting is a method of regression in which a naive model is developed in the beginning. This model is iteratively [21] developed further based on the accuracy of the predictions made by the model. The maximum number of models to be made is specified among which the best will be selected. Following is the way in which the training data is fit into the model:

```
fromsklearn import ensemble
```

```
params = {'n_estimators': 500, 'max_depth':4,
'min_samples_split': 2,'learning_rate': 0.01, 'loss': 'ls'}
model =
ensemble.GradientBoostingRegressor(**params)
model.fit(x_train, y_train)
```

##### 4.5 XGBoosting

Gradient boosting is a ML technique for regression and classification problems, which produces a prediction model in the form of an ensemble of weak prediction models, typically decision trees [20]. It builds the model in a stage-wise fashion like other boosting methods do, and it generalizes them by allowing optimization of an arbitrary differentiable loss function. Given below is the procedure to fit data into the model:

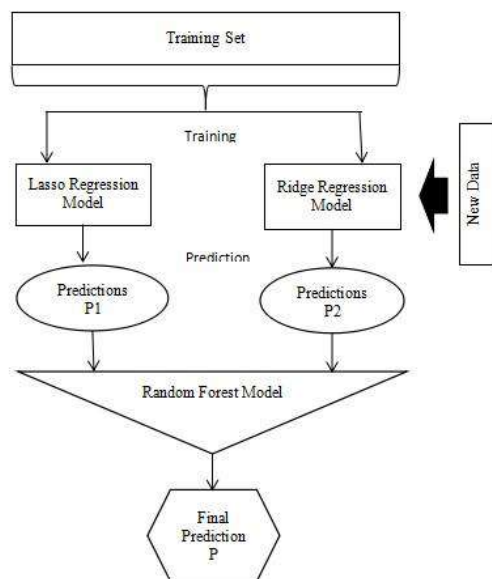
```
fromxgboost import XGBRegressor
model = XGBRegressor(n_estimators=1000,
learning_rate=0.05,n_jobs=4)
model.fit(x_train, y_train, early_stopping_rounds=5,
eval_set=[(x_train, y_train)], verbose=False)
```

##### 4.6 Stacking

Stacking or ensembling is a method of combining more than one methods of ML to obtain the predictions. Stacking of lasso, ridge and random forest methods is used to obtain predictions of expected arrival time. Figure below shows the block diagram of Stacking.

The procedure to fit the data is shown in the following procedure snippet:

```
ridge = Ridge(alpha=1.0)
lasso = linear_model.Lasso(alpha=0.1)
rf = RandomForestRegressor()
stregr = StackingRegressor(regressors=[lasso, ridge],
meta_regressor=rf)
stregr.fit(x_train, y_train)
```



**Figure 4.6. Stacking Block Diagram**

### 5 Making Predictions

Predictions are made with model fitting the data. These predictions are tested for accuracy in the next session.

`y_pred = model.predict(x_test)`

```
In [3]: y_pred
Out[3]: array([[58669. , 17207.1, 17207.1, 17153. , 17153. , 17153. , 58669. ,
  61622. , 61614. , 61608. , 61741. , 61620. , 73930. , 25755. ,
  25755. , 25802. , 25792. , 25775. , 73964. , 65401. , 65399. ,
  65475. , 65456. , 66021. , 29640. , 51706. , 51872. , 51742. ,
  51777. , 51706. , 29636. , 31363. , 31371. , 31376. , 31536. ,
  31370. , 32698. , 32703. , 32667. , 32711. , 32865. , 32664. ,
  32747. , 61510. , 61505. , 61543. , 61508. , 61581. , 1006. ,
  69426. , 69377. , 69358. , 69358. , 69359. , 1011. , 28094. ,
  28107. , 28266. , 28137. , 28094. , 63490. , 36162. , 36265. ,
  36077. , 36051. , 36074. , 63631. , 56143. , 55984. , 55935. ,
  55927. , 55927. , 3024. , 2969. , 58583. , 58570. , 58590. ,
  58570. , 58646. , 84191. , 84189. , 53867. , 53867. , 53875. ,
  53892. , 53918. , 54135. , 66012. , 66175. , 66033. , 66033. ,
  66066. , 54050. , 18756. , 18756. , 18759. , 18756. , 18756. ,
  18756. , 18795. ])
```

**Figure 5.1 Predicted Values**

## 6 Dataset and Result Analysis

### 6.1 Data Set Description

The data set used here is the data set from the data science website kaggle.com [1]. The data set is a 1.3 GB. A CSV file is downloaded from the website. Name of the file used is mta\_1706, there are 17 fields in the database viz. RecordedAtTime, DirectionRef, PublishedLineName, OriginName, OriginLat, OriginLong, DestinationName, DestinationLat, DestinationLong, VehicleRef, VehicleLocation.Latitude, VehicleLocation.Longitude, NextStopPointName, ArrivalProximityText, DistanceFromStop, ExpectedArrivalTime, ScheduledArrivalTime. It has 6730856 number of records. The Latitude and longitude values are of type float whereas the Distance is of type integer,

the time are of type datetime and the rest of type text. The data of datetime type needs to be converted to type integer value ie. seconds, as the algorithms process values of integer or float type only.

After cleaning the dataset the cleaned dataset is written to the file mta\_1706\_clean. It has 5804362 number of records. The dataset has 11 fields. All the values in the data set are either integer or float.

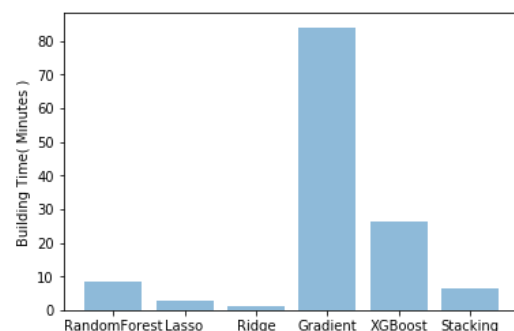
### 6.2 Result Analysis

The table below gives the time taken by the models to build and the time taken by the models to predict the data.

Models	Building Time (Minutes)	Prediction Time (Seconds)
RandomForest	8.4	0.4
Ridge	1.2	0.2
Lasso	2.1	0
Gradient	84.2	0
XGBoost	26.4	0
Stacked	6.8	7

**Table 6.1 Time Taken By Models**

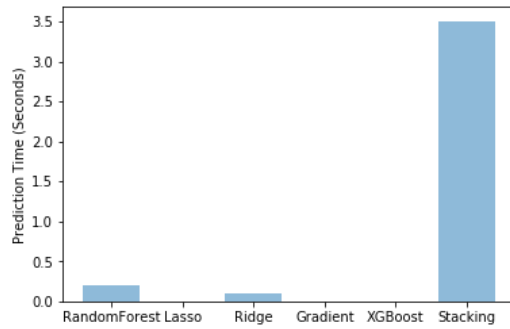
The bar graph below show the time taken by various models to build the models.



**Figure 6.1 Model Building Time**

As shown in Figure 6.1 the time taken by algorithms to build model is the lowest for linear models such as Ridge and lasso regression models. The time taken to build the models is the highest for gradient boosting model. XGBoost algorithm takes the second largest time to build the model. Random forest and stacking models take around 10 minutes to build the models.

The bar graph below shows the time taken by models to predict the data.



**Figure 6.2 Data Prediction time**

As seen in Figure 6.2 the time taken by stacking model to predict the data is the highest at around 3 seconds. All the other models require time less than one second to predict the data.

A bus arrival time prediction application is a technique of regression. Thus we use the most common regression metrics like variance, mean absolute error, mean squared error, mean squared log error, median absolute error and r2 score to evaluate bus arrival prediction system.

### 6.2.1 Variance Error

Variance is the measure of deviation of the random variable from the mean. Variation measures how far the samples are spread from their average value. The value zero indicates that there is no variability in the values. The formula for variance is given below:

$$\sigma^2 = \frac{\sum (X - \mu)^2}{N} \quad (1)$$

Where  $\sigma$  = Variance

$\bar{X}$  = Average value of sample

$\mu$  = Individual values

$N$  = Total number of samples

The value of variance is the same for all the algorithms. This indicates that the variance among the predicted values is higher.

### 6.2.2 Mean Absolute Error

Mean absolute error (MAE) is the measure of difference between two continuous variables. MAE is the metric used in determining the difference between the predicted and observed value. MAE is the average of the differences between the observed and predicted values. The formula for MAE is given below:

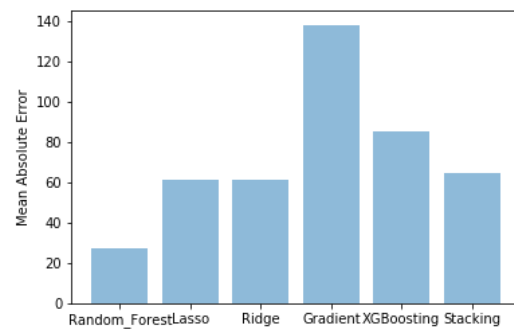
$$MAE = \frac{\sum_{i=1}^n |y_i - x_i|}{n} \quad (2)$$

Where  $y_i$  = Observed value

$x_i$  = Predicted value

$n$  = Number of samples

Mean absolute error for the test data is shown in Figure 6.4



**Figure 6.3 Mean Absolute Error**

As seen in Figure 6.3 the value of mean absolute error is the minimum for random forest at around 20 seconds. It is followed by lasso and ridge regression both at 60 seconds. Stacking of random forest lasso and ridge yields the fourth rank at 62 seconds. XG Boost and gradient algorithms follow at 84 and 135 seconds respectively

### 6.2.3 Mean Squared Error

Mean squared error MSE is the square of difference between the observed value and the predicted value. The formula for MSE is as given below:

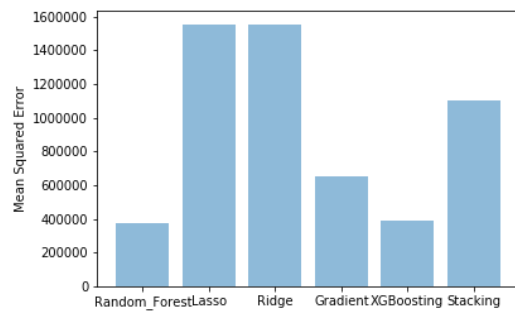
$$MSE = \frac{\sum_{i=1}^n (Y_i - \hat{Y})^2}{n} \quad (3)$$

Where  $Y_i$  = Observed value

$\hat{Y}$  = Predicted value

$n$  = Number of Samples

Mean squared error for the test data is shown in Figure 6.4



**Figure 6.4 Mean Squared Error**

The value of mean squared error is the minimum for random forest regressor, followed by XGBoost and gradient boosting. Stacking gives the fourth highest mean squared error. It is followed by lasso and ridge regression models.

#### 6.2.4 Mean Squared Log Error

Mean squared log error is the average of the difference between the logarithm of the observed and predicted values. The formula for mean squared log error is given as below:

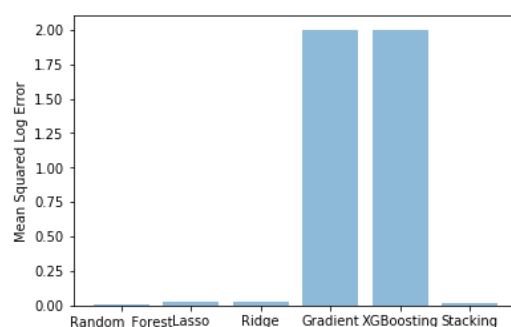
$$\frac{1}{N} \sum_{i=1}^n (\log(x_i) - \log(y_i))^2 \quad (4)$$

Where  $N$  = Total number of samples

$x_i$  = Observed values

$y_i$  = predicted values

Mean squared log error for the test data is shown in Figure 6.5



**Figure 6.5 Mean Squared Log Error**

As observed in the Figure 6.6 random forest, lasso, ridge and stacking all give mean squared log error less than 0.1. It is observed that XG and gradient boosting algorithm perform poorly.

#### 6.2.5 Median Absolute Error

Median absolute error (MAE) is the measure of difference between two continuous variables.

MAE is the average of the differences between the median value and predicted values. Median absolute error has an advantage of being less affected by noise. As the median always lies at the center of predictions, it cannot be one of the noise outputs. The formula for MAE is given below:

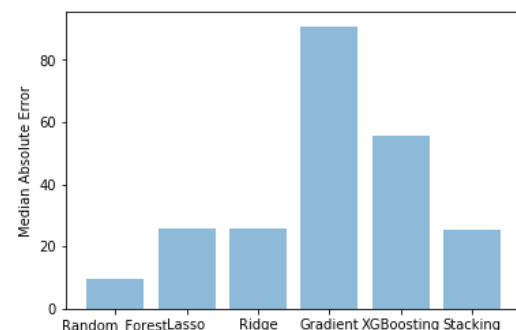
$$MAE = \frac{\sum_{i=1}^n |y_i - x_i|}{n} \quad (5)$$

Where  $y_i$  = Median value

$x_i$  = Predicted value

$n$  = Number of samples

Median absolute error for the test data is shown in Figure 6.5



**Figure 6.6 Median Absolute Error**

As seen in Figure 6.6 the value of median absolute error is the maximum for gradient boosting algorithm and XG boosting algorithm at 95 and 55 seconds respectively. Random forest has the lowest of median absolute error at 15 seconds. Lasso ridge and stacking all have median absolute error of 25 seconds.

#### 6.2.6 R2 Score

R2 is also known as coefficient of determination. R2 score is the proportion id dependent variable that can be determined from the independent variable. It provides a measure of how well the observed outcome is reflected in the predicted outcomes. The sum of square is given by the formula:

$$SS_{tot} = \sum_i (y_i - \bar{y})^2 \quad (6)$$

Where  $\bar{y}$  = Mean of observed data

$y_i$  = Individual observed value

Residual sum of squares is given by the formula:

$$SS_{res} = \sum_i (y_i - f_i)^2 \quad (7)$$

Where  $y_i$  = Observed values

$f_i$  = Residual values

Then the coefficient of determination R<sup>2</sup> is given by formula:

$$1 - \frac{SS_{res}}{SS_{tot}} \quad (8)$$

R<sup>2</sup> value is 1 for all the algorithms. It can be inferred that the independent factors are represented very well in the predicted values.

## 7 Conclusion

Stacked (lasso, ridge and random forest) model is effective. It gives a variation of 30 seconds which is acceptable. Random forest regression performs better as compared to other individual methods. Ensemble technique is better as compared to boosting techniques. This application is useful and reliable in the smart cities for road transportation. A real time feed of data can be useful for more accurate predictions.

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## USABILITY ANALYSIS AND IMPROVEMENTS WITH AGRICULTURAL SERVICES.

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### **Abstract:**

*Agriculture is the backbone of India as a developing country. Most of the people in rural areas practice agriculture as their main occupation. Since ages, they have been practicing traditional methods of farming and they have a wide knowledge about those methods. Nowadays technology have developed so much that farmers are not much familiar with newer agriculture techniques. Tremendous digital data is available related to agriculture but they are not able to access real time to the factual information. The proposed system represents a digital tool in the form of website as well as a mobile application: e-farm with C.R.O.P named as "CropCare" which will help farmers intelligently. It will include services such as crop disease detection with solutions and nearby pesticide vendors, crop yield predictor and recommendation of best crop. Prime focus is to improve the usability of designed ICT tool. Other features would include discussion forum, weather updates and multi-lingual support to user. The ICT tool is designed and implemented with an aim of providing scalability, ease of use and community oriented design. This will reduce the digital gap among famers towards technology. Increasing the usability of agricultural services by providing a better tool is the prime focus.*

### **Keywords:**

*Agriculture, Usability, Crop disease management, Crop yield prediction, Best crop, Usability evaluation, SUS, ICT.*

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## I. INTRODUCTION

In India most of the population follows agriculture as their occupation. Being an agriculture based developing country there is a need to provide the best platform to agricultural services. People in rural areas are unaware about the advancement in technologies. The progress in rural areas is affected by poor economic condition, illiteracy, lethargic attitude towards technology, lack of good information dissemination tools, technological anxiety towards IT infrastructure. Since old days, farmers have been practicing traditional agriculture methods so they are not much familiar with newer techniques. Lots of digital data is available today in agricultural domain but the rural people are not able to make use of it. There is a need to develop good crop detection systems, crop yield prediction tool, regular weather updates etc. ICT tools such as websites, mobile applications act as a good medium to exchange agricultural information between users and providers. This will help them connect with the real time systems. Websites as a best communication media these days. Mobile apps have become very handy and easy to use tool. Usability is an important factor which decides whether the system is usable to

user or not. Acceptance of any new tool depends on the usability of tool. Usability in agriculture area seems to be bit complex as lots of data is available but the users are unaware about it, how to use it and how to practice it in daily life. A good dissemination system with multiple agricultural services will bridge the digital gap among the rural farmers of India.

So as a solution to improve the usability in agricultural domain, this project explores to design and develop a user friendly ICT tool "e-farm with C.R.O.P names as CropCare where **C**: Crop disease detection, **C**: Crop yield prediction, **R**: Recommendation of best crop, **O**: Other services such as weather updates, discussion forum, **P**: Pesticide recommendation. It would be a user-centric ICT (Information and Communication Technology) solution that will be scalable, efficient, easy to use, community oriented tool. [2]

## II. OBJECTIVES

- Recommendations or solutions to improve usability in the context to minimize digital divide.

- Providing a crop detection tool in which farmers will be able to detect crop diseases by uploading images as well as by entering symptoms and get solutions along pesticide vendors of their region.
- Providing a crop yield predictor with respect to water, temperature, soil etc which will help farmers in decision making.
- Solving linguistic problem by providing solutions in local language.
- Providing recommendation of best crop for their region.
- Discussion forum which will gather farmers to discuss about their farming problems.
- Providing weather forecast of different regions.

### III. ARCHITECTURE OF THE PROPOSED SYSTEM

The proposed system given below integrates multiple technologies and services that will improve the usability in agricultural activities. Users can detect crop diseases, calculate the crop yield, select the best crop to harvest according to their region. Additional features will include weather details, discussion chat box, various videos will be provided. Information will be provided in farmers regional languages.

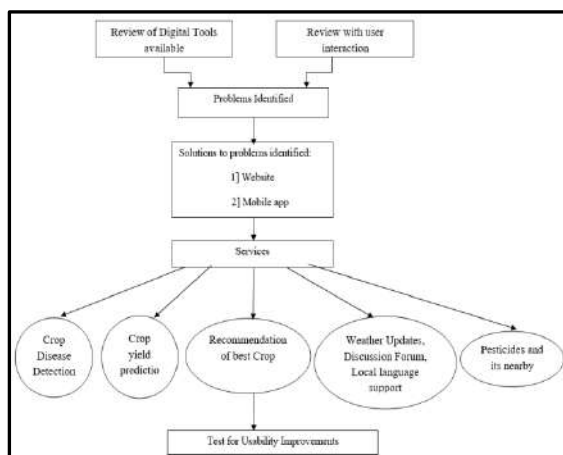


Fig 1:- Architecture of Proposed System

### IV. SYSTEM METHODOLOGY OF SERVICES

#### A. Crop Disease Detection

Here the image processing techniques is used to detect crop disease. Diagnosis is done using infected images of crops. Text based search is also provided. This will:

- Create a very handy agriculture environment for rural farmers to identify the diseased crops.

[2] SIFT an image processing algorithm would be used for different feature extraction from images and then do similarity matching to get the results. The architecture for crop disease detection is given below in figure 2.

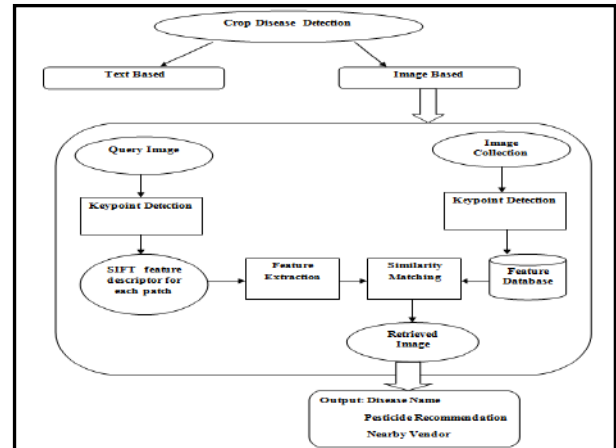


Fig 2:- Crop disease detection technique architecture

#### Method 1: Text Based Crop disease detection

Here user need to just enter the crop details. Simply by entering crop name, part of affected crop and its symptoms, system will generate the output with disease name and solutions for it.

#### Method 2: Image Based Crop disease detection

In this user need to either click the crop image or upload it directly and the system will apply Scale-invariant feature transform (or SIFT) algorithm to it. It is an algorithm in computer vision to detect and describe local features in images. Detection of various distinct, scale invariant image feature points is done by SIFT. Then it will be matched for query image and the image from database. In this way crop disease would be found out along with its solutions to cope up with that disease.[2]

#### SIFT Algorithm :

- Step 1: To construct a scale space
- Step 2: Perform LoG Approximation
- Step 3: To find key points
- Step 4: Remove bad key points
- Step 5: Key points are assigned an orientation
- Step 6: Generation of SIFT local features
- Step 7: Perform Similarity Matching

#### B. Crop Yield Prediction

One of the tool required for farmer in his farm is crop yield predictor. It will help to estimate the crop

production in agriculture domain. This will help users to make strategic decisions in farming activities to improve the crop yield in future. For this past data and its analysis is to needed. To do this multiple regression technique proves to be the best. It will be done using factors such as farmer skill, temperature, soil type, water availability, area, market demand, crop yield, etc as shown in figure 3.

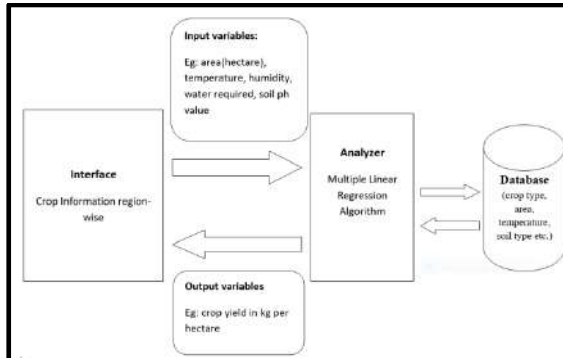


Fig 3:- Architecture of multiple regression for crop yield prediction

Following are the steps to construct regression models in figure 4 [12]:

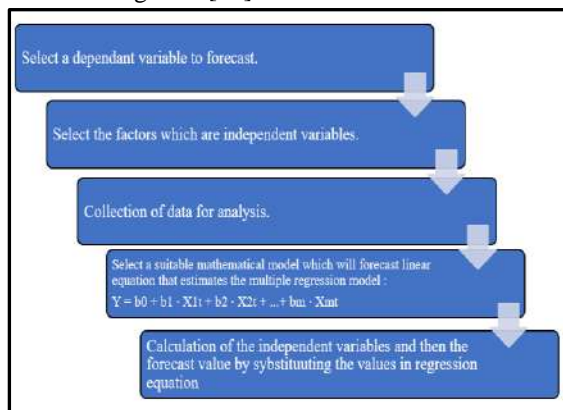


Fig 4 :-Multiple Linear Regression Steps

### C. Recommendation of best crop

In this service, a recommendation system will be developed which will help farmers to select the best crops for their region FAHP (Fuzzy Analytic Hierarchy Process) is selected as an effective tool as it handles uncertain data as well. Fuzziness of data in the process is also taken care by FAHP.

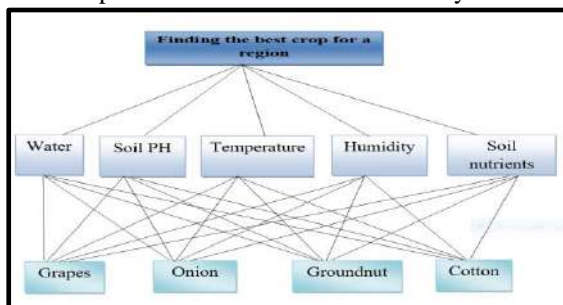


Fig 5:- Hierarchy for farmer's decision problem.

### Fuzzy AHP Algorithm :

To recommend the best crop for a region to farmers considering conditions and determined criteria in order of priority.

Fuzzy AHP steps [9]:

**Step 1:** For each criteria, develop weights or ranking by developing a pair -wise comparison matrix with respect to criteria. For that use the following table ;

Table 1: Triangular Fuzzy Numbers in FAHP

	Triangular Fuzzy Number	Description
A	(1, 1, 1)	Equally important
B	(1/2, 1, 3/2)	Intermediate
C	(1, 3/2, 2)	Weakly more important
D	(3/2, 2, 5/2)	Intermediate
E	(2, 5/2, 3)	Strong more important
F	(5/2, 3, 7/2)	Intermediate
G	(3, 7/2, 4)	Very strong more important
H	(7/2, 4, 9/2)	Intermediate
I	(4, 9/2, 9/2)	Absolutely more important

- Calculate fuzzy synthetic extent by referring to the comparison matrix and using the below formula [9],

$$Si = \sum_{j=1}^m M_i^j \times \frac{1}{\sum_{i=1}^n \sum_{j=1}^m M_i^j}$$

Where:

$$\sum_{j=1}^m M_i^j = \sum_{j=1}^m l_j, \sum_{j=1}^m m_j, \sum_{j=1}^m u_j$$

- Determine the vector value (V) by comparing each fuzzy synthetic extent values, and assign appropriate values to V. Consider,

$$M_2 = (l_2, m_2, u_2) \text{ and } M_1 = (l_1, m_1, u_1).$$

The degree of possibility for,

$$M_2 \geq M_1$$

is defined as:

$$V(M_2 \geq M_1)$$

$$= \begin{cases} 1 & \text{if } m_2 \geq m_1 \\ 0 & \text{if } l_1 \geq u_2 \\ \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)} & \text{otherwise} \end{cases}$$

- Determine Defuzzification ordinate (d) by assigning the minimum vector value(V) to corresponding d [9].

$$d(A_i) = \min V(S_i \geq S_k)$$

where  $A_i (i=1,2,...,n)$  are n elements ,  $i=1,2,...,k$  and  $k=1,2,...,n$

- We normalize the defuzzification ordinate (d) to get weightages ,

$$W = (d(A_1), d(A_2), ..., d(A_n))^T$$

where W is a non fuzzy number.

**Step 2.** Develop the weight-ages for each decision alternative (here crops) with respect to each criterion by repeating above steps.

**Step 3.** To obtain an overall rating for the alternatives, aggregate the relative weights of decision elements. Then finally the alternative with highest weight is the best alternative.

#### D. Other alerts such as discussion forum, weather updates, multilingual language support

Farmer will be able to get the weather details about his region. Discussion forum is the best way to put forward the queries related to farm activities. The tool data will provide all information in farmers local native language such as Marathi, Hindi ,English.

### V. USABILITY EVALUATION

Usability is a major factor when users consider if a new system is taken into wide use or not. The ISO 9241-11 standard defines usability as “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use”.

- Effectiveness: It tells about the completeness and accuracy with which users achieve specified goals.
- Efficiency: It tells how much effort do users require to do the specified goals.
- Satisfaction: It tells about comfort and acceptability of system for use.[10]

#### Empirical Testing process

An empirical study of a product's usability is obtained by users performing the real tasks with the developed system. Empirical evaluation means that information is obtained from actual users of the system.

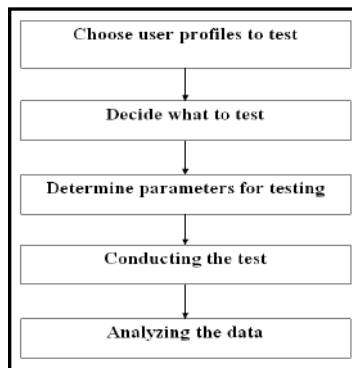


Fig 6:- Testing Flow for usability improvement

### VI. RESULTS AND DISCUSSION

#### A. Modified SUS for measuring usability of CropCare tool

This is a modification done to System Usability Scale (SUS) technique which contains 20 item questionnaire which has five response options for respondents. The range is from Strongly agree to Strongly disagree. Below is the modified SUS score for the questionnaire test conducted for 20 users.

Users	Modified SUS score
U1	96.25
U2	95
U3	86.25
U4	96.25
U5	100
U6	92.5
U7	82.5
U8	72.5
U9	87.5
U10	96.25
U11	82.5
U12	87.5
U13	92.5
U14	90
U15	88.75
U16	95
U17	96.25
U18	95
U19	98.75
U20	96.25
Average SUS score for website usability	
91.375	

[3] Fig 7:- Analysis of modified SUS for CropCare

Therefore, Usability score for CropCare ICT tool is **91.37** which falls under grade A+ according to the grading scale interpretation of SUS scores.[13]

#### B. Overall Usability analysis

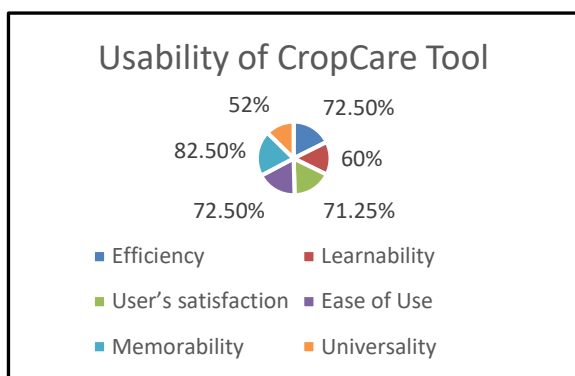
The following are the usability parameters on which the tool was examined with empirical method :

[4] Table 2: Usability ratings of parameters for CropCare tool

Usability Parameters	Ratings
Efficiency	72.50%
Learnability	60%
User's satisfaction	71.25%
Ease of Use	72.50%
Memorability	82.50%
Universality	52%

The table 1 shows the analysis of usability parameters for CropCare. The overall rating for Efficiency is 75%, Learnability is 60%, User's Satisfaction is 71.25%, Ease of Use is 72.50%, Memorability is 82.50% and Universality is 52%.





[5] Fig 8:-Graph analysis of CropCare tool  
Overall Average Usability of CropCare tool = (Efficiency + Learnability + User's Satisfaction + Ease of Use + Memorability + Universality) / total no of usability parameters = 68.46%  
Therefore, the usability of CropCare tool is **68.46%** with usability score **91.37** according to SUS interpretation. The usability grade for CropCare is **A+**.

## VII. CONCLUSIONS

To empower farmers and to increase the productivity there is need to provide the best dissemination tool for their farming activities. To cope up with the regular issues that farmers face in their farms, this developed systems will be very handy and beneficial. The developed ICT agricultural tools focus on very important agricultural services such as crop disease detection, crop yield predictor will help them to estimate the crop yield which will help them to make decisions in future, recommendation of best crop will help farmers to grow crops that will benefit in their respective region, help farmers to locate the pesticide vendors, weather services, discussion forum to communicate. Both website and mobile application interface are developed in local languages and the content is available in localized language. This will remove multilingual issues and bridge the gap between farmers and technology 'CropCare' shows promises and gives a future direction for a robust application, making it a more effective tool that all farmers can use for management of all kinds of crops.



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# INTELLIGENT GREENHOUSE MONITORING SYSTEM BASED ON INTERNET OF THINGS TECHNOLOGY

Payel Thakur, Aradhana Potteth, Shweta Purushothaman, Jidnyesha Takle, Rohini Bridgitte Stanly\* (PCE, New Panvel, India, Affiliated to University of Mumbai).

## Abstract:

Nowadays, technology is being used in our daily life. If agriculture is combined with automation, it will reduce manual hard work to a great extent. IOT (Internet of Things) technology was developed for connecting a billion of devices to an Internet. This technology has become very useful in agricultural modernization. A huge amount of information is transferred between the electronic devices. It is a new way to interact between device and people. We will use CC2530 chip as the core. This chip which is based on Zigbee technology will be connected to Raspberry pi. Sensor nodes will be connected to CC2530 chip. The system will be made to control temperature, humidity, moisture and light inside the greenhouse. The sensor nodes will sense the parameters inside the greenhouse and will provide notification to the user if necessary. User will control the parameters using Android application accordingly.

## Keywords:

Internet of Things, Raspberry Pi, , CC2530, CC2530F256, Zigbee technology

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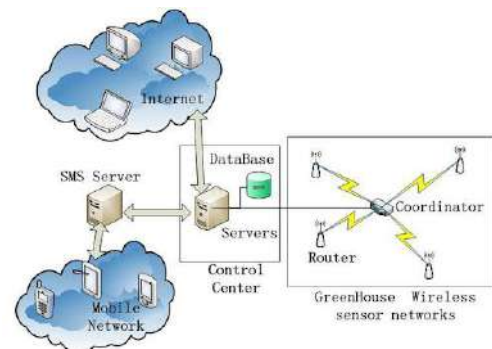
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## I. INTRODUCTION

This paper introduces a kind of greenhouse monitoring system which is constructed based on Zigbee technology.

The idea of this project is to build greenhouse based on IoT technology to monitor and control the environmental conditions in greenhouse frequently. It focuses on saving water, increasing efficiency and reducing the environmental impacts on production of plants. The user can see the current atmospheric conditions of the greenhouse plants on android application which are sensed using sensor and can control the environmental conditions accordingly. It is convenient as it can be controlled from faraway places.

Principle rule of the system is to control the present environmental conditions of the Greenhouse using sensors and chips. For IoT based system, the sensors and the chips will be controlled by Raspberry Pi 3. The chip for controlling sensors will be CC2530 more specifically CC2530F256 which provides a robust and complete ZigBee solution. The entire system will be managed manually using Android application.



**Fig. 1** Principle of the system [8]

## II. RELATED WORK

We referred various research papers. Out of the ten papers, six of them were based on Internet of Things technology. While two were based on Android platform. The remaining two depends on Micaz motes and embedded Web server technology respectively.

“Liu Dan Cao Xin Haung Chongwei Ji Liangliang” [3] et al. proposed greenhouse monitoring system by considering CC2530 chip as its core in WSN, the system is made up of front end and back end. In front end, actions such as data acquisition and data reception are performed, and in the back end, data processing and data transmission are performed. The ambient temperature is real time processed by temperature sensor and in the same way different parameters are processed using sensors. The processed data is send to intermediate node which combines all the data and sends it to PC through serial port; at the same time, staff may view and may send various

operations to be perform.

To meet the needs of remote monitoring of greenhouse system, a combined embedded technology with 3G communication technology and a scheme for monitoring real-time information and to control the parameters through an Android based platform is discussed in the paper proposed by “Li Zhang, Congcong Li” et. al.[6]

Integrating web and embedded technology, “Gao Junxianga” et. al. proposes a design for monitoring greenhouse system based on embedded web server and wireless sensor network. Firstly, tiered architecture monitoring system is discussed, and then detailed design of the system is given including hardware and software of embedded web server and wireless sensor network. The embedding way of web server in the device enable the embedded devices to be connected to the Internet and also enable users to access, control and manage the embedded devices using a standard web browser over the Internet without restrict of time and space.[7]

“Mustafa Alper Akkas” et. al. presents a WSN prototype consisting of MicaZ nodes which are used to measure greenhouses' temperature, light, pressure and humidity. Measurement data have been shared with the help of IoT. With this system farmers can control their greenhouse from their mobile phones or computers which have internet connection.[5]

### III. METHODOLOGY

The major components are Raspberry pi, GSM, a block consisting of factors such as temperature, humidity, light intensity and soil moisture and a block of actuators including fan, spray, light source and motors.

Sensor will sense the parameters such as temperature, humidity, light intensity and soil moisture present inside the greenhouse. If the parameters deviates from the threshold value, the user will get a notification in his cell phone via Android app.

The user will be able to control the greenhouse via installed actuators. Actuators include fan, sprinkler, light source such as LEDs and motor.

There are various applications of intelligent agriculture greenhouse environment monitoring system based on Internet of Things (IoT). The project is inclined towards a number of social applications. Various applications include Horticulture, Precision agriculture (PA) or Site Specific Crop Management (SSCM), Floriculture or flower farming, Greenhouse

automation, Crop management, Smart farming, End-to-end farm management systems.

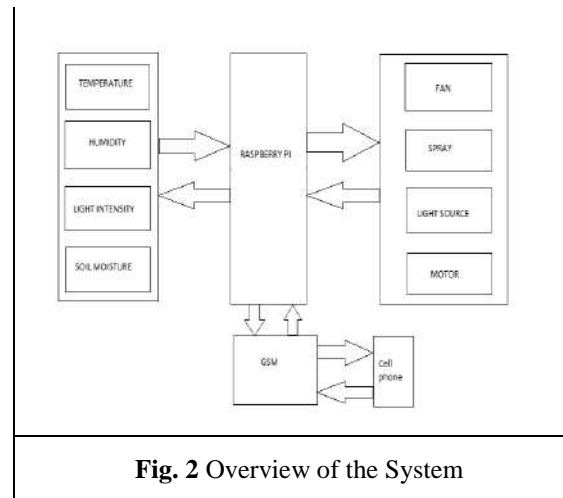


Fig. 2 Overview of the System

### IV. EXPERIMENTATION

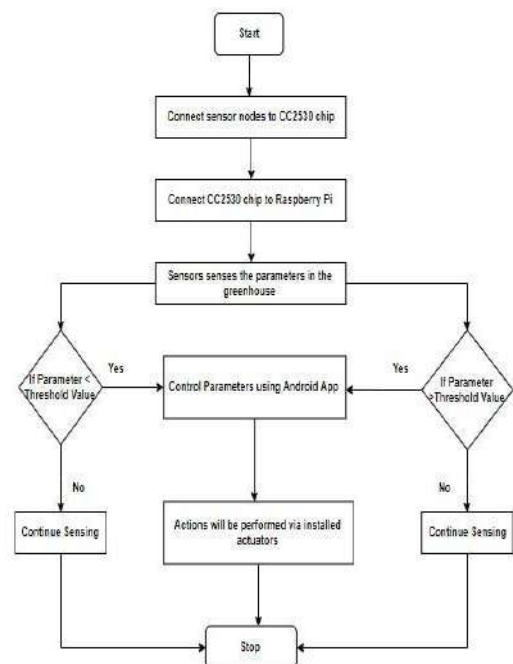


Fig. 3 Flowchart

The system is made up of front-end and back-end where the operations such as data acquisition, data processing, data transmission and data reception are performed. The real time parameters are taken into consideration. The real time data such as temperature, humidity, light intensity and soil moisture is processed using different sensors for each parameter of data terminal node. Processed data is sent to the intermediate node via wireless network. The intermediate node combines all the data and sends it to the user through a wireless GSM network and all this information is received by the user via an android application. So at the same time, staff may view,

analyse or store data on their phones using Android Application which can be used to provides different operations to be performed according to the statistics of the real-time data for agriculture greenhouse. Fans, motors and other parameter controlling actuators are present, in order to achieve automatic environment control.

Creation of the system is explained below: Connect sensor nodes to CC2530 chip. Connect CC2530 (more specifically CC2530256 K) chip to Raspberry pi. Sensor senses the parameters inside the greenhouse. If parameters exceed the threshold value, control the parameters using Android App via installed actuators. Else, continue sensing. Similarly, if parameters fall behind the threshold value, control the parameters using Android app via installed actuators. Else, continue sensing.

Many of the existing systems are using websites. The farmers who are not so educated can make mistakes while typing the url. Since we are using Android app, it can be installed by anyone. Also, the greenhouse can be controlled from any place. Thus, mobility is achieved.

## V. RESULTS AND DISCUSSION

There are various parameters present inside the greenhouse. Attributes such as temperature, humidity, light intensity and soil moisture are received via sensors. The sensors are there inside the greenhouse. The inputs for Android application are user controlled parameters and threshold values. Let us discuss the output. For the android application, various actuators such as fan, spray, light source and motor can be considered as the output.

The table given below represents sample dataset. The sample dataset consists of parameters and their corresponding threshold values. The dataset includes temperature, humidity, moisture and light intensity. The threshold value for temperature is 77F whereas the threshold for humidity is 35%.The standard values for moisture and light intensity are 32% and 33.8% respectively.

Dataset	Threshold
Air Temp (F)	77
Humidity (%)	35
Moisture (%)	32
Light intensity (%)	33.8

**Table 1.** Sample Dataset

## VI. CONCLUSIONS

We are designing an Android app which can be easily installed in any platform. As it is an app, we can use it anytime, anywhere. This way, mobility can be achieved. The Zigbee technology has low cost and low power. Since wireless sensor network instead of traditional wired network is used, it improves the operational efficiency and system application flexibility. As the system is automated, it reduces the manpower to a great extent.

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## DETECTION OF CYBERHECTORING ON INSTAGRAM

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### **Abstract:**

Cyberhectoring is a growing problem affecting more than half of the population. Cyberhectoring is affecting mostly among teenagers. This problem has to be tackled which is been done by many researchers. The main goal of this is to understand and automatically detect the incidents of cyberhectoring. This paper focuses on collecting data sets of Instagram i.e. images and their associated comments. A detailed analysis of the labelled data, including a study of relationships between cyberbullying and a host of features such as profanity, temporal commenting behavior, linguistic content and image content is made. The collected data is then processed and classified using classification algorithms and is further classified into bullying and non bullying content. Using the labelled data, we further design and evaluate the performance of classifiers to automatically detect incidents if cyberhectoring.

### **Keywords:**

Cyberhectoring, Cyberbullying, Automated detection, Machine Learning, CNN.

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## **I. INTRODUCTION**

A developing assortment of examination into cyberbullying in on the web social systems has been catalyzed by increasing commonness and extending outcomes of this sort of maltreatment. To date, automated recognition of cyberbullying has focused on investigations of content in which tormenting is suspected to be available. However, given the increase in media accompanying text in online social networks, an increasing number of cyberbullying incidents are linked with photos and media content, which are often used as targets for harassment and stalking. For the purpose of detecting cyberbullying, techniques such as Convolutional Neural Networks (CNN), Support Vector Machines (SVM), Bag Of Words, Word2Vec and OFFensiveness can also be used. We can analyze these techniques which are in association with our system. We can recognize the importance of these propelled highlights in identifying events of cyberbullying in posted remarks. We will be able to give results on assignment of pictures and subtitles themselves as potential focuses for cyberbullies. Utilizing highlights of the posted pictures and inscriptions.

## **I. OBJECTIVES**

The objective of detection of cyberhectoring is being

able to reduce the amount of bullying on Instagram. The objectives of this work is as follows:

1. To study the psychological impact on teenagers and attempt to reduce it.
2. To understand the behavior and reaction of the victim and the guilty on offensive and bullying content on social media.
3. To identify the intensity of bullying done with the help of text in caption or objects present in an image or both.

## **II. LITERATURE SURVEY**

We have learned various techniques that can be used in association with our system.

The detection of cyber hectoring in text can be done using various algorithms like Word2Vec, OFFensiveness, Bag Of Words (BOW) and the detection of cyber hectoring in image can be done using various algorithms CNN (Convolutional Neural Network) in Caffe. It can be used to prevent sharing of harmful or offensive content by detection. Although Warning mechanism is not provided [1].

Steps taken for detection of bullying on social media is learned. It provides guideline for the detection of cyber bullying. Although Data models are not

classified into predefined categories [2].

Detection of bullied images and texts by behavioral analysis using limited classifiers is done. Prediction of onset cyberbullying incidents is also mentioned. Although It detects only one profanity word [3].

Author is using deep learning for Systematic Analysis of Cyberbullying on various SMPs .Although Limited Information about the profiles on various SMPs. Current DataSet doesn't provide information about severity of Bullying[4].

### III. METHODOLOGY

The data in the captions of an image or that particular image itself is detected if they both or anyone consists of any sensitive or offensive information. This can be done using various

algorithms like Word2Vec, OFFensiveness, Bag Of Words (for text detection) and Convolutional Neural Networks CNN (for image detection). The algorithms used for text and images will be implemented using trained data sets which will be pre-defined data sets and these will be integrated for the purpose of showing connectivity or relation of captions with the images. This pre-defined data sets and integrated algorithms will be used to detect bullying content in the testing data sets. The detected text or image will appear as "Bullying Content Present" before displaying the actual image or text. Thus, we can say that the testing data sets is the input to the system and the message that displays the presence of cyber bullying is the output of the system.

The techniques which can be used for the detection of cyber hectoring in text in the caption of the image and that in the image itself is done by integrating the algorithms which can be used for individual text or individual image. The Output that can be obtained in CNN is in the form of text which is obtained from the input image having any kind of sensitive object in it, it can be detected using its algorithm. Now this text (object defined in terms of text) can be given as an Input to the Techniques used for text.

Rate of cyberhectoring amongst the teenagers is increasing with the increase in the usage of social media. The main goal of this project is to understand and automatically detect the incidents on cyberbullying. In recent times, techniques such as Convolutional Neural Networks (CNN), Support Vector Machines (SVM), Bag Of Words, Word2Vec

and OFFensiveness have also been used. We analyze these techniques which are in association with our system.

Various techniques and approaches can be proposed and developed to detect cyber bullying. The proposed approaches have focused only on the text and some only on the images. For the purpose of detection of cyber hectoring, techniques are divided into three major categories:

- 1) Detection of sensitive text.
- 2) Detection of objects in an image.
- 3) Detection of text and image together.

#### 1. Detection of sensitive text

The techniques in this category which can be used to detect the bullying occurring in the text. Their short description is given below:

##### 1a. Bag Of Words

To focus on the main topics and jargon used in the captions for images, we analyzed word frequency, using a Bag of Words model. The "Bag of words" model (BoW) is a baseline text feature wherein the given text is represented as a multiset of its words, disregarding grammar and word order. Multiplicity of words are maintained and stored as a word frequency vector. We applied standard word stemming and stop listing to reduce the dictionary size, then created a word vector in which each component represents a word in our dictionary and its value corresponds to its frequency in the text. Finally, we create a word vector, where each component represents a word in the dictionary we have generated and its value corresponds to its frequency[1].

$$\text{BoW3} = \text{BoW1} \cup \text{BoW2}$$

where BoW1 and BoW2 is the input of first sentence and second sentence respectively. The "union" of two documents in the bags-of-words representation is, formally, the disjoint union, summing the multiplicities of each element.

##### 1b. OFFensiveness

This technique is used for indicating that the occurrence of second person pronouns in close proximity to offensive words is highly indicative of cyberbullying, we use an "offensiveness level" (OFF) feature. We first use a parser to capture the grammatical dependencies within a sentence. Then for each word in the sentence, a word offensiveness

level is calculated as the sum of its dependencies' intensity levels.

$$O_s = O_w * D_j$$

where  $O_w = 1$  if word  $w$  is an offensive word, and 0 otherwise. For word  $w$ , there are  $k$  word dependencies, and  $d = 2$  if dependent word  $j$  is a user identifier,  $d = 1.5$  if it is an offensive word, and 1 otherwise[1].

### 1c. Word2Vec

Word2Vec is used for computing a continuous vector representation of individual words, commonly used to calculate word similarity or predict the co-occurrence of other words in a sentence. Here we generate a Word2Vec comment feature vector by concatenating each word's vector, based on the observation that performing simple algebraic operations on these result in similar words' vectors. For testing purposes, we apply pre-trained vectors trained on data[1].

$$M = U \cdot \Sigma \cdot V^T$$

where  $U$  is the topic matrix  $V$  is the image matrix and  $\Sigma$  is the matrix of singular values. Vector column of  $V$  sufficiently close:

$$1 < (v_i \cdot v_j) \div (||v_i|| ||v_j||) < 0.05$$

## 2. Detection of objects in an image

The techniques in this category are used to detect the bullying occurring in an image. Their short description is given below:

### 2a Convolution Neural Network (CNN)

Convolutional Neural Networks are used to detect objects present in a particular image. They are made up of neurons that have learnable weights and biases. Each neuron receives some inputs, performs a dot product and optionally follows it with a non-linearity. The whole network still expresses a single differentiable score function: from the raw image pixels on one end to class scores at the other. And they still have a loss function (e.g. SVM/Softmax) on the last (fully-connected) layer and all the tips/tricks we developed for learning regular Neural Networks still apply[1].

**3. Detection Of Image and text together:** In this technique, the combination of category 1 and 2 is used. The Output that is obtained in CNN is in the form of text which is obtained from the input image having any kind of sensitive object in it, it is detected

using its algorithm. Now this text (object defined in terms of text) is given as an Input to the category one. So here, the output of category 2 is given as input to category 1[1].

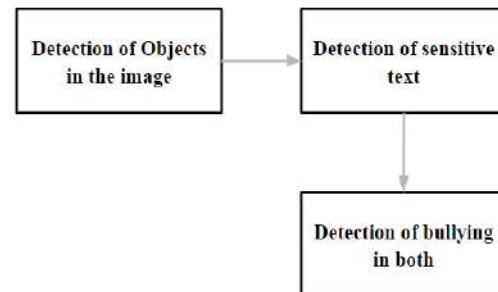


Figure 1.1: Hybrid technique

## IV. SUMMARY

We have considered the discovery of cyberhacking in photo sharing systems, with an eye on the advancement of early cautioning components for recognizing pictures powerless against assaults. With regards to photograph sharing, we have refocused this exertion on highlights of the pictures and inscriptions themselves, finding that subtitles specifically can fill in as a shockingly great indicator of future cyberhacking for a given picture. This work is a primary advance toward creating programming apparatuses for informal organizations to screen cyberhacking. The system we proposed will be used to detect cyber bullying in the text in the captions and in the images.

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## SMART AGRICULTURE

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**Abstract:**

Indian agriculture is diverse. It ranges from impoverished farm villages to developed farms utilizing trendy agricultural technologies. Lack of tangible information and communication ends up resulting in the loss in production. Promoting application of contemporary info technology in agriculture can solve a series of issues faced by farmers. Creating a "smart agriculture stick" can help combat the issues by providing all the data together which can be remotely viewed. Although about 71 percent of earth is covered by water, only about 2.5 percent is drinkable water. Therefore, it is quite evident that water is a precious resource. As gallons of water is wasted every year due to human negligence. "Water Level Detector And Controller" is an effort to reduce this wastage of water by carefully monitoring the level of water present in the well or any other water resource and automatically cutting off the supply of water when the tank is about to get full. If implemented properly and on a large scale, "Water Level Detector And Controller" project has the potential to save gallons of water and therefore contribute to a better tomorrow.

**Keywords:**

Green building, Energy, resource, Environment

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### I. INTRODUCTION

India is an agriculture oriented country and the rate at which water and soil resources are depleting is a dangerous threat hence there is a need of smart and efficient way of irrigation. Initially the farmer used to go and check the moisture in soil and condition of crop on his field every single day. This leaves the farmer very little time to do other work such as sell his crops, take care of cattles etc. it is also expensive and time consuming to call in an official operator to measure the level of moisture in soil. It is essential that we ditch the traditional methods of agriculture and give way to use of improved modern technology. This system provides an intelligent monitoring platform framework and system structure for facility agriculture ecosystem based on IOT.

It is also essential that we use the available water resources efficiently. For this there is a need for a system that monitors the water level as well. This will be a catalyst for the transition from traditional farming to modern farming. This is also an opportunity for creating new technology and service development in IOT (internet of things) farming application. [1]

### II. LITERATURE SURVEY

1. IOT based Agriculture System Using NodeMCU [K. Jyotsna Vanaja<sup>1</sup>, Aala Suresh, S. Srilatha, K. Vijay Kumar, M. Bharath [International Research Journal of Engineering and Technology

(IRJET) e-ISSN: 2395-0056 Volume: 05

Issue: 03 | Mar-2018 ]:

[6] Sensors are used to monitor the soil properties like temperature, humidity soil moisture PH. They aimed to overcome the disadvantage of Arduino boards and GSM technology where in Arduino boards acts as a microcontroller but not as a server. The main aim is to avoid water wastage in the irrigation process.

2. Sensor based Automated Irrigation System with IOT: A Technical Review [Karan Kansara et al, / (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 6 (6) , 2015, ]:

[7] Automatic microcontroller based rain gun irrigation system in which the irrigation will take place only when there will be intense requirement of water that save a large quantity of water. This application makes use of the GPRS feature of mobile phone as a solution for irrigation control system. These system covered lower range of agriculture land and not economically affordable.

3. IoT based Smart Agriculture Nikesh Gondchawar , Prof. Dr. R. S. Kawitkar [International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 6, June 2016]:

[8] This system which will inform the users about the level of liquid and will prevent it from



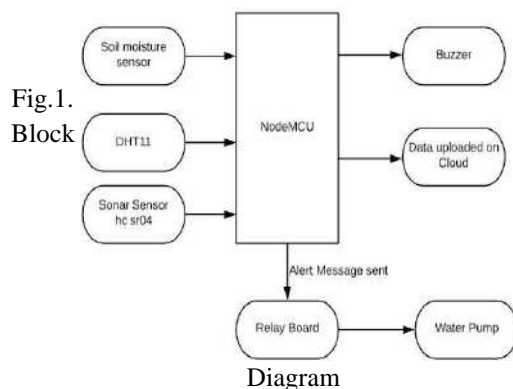
overflowing The system puts on the buzzer when the level of liquid collected crosses the set limit. Thus this system helps to prevent the wastage of water by informing about the liquid levels of the containers by providing graphical image of the containers via a web page.

[9]

### III. METHODOLOGY

Data has been obtained from analysing previous research papers and observation from day-to-day life. The system using 2 sensors viz. DHT11 (Temperature and humidity sensor) and Soil Moisture sensor It would be feasible for the operator as he can depict the temperature, humidity and the soil moisture from this model. The project connects and stores the data on a web server. The process of sending data to the internet using Wi-Fi is repeated after constant time intervals. The data available on cloud can be interpreted as it is on in the form of charts and graphs. Thus user gets real time information about the environment and condition in which his crops are in.

#### Block Diagram:



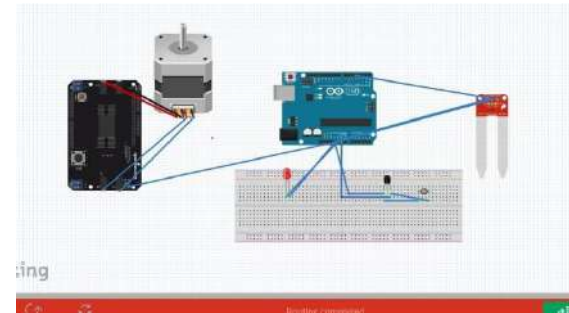
1. NodeMCU: This is considered as the brain of the project. This will be controlling and coordinating all the other blocks
2. Soil moisture sensor: It senses volumetric water content in soil. If the moisture level drops below a specified threshold (which can be set by the user) then it gives an alert message to the operator.
3. Dht11: This sensor senses the temperature and humidity of the environment.
4. Ultrasonic Sensor: This is mainly responsible for measuring the water level.
5. Single Channel Relay Board. NodeMCU will be controlling the Pump using this section.
6. Water pump: The operator can switch on/off the water pump according to the alert message received.
7. Buzzer. We use this unit to make the project more users friendly. This will produce beeping sound while the water level is very low or high.

The data is being uploaded on cloud simultaneously. The data can be accessed by authorised person for future reference and use.

### IV. EXPERIMENTATION

#### A. Circuit diagram:

Smart Farming stick:

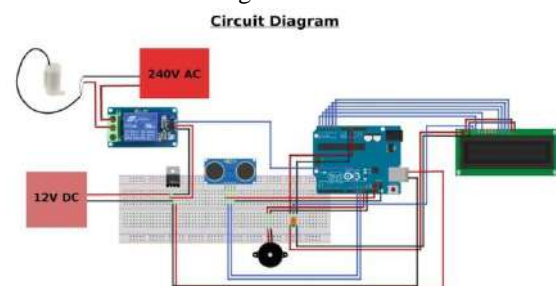


Connectivity of circuit

1. The output pin of moisture sensor is connected to analog pin A0 of nodemcu.
2. GND and VCC pin are connected to DND and 3v pins of nodemcu respectively.
3. Output pin of DHT11 sensor is connected to Digital pin D4 of nodemcu
4. GND and VCC pin are connected to DND and 3v pins of nodemcu respectively.
5. Negative of water pump is connected to GND of nodemcu and positive is connected to a power source.

#### B. Circuit Diagram:

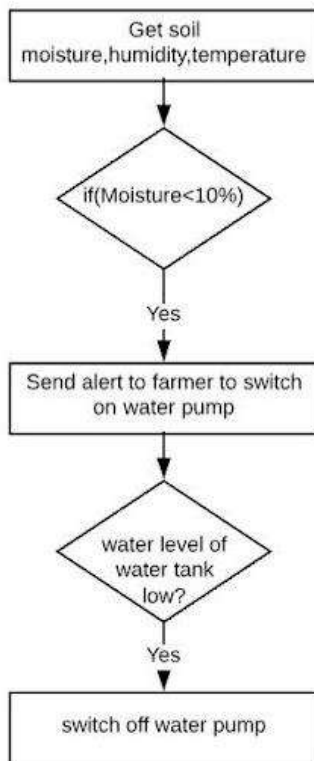
Water level monitoring:



The circuit connections are made as follows:

The sensor Vcc is connected to the NodeMCU Vin. The sensor GND is connected to the NodeMCU GND. The sensor Trigger Pin is connected to the NodeMCU Digital I/O D5. The sensor Echo Pin is connected to the NodeMCU Digital I/O D6.

#### C. Algorithm:



## V. EXPERIMENTATION

We have used C language to program the project. The program was compiled using Arduino IDE. This software allows the user to compile upload and see the result in the serial monitor. DHT11 sensor and Soil moisture sensor senses the data and sends it to the microcontroller. After the data is sent to the user, he can take appropriate action. If the water level is low, user switches on the water pump and hence the crops are watered.

```

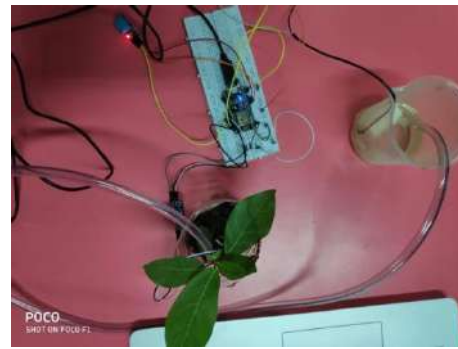
Serial.println(DHT11.readTemperature());
Serial.println("Current humidity = ");
Serial.println(DHT11.readHumidity());
delay(500);

float moisture_percentage;
moisture_percentage = (100.00 - ((analogRead(sensor_pin)/1023.00) * 100.00));
Serial.println("Soil Moisture (in Percentage) = ");
Serial.println(moisture_percentage);
Serial.println("\n");
if(moisture_percentage < 10){
  Serial.println("Moisture level below normal. SWITCH ON WATER PUMP\n");
}
// Thingspeak write
Thingspeak.write(Thingspeak.ChannelNumber, 1, 1, myWriteArray);
Thingspeak.write(Thingspeak.ChannelNumber, 2, 2, myWriteArray);
Thingspeak.write(Thingspeak.ChannelNumber, 3, moisture_percentage, myWriteArray);
delay(10000); // Thingspeak will only accept updates every 15 seconds.
}
  
```



**Fig. 1** Code implemented

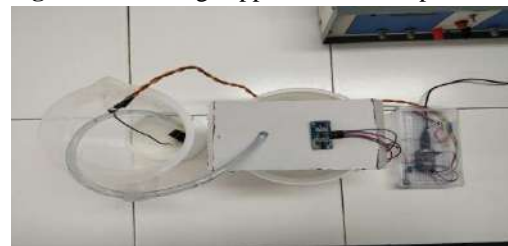
Using thingspeak we can upload the data being sensed real time on the cloud. Thingspeak also allows the user to see the data in different forms such as chart, graphs .etc



**Fig. 2** Working of project



**Fig. 3** Water being supplied to the Crop



**Fig. 4** Water level System



**Fig. 5** Buzzer rings when tank empty

**Data uploaded on Thingspeak:** The data is uploaded on the thingspeak channel in real time. The only requirement is the Wi-Fi be connected on the system. Using thingspeak the user can get all the data integrated on one platform. Thingspeak allows the user to view the data in the form of graphs, pie charts etc.



**Fig. 6** Humidity Data shown in thingspeak



**Fig. 7** Temperature Data shown in thingspeak



**Fig. 8** Soil Moisture Data shown in thingspeak

## VI. FUTURE SCOPE

In future we can add a switch which further automates the process of switching ON/OFF the water pump.

2. We can also add cameras to provide security from theft.

## VII. CONCLUSIONS

The whole system is almost automated, hence the efforts of the farmer is reduced. The data can be viewed remotely which makes it accessible anywhere anytime. This can not only be used for keeping the crops in safe environment but also to have an effective production rate.

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## SMART GARBAGE MANAGEMENT

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### **Abstract:**

*In the present scenario as the population is increasing day by day, the environment should be clean and hygienic. In most of the cities, the overflowed garbage bins creating an unhygienic environment. This will further lead to the arise of different types of unnamed diseases. This will degrade the standard of living. This project IOT based Garbage monitoring system is a very innovative system which will help to keep the cities clean. This system monitors the garbage bins and informs about the level of garbage collected in the garbage bins via LED's , buzzer and data uploaded in cloud. The system makes use of thingspeak for sending data and a buzzer. The data uploaded via thingspeak shows a statistical information. The display shows the condition of the trash stage and the other feeler information. The system puts on the buzzer when the level of garbage composed crosses the set limit. Thus this scheme helps to maintain the city sparkling by informing about the trash levels of the bins by providing graphical representation of the bins via thingspeak and blynk app.*

### **Keywords:**

*Internet of things, cloud computing, blynk notifications, smart garbage monitoring system, smart country.*

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## I. INTRODUCTION

In the present scenario as the population is increasing day by day, the environment should be clean and hygienic. In most of the cities, the overflowed garbage bins creating an unhygienic environment. This will further lead to the arise of different types of unnamed diseases. This will degrade the standard of living.

This project IOT based Garbage monitoring system is a very innovative system which will help to keep the cities clean. This system monitors the garbage bins and informs about the level of garbage collected in the garbage bins via LED's, buzzer and data uploaded in cloud. For this, the system uses ultrasonic sensor placed over the bins to detect the garbage level and compare it with the level of the garbage bins depth. The system makes use of thing speak for sending data and a buzzer. The system is powered with 5V power supply from the arduino board itself. The Organic Light Emitting Diode (OLED) screen is used to display the status of the level of the garbage collected in the bins. The data uploaded via thingspeak shows a statistical information. The display shows the condition of the trash stage and the other feeler

information. The system puts on the buzzer when the level of garbage composed crosses the set limit. Thus this scheme helps to maintain the city sparkling by informing about the trash levels of the bins by providing graphical representation of the bins via thingspeak.

## II. LITERATURE SURVEY

### **1.Smart Bin internet-of-things garbage monitoring system:-**

Mustafa M.R ,and Ku Azir K.N.F in their project had demonstrated a system that allows the waste management to monitor, based on the level of the garbage depth inside the dustbin. The system let users being alert the level of garbage on four types of garbage; domestic waste, paper, glass and plastic.

**2.Smart Dustbins For Economic Growth**  
[Nagaraju Urlagunta 2017](#), in his paper specifies a GSM modem which accepts a SIM card, and operates over a subscription to a mobile operator just like a mobile phone. Level detector is also used which consists of IR sensors which is used to detect the level of the garbage in the dustbin. This



output is given to microcontroller to send the message to the Control room via GSM module.

### 3. IOT garbage monitoring system

Dr. K. Alice Mary , Perreddy Monica , A. Apsurrunisa , Chathala Sreekanth , G. Pavan Kumar, in their project, which is built on Arduino board platform and IOT gecko web development platform. At the start, the garbage bin is unfilled and the sensors placed over the bins senses the level of the garbage composed in the bins. If the sensor senses no garbage in the bin then it does not refer information to the person who are monitoring in the control room.

### 4. Smart Garbage Monitoring System for Waste Management

[S. Vinoth Kumar, T. Senthil Kumaran](#), Aug 2017, in their paper "Smart Garbage Monitoring System for Waste Management" describes the level or the height of the garbage in each bin is measured by using the ultrasonic sensor. This information is then received and processed by the Arduino Uno. It will determine whether the garbage level has been surpassing the threshold level or not.. In this case, all the residents will be alerted when the red LEDs are turned ON.

### 5. Smart Garbage Monitoring System Using Sensor and RFID

[Somu Dhana Satya Manikanta](#), Narayanan [Madeshnan 2017](#) in their paper: have used RFID card where if the person coming to throw the waste into the bin RFID card reader read the information stored in the tag. Photoelectric sensor detects the clear detection of the object and sends the outline representation of object to the local authorities if is there any electrical components present inside the bin. Weight sensor detects the weight of the garbage present in the bin and with the help of RFID and IR sends the up to date information to the officers. They can monitor the bin if it fills they can squash that bin.

## III. METHODOLOGY

In Fig.1, The system is built up using NodeMCU, ultrasonic sensor, soil-moisture sensor, buzzer's and leds. The sensors are connected to the NodeMCU. Thingspeak and Blynk softwares are used.

The data obtained by the sensors are uploaded into the thingspeak. Blynk will help for getting

Notifications and emails on mobile phones of the person who is monitoring this system.

### BLOCK DIAGRAM:

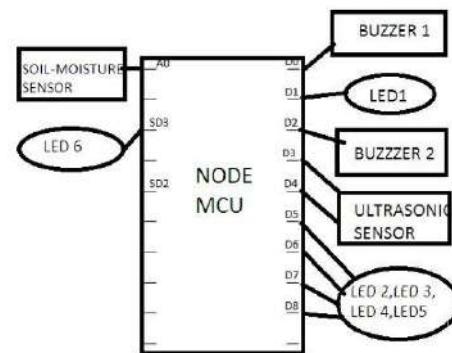


Fig.1 Block Diagram

### Hardware and Software used are:

**1. Ultrasonic sensor:-** As the name indicates, ultrasonic sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception.

We are putting this sensor on the lid of dry waste for measuring the level of garbage in the dustbin and comparing it with height of dustbin for giving information and knowing the status of garbage bin.

**2. Soil Moisture Sensor:-** Soil Moisture Sensor is a simple breakout for measuring the moisture in soil and similar materials. The soil moisture sensor is pretty straightforward to use. The two large exposed pads function as probes for the sensor, together acting as a variable resistor.

We are putting this sensor on the lid of wet waste for measuring the moisture in the wet garbage. If moisture level in the garbage bin is above the fixed threshold then notification will get on the mobile and the person who is monitoring it will get know the status of the wet dustbin.

**3. Buzzer and led:-** we are adding buzzer and three led for each dry as well as wet dustbin. when dustbin is 10% full then lower (yellow) led will glow, when dustbin is 50% full then middle (green) led will glow and when the garbage level cross the third threshold level i.e. when garbage in the dustbin is above 75% and it is getting full that time higher (red) led will glow along with buzzer and blynk will send the

notification and emails regarding the cleaning of dustbin.

### I. Circuit diagram:

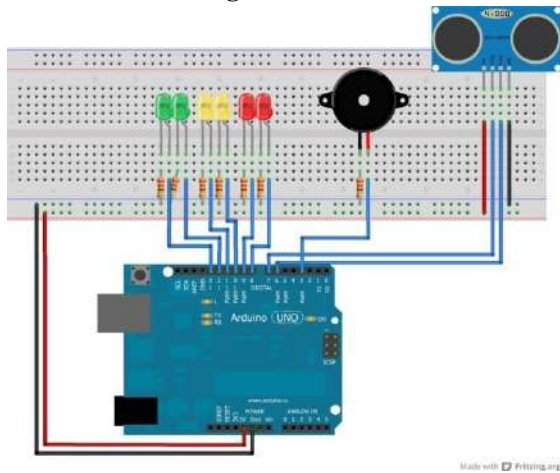


Fig.2 Circuit Diagram

Fig.2 shows the connection of components, we can use nodeMCU in place of arduino uno.

### Steps of working project:

1. Components like nodeMCU, arduino uno, ultrasonic sensor, moisture sensor, led's, jumper wires, registers, buzzer, 2 sample dustbins, breadboard etc are arranged.
2. Installation of arduino IDE
3. Arduino is used for 5V power supply to ultrasonic sensor.
4. Connections are made according to requirements with both ultrasonic and moisture sensors.
5. Code implementation, verification and uploading.
6. After uploading the code into node MCU, it shows the output at different thresholds levels by led blink and buzzer blow in both wet and dry waste.
7. Creating account in thingspeak, with channel name:- Garbage Monitoring System.

### 1. System setup:-

The whole setup includes components like nodeMCU, arduino uno, ultrasonic sensor, moisture sensor, led's, jumper wires, registers, buzzer, 2 sample dustbins, breadboard etc. For dry waste bin we have attached a ultrasonic sensor on the lid of the bin to calculate the distance at every threshold level. Similarly to calculate the moisture content in the garbage moisture sensor is used. 5V power supply is provided through arduino uno. Other connections are done using nodeMCU.

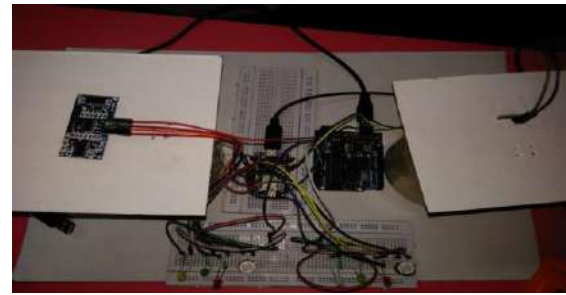


Fig.3 connection of components

### 2. Connection with Laptop

For uploading the data of content/garbage present in the bin, we have first attached both arduino uno and nodeMCU to the laptop. The blinking light in both the iot tools confirm its accurate working.

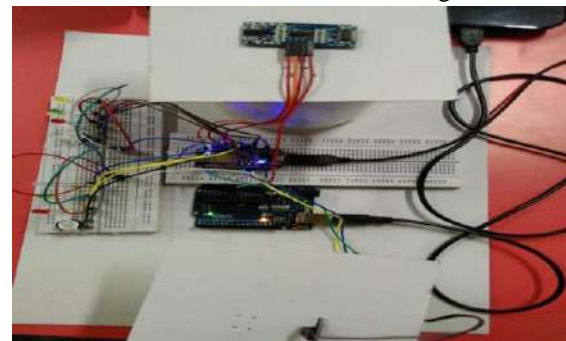


Fig.4 connection of setup with laptop

### 2. Dry garbage upto 10%

Now we will first add some 10% of garbage in the dry bin. While programming for the same in the arduino IDE we have already set a range of glowing lights at every 10%, 50% and 100% threshold levels. With the reach of 10% garbage the ultrasonic sensor detect its distance and compares it with the range provide in the program. As a result the first blue LED glows.

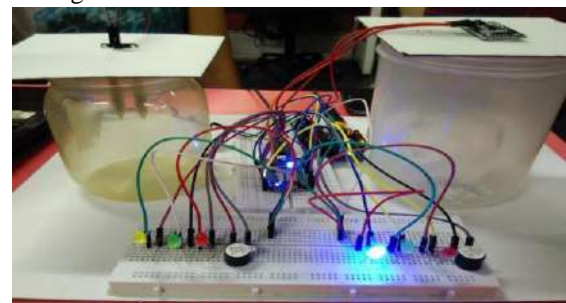
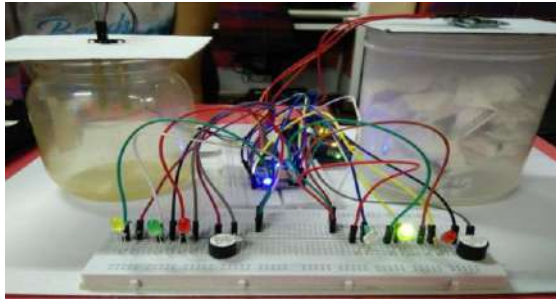


Fig.5 status of dry dustbin at 10% fill

### 3. Dry Garbage upto 50%

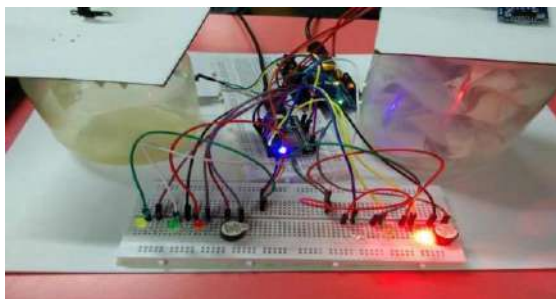
On filling the dry waste bin upto 50%, the next threshold level sets and thus the yellow LED glown. It means on increasing the garbage the distance towards the sensor decreases.



**Fig.6 status of dry dustbin at 50% fill**

#### 5. Dry garbage upto 100%

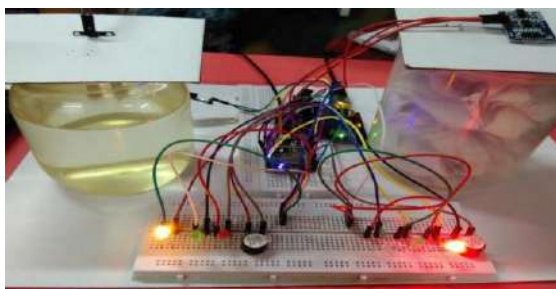
According to the code range set, when the garbage in the bin increases its level and thus getting in the range of ultrasonic with the distance of 5 or less, the upper limit is reached and the bin is thus indicated as full. The indicator for this is the red LED along with the buzzer sound.



**Fig.7 status of dry dustbin at 100% fill**

#### 6. Wet garbage upto 10%

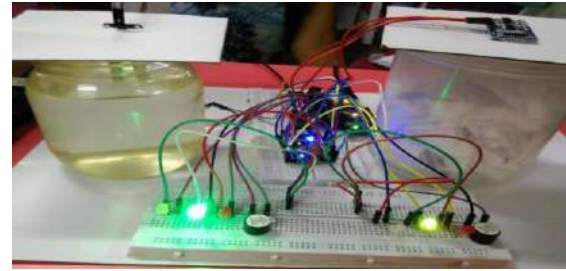
In a similar manner, when the moisture content in the bin is reached to 10% of moisture sensor, the yellow LED on left side glows.



**Fig.8 status of wet dustbin at 10% fill**

#### 7. Wet garbage upto 50%

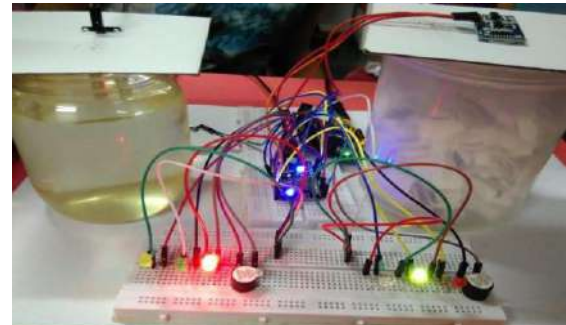
On increasing the moisture content upto 50% in the bin the next green LED glows. Here as well the range for moisture content in the bin is detected through moisture sensor and gives indication through LED's at every 10%, 50% and 100% threshold reach.



**Fig.9 status of wet dustbin at 50% fill**

#### 8. Wet garbage upto 100%

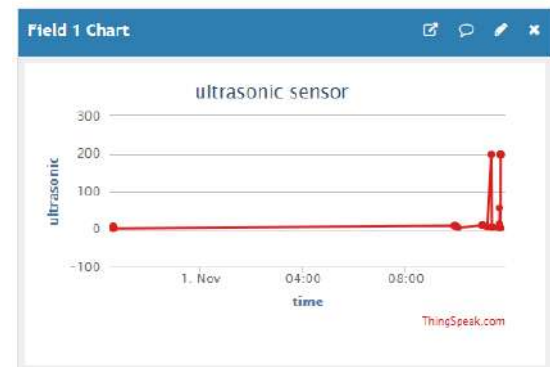
Finally the moisture in the bin reaches to 100% threshold level where now we need to clean it up. Thus for the indication purpose we have attached red LED and a buzzer. So when the buzzer blows and red led lights up, the garbage bin is full of moisture and thus required to be taken away.



**Fig.10 status of wet dustbin at 100% fill**

### IV. Results and Discussion

#### Graph of dry waste:

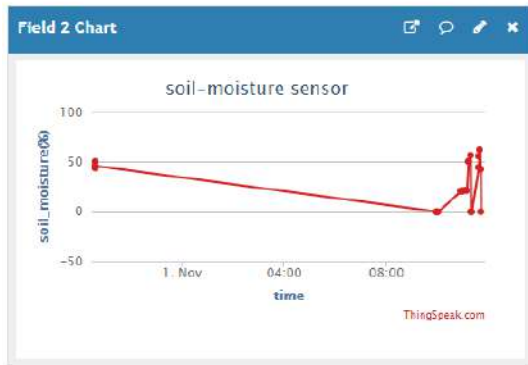


**Fig.11 Thingspeak graph of dry waste**

fig.11 is the result of output obtained from dry garbage monitoring system. peak points of ultrasonic sensor graph shows that the dry dustbin is not yet full whether constant points shows that the dry dustbin is full or getting full soon.

#### Graph of wet waste:



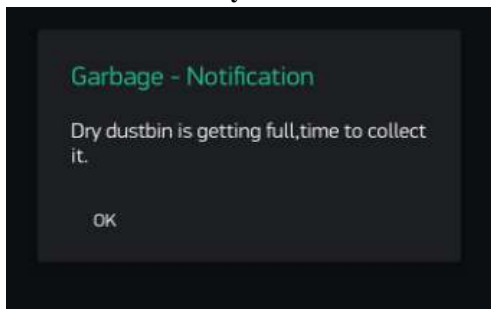


**Fig.12 Thingspeak graph of wet waste**

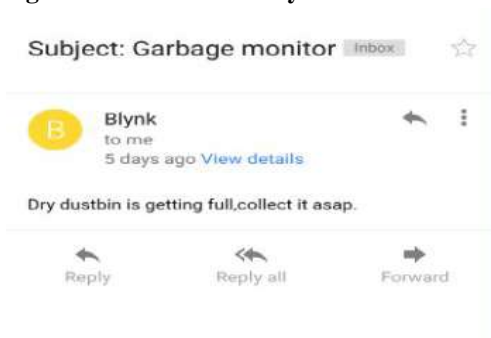
fig.12 is the result of output obtained from wet garbage monitoring system. in soil moisture graph, peak points shows that the wet dustbin is full whether the constant readings shows that the wet dustbin is not full yet.

**Screenshots of blynk notifications obtained for dry and wet waste:**

**1.Notification for dry waste:**



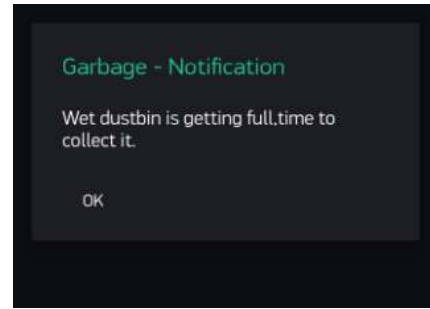
**Fig.13 Notification for dry waste**



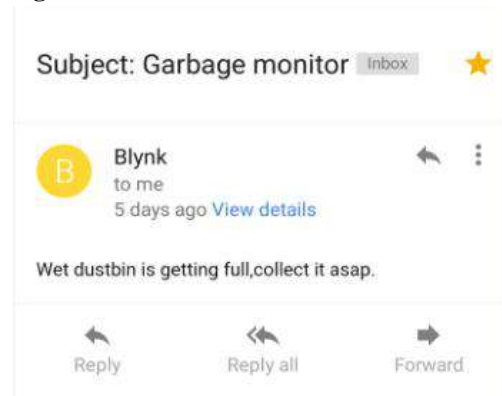
**Fig.14 Email for dry waste**

When dry dustin crosses the fixed threshold limit and getting to full, that time the person who is monitoring the garbage bin will get the notification as well as an email alert as shown in Fig.13 and Fig.14 respectively.

**1.Notification for wet waste:**



**Fig.15 Notification for wet waste**



**Fig.16 Email for wet waste**

When wet dustin crosses the fixed threshold limit and getting to full, that time the person who is monitoring the garbage bin will get the notification as well as an email alert as shown in Fig.15 and Fig.16 respectively.

## V. Conclusions

Solid waste management is a challenge for the cities authorities in developing countries mainly due to the increasing generation of waste, the burden posed on the municipal budget as a result of the high costs associated to its management, the lack of understanding over a diversity of factor that affect the different stages of waste management and linkages necessary to enable the entire handling system functioning. As a result it has become a challenge for the authorities to know the information of garbage full bins as they are many in number. Thus bin overflow could occur and may lead to bad odor at the surroundings which finally could spread dangerous diseases. This project IOT Garbage Management system is a very low cost and an innovative system that provides a solution to the above discussed problem which will help to keep the cities clean and contribute for smarter cities.

We actually aim to implement the system on the crowded streets. The WiFi module will actually send the data to the nearest router and send the correct data to the server every time.

## VI. Future Scope:

The main aim of this project is to reduce human resources and efforts along with the enhancement of a smart city vision. We have often seen garbage spilling over from dustbins on to streets and this was an issue that required immediate attention. The proverb "Cleanliness is next to godliness " and "Clean city is next to heaven" inspired us to conceptualized the project. Smart dustbin helps us to reduce the pollution. Many times garbage dustbin is the message can be sent directly to the cleaning vehicle instead of the contractor's office. In our system, the Smart dustbins are connected to the internet to get the real time information of the smart dustbins. In the recent years, there was a rapid growth in population which leads to more waste disposal. So a proper waste management system is necessary to avoid spreading some deadly diseases.overflow and many animals like dog or rat enters inside or near the dustbin. This creates a bad scene. Also some birds are trying to take out garbage from dustbin. This project can avoid such situations. And This system is use to clean our city clean and giving status of garbage bin at each level to the garbage monitoring person to make his work easy and overcoming physical work.But this system is not giving the location of the garbage bin,so as of now we can use this system only in limited area like home or in societies.

By using GSM module,we can improve the features of this system as gsm module will help us to give the location of garbage bin and when dustbin will get full,we can easily collect it and clean the bin.This will also reduce the physical work of humans and time to collect the garbage.By adding gsm module in this system and modifying it,we can implant such system in india and make our india clean and can create healthy environment by contributing in "Swachh Bharat Abhiyan".

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	<p>Mimi Cherian is currently working as Assistant Professor in Department of Information Technology Engineering of Pillai College of Engineering and pursuing PhD from Mumbai University . Her research interests are in the area of Internet of things [IOT] and Software Defined Network (SDN).</p> <p>Email address:  <a href="mailto:mcherian@mes.ac.in">mcherian@mes.ac.in</a></p>

## INVESTIGATION ON POSSIBILITIES OF COOLING EFFECT FROM OXYGEN LINES IN A MUNICIPAL HOSPITAL

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Sandeep M. Joshi (Pillai College of Engineering, New Panvel, India, Affiliated to University of Mumbai).

### Abstract:

*The consumption of energy in the world is increasing day by day, which results in faster depletion of energy resources. This problem to some extent can be tackled by using Waste Heat Recovery System. Waste Heat recovery process consists of using waste heat produced from a system for pre-heating or cooling the air in the same system or other. Large size capacity oxygen tanks are installed in hospitals for supplying oxygen gas. This liquid oxygen undergoes phase transitions while absorbing heat from surroundings thereby producing cold energy at the vicinity. From the study, we understood that around 3TR of cooling capacity is available which can be utilized for cooling purpose via insulated ducts. This will help in the conservation of energy. After simulation, we observe that there is an only small temperature difference between the inlet and outlets of the duct. Room simulation tells us that inside temperature of the room is around 292K when the surrounding temperature is 308K.*

### Keywords:

*Waste heat recovery, Cold energy, Liquefied oxygen, axial fan, duct, cooling.*

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**Accepted on:** 24/12/2018

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## I. INTRODUCTION

In the coming days, we have to depend upon the alternative sources because of the scarcity of energy resources. So one of the sources are waste heat which is normally not being used, if we utilize this sources our dependency on the present resources would be slight. Waste heat is the heat which is rejected to the surroundings by the system which undergoes various processes.

Oxygen is one of the life-saving medicines to human beings. The invention of liquid oxygen is one of the major discoveries in the field of medical sciences. Cryogenic oxygen cylinder which is powder and vacuum insulated stores liquid oxygen at a temperature around -196°C. It has a density of  $1.141 \frac{g}{cm^3}$  [4].

Liquid oxygen is obtained by fractional distillation. The process follows by compressing and purifying the atmospheric air by removing carbon dioxide, hydrocarbons etc [3]. It is then brought down to a cryogenic temperature in the heat exchanger. Nitrogen vapours and liquid oxygen formed at the upper and bottom of the distillation column. From there it is sent to cryogenic cylinders.

These cylinders are installed in hospitals in order to provide oxygen gas. Phase transformation of liquid oxygen to oxygen gas take place while passing through the evaporator. During this process, a large amount of cold energy is formed. Many researchers have studied utilizing this cold energy for useful purposes. Replacement of mechanical refrigeration with a proposed system which provides cold energy from LNG in LNG fuelled vehicle [1]. In this cold energy is utilized for refrigerating compartments. In a similar paper, it also shows about cooling the driver's cabin by cold energy from LNG [2].

The aim of this paper is to theoretically estimate; availability of cold energy which may be recovered from the surface of the evaporator of the liquid oxygen tanks and simulates the possibility of its use for air cooling of nearby rooms by incorporating a blower, a duct, and insulation.

## II. METHODOLOGY

Cold energy formed around evaporator is identified. By calculating the mass flow rate of oxygen we can obtain the amount of cold energy produced. Then we model and simulate the system

in solid works and ansys software. After simulating, we observe the results and conclude it.

### III. THEORETICAL ANALYSIS

Liquid oxygen cylinder i.e. cryogenic cylinder is installed in hospitals in order to provide oxygen gas. So as to supply oxygen in the form of gas, liquid oxygen passes through the evaporator where it absorbs latent heat of vaporization from the surrounding air in order to form oxygen gas. While liquid oxygen changes to gas large amount of cold energy are formed around the coils of the evaporator. As the cold energy is not utilized, ice is formed at the initial part of the evaporator. In order to avoid the formation of ice and conserve energy, an axial fan along with insulated duct can be utilized for cooling the nearby rooms by this waste cold energy. The proposed system is shown as follows where in case 1 it's forced and in case 2 its induced flow of air.

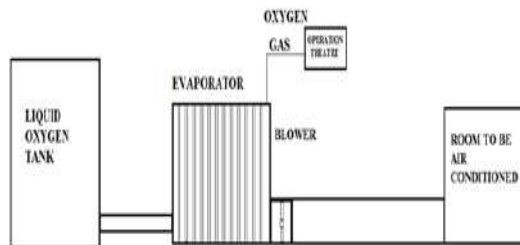


Fig. 1- Proposed System(Case 1)

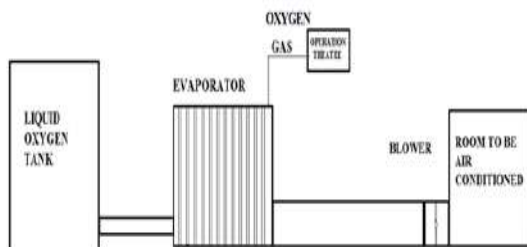


Fig. 2 –Proposed System (Case 2)

Given **Error! Reference source not found.**Details regarding oxygen supplied to the hospital for 21 days.

	Date	Supplied Qty(ℓ)
1.	29/6/16	3850
2.	1/7/16	1400
3.	3/7/16	3542
4.	6/7/16	1893
5.	7/7/16	5347
6.	8/7/16	2283
7.	9/7/16	2583
8.	10/7/16	1796
9.	12/7/16	4019
10.	14/7/16	2132
11.	16/7/16	2365
12.	18/7/16	2311
13.	20/7/16	3642
14.	22/7/16	2680
15.	23/7/16	2362
16.	25/7/16	5288
17.	26/7/16	1200
18.	27/7/16	2055
19.	28/7/16	3064
20.	30/7/16	1781
21.	31/7/16	2513
Total	21 days	58108

Oxygen supplied to the hospitals for 21 days is  $58108 \ell / \text{day}$ .

$$\begin{aligned} \text{Consumption/day} &= \frac{\text{Total Supplied Quantity}}{\text{No of days}} \\ &= \frac{58108}{21} \\ &= 2767 \ell / \text{day} \end{aligned}$$

$$= 2.767 \text{ m}^3 / \text{day}$$

$$\text{Consumption per hour} = 0.1153 \text{ m}^3 / \text{hr}$$

$$\text{Density of Lox} = 1.141 \frac{\text{g}}{\text{cm}^3}$$

$$\text{Mass Flow rate } (\dot{m}) :- \text{Consumption per hour} \times \text{Density}$$

$$= 0.1153 \times 1141$$

$$= 131.5 \text{ kg} / \text{hr}$$

Available cooling capacity from Lox is obtained from the below equation

$$Q = m \text{ Cp } \Delta T$$

where m = mass flow rate of Lox.

Cp = specific heat of Lox

$\Delta T$  = Temperature difference

$$\therefore Q = \frac{131.5}{3600} \times 1.71 \times (298 - 90)$$

$$= 12.99 \text{ KJ} / \text{s}$$

$$= \frac{12.99}{3.516} \text{ Ton} = 3.7 \text{ Ton}$$

From the papers, we have understood that 1 ton of refrigeration has the capacity to cool 100sq.ft.

3 TR of refrigeration has the capacity to cool 300sq.ft.

#### IV. MODELLING AND CFD ANALYSIS

##### [10] Modelling

By calculating the amount of cold energy, we get 3 TR of cooling capacity which can be used for cooling nearby rooms. This cold energy is passed through the insulated duct and supplied to the room. The model of the axial fan along with duct and room is shown as below:-

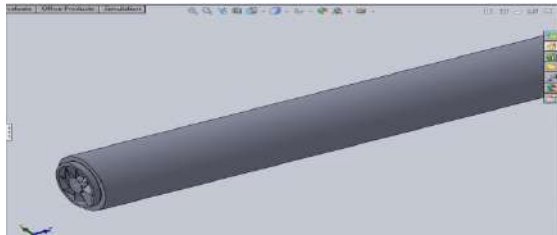


Fig. 3-Axial fan and insulated Duct

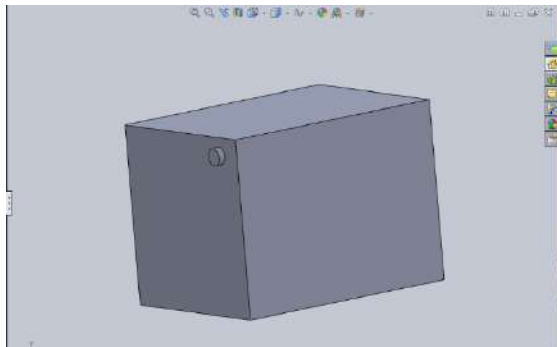


Fig. 4-Solid work model of Room

##### [11] Simulation

After modeling duct and room, we simulate first both the cases i.e. a and b of the insulated duct in order to check any heat loss along the duct. Initial conditions are  $T = 275\text{K}$ ,  $v = 5.15\text{m/s}$  and duct material as PIR (Polyisocyanurate) and the simulation of the room is done.

#### V. RESULTS AND DISCUSSION

i) After simulation of the duct, we understand that in both the cases heat losses along the duct is small i.e. negligible. The inlet and outlet temperature merely differ.

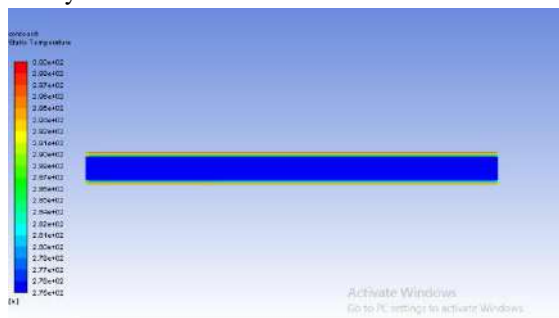


Fig. 5-Temperature plots (Case 1)

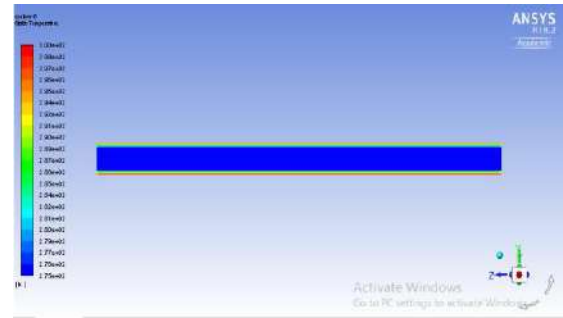


Fig.. 6-Temperature plots (Case b)

ii) After room simulation, when the surrounding temperature is 308K, we get inside room temperature as 292 K.

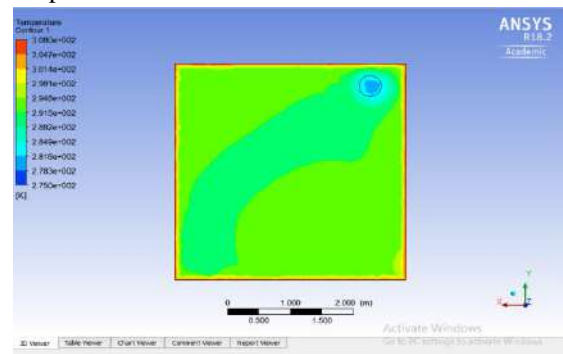


Fig. 6- Temperature plots at 308K

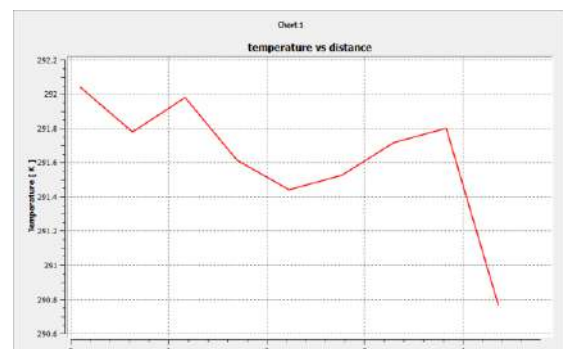


Fig. 6- Temperature vs distance at 308K.

#### VI. CONCLUSIONS

Energy conservation and waste heat recovery were the objectives of this study. The conclusions to be drawn from this investigation are as follows.

- 2) Approximately 3 TR of cooling capacity is produced while the evaporation of liquid oxygen
- 3) No heat losses were observed along the duct during simulation in both cases.
- 4) This cold energy wasted can be utilized for cooling the room by using the proposed system
- 5) From the simulation of room we understand that inside temperature of the room would be 292K when initial and

surrounding is 275K and 308 K respectively.

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### Author Biographical Statement

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Sruthi D. Kunnikulath is Post Graduate student of Pillai College of Engineering, New Panvel. She has one year of teaching experience. Her field of research includes Air conditioning, Cryogenics, Heat Transfer.

#### Biographical Statement for Author B

Photograph of Author B



Dr. Sandeep M Joshi is currently Principal of Pillai College of Engineering, New Panvel. He has over 23 years of teaching experience. His field of research includes Utilisation of Solar Energy, Heat Transfer, Heat Exchanger Design, Waste Heat Recovery, Energy Conservation, and Renewable Energy Recourses. He has about 25 publications in national as well as international conferences and journals of repute and one Indian patent is at his credit.



## EXPERIMENTAL STUDY OF CONDENSATION OF STEAM IN HELICALLY COILED TUBES

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### Abstract:

Helical coils are most widely used enhancement technique because of its compact structure, low cost and long life. The condensation process of steam inside helical coil is investigated for different mass flux range from 68 to 97 Kg/m<sup>2</sup>s. and different average vapor quality. Experimental data were plotted against flow maps of Breber and Tandon which matches qualitatively. Heat transfer coefficient and overall HTC is plotted against mass flux and average vapour quality which shows it increases with increase in mass flux and vapor quality of steam.

**Keywords:** Coefficient of heat transfer, Mass flux, vapour quality, flow regime maps.

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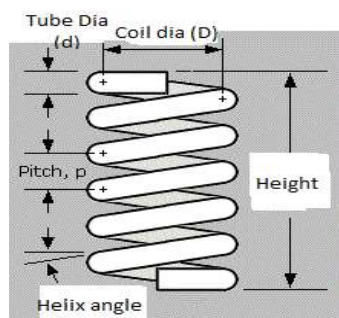
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### I. INTRODUCTION

The need of development in the heat exchangers design to fulfil growing industrial demands led to the evolution of helical coil heat exchanger. The Helical coil is widely used passive heat transfer enhancement technique which is used in many ongoing industrial applications including steam generation in nuclear reactors, due to its higher compactness and superior heat transfer ability over a straight tube.

#### 1. Nomenclature of helical coil



**Fig.1** Basic Geometry of Helical Coil

Tube diameter:  $d$  or  $2r$

Coil diameter:  $D$  or  $(2R)$  Measured between centres of the pipe.

Pitch:  $P$ : Distance between two adjacent arms.

Helix angle: The angle made by the projection of one turn of coil with the perpendicular to axis of coil when projection is taken on the plane passing parallel and through the axis of coil.

### 2. Literature Review

Jayakumar et al studied the heat transfer process in helical coil heat exchanger experimentally and by using computational tool. The effect of coil diameter, coil pitch, tube diameter and void fraction on heat transfer coefficient and pressure drop was investigated. CFD simulation was done for constant and variable properties of fluid. Observation states that heat transfer increases with increase in tube diameter and decrease in coil diameter [2]. Ebadian investigated condensation heat transfer and pressure drop characteristics of R-134a at different mass flux, orientation and different saturation temperature flowing through helical tube and annular passage. Results show that overall and refrigerant side heat transfer coefficient is highest at inclined position and lowest at vertical position. [3][4][5]. Mozafarai studied condensation process for different orientation and vapour quality and performance index of helical coil is tested against straight pipe results which show helical coil gives higher heat transfer rates. [6]. Wongwises performs the experiments by taking R-134a as working fluid. He observes that Frictional pressure drop, and heat transfer coefficient increases with increase in vapour quality while decreases with increase in saturation temperature. New frictional pressure drop and HTC correlation was developed [7]. Salimpur studied thermal performance of R-404 for different coil radii by varying vapour quality he finds that decreasing

coil radius enhances the heat transfer rate and proposed new correlation for heat transfer coefficient [8]. In recent years Ravi kumar performs the experiment for shell and coil heat exchanger for smooth and dimpled helical coil tube and compares it with its straight tube counterpart. Result shows that dimpled tube helical coil gives higher heat transfer coefficients and frictional pressure drop than other heat exchangers. He presented new correlations for two phase heat transfer coefficient and frictional pressure drop. Ravi kumar also plotted his data against Taitel flow regime maps for investigating the flow regime transition [9] [10]. For horizontal flow Baker investigated the flow regimes for designing the pipelines of oils and gas industries for simultaneous flow. The flow patterns described as bubble flow, plug flow, stratified flow, wavy flow, slug flow, annular flow and spray flow. Transition lines on graph are functions of mass velocity of gas phase and ratio of gas liquid mass velocities [11]. Taitel et al come up with new approach to identify different transition regimes. He gives physically realistic mechanic of force balance for plotting transitions boundaries. Gas and liquid mass flow rates, properties of fluids, pipe inclination and pipe diameter are considered to make relationships for these transitions [12]. Breber compared the Taitel flow regime transition criteria's with theoretical derivation and also by experimental data of other researchers available in open literature. On the basis of that he proposed his own simplified criteria in which he basically focused on four regimes as annular, wavy stratified, bubble and sludge flow. Maps shows that the transition of flow patterns are over the range of defining parameters and states the existence of transition zone in between every main zone [13]. Tandon came up with new parameters which resembles void fraction is taken on x axis, and non dimensional gas velocity as ordinate. Data from literature is plotted against new parameters which conclude simplified criteria gives better agreement for annular, semi annular and wavy flow patterns which occupies most of the region in condensation process [14]. For vertical flow regimes wispy annular flows is newly observed by Bennett as high moving entrained phase flowing in core when liquid film moves along the wall with low velocity [15]. Usui proposed the flow regime map by investigating average void fraction and void distribution for air water two phase flows at atmospheric pressure. Based on flow transition

mechanism he developed different correlation for void fraction for different flow regimes [16].

Murai studied the air water two phase flows in helical coil tube, the effect of centrifugal acceleration on flow pattern and temporal flow structure distribution were investigated. Results show that bubble to plug transition is significantly quickened as curvature radii decreases [18]. A Sarmadian et al studied the condensation of R-600a inside plane and helically dimpled horizontal tube. The condensation process is visualized to evaluate flow pattern transition. Observations show that enhancement in surface delays the transition from annular to intermittent flow and hence increases rate of heat transfer. The stratified wavy flow observed in smooth tube was not seen in dimpled tube [19].

## II. EXPERIMENTAL FACILITY AND PROCEDURE

The test section was condenser with 3 different helical coils with different coil diameter remaining the pitch and tube diameter constant. Details are in table.

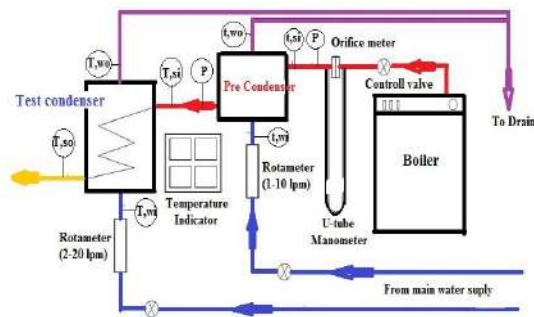
**Table 1** Details of Helical coils

Coil	Coil diameter (mm)	Curvature ratio (d/D)	Length (mm)
A	125	0.07376	2159.845
B	150	0.06146	2591.814
C	175	0.05268	3023.783

Steam is produced by portable electric boiler. Orifice meter is used to find the mass flow rate of the steam (working fluid) along with Differential manometer. Mass flow rate is controlled by ball valve in-line with orifice meter.

17 number of T-type thermocouple (copper-constantan) was used to measure the outer wall temperature of the test condenser. They are placed at 120 degree apart from each other on the outer periphery of the coil and are securely placed by using mechanical clamp with rubber shoe to insulate it from the surrounding water. Inlet & outlet temperature of the cooling water to the shell side and that of steam for coil is taken by RTD sensors. Temperature is displayed on 8-channel digital temperature indicator Thermocouples were calibrated against Thermometer having 1°C of resolution and graphs are plotted for same.

Cooling water from the city main is supplied to the tank of test section which has arrangement to accommodate different coil diameters. Cooling water flow rate is measured using acrylic rotameter .range is 0-20 ℓ/min with 0.5 ℓ/min calibration. Complete piping system is thermally insulated by *Supertlon* pipe insulator having thickness of 19mm. Initially Steam is supplied to the condenser where steam releases its heat to the cooling water flowing through the shell. Wet steam is then supplied to the post condenser to cool down and then delivered to the drain tank. Pressure drop is observed by using U-tube manometer across the test section. Some experimental operating conditions are repeated to ensure the repeatability of the boiler and instruments. Readings are taken at interval of every 15 minute. Steady state is considered when 2-3 successive readings are constant or remain same.



**Fig.2** Schematic of Experimental Facility

Pre-condenser is used to control the inlet quality of the steam which is provided to the test section. Cooling water flow rate is varied to control the vapour quality of steam and it is measured by using rotameter (range 1-10ℓ/min.) RTD sensors are used to detect the inlet and outlet temperature of steam as well as water.

### 3. Data Analysis

Data analysis is essential to find the values of heat transfer coefficient, mass flux and average vapor quality during each test run at steady state. Steady state is confirmed when 2-3 successive reading are constant. Thermo-physical properties of steam are taken from online source as given in reference [20]. Table show the range experimental test conditions.

**Table 2** Range of operating parameters

Parameters	range
Saturation temperature of steam (°C)	111.2±0.3 to 120 ±0.3
Mass flux (kg/m <sup>2</sup> s)	68 - 98
Cooling water flow rate (ℓ/min)	2,5,7,9
Steam pressure (barg)	0.5,0.8,1

Average heat transfer coefficient can be calculated by following equation

$$h_{steam} = \frac{Q_w}{\pi d_i L (T_s - T_{i,wall})}$$

Where  $T_s$  is saturation temperature of steam  $T_{i,wall}$  is inner wall temperature and  $Q_w$  is amount of heat taken away by cooling water.

Inner wall temperature is calculated by finding out average outer wall temperature  $T_{o,wall}$  which is arithmetic mean of temperature measured at 17 location along the coil.

$$T_{o,wall} = \frac{1}{N} \sum_{i=1}^N T_{o,wall,i}$$

$$T_{i,wall} = T_{o,wall} + \frac{Q_w \ln\left(\frac{d_o}{d_i}\right)}{2 \pi L k}$$

The heat transfer rate  $Q_w$  is determined by rise in cooling water temperature and mass flow of the same by using following equation.

$$Q_w = \dot{m}_w \times C_p \times (T_{wi} - T_{wo})$$

Where,  $\dot{m}_w$  mass flow rate of water.

The average dryness fraction of steam inside test section is determined by

$$x_{avg} = \frac{x_{i,ts} + x_{o,ts}}{2}$$

The values of  $x_i$  and  $x_o$  are determined from heat balance of pre-condenser and test condenser

$$x_{avg} = x_{i,ts} - \frac{Q_w}{h_g - h_f} \quad [9]$$

### III. RESULTS AND DISCUSSION

The three helical coils with the same pitch, number of turns and tube diameter and with different coil diameters were tested against different mass fluxes, saturation temperature, different average and inlet vapour quality. Total 48 tests were carried out to generate the data

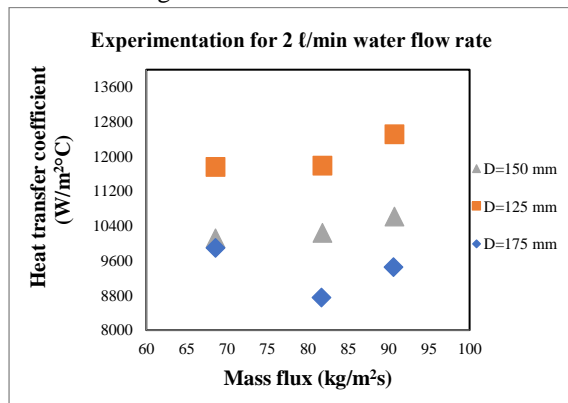
#### 4. Impact of mass flux on Coefficient of heat transfer

To find out the influence of mass flux on the heat transfer process we have used three different mass flow rate of steam

The steam side CHT is plotted against mass fluxes in the following figure. It demonstrates that the CHT increases with the increase in mass flux. This is because an increase in mass flux increases the flow velocity of vapour and liquid film which in turns increases the flow turbulence.

The effect of coil diameter is also studied which shows that as the coil diameter decreases the CHT increases. The decrease in curvature radius enhances the effect of centrifugal forces on the flow

characteristics. The secondary flow is boosted as curvature radius is decreased and Dean Number is increased. With higher mass flux the phenomenon shows more significance.



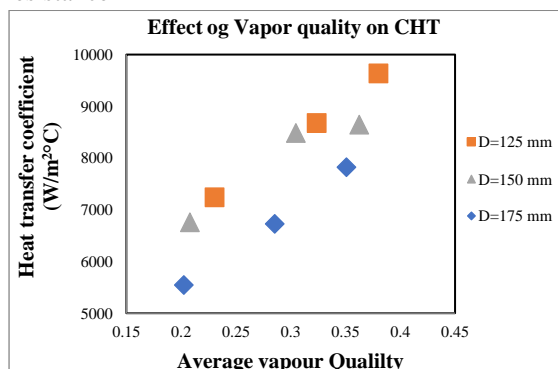
**Fig.3** Effect of Mass flux on Heat transfer coefficient ( $h_o$ ) for 2 l/min

The change in heat transfer coefficient with change in mass flux is shown in fig. 3 for water flow rate 2 l/min for all the three helical coils. It shows that difference in heat transfer coefficient for coil diameter is increased with mass flux increment.

#### 5. Effect of vapour quality on coefficient of heat transfer

The steam side average CHT is plotted against average vapour quality. It shows that HTC increases with increase in vapour quality

The high vapour quality steam flows through helical coil at high velocity which produces higher shear stress at liquid vapour interface. This high shear stress generates more waves on liquid film thus increasing surface area of heat transfer and increases film turbulence. The higher vapour quality causes strong secondary flow leading to more entrainment and redeposition of liquid droplets which reduces the liquid film thickness thus lowers the film resistance

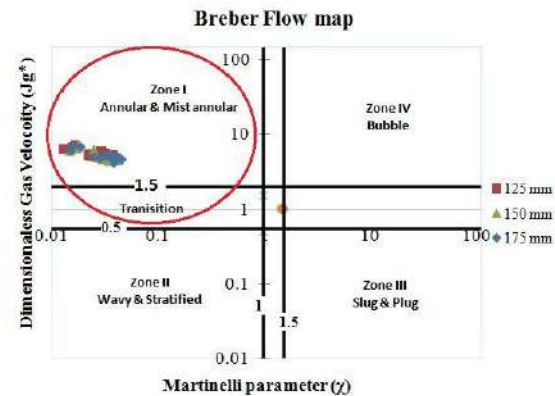


**Fig.4** Effect of average vapour quality on coefficient of heat transfer

Effect of vapour quality on average heat transfer coefficient is shown in figure 4.

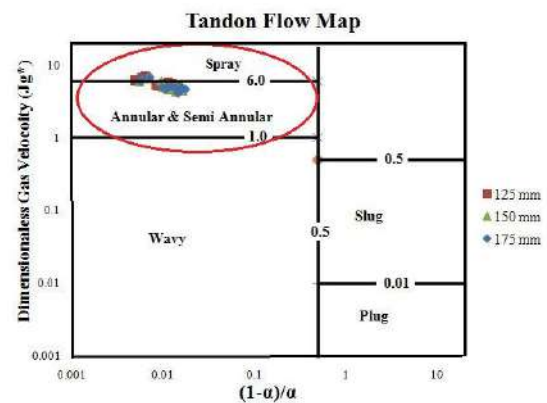
#### Plotting of experimental readings on flow regime maps

The experimental data were plotted against the flow patterns maps of Breber and Tandon by use of the equations provided to find out the regime numerically to confirm the flow regime during the condensation of steam for this experimental condition.



**Fig.5** Plotting on Breber flow pattern map

Shows the Breber Flow regime map on which experimental data is plotted. Data points occupy the zone I on Breber flow map which confirms the presence of Annular & Mist annular flow in our experiment.



**Fig.6** Plotting on Tandon flow regime map

Experimental data is plotted on tandon flow regime map by using given criteria and it is found that data is sprayed over Spray and Annular & semi annular region.

#### IV. CONCLUSIONS

The steam side average heat transfer coefficient has direct relation with the mass velocities of the steam. Coil diameter has significant effect on heat transfer coefficient. Average heat transfer coefficient increases with increase in average vapour quality of steam.



The generated data is plotted against flow maps of Breber and Tandon. Which shows that annular and mist annular flow regime occupies most of the length in condensation of steam inside helical coil for all tested conditions in this research. These results are in good agreement with literature qualitatively

Nomenclature		
Symbol	Description	Units
$h_f$	Enthalpy of saturated liquid	kJ/kg
$h_g$	Enthalpy of saturated vapour	kJ/kg
$h_{steam}$	Average heat transfer coefficient of steam	W/m <sup>2</sup> °C
$J_g^*$	Dimensionless gas velocity	
$Q$	Heat transfer rate	W
$T_s$	Steam Temperature	°C
$\alpha$	Void fraction	
$x$	Dryness fraction	
$\chi_{tt}$	Martinelli Parameter	

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## AIR FLOW PATTERN SIMULATION OF LOW TEMPERATURE DRYING CABINET

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### **Abstract:**

*In this work, drying cabinet is designed for drying load of 2 kg onion. Drying cabinet, with air inlet and outlet, is designed with five perforated trays which are mounted one above the other. Each perforated tray has square perforation of size 15 mm each. Keeping the design dimensions of drying cabinet same just by changing locations of inlet and outlet with and without introduction of deflector six cases of drying cabinets were defined as DC1, DC2, DC3, DC4, DC5 and DC6. Air flow simulation is performed inside the drying cabinet without drying load on perforated trays with inlet volumetric flow rate of 0.15 m<sup>3</sup>/s and inlet air velocity of 6.67 m/s using CFD tool available in SolidWorks. Air flow simulation patterns are studied, analysed and total percentage of weak zone is determined from simulation results. In this analysis drying cabinet DC5 has least value of total percentage of weak zone i.e. 13.22% among the six drying cabinets.*

### **Keywords:**

*Drying Cabinet, SolidWorks Flow Simulation, Percentage of weak zone perforation*

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### **I. INTRODUCTION**

Food, cloth and shelter are three basic needs of human being. Demand of basic needs is directly proportionate to population growth which is increasing year by year. While focusing on food as daily need, the agricultural land is limited and from last few years global development pulling agricultural workforce towards them. Various causes of shortfall between demand and supply of food are: percentage of reduction in agricultural land due to global development, decrease in fertility and water holding capacity of soil, inadequate irrigation facilities, post harvesting losses and natural calamities such as flood, drought etc. Post harvesting loss can be minimized by agricultural product drying. In agricultural product drying solar drying i.e. use of solar radiation as energy input for drying is sustainable method. Still many developing countries follows traditional methods for drying of agricultural product. Traditional drying methods in which product is dried under sun on open floor which has limitations in the form of poor quality and reduction in quantity too.

Reduction in food losses is one of the way to make balance between supply and demand of uncontrolled population growth. Solar drying is effective means of food preservation for small farmers in tropical and subtropical regions [1]. Solar drying involves application of solar thermal energy as a heat source to vaporize moisture and removing water vapour after its separation from the food product. Solar energy is used as either the sole source of the

required heat or as a supplemental source. The heating procedure could involve the passage of preheated air through the product or by directly exposing the product to solar radiation or a combination of both. Solar dryers are the systems in which the drying procedure is carried out. Based on operating temperature solar dryers are classified as: high temperature dryers and low temperature dryers. Low temperature solar drying is desirable in case of food drying.

Low temperature cabinet dryers are favourite equipment used in farms for fruit and vegetable drying [6]. Advantages being ease in handling and controlled operation of drying. In cabinet dryer atmospheric air is heated by solar radiation in solar air heaters upto desired operating temperature, this preheated air enters the drying cabinet through inlet for moisture removal and exit via outlet. Performance of cabinet dryer depends on: velocity and temperature of inlet air and air flow distribution inside drying cabinet. In cabinet dryer uniform moisture content is not found in endproduct due to non-homogeneous air flow distribution and it is drawback of cabinet dryer [6]. Importance of uniform air flow distribution inside drying cabinet is understood from few references like: Non uniform drying causes the degeneration of agro product during storage time [4]. Non uniform drying losses of fruits and vegetables during their drying in developing countries are estimated to be 30 – 40 % of production [2].

One of the problem with cabinet dryer is non – uniformity in the desired moisture content of end product. This non – uniform moisture content of end product is due to non – uniform air flow distribution inside drying cabinet. To obtain a uniform air flow distribution, six different cases of drying cabinets were studied theoretically (computational fluid dynamics (CFD) by using solidworks software).

## II. GEOMETRY DESIGN AND MODELLING

### A. Onion Sample Making

Onions were sliced about 3 – 4 mm thickness and 30 – 55 mm in diameter. 2 kg of onions after slicing, weighted and found to be 1950 gm with 50 gm of wastages as bulb, tunic etc. 1950 gm of drying load is equally divided into five parts, for each part 390 gm of drying load comes. 390 gm of drying load was loaded in single layer as shown in Fig. 1. The dimension of below Fig. 1, is measured and found to be  $350 \times 350$  mm i.e. tray size of DC. Number of trays required for 1950 gm of drying load in single layer are 5.



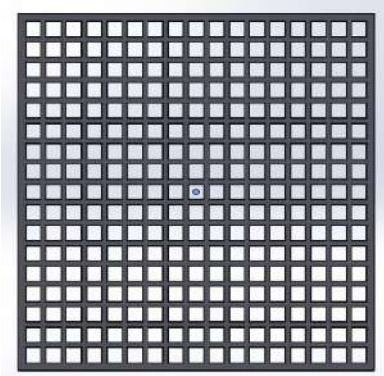
**Fig. 1** Onion Sample in Single Layer Drying

### B. Geometric Modelling of Perforated Tray and Drying Cabinet

Details of perforated tray relating to Fig. 2, are represented. Dimensions related to Fig. 3, will be same in all the six cases, only input and output positions will change with introducing deflector in case DC5 and DC6.

- Square perforation =  $15 \times 15$  mm (onion slice diameter 30 – 55 mm)
- Pitch of perforation pattern = 20 mm
- Number of perforated rows and columns = 17
- Number of perforated entities in single tray =  $17 \times 17 = 289$ .
- Total number of perforated entities in drying cabinet = (number of trays  $\times$  number of

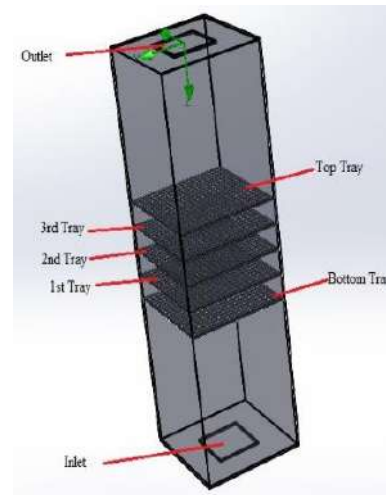
perforated entities in single trays) =  $(5 \times 289) = 1445$ .



**Fig. 2** Perforated Tray

- Size of Inlet and Outlet =  $150 \times 150$  mm
- Distance of bottom tray from inlet = 450 mm
- Distance of top tray from outlet = 450 mm
- Distance between five trays = {(number of spacing  $\times$  distance between two trays excluding height of trays) + (number of trays  $\times$  height of tray)} =  $\{(4 \times 70) + (5 \times 4)\} = 300$  mm

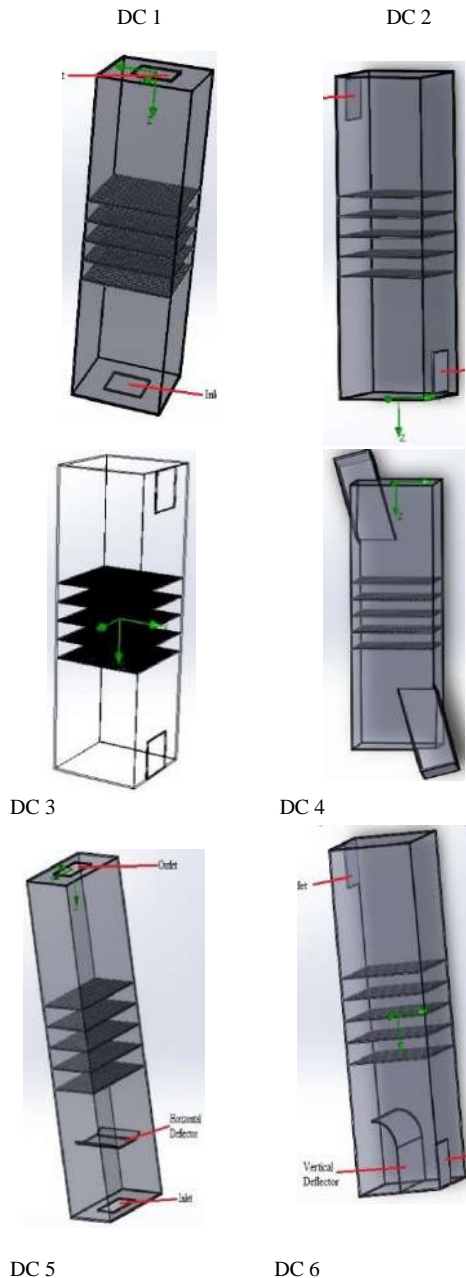
Total height of drying cabinet is = Distance of bottom tray from inlet + Distance of top tray from outlet + Distance between five trays =  $450 + 450 + 300 = 1200$  mm



**Fig. 3** Drying Cabinet

### C. Geometric Models of Drying Cabinet

DC 1 in which inlet and outlet are co-axial. DC 2 in which right inlet and left outlet. DC 3 in which inlet and outlet are on same plane. DC4 which has inlet and outlet placed diagonally. DC 5 has vertical deflector with inlet left and outlet right. DC 6 has horizontal deflector with inlet and outlet co-axial.



**Fig. 4** Geometric Models of Drying Cabinet

### III. AIR FLOW PATTERN SIMULATION

#### A. Heat Energy for Moisture Removal from Drying Load

Fresh onion has 80% moisture content and raw onion has 4% of moisture content on wet basis. In this case 1950gm of onion is drying load.

$$\begin{aligned} \text{Total Moisture Removal} &= \text{Initial moisture content} \\ &\quad - \text{Final moisture content} \\ &= 80\% - 4\% \end{aligned}$$

$$\text{Total Moisture Removal} = 76\% \text{ wet basis}$$

$$\text{Water to be evaporated from 1950 gm drying load} = 1950 \times 76\% = 1482 \text{ gm.}$$

$Q_{\text{req}}$  = amount of water to be evaporated in gm  $\times$  Heat of vaporization of water per gm

$$Q_{\text{req}} = 1482 \times 2260$$

$$Q_{\text{req}} = 3349320 \text{ J} = 3349.32 \text{ kJ.}$$

#### B. Calculation of Minimum Mass and Volumetric Flow of Air for Drying Load

- Elevated cabinet inlet temperature  $55^\circ\text{C}$  increases the moisture holding capacity than ambient temperature.
- Drying cabinet outlet temperature of air is  $40^\circ\text{C}$  [5].
- Drying time  $t$  is 6 hours is considered.
- The mass flow rate of air per second required for 76% of moisture removal is calculated as:

$$Q_{\text{req}} = \dot{m}_a \times C_{pa} \times (T_{\text{cabinet, inlet}} - T_{\text{cabinet, outlet}}) \times t$$

$$3349.92 \times 10^3 = \dot{m}_a \times (1.005 \times 10^3) \times (55 - 40) \times 21600$$

$$\dot{m}_a = 0.010286 \text{ kg/s}$$

Corresponding volumetric flow rate will be:

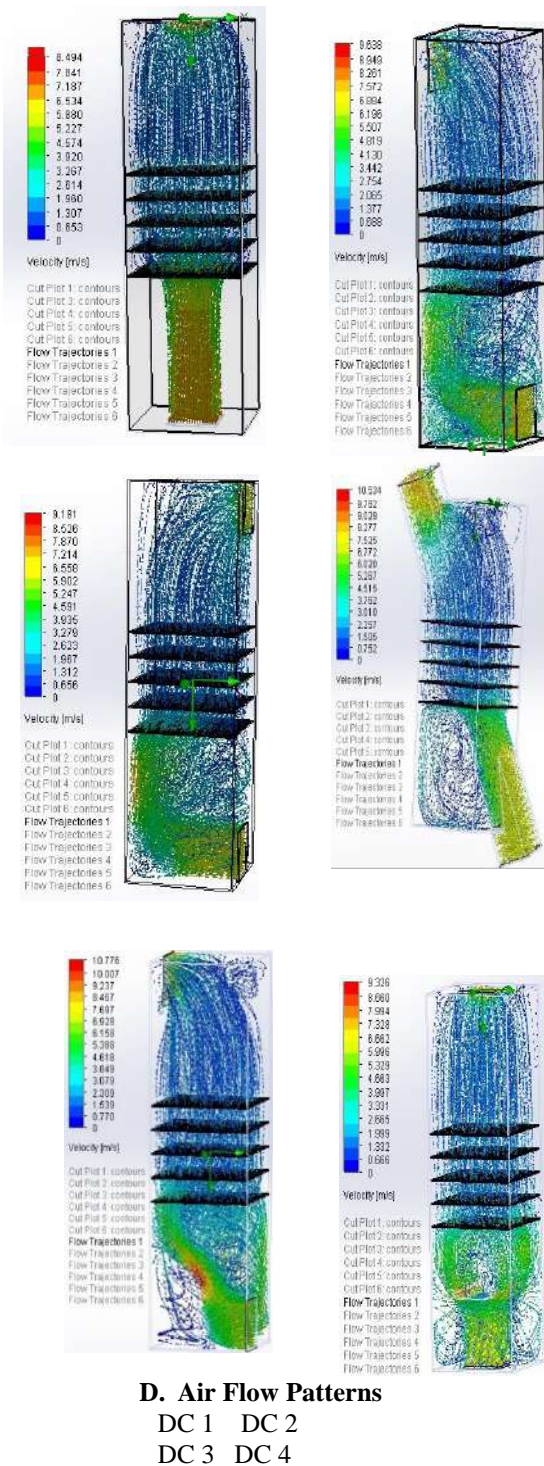
$$\begin{aligned} \dot{Q}_{\text{vol}} &= \frac{\dot{m}_a}{(\rho_{\text{air, at } 55^\circ\text{C}} + \rho_{\text{air, at } 40^\circ\text{C}})/2} = \frac{0.010286}{1.1064} = \\ &0.00934 \text{ m}^3/\text{s} \end{aligned}$$

#### C. Air Flow Simulation Details

Flow simulation results in SolidWorks are carried out with model configuration in software, boundary conditions set up, deciding goals, meshing and run configuration. Boundary conditions were defined as: All the six air flow simulations were performed with same boundary conditions. Inlet boundary condition was chosen to be velocity. Inlet flow is taken as  $0.15 \text{ m}^3/\text{s}$  which is more than the calculated value because flow is upward, for this flow rate value of air inlet velocity is taken as  $6.67 \text{ m/s}$ . Outlet is assumed to be at atmospheric pressure of  $1.01325 \text{ bar}$ . Wall conditions are assumed to be perfectly



smooth and adiabatic. Turbulence length of 0.035 m and turbulence intensity of 2 % were set.

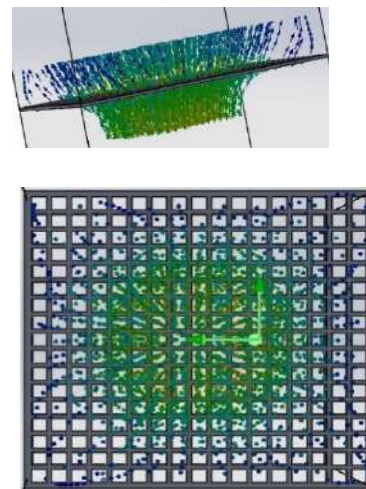


**Fig. 5** Air Flow Pattern in Drying Cabinet

Air flow pattern in drying cabinets are shown in above Fig. 5, which were simulated with same boundary conditions at inlet in Flow Simulation tool of SolidWorks software.

#### IV. RESULTS AND DISCUSSION

Perforation through which air is not passing, is called as 'Weak Zone Perforation'. In a single tray there are 289 perforations and 1445 perforations in each drying cabinet. Counting of weak zone perforations is based on visibility study of top view of the flow trajectory across perforated tray as shown in Fig. 6. Flow trajectory study across each tray is carried out with entry of 300 particles at inlet in all drying cabinets. Weak zone perforations are counted from top views of flow trajectory across each tray and data is tabulated and graphically represented for drying cabinet 1 to drying cabinet 6.



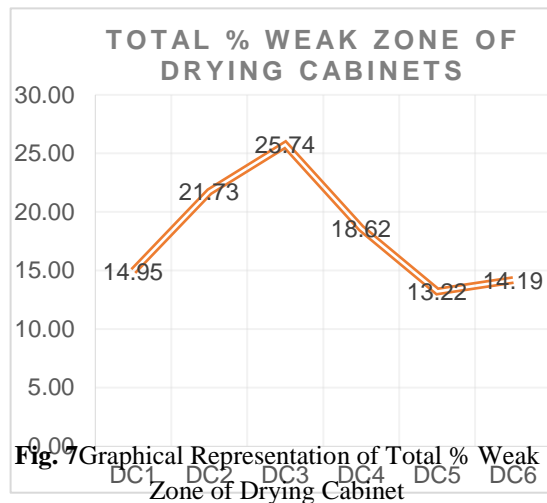
**Fig. 6** Top View of Flow Trajectory

Based on above flow trajectories results number of perforations without air flow (weak zone perforation) are counted and data is tabulated.

**Table 1** Total Percentage of Weak Zone of Drying Cabinet

Drying Cabinet	Number of Perforations without Air Flow (Weak Zone Perforations)	Total Number of Perforations	Total % of Weak Zone
DC 1	216	1445	14.95
DC 2	314	1445	21.73
DC 3	372	1445	25.74
DC 4	269	1445	18.62
DC 5	191	1445	13.22
DC 6	205	1445	14.19

Data of table 1 is represented graphically, on Y-axis total percentage of weak zone versus drying cabinet on X-axis.



Referring to the Fig. 7, graphically represented data, drying cabinet 3 has highest value of 25.74 of total percentage weak zone where as drying cabinet 5 has least value of total percentage of weak zone among all drying cabinets i.e. 13.22 percentage.

## V. CONCLUSIONS

- Heat energy required  $Q_{\text{req}}$  for moisture removal from 80% to 4% i.e. 76% from drying load of 1950 gm onion is 3349.32 kJ.
- For drying time of 6 hours minimum volumetric flow rate of air required for 76 % of moisture removal is 0.00934 m<sup>3</sup>/s.
- 25.74 percentage is highest value of total percentage of weak zone is observed for drying cabinet 3. Result shows lowest value of total percentage of weak zone is observed for drying cabinet 5 i.e. 13.22 percentage hence drying cabinet 5 is the best choice among the six drying cabinets.

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## Author Biographical Statements

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## INVESTIGATIONS ON RECEIVER OF PARABOLIC TROUGH COLLECTOR

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### **Abstract:**

*The flow pattern and attributes of heat transfer in symmetric outward curved layered corrugated tube has been researched based on Reynolds stress transport (RST) model using numerical simulations. In this study validation of obtained RST modelling results and existing RST modelling results of simulation by Feng-Chen Li has been carried out and results match well. Based on this, same procedure of RST modelling simulation is applied to investigate detailed pattern of flow and mechanism of heat transfer in proposed model of corrugated receiver tube. In one corrugation of the model, detailed study of velocity, temperature and Reynolds stress distribution for various profiles is done. It is determined that, in proposed model of corrugated receiver tube structure intensity of velocity fluctuation greatly increases, as a result of that there is rise in rate of heat transfer which leads to raise in efficiency of thermal power plant application.*

### **Keywords:**

*Symmetric outward convex corrugated tube, Reynolds stress transport model, Heat transfer improvement.*

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## I. INTRODUCTION

Parabolic trough concentrators play an essential function of concentrating sun energy onto place of heating. Numerous types of collectors are utilized for applications of heating. In collectors, usage of sun power in large part relies on development and monitoring components in mechanism. Analyzation of various methods of improving behaviour of heat transfer and thereby improving efficiency of device has been made. Some of those methods include use of Nano fluids, twisted tape, dimples, fins etc. to improve heat transfer performance of receiver of parabolic trough collector.

(He, et al., 2012) have proposed model of unilateral multi-longitudinal vortices improved parabolic trough receiver (UMLVE-PTR) and showed that with increase in Reynolds number the thermal losses reduced by 1.35-12.10%, with increase in inlet temperature of heat transfer fluid the thermal losses reduced by 2.23-13.62% [2].

(Li, et al., 2013) have examined the predictive capacity and dependability of Reynolds stress transport (RST) model having turbulent flow in wavy tube wall. They concluded that behaviour of heat transfer can be enhanced by increasing height of corrugation [1].

(Li, et al., 2015) have established a 3D numerical model of PTRs having dimples, protrusions or helical fins and they concluded that deeper depth dimples, smaller pitch more in numbers in direction of circumference is beneficial in enhancing heat transfer behaviour while arrangements of dimples have no impact [3].

(Jianyu, et al., 2016) found that use of receiver having asymmetric outward convex corrugated tube, the maximum improvement of usual heat transfer behaviour component is 148% and maximum restraint of von-mises thermal strain is 26.8% [4].

(Papanicolaou, et al., 2016) have presented the numerical results of a parabolic trough collector system with Syltherm 800/Al<sub>2</sub>O<sub>3</sub> Nano fluid as the heat transfer fluid. They found that the presence of nanoparticles enhance heat transfer and increase the collector efficiency about 10% [5].

Above studies shows that there are many mechanical stresses acting on receiver of Parabolic Trough Collector (PTC). It has been concluded that receiver tube of PTC has to withstand with drastic temperature difference, therefore there are many losses in the receiver of PTC by conduction, convection and radiation. Earlier, these losses were reduced by inserting twisted tapes, dimples and protrusions and also by giving turbulence to the flow, heat transfer was increased. Still there is a

scope that these losses can also be reduced by modifying the shape of the receiver tube of PTC and by changing the type of flow of fluid. Therefore, in this work the shape of receiver is modified in such a way that there is increase in heat transfer performance of PTC.

## II. METHODOLOGY

The various types of losses in conventional receiver had been identified. Methods of reducing these losses had been studied. The existing receiver had been designed and simulated in ANSYS FLUENT 18.2 with same given boundary conditions. The obtained results had been validated with existing system results. For improvement in rate of heat transfer and efficiency of PTC, shape of the receiver tube has been modified. The proposed shape has been designed to increase heat transfer surface area. Then, the proposed model has been simulated in ANSYS FLUENT 18.2. After simulating the proposed model, the obtained results are compared with the existing system.

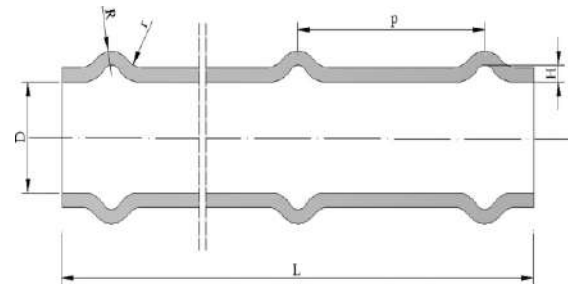
## III. SIMULATION PROCEDURE

### D. Geometry of receiver tube of proposed symmetric outward convex corrugated model and meshing system

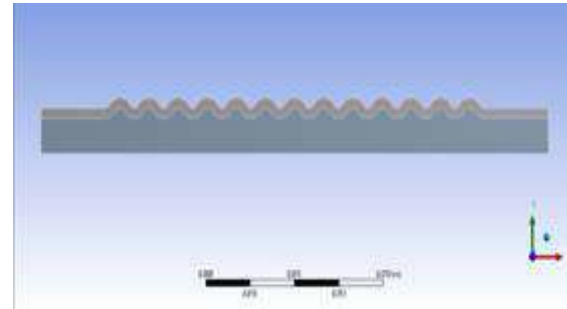
The set of design parameter of model includes Length of receiver tube,  $L = 200$  mm, Diameter of receiver tube,  $D = 20$  mm, Thickness of receiver tube,  $t = 3$  mm, Height of corrugation,  $H = 3$  mm, Corrugation crest radius,  $R = 5$  mm, Corrugation trough radius,  $r = 2$  mm as shown in Fig. 1. Schematic diagram of receiver tube of proposed symmetric outward convex corrugated model is as shown in Fig. 2. Helium gas is used as a heat transfer fluid in tube and material for tube wall used is steel [1]. Properties of material of working fluid and wall of tube are shown in the Table 1.

**Table 2** Properties of material of working fluid and tube wall

Variable	Unit	Helium	Steel
Density ( $\rho$ )	kg/m <sup>3</sup>	2.1659	-
Specific heat ( $C_p$ )	J/(kgK)	5191	8030
Thermal conductivity( $\lambda$ )	W/(mK)	0.2724	502.48
Dynamic viscosity ( $\mu$ )	kg/(ms)	$3.46 \times 10^{-5}$	16.27



**Fig. 3**Diagram of model showing all design parameters



**Fig. 2**Diagram of proposed symmetric outward convex corrugated receiver tube model

Numerical simulations are based on following assumptions: properties of helium gas remain constant as given in Table 1; gravitational force is neglected and the flow is incompressible. For numerical simulation, two-dimensional model with axisymmetric option is used.

For meshing of all models, in order to accurately control size and number of cells in domain a MultiZone Quad/Tri method is used as shown in Fig. 3. The region near wall represents the most important velocity and temperature gradients. Inflation is given near walls with growth rate of 1.2 to resolve velocity and temperature boundary layers.



**Fig. 3** Schematic diagram showing meshing used in proposed model

### E. Initial conditions and boundary conditions

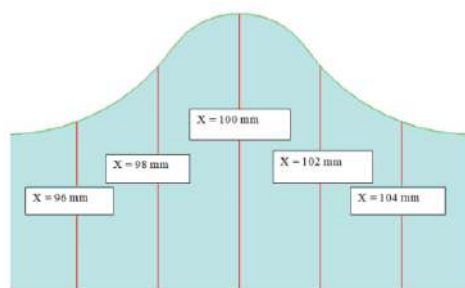
Following initial as well as boundary conditions used for both existing model and proposed model:-

1. Conditions for inlet of tube are:- Velocity inlet  $U_{in} = 44$  m/s, Inlet temperature  $T_{in} = 663.15$  K, Turbulent intensity (%) = 5, Turbulent viscosity ratio ( $\mu_t/\mu_{lam}$ ) = 5.

2. Conditions for outlet of tube are:- Pressure = 3 MPa, Turbulent intensity (%) = 5, Turbulent viscosity ratio ( $\mu_t/\mu_{lam}$ ) = 5.

3. Wall conditions:- A constant wall temperature is applied on outer wall of the tube. No slip boundary condition is applied on the inner wall. Temperature of the wall = 600 K.

Five different profiles in middle corrugation are used to study difference in flow pattern and characteristics of heat transfer occurred due to variety of corrugation pitches as shown in Fig. 4.



**Fig. 4** Schematic diagram of acquired profiles in the corrugated tube

#### F. Numerical procedure

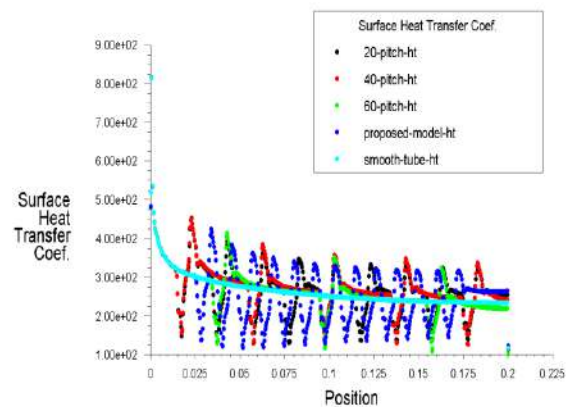
The pressure-velocity coupling is achieved by using SIMPLE scheme. For the momentum and energy equation second order upwind discretization is used. The two-dimensional computations are carried out using CFD package ANSYS FLUENT 18.2.

#### IV. SIMULATION RESULTS AND DISCUSSION

For analysis of existing as well as proposed model, Reynolds stress transport model is used with enhanced wall treatment. Five different models including one smooth tube and four having different corrugation pitches are simulated in ANSYS FLUENT 18.2. The set of parameters consist of  $R = 5$  mm,  $r = 5$  mm and  $H = 3$  mm is used to get the plot of Reynolds stress for five different profiles in middle corrugation which is shown in Fig. 5 respectively.

#### G. Analysis on distribution of coefficient of surface heat transfer

The Fig. 5 shows distribution of convective surface heat transfer coefficient along the wall of receiver tube for different corrugation pitches.



**Fig. 5** Distribution of Surface heat transfer coefficient along receiver tube wall

The Fig. 5 shows significant enhancement in turbulent flow convective heat transfer in case of proposed model compared to that of smooth wall tube and other corrugated tube models. Increase in intensity of fluctuation of velocity is main cause of enhancement in performance of heat transfer. As the larger increase in the intensity of velocity fluctuation found in proposed model compared to other models which causes enhancement in heat transfer behaviour. Therefore, it is concluded that in corrugated tube, improvement of heat transfer characteristics depends on the corrugations per unit length. It is found that the total heat transfer rate in proposed model is increased by about 18.66% as compared to smooth tube model. Also, the total heat transfer rate in proposed model is increased by 1.24%, 4.68% and 13.03% when compared with corrugated tubes having pitch of 20 mm, 40 mm and 60 mm respectively.

#### V. CONCLUSIONS

- The proposed model shows more separation of flow and then reattachment of boundary layer of turbulent flow occur in corrugation of proposed model as compared to the existing model, which results in increase in Reynolds shear stress.
- As the velocity fluctuations and thermal change in characteristics are principle reason of heat transfer improvement, the proposed model is able to give the better heat transfer performance as compared to the existing model.
- It is concluded that, the heat transfer performance depends on corrugations per unit length.
- If corrugation numbers are increased, then heat transfer performance is also increased.

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Photograph of Author B



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## EXPERIMENTAL INVESTIGATION OF V-TYPE SOLAR STILL COUPLED WITH SOLAR WATER HEATER.

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### **Abstract:**

*Water is one of the most essential gifts of nature to mankind. Life exists on earth because of water this makes it unique and precious among the other celestial bodies in universe. Two Thirds of earth's surface consists of water and of which only 1% of water is useful to us.*

*Solar distillation happens in the air tight vessel called still. Productivity is the main constraint for solar still. The current work investigates the solar distillation using solar energy and flat plate solar water heater when connected to V type solar still manufactured from Fibre reinforced plastic material. The study involves calculating solar still efficiency at different water level from 10 to 80mm for passive mode and active mode at 80 mm water level. Efficiency and results are compared and concluded. It can be concluded from that distillate output collected in case of active mode is more compared to passive mode. It is due to fact that large difference of temperature observed between basin water temperature and inner glass temperature in active mode than in passive mode. In spite of having high output, still efficiency in active mode is lower than passive mode because of thermal energy loss and high operating temperature*

### **Keywords:**

*V-type solar still, solar water heater, Flat plate collector, FRP, Solar Desalination, Solar Distillation, Solar energy.*

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### **I. INTRODUCTION**

Water is the essence of life. Life without water would have been impossible on earth. Despite three fourth of earth is covered with water fresh water it is inadequate. Only 1% of volume is fresh water. To suffice ever increasing demand desalinating of sea water is one of the alternatives. Desalination is initial forms of water treatment method is still practiced throughout the world. Some of desalination methods like multi stage flash, reverse osmosis, electro dialysis are not cost effective for the producing little quantity of fresh water. A conventional energy source has a harmful effect on the surroundings. The geographical location of India is such that most part of the country experiences sunny days favouring harnessing solar related technology. Solar distillation is a natural phenomenon on Earth. Solar insolation heats water in natural reservoirs, evaporating & condensing in to

clouds & return back as rain drops. It proves to be economic techniques in rural areas.

### **Literature Review**

Tiwari et, al (1990) [1] studied performance of single basin solar still manufactured from fibre reinforced plastic (FRP) still, Double slope FRP still. It was observed that in winter for Delhi conditions the single slope FRP still give better yield than double slope still. In summer the double slope stills give better yield than the single slope still. YP Yadav (1993) [2] Studied transient performance of a solar still coupled to FPC and operating in thermosiphon mode. The study revealed that it was prudent to consider a temperature dependent evaporative heat transfer coefficient when ( $T_w > 40^\circ \text{C}$ ) and basin water depth ( $h < 20 \text{ cm}$ ) while calculating the performance of a high-temperature solar distillation system. Emran Khan et al (1994) [3] in this paper, influence of orientation, glass cover inclination and water depth for higher yield, hourly instantaneous



cumulative and overall thermal efficiency and internal heat transfer coefficient of a solar for Delhi climatic conditions is studied. It was concluded that east-west orientation of a double slope solar still gives the maximum yield for a glass cover inclination. Emran Khan et al (1995)[4] In this paper, for Delhi climatic conditions influence of glass cover inclination for maximum yield is studied. It was concluded that in winter yield increases with increase in inclination and in summer yield decreases with increase in inclination. Bilal A Akash et.al (1998) [5] studied the effect of using different absorbing materials in a solar still, on the productivity of water for single-basin solar still with double slopes. The experimental results concluded that i) Productivity of distilled water were enhanced by 38% by using an absorbing black rubber while black ink increased it by 45% and use of black dye resulted in an enhancement of yield by about 60%. S.AboulEnein et.al (1998) [6] studied the thermal performance of the still experimentally and theoretically. Effect of heat capacity of basin water on the day light and overnight productivities was studied. It was concluded that productivity of the still decreases with an increase of heat capacity of basin water during daylight and the reverse in the case at night. Good agreement between experimentally and theoretical results was observed MBoukar (2001)[7] studied the influence of desert conditions at Adrar Algeria on the performance on simple basin solar still and a solar still coupled to a flat plate solar collector. The comparison of performance of the simple still with the coupled one under clear sky conditions at various depth levels of saline water for winter and summer period was carried out. It was concluded that the coupled still gives maximum yield at all depth of basin water but not the simple still. RJayprakash (2008) [8] studied thermal performance of a "V" type solar still with charcoal absorber is analysed and water collection output is estimated under similar climatic conditions. The overall efficiency of the still was of (24.47% without charcoal), 30.05% for charcoal, 11.92% with boosting mirror and 14.11% with boosting mirror and charcoal. In spite of high yield in case of still with charcoal & boosting mirror thermal efficiency was less due to more overall loss and high temperature. Kumar et.al (2010) [9] studied two solar stills (single slope passive and single slope photovoltaic/thermal (PV/T) active solar still) at IIT New Delhi. Photovoltaic operated DC water pump was used in active solar still to re-circulate the water

through the collectors and solar still. Experiments were performed for 5, 10, and 15 cm water depth, for both the stills. It was concluded that the daily yield from hybrid active solar still was 3.2 times in summer and 5.5 times in winter. Higher electrical and overall thermal efficiency was achieved from design of the hybrid active solar still. K Sampathkumar (2010) [10] studied effective utilization of solar water heater for still productivity enhancement. The evacuated tube collector solar water heater is coupled to still, & performance study was conducted at different day timing. The study revealed that the productivity of the still was doubled when it was coupled for 24-hour period. Alternatively when the solar collector was coupled with the still on attainment of storage tank water temperature of 60°C, it was observed that yield increased by 77% when compared to passive solar still. JD Obayemi et.al (2014) [11] Altered solar still with adjustable inclination angle (still A), and a conventional solar still with rigid angle of inclination (still B) are studied. The work explores the efficiency evaluation and performance of two single slope solar stills. The results clearly suggest that, there is no substantial difference between the distillate of still A (efficiency of 42%) and still B (efficiency of 39%). The importance is to be able to function properly by variation of the angle at which solar radiation is optimally incident on the system at different locations and time

MM Morad et.al (2014) [12] studied performance of active (Solar still combined with flat plate solar collector) and passive solar still in Zagazig City, Egypt. The experimental results revealed that active solar still maximizes both fresh water productivity as well as internal thermal efficiency (80.6%) compared with passive solar still day productivity and 57.1% internal efficiency) for conditions of 1 cm basin brine depth and glass cover thickness of 3mm.

Husham M Ahmed et.al (2014) [13] studied the three solar stills with identical basin shape and dimensions, but dissimilar glass cover configuration carried out at Kuwait. The glass cover configurations were single slope cover, double slope cover, and pyramid shaped cover. It was found that the pyramid still had the highest yield and this was accredited to the fact that more direct solar radiation was received in smaller space volume.

T.V. Arjunan et.al (2016) [14] studied the effect of Pebbles as energy storage medium on the performance of a solar desalination system.

Comparison of yield of two single basin identical solar still one with pebbles and other without is carried out under same climatic condition and different mode of operation. It was concluded that productivity improved by 9.5%.

Ramchandra Raju (2018) [15] studied the effect of FPC on distillate output and performance of solar still Kakinada, A.P. It was concluded that solar still with two FPC connected in series provides 41% more distillate yield and 47% more efficiency when compared with single FPC whereas when connected in series with 3 FPC produces 89% more distillate output and 48% more efficient when compared with single FPC. This was due to attainment of high water temperature.

From the above study, it is concluded that very few experimental investigations were carried out on V-type solar still coupled with solar water heater. This experimental investigation focuses on desalination of saline water using V Type solar still. The investigation is done when still is coupled (active) and uncoupled (passive) with flat plate solar water heater. The main problems areas in solar distillation system are i) High initial cost, results in high cost per unit output. ii) Improve Productivity i.e. LPD/m<sup>2</sup>. Experimental Investigation on Productivity for 10 to 80 mm water level for passive mode and at 80 mm water level is carried out.

## II. METHODOLOGY

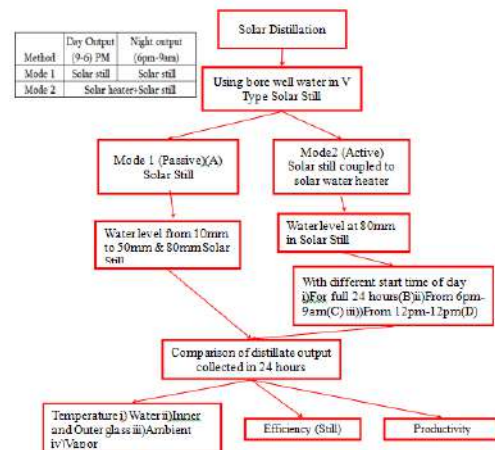
### EXPERIMENTAL SETUP

The Experimental set up is shown in Fig.1 was assembled in Pillai College of Engineering, New Panvel Maharashtra in an open ground. The V-type solar still of dimension 1metre X 1metre X 0.3metre is fabricated using Fibre Reinforced Plastic (FRP) sheet of 5 mm thickness. The complete assembly of the setup at site is shown in Figure 1. The V-type solar still is mounted on the stand fabricated from MS angles and MS strips. The still base is kept at viewable height from ground level. All the surface of still is insulated from (lateral faces and base) by insulating material Rockwool, to prevent heat loss. The glass is inclined at 15° to the horizontal on either side to form V shape. The glass surface of the still acts as a condensing surface for evaporated water vapours is facing East West direction. The glass surface is sealed using silicon adhesive thus making it leak proof at the joint. Methodology is explained in detail in flow chart shown in Fig 2. Flat plate solar heater will be used to preheat the brackish water before sending it to the still.



**Fig. 1** Experimental setup at site.

Apart from above two components on one inch line ball valves, gate valves, check valves are assembled and checked for satisfactory performance of the system. The preheated water is supplied to solar still which will enhance evaporation rate and will result in improved productivity. The still is in passive mode when not coupled to flat plate solar water heater, solar energy is used directly for raising water temperature. In active mode when coupled to flat plate solar hot water from storage tank and solar energy absorbed by water in still is used to evaporate water. Solar water heater works in a normal circulation mode and water flows due to change of its density.



**Fig. 2** Methodology flow chart

The heated water from solar water heater is stored in hot water tank and is utilized as per the model (passive) and mode2 (active) as mentioned in above flow chart. The use of solar water heater is used during the period when demand for hot water for domestic purpose is less. For this experimental investigation distillate output readings are taken for full one day 24 hours. Day time of the investigation is taken from 9am to 6pm and night time is taken as 6pm to 9am. At various conditions as mentioned in above flow chart Fig.2 the investigation of V type

solar still is done in passive and active mode. At the initial stage of experiment. Trial run for a day or two is taken to achieve a steady state condition. The water level in the solar still is kept for mode 1 Passive from 10mm to 50 mm at an increment of 5mm and 80 mm. For mode 2 active method of operation 80 mm of water is kept in still. During beginning of experiment to avoid dust deposition glass cover on still and solar water heater it is cleaned and wiped on regular basis. The quantity of water collected in the measuring cylinder is noted and recorded. The experiment readings are taken at an interval for 1 hour during day time i.e. from 9am to 6pm (day output). Collective distillate output is taken at 9am for period from 6 pm to 9am (night output). Total output collected is sum of day and night output. Thermocouple wire and temperature indicator were used for the temperature measurement of the system. Following were measured, temperature of water ( $T_w$ ) in the still, vapour temperature between glass and water ( $T_v$ ); inner side of the glass cover of still ( $T_{gi}$ ), outer side of the glass cover ( $T_{go}$ ), hot water storage tank temperature, collector inlet temperature and the ambient temperature of the surrounding. ( $T_a$ ) type thermocouple indicator wire and sensor are used to measure above temperature parameter. T type Thermocouple Copper Vs. Constantan elements. T type Thermocouple has minimum error of  $1^\circ\text{C}$  for operating temperature range of 25 to  $75^\circ\text{C}$ . Solar insolation is calculated theoretically by ASHRAE Model and it's equations and formulae.

### III. EXPERIMENTATION

#### H. Stage 1

The main objective of this work was to

- To fabricate and assemble the experimental setup.
- To investigate experimentally V type solar still coupled with solar water heater.
- To test the set up for performance.
- To generate experimental data.
- To calculate the passive and active efficiency of still and record the distillate output and experimental parameter of the experimentation.
- Compare the above results.

#### v. Stage 1 Passive Mode

Daily thermal Efficiency of solar still is calculated by equation.  $\eta_{\text{passive}} = \frac{\Sigma M_{\text{ew}} \times L}{I(t) \times 3600 \times A_s}$

Where  $M_{\text{ew}}$  mass of water evaporated in 24 hours and  $I(t)$  is Intensity of solar radiation on inclined

surface of the solar still ( $\text{W/m}^2$ ) and  $A_s$  is area of still in  $\text{m}^2$ .

#### vi. Stage 2 Active Mode

Experimentation is started at different time of day i.e. 9am, 12pm, 6pm and carried out for 24 hours. The daily thermal efficiency of an active solar still is calculated by equation.

$$\eta_{\text{active}} = \frac{\Sigma M_{\text{ew}} \times L}{\Sigma I(t) \times 3600 \times A_s + \Sigma I(t) \times 3600 \times A_{\text{tc}}}$$

Where  $M_{\text{ew}}$  Hourly output from solar still ( $\text{kg/m}^2\text{h}$ ) and  $I(t)$  is Intensity of solar radiation over the inclined surface of the solar still ( $\text{W/m}^2$ )

$I(t)$  is Intensity of solar radiation over the inclined surface of the solar collector ( $\text{W/m}^2$ ).

$A_s$  area of the still in  $\text{m}^2$  and  $A_{\text{tc}}$  is area of the collector in  $\text{m}^2$

### IV. RESULTS AND DISCUSSION

i) Passive mode (Still under clear sky from 10mm to 50mm and 80mm)

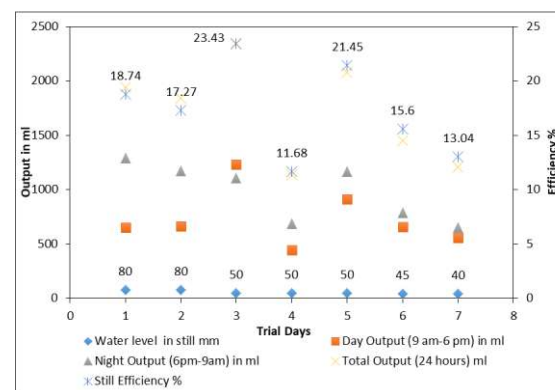


Fig. 3 Graphical Representation of results for Passive mode trial from 40 to 80 mm

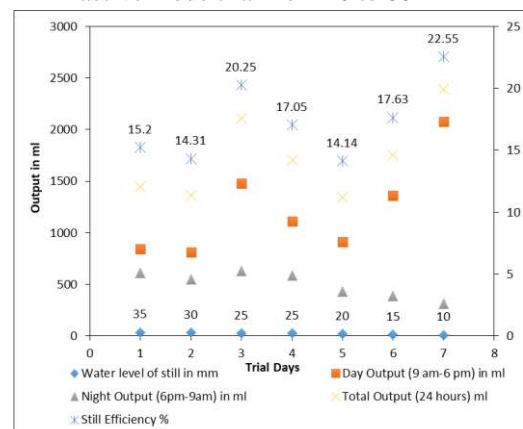
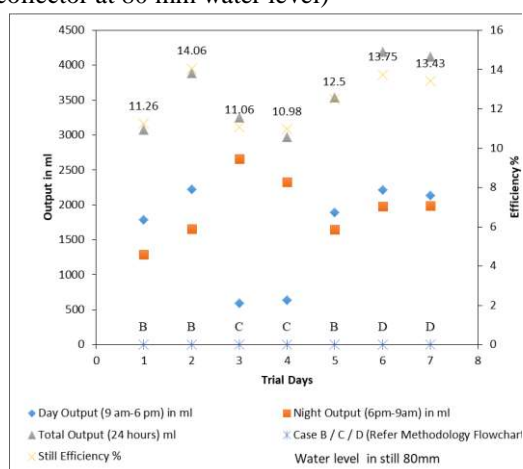


Fig. 4 Graphical Representation of results for Passive mode trial from 10 to 35 mm

The experiments were carried out for 24 hours however the hourly data is represented for day time only. Fig 3 and Fig 4 represent results of the tests conducted for 14 days from 7/11/2017 to

25/01/2018 for different water level from 10 mm to 50mm and 80 mm. Almost every day significant desalinate was after 11 am. The same gradually go on increasing till early evening and again dropping towards the evening. The output was measured in terms of day output and night output. The Total output was ranging from 1.135 L/m<sup>2</sup>-d to 2.38 L/m<sup>2</sup>-d collected for entire day (24 hours). During sunshine hour's day collection was almost varying from 0.445 litres to 2.07 litres. During non-sunshine hours night collection it was 0.305 litres to 1.29 litres. On i.e. 22/11/2017 the collection was low due to non-clear sky.

ii) Active mode (Still coupled to flat plate collector at 80 mm water level)



**Fig. 5** Graphical Representation of results for Active mode trial for 80 mm

The experiments were carried out for 24 hour still was coupled to flat plate collector. Fig.5 represents graphical results of the tests conducted for 07 days on dates from 23/01/2018 to 31/01/2018. The water level was 80 mm. The experiment was started by transferring the hot water stored in hot water tank to still at 80 mm water level. For different time of day i.e. at 9am, 12pm, 6pm.

## V. CONCLUSIONS

In the experimental investigation carried out from 07th November 2017 to 31st January 2018 for active mode, 80mm level and passive mode for water level from 10 mm to 80 mm in a V Type solar still made up of FRP constructions following were the conclusions a) Distillate Output per hour/m<sup>2</sup> is more in case of active mode. This is due high temperature difference between water surface & inner glass temperature (dT). In case of Active mode output was maximum as dT varied from 10-20deg.C whereas in passive mode dT varied from 2-12 deg. C

ii) Efficiency of active solar still is lower than passive solar still despite higher output this is due to higher operating temperature and thermal energy loss in active solar still

iii) Maximum collection in case of Active mode was 4.195L/m<sup>2</sup>-d with efficiency of 13.75% whereas in case of passive mode the collection was 2.380 L/m<sup>2</sup>-d with efficiency of 23.43%

iv) In active mode output is increased by 76% when compared to passive mode

## VI. ACKNOWLEDGMENT

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# CFD ANALYSIS OF CONDENSATION HEAT TRANSFER IN HELICAL COIL HEAT EXCHANGER

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## Abstract:

*In the present study effect of steam temperature on heat transfer coefficient is studied using ANSYS Fluent (2015). In this study CFD analysis is performed to validate experimental data of condensation heat transfer coefficient. Steam temperature is varied from 103°C - 115°C and its effect on heat transfer coefficient is done. Three helical coils having different coil diameter is used.*

*Steam is flowing inside the tube and water is flowing through the shell. It is observed that as saturation temperature of steam increases heat transfer coefficient increases and as coil diameter increases heat transfer coefficient decreases and the percentage of error is within 9-15%. In addition with this impact of variation in tube diameter on heat transfer coefficient is studied and it is observed that as tube diameter increases heat transfer coefficient increases.*

**Keywords:** Coefficient of heat transfer, CFD, Condensation, Helical coil.

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## I. INTRODUCTION

Heat exchanger is a device that transfers heat from one medium to another. A heat exchanger is a device which is used to transfer thermal energy between two or more fluids which may be in direct contact or flowing separately at different temperature and in thermal contact. It is found from literature that heat transfer rate in helical coil is higher as compared to straight tube. Helical coil is more advantageous than straight tube due to their compact structure and enhanced heat transfer coefficient. The increase in heat transfer coefficient of helical coil is result of coil curvature, curvature of coil produces centrifugal force on moving fluid and secondary flow. The secondary flow produces additional transport of the fluid over the cross – section of the pipe. Due to this additional convective transport both heat transfer and pressure drop increases as compared to straight tube. In many industrial application helical coil heat exchanger are one of the most common equipment. Helical coils are widely used as heat exchanger and reactor because of higher narrow residence time distribution, compact structure, mass transfer coefficient and higher heat transfer coefficient. Due to centrifugal force the flow in helical coiled tubes is modified. In helical coiled tube fluid particles move toward the core region of the tube due to development of secondary flow field. The heat

transfer rate in helical coil increases due to secondary flow as it reduces the temperature gradient across the cross-section of the tube. From various studies it is found that helical coiled tubes are more superior to straight tubes when applied in heat transfer application. The development of secondary flow is the result of centrifugal force due to curvature of coil which helps in mixing the fluid and increases heat transfer.

## II LITERATURE REVIEW

Jose Fernandez-seara et.al (2014)[1] carried work on the performance of a vertical coil heat exchanger. Numerical model and experimental validation. In this study a numerical model was developed to see the effect of coil tube diameter, pitch, tube length and coil diameter on the heat transfer coefficient and pressure drop. Natural convection was considered as boundary condition. The result obtained shows that nusselt number increases with increase in outer tube diameter. It was also observed that as number of turn's increases for the same  $D_c$ ,  $p$  and  $d_o$ , nusselt number decreases and it also shows larger influence of the increasing diameter on the reduction of pressure drop. R.Thundil karuppa Raj et.al (2014)[2] had investigated numerical analysis of helically coiled heat exchanger using CFD technique. The geometry was created in Unigraphics software and

meshing was performed in ICEM CFD tool. 3D numerical analysis was performed to see the effect of different pitch size on heat transfer characteristic. In this analysis flow inlet velocity was changed from 1 to 3m/s and SST k- $\omega$  turbulence model was used with standard wall function. It was found that 60 mm coil pitch gives better heat transfer coefficient as compared to 30 mm coil pitch. Mir Hatef Seyyedvalilu and S.F. Ranjbar (2015)[3] had studied the effect of geometrical parameter on heat transfer and hydro dynamical characteristic of helical exchanger. In this research work CFD investigation was done to see the influence of various parameters such as coil radius, coil pitch and inner diameter of tube on heat transfer characteristic of double tube helical heat exchanger. It was concluded that maximum velocity is obtained in central region of the inner tube. By increasing inner tube diameter, overall heat transfer coefficient of heat exchanger increases. It was also observed that as pitch size increases heat transfer coefficient reduces and as number of coil increases, nusselt number decreases. G.B.Mhaske and D.D.Palande (2015)[4] studied enhancement of heat transfer rate of tube in tube helical coil heat exchanger. In this study LMTD, heat transfer rate, overall heat transfer coefficient, efficiency, Reynolds number, nusselt number and friction factor were calculated using experimentation. CFD analysis was carried out for helical coil tube in tube heat exchanger and analysis results were used to predict the flow and thermal development in tube in tube helical coil heat exchanger. It was found that inner tube nusselt number increases by 4.92% compared to conventional heat exchanger. It was also observed that log mean temperature difference (LMTD) of helical coil heat exchanger was 1.4°C more as compared to conventional heat exchanger. J.S.Jayakumar et.al (2008) [5] had carried out experimental and CFD estimation of heat transfer in helically coiled heat exchanger. In this study geometry and the mesh were created in GAMBIT 2.2 of the CFD (fluent package). In this study heat transfer coefficient were compared for various boundary conditions. It was found that for actual heat exchanger boundary condition like constant wall temperature or constant heat flux not reaches to proper modelling hence it should be modelled by considering conjugate heat transfer. After comparing experimental result with CFD calculation result using CFD package 6.2 a new correlation was developed to calculate inner heat transfer

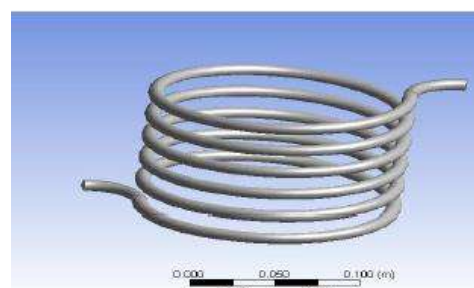
coefficient. Jiawen Yu et.al (2018) [8] has carried out numerical investigation on flow condensation of zeotropic hydrocarbon mixtures in a helically coiled tube. In this study a numerical analysis was carried out to see the effect of mass flux, saturation pressure and vapour quality on heat transfer coefficient of methane/propane and ethane/propane mixture in a helically coiled tube. It was found that heat transfer coefficient increases with increase in mass flux and vapour quality whereas it decreases with increase in saturation pressure. Results obtained from CFD simulation were compared with existing condensation heat transfer coefficient correlation and improved heat transfer correlation was developed.

### III. OBJECTIVES

- I. To validate experimental data with CFD simulation for condensation heat transfer in helical coil heat exchanger.
- II. To study effect of steam temperature, and coil diameter on heat transfer coefficient.
- III. To study impact of variation in tube diameter on heat transfer coefficient.
- IV. Study of Temperature variation inside the tube.

### IV. CFD METHODOLOGIES

For simulation of condensation heat transfer in helical coil heat exchanger first geometry of helical coil is created in SOLIDWORKS 2016. After creating geometry it is imported in ANSYS 2015. After importing geometry and meshing problem is analyzed in ANSYS 15. Inner fluid is taken as steam and outer fluid as water. Modelling starts with defining initial boundary condition. Finally, it is followed by result, discussion and conclusion.



**Fig.1** Model of heat exchanger helical coil

**Solution:**

It is achieved in following steps:

**General:** Type-Density based, Time- steady, Velocity formulation- Absolute

**Model:** Energy equation-ON, Viscous model- K- $\epsilon$  model, Multiphase- Implicit

**Material:** Phase1-water vapour, phase 2- water liquid, solid- steel

**Cell zone condition:** Fluid

**Boundary condition:** inlet- mass flow, outlet- pressure, wall- constant temperature.

**Solution Methods:** Scheme – Simple, Pressure-standard, Gradient- least square cell based, Momentum- second order upwind, Turbulent dissipation rate – Second order upwind, Turbulent kinetic energy- Second order upwind

**Solution initialization:** Hybrid initialization

**Run calculation:** Number of iteration-500, reporting interval -1, profile update interval -1

**Results:** graphics and animation- contours of wall fluxes and heat transfer coefficient.

## V. RESULTS AND DISCUSSION

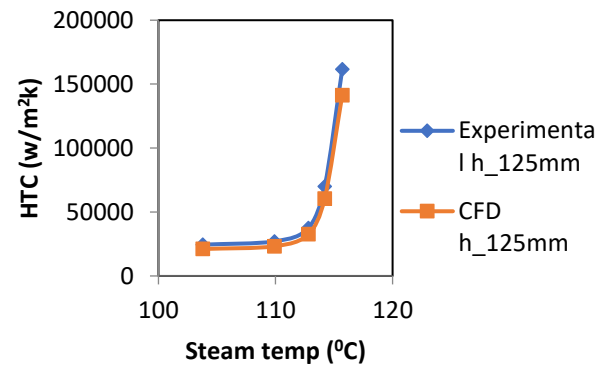
The three helical coils with the same pitch, number of turns and tube diameter and with different coil diameters were tested against saturation temperature of steam. Total 15 tests were carried out to generate the data

### 1. Validation Of Impact Of Saturation Temperature Of Steam On Coefficient Of Heat Transfer Using CFD Analysis

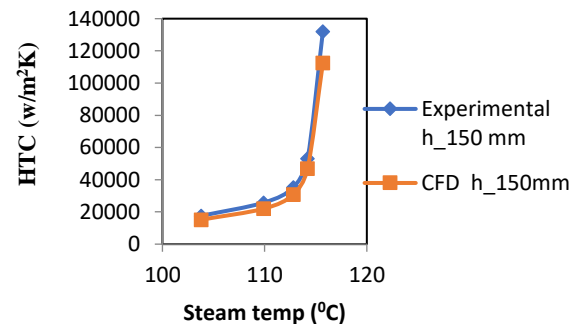
To find out the influence of steam temperature on the heat transfer process we have used five different saturation temperature of steam

The steam side HTC is plotted against steam temperature in the following figure. It demonstrates that the CHT increases with the increase in saturation temperature of steam.

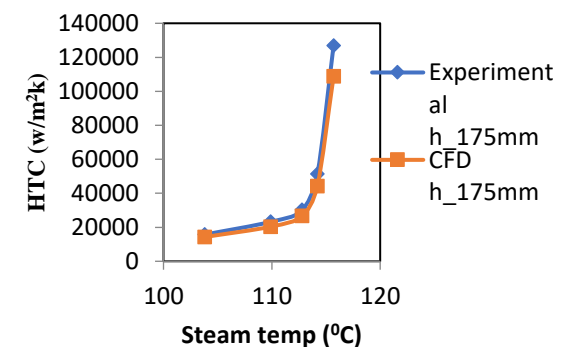
The effect of coil diameter is also studied which shows that as the coil diameter decreases the CHT increases. The decrease in curvature radius enhances the effect of centrifugal forces on the flow characteristics. The secondary flow is boosted as curvature radius is decreased and Dean Number is increased.



**Fig.2** Effect of steam temperature on Heat transfer coefficient ( $h_0$ ) for 8LPM



**Fig.3** Effect of steam temperature on Heat transfer coefficient ( $h_0$ ) for 8LPM

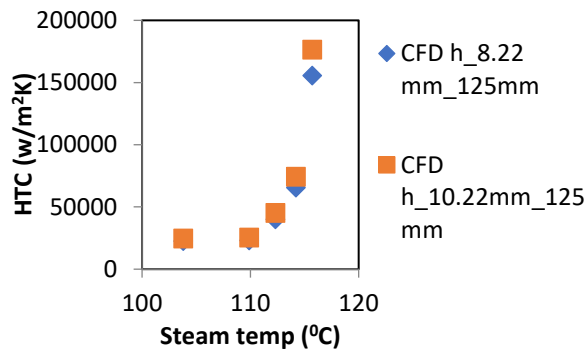


**Fig.4** Effect of steam temperature on Heat transfer coefficient ( $h_0$ ) for 8LPM

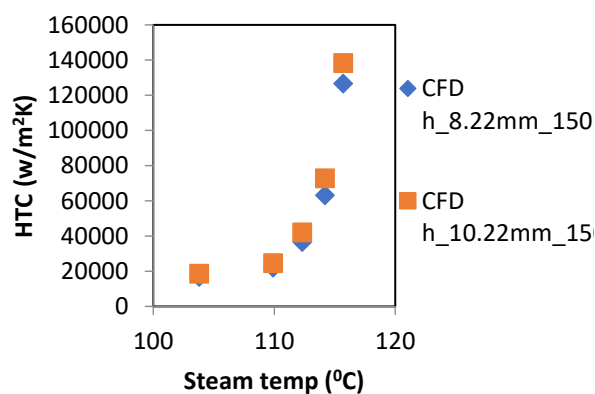
The change in heat transfer coefficient with change in steam temperature is shown in fig. 2, fig.3 and fig. 4 for water flow rate of 8 lpm respectively for all the three helical coils. It shows that difference in heat transfer coefficient for coil diameter is increased with increase in steam temperature.

### 2. Effect Of Variation In Tube Diameter On Coefficient Of Heat Transfer

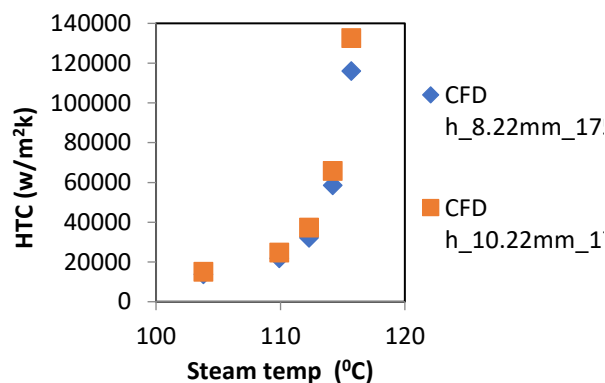
The steam side average CHT is plotted against steam temperature. It shows that HTC increases with increase in tube diameter. Here tube diameter is varied as 8.22mm and 10.22mm and its impact on heat transfer coefficient is studied.



**Fig.5** Effect of steam temperature on coefficient of heat transfer for 125mm



**Fig.6** Effect of steam temperature on Heat transfer coefficient ( $h_0$ ) for 150mm

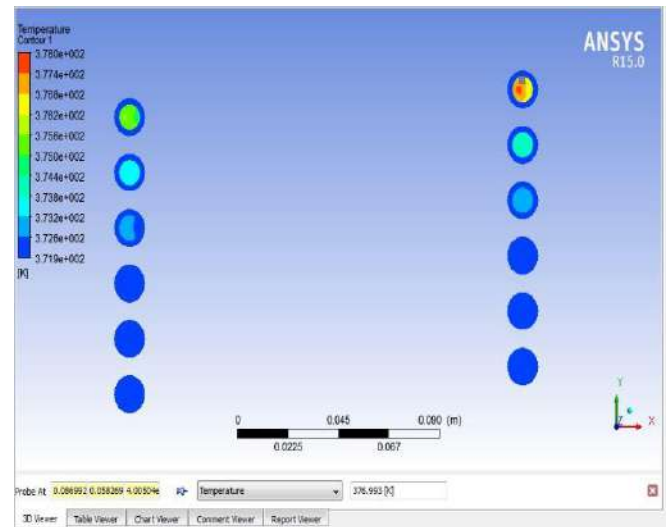


**Fig.7** Effect of steam temperature on Heat transfer coefficient ( $h_0$ ) for 175mm

Effect of tube diameter on average heat transfer coefficient is shown in fig.5, fig 6 and fig.7. The heat transfer coefficient increases with increase in tube diameter.

### 3. Study Of Temperature Variation Along The Path

In this section study of temperature variation inside the tube is done. Values of steam temperature at different location inside the tube is studied.



**Fig.8** Temperature at various locations

**Table.1** Values of temperature at various location

Positio n	Locatio n (degree)	Temperatur e (K)	Temperatur e (°C)
1 <sup>st</sup> turn			
(right side)	0	376.137	103.137
	90	376.993	103.993
	180	377.285	104.285
	270	376.898	103.898
(left side)	0	374.79	101.79
	90	375.276	102.276
	180	375.507	102.507
	270	375.295	102.295

Table shows the temperature at four location ( $0^\circ, 90^\circ, 180^\circ$  and  $270^\circ$ ) of left side and right side of first turn. From table it can be seen that temperature is maximum at outer side as compared to inner side which is result of secondary flow effect.

## VI. CONCLUSIONS

CFD package (ANSYS FLUENT 15.0) is used to validate experimental data of condensation heat transfer coefficient. The effect of steam temperature on heat transfer coefficient is studied and it is observed that as steam temperature increases heat transfer coefficient increases and also observed that heat transfer coefficient is maximum for smaller coil diameter and lower for bigger coil diameter. It is found that as tube diameter increases heat transfer coefficient increases. From study of temperature variation at various locations it is observed that temperature is higher at outer side of tube as compared to inner side which is the result of secondary flow generation.

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## ADVANCED AUTOMATIC RATION MATERIAL DISTRIBUTION SYSTEM

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### **Abstract:**

*Government of India provides various facilities to the people those are under poverty line but such facilities do not reach to the poor and needy people due to the corruption present in the distribution chain. One of such facility provided by the government is ration material distribution system (RDS). In RDS, people can buy ration material (sugar, rice, oil, kerosene, etc.) from the ration shop with the special cost ones in the month. If it is not purchased by the card holder then there is a possibility of misuse of material by shopkeeper, like he can sell it illegally in market with high cost and gains more profit. So, to overcome this problem, one can have a transparent central monitoring system which will be linked with the government offices, ration distributors and the ration card holders. For this GSM technology will be helpful for wireless data transmission, Biometric Machine for authentication of consumer, RFID card for identification & transaction and advance processor to process the system such as Arduino UNO. In this paper different types of system implemented for similar application was describe with their advantages disadvantages and applications. Inline to this a new approach to automatic ration distribution is given to overcome all the basic drawbacks of existing system*

### **Keywords:**

*Advance Automatic Ration Material Distribution System (AARMDS), Biometric Machine, GSM Module, RFID, Arduino UNO, Fair Price Shops (FPS).*

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**Accepted on:** 24/12/2018

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## I. INTRODUCTION

Government of India is issuing Ration Card to every Indian family for fulfilling their daily meal needs. Alongside the Government of India provides different facilities for ration distribution towards a poor people but such facilities do not reach up to needy and poor people due to the corruption present in distribution. While doing the literature survey, field visit and consumer review some of major problems are identified in government ration distribution system such as

- vii. *Improper calibration of measuring instruments*
- viii. *No Modernizing (updatation) of rate chart.*
- ix. *Deficiency of information regarding stock availability towards distributor to Customer and DSO*

According to the government rules and regulation it is mandatory to the consumer to produce a valid ration card to buy any materials from the government ration distribution shops. Presently the ration distribution process is based on monthly distribution pattern and hence the stock verification is only done at the end of month. It menace that there

is a lacuna for daily monitoring of unused or balance food material at the distribution centre. Many times it is found that the consumer will not get proper quantity of material even after paying full payment due to improper calibration of measuring instruments. The third issue which has been observes that Gov. of India always try to give and distribute the material with minimum amount of cost depending upon various factors which is to be updated and followed by distributor but it is not happen actually. In this paper the solution to the above cited problem of manual distribution system is studied and comparative study of different ration distribution systems is presented. The solution for above problem can be provided if the automated system will be linked with government offices, shopkeepers and the ration card holders for updating of stock at distributor, and automatic approach of distribution through atomization in distribution system through which the problem of calibration will overcome and real time automatic billing, authentication and database management .

In this paper in section I the introductory contain is given in which author has given brief review of

actual distribution system in India. In section II the literature survey has been given in which around three advance systems are taken into consideration for further study and implementation. Section III gives the idea about the new approach to ration distribution system through and implementation of ration distribution system using GSM, RFID, Fingerprint sensor and Arduino UNO. This section also consists of block diagram and flowchart with other details of system to be implemented. In section IV the comparative result discussion is given along with the parameter discussion. In last section the paper was concluded with the conclusion based on the entire study, survey and literature review.

## II. LITERATURE SURVEY

### I. Document survey

S. R. Kurkute, D. P. Patil published a paper with title “Automatic Ration Distribution System-A Review” in (WPNC&GSW-2015) IEEE conference INDIA com, in which the ration distribution system was explain. In the said paper author has given the detail literature survey of ration distribution system. The discuss system can be implemented using controller and RFID cards for transaction and identification of card holder. The GSM system is used for wireless data transmission. [1]

Shubham Mahesh Wari, Mukesh Tiwari proposed a Smart Public Ration Distribution System They have used RFID cards for authentication and OTP for security of user. An OTP is sent to user with the help of GSM (SIM900). They have managed user database using MS-SQL DBMS. The whole system is built around ARM7 microcontroller i.e. LPC2148 (works on 32 bit ARM instruction set). [3].

K. Balakarthik gives the idea under title “Cloud-Based Ration Card System using RFID and GSM Technology”, This paper presents an efficient method for the user to buy the products in the ration shop by just flashing the card at the RFID reader. This paper was published in vol.2, Issue 4, Apr 2013.[4].

Rajesh C. Pingle, P. B. Borole gives the idea about automatic ration distribution system thorough his paper under title “Automatic Rationing for Public Distribution System (PDS) using RFID and GSM Module to Prevent Irregularities”, In this automated system conventional ration card is replaced by smartcard in which all the details about users are provided including their AADHAR (social security) number which is used for user authentication. This prompted us to interface smart card reader (RFID

Based) to the microcontroller (AT89C51) and PC via RS232 to develop such a system. Using such a system, Government would have all required control/monitoring over the transactions at ration shop. To involve government in the process we proposed connecting the system at ration shop to a central database (provided by government.) via GSM module (SIM900D) and RS232. Quad-band intelligent GSM/GPRS modem suitable for long duration data transmission. [5] Hence it is possible to prevent the corruption and irregularities at ration shop. This would bring the transparency in public distribution system and there will be a direct communication between people and Government through this. This paper was published in Volume issue by 2, pp.102-111, Mar 2013 [6]

### J. Market survey

The market survey has been done in which around 28 states are taken into consideration from India out of which 22 states are using manual ration distribution process. Some of states are in process to upgrade the system with biometric ration distribution. The statistic shows the summarization of market survey. The data collected in the month of Sep 2018 from internet resources. Figure1 Shows Market Survey Summery and Figure 2 show the manual distribution process.

### Market Survey Summery

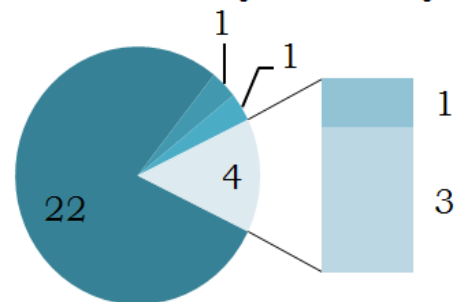


Fig. 4 Market Survey Summery

Table 2 Different Types of Ration Distribution

Different Types of Ration Distribution
22 state using Manual distribution
1 state using Manual + Online ration card
1 state using Manual + Biometric
1 state using Manual + Smart card
3 state using Manual + Biometric



**Fig. 2** Manual Distribution System

### III. SYSTEM DESIGN

Quantities of different food like rice, sugar, kerosene etc. is fixed for every month per families depending upon their income and total number of person in that family and commodities are allocated to ration card holder per ration card as shown.

**Table 2** Ration card types and allotted ration

Type of card	Commodity	Ration per member	Price per kg
APL	Wheat	3Kg	3
	Rise	2Kg	2
	Kerosene	1lit	30
BPL	Wheat	3Kg	3
	Rise	2Kg	2
	Kerosene	1 lit	30

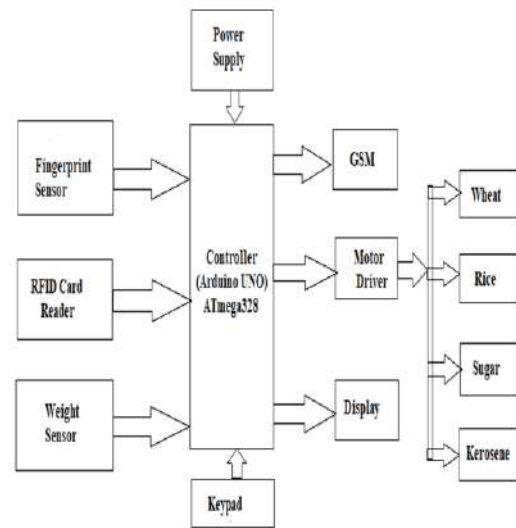
**Table 3** Ration card types and allotted ration

Type of card	Commodity	Fixed Ration	Price per kg
AAY	Wheat	21Kg	2
	Rise	14Kg	3
	Sugar	1Kg	20
	Kerosene	1lit	30

From the above review study in this section the implementation of system which is design to distribute ration material automatically is discussed. This system will reduce human efforts as well as it will control the corruption in ration material distributions. The system will also be capable of identification of user's information and the amount of material allotted to him according to type of card issued by the government of India.

The proposed system is based on an ATmega328 which is used for user authentication, validation and notification. The server will keep all the records. It also manages some activities such as user

identification, updating of the database. The admin can login into the system to access the server data. The complete block diagram of the system is illustrated in fig.3.



**Fig. 3** Block Diagram of AARMDS

Initially all ration customers need to register at fair price shops (FPS) of their region. The FPS distributor will take registration and forward it to the higher authority for verification along with necessary documents. The registration consists of collecting personal information such as number of persons in family, income, contact number, fingerprint of all members etc. after the registration each family is provided with a RFID card of unique number which will be used to purchase the ration. Only the members of family are allowed to collect the ration. To ensure this fingerprint authentication is used. The authentication process involves fingerprint scanning and fingerprint matching. After scanning of fingerprint the controller will compare the fingerprint with the stored fingerprints in the database. This is very important because it assures that the allotted ration will be reached to only family members. If fingerprint is not match with database then controller will send SMS to customer and distributor and wait for 2 minutes so you can understand that the wrong person is using your card. Fingerprint based systems are quite strong and can be deployed across any kind of environment. This system is less intrusive than iris or retina scans [7]



**Fig. 4** Thumb Scanning

The SIM900 GSM module is used to send a SMS of successful transaction and notification.

Here passive RFID (Radio Frequency Identification) card is used. Radio Frequency Identification Device is a technology which works on the principles of radio waves [8] [14] [15]. The EM18 reader module is used to read these RFID cards. This card consists of small antennas and it is capable of accumulating approximately 2000 bytes of data. The Reader module continuously transmitting 125 kHz electromagnetic waves, an antenna inside the card is power up and reflects these EM waves. When card is brought near to the reader module a unique hexadecimal number is read by the reader module. This unique number is used to identify the customers. Weight sensor is used to measure weight of materials and with the help of motor driver material will be distributed as per quantity given by customer.

#### K. Flow chart

The flow chart gives the idea about the actual working and operation of system in which GSM module will send the information in the form of SMS to user as well as DSO officer with get update about available stock details in ration shop.

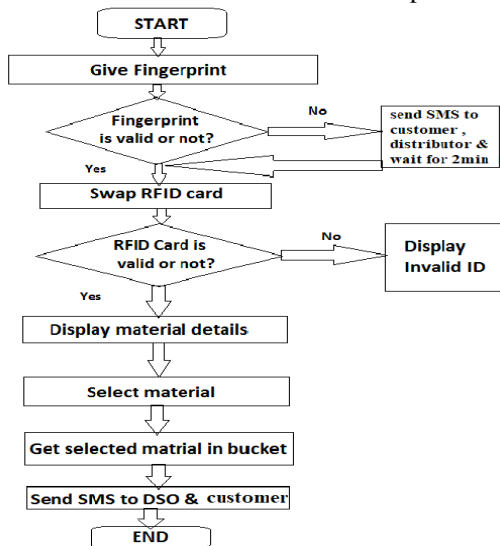


Fig. 5 Flow chart

#### IV. EXPERIMENTATION

As an experimentation of discussed system, we are going to develop a prototype of automatic ration distribution system for 20 kg material distribution. During experimentation we are going to consider rice, wheat, sugar and kerosene as material for distribution. Hardware includes the controlling unit, RFID tag, Fingerprint sensor, material storage,

automatic billing system. Most important is GSM so as to provide legal data information to Gov. of India. [13]

#### V. RESULTS AND DISCUSSION

The expected results from the system is the system should have a display which shows the following information on screen when RFID card is inserted by the customer.

**User 1 (AAY)**

**Card no.8275838086**

**Available material in ration shop:**

wheat-200kg,Rice-100kg,Sugar-50kg,Kerosene-50litre

**Allotted material:**

wheat-21kg,Rice-14kg,Sugar-1kg,Kerosene-1liter

If the card is Invalided the system should shows the massage on screen as

**User 2 (AAY)**

**Invalid ID**

After purchasing the material allotted to the customer the massage should be deliver which includes details of bill and amount to be paid to distributor.

**User 1 (AAY)**

**Card no.8275838086**

**Allotted material:**

wheat-21kg ,Rice-14kg ,Sugar-1kg ,Kerosene-1liter

**Material parches:**

wheat-10kg ,Rice-7kg ,Sugar-1kg ,Kerosene-1liter

**Delivered material:** 12:36pm, 05/10/2018

**Total amount to be paid:** Rs.91

**Balance Material:**

wheat-11kg , Rice-7kg, Sugar-0kg , Kerosene-0 liter

**Available material in ration shop:**

wheat-190kg, Rice-93kg, Sugar-49kg, Kerosene-49 litre

Automatic bill should be generating after confirmation and the database should be auto update after every customer. Figure shows the expected format of auto generated bill. The rates included in bill are as per data collected in that month according to the governments norms. The note should be given at the end of bill which gives the idea about rate of material and related circler pass by government of India or by state government.



## VI. CONCLUSIONS

In the presented paper the details about advance ration material distribution system was discussed. The market survey has been done in which it was found that no state government in India is presently distributing the ration with complete automation. During survey of ration distribution system some of problems were identified such as improper calibration of measuring instruments, No Modernizing (up-dation) of rate chart and Lack of information regarding stock availability at distributor to Customer and DSO. All such problems can be overcome with sort of modification in system. All such modification was discussed in above system. The presented system will be a new approach to modernization of villages and will be helpful for controlling the unethical practices in public ration distribution system. Due to its continuous monitoring and data collection the system will play an important role in Disaster management.

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## AN APPROACH TO ENHANCE ENERGY EFFICIENCY USING SMALL CELL IN SMART CITY

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### Abstract:

The idea of Smart home in smart city is the most acceptable in the cloud computing and Internet of Things (IoT) world. The traffic emanating from the smart home is a major challenge. This significant amount of traffic can be handled by the small cell i.e. home eNodeB (HeNB). Small cell has a property of self organizing (SON) and self healing to efficiently handle the indoor traffic between various devices (e.g mobile, laptop, home appliances, sensors and Body Area Network (BAN). Moreover, the success of smart city depends on the availability of broadband service to support the huge number of devices. Thus, in this paper introduction of small cell in smart home network is discussed and an algorithm is proposed which saves energy by switching off the redundant small cells known as sleep mode mechanism. Here open access operation of small cell is considered. The energy saving algorithms will result considerable amount of gain (Quality of Service (QoS)) which leads to energy efficiency.

### Keywords:

Smart city, smart home, small cell, sleep mode, energy efficiency

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### I. INTRODUCTION

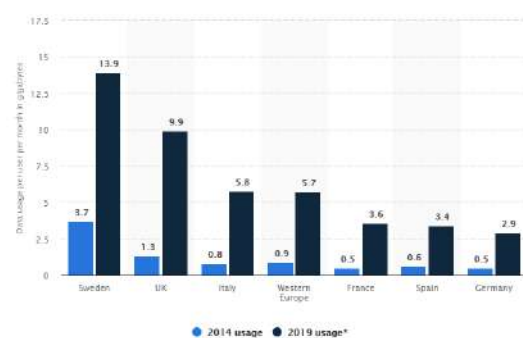
With the seismic shift toward smart cities and the internet of things (IoT), reliance on telecommunication i.e. wireless and wireline broadband infrastructure is becoming larger and larger. Smart devices like smart phones, IoT devices and other wireless gadgets are becoming universal. Cellular data consumption in selected European countries increases by 6 times in last five years and has reached approximately 10 Gigabytes per user per month. This number is projected to grow another 4 fold by 2022.

The mobile operators are rolling out the 5G internet services gradually, as well as the IoT and cloud services, to the millions of smart devices connected to the internet. Due to this cities may face increasing wireless traffic demand from residents and to make broadband communication facilities and infrastructure demands becomes more competent it needs some energy efficiency measures. [1][5].

**Smart city** includes smart home, smart healthcare, smart hospitals and smart way of managing traffic, smart vehicle and smart entertainment. There are various domains, such as, the city environment (pollution in air and water),

waste management, street light, car and traffic etc. [2].

Sensors also can be deployed on the roads to detect if the traffic on the road is above the predefined threshold, if there is any damage on the road and will dynamically reroute the traffic by receiving real time information on GPS application like Google maps.



**Fig. 5** Mobile data usage per user per month in selected European countries in 2014 and 2019 (in gigabytes) [5]

- Sensors can be used in street lights to detect vehicles or movement of humans. Depending upon the presence/absence of traffic/human beings it can be dynamically turned on/off on that particular place. This will help to save energy of

the city, and will also ensure the security by avoiding dark area around that place.

- Sensors can be used to detect the pollution level in the environment and water. Necessary precaution measures can be taken to reduce the pollution and to alert the people.
- Sensors can be connected to the trash bins as well for public toilets to detect places containing dirt and to report/communicate for taking necessary action (i.e. clean the toilets, empty the bins etc.).
- As per the sensor data, the mobility of the inhabitant's and depending on the actual usage of the city according to the utilities, infrastructure and urban planning can be done.
- Sensors can be used to monitor and alert the potential issues and automate the maintenance of city infrastructures like, bridges, buildings and roads.
- Sensors can be used to support self-driving vehicles. It can also be used for car pooling and unmanned railway crossings.

Various services can be aggregated inside the smart city using multiple data centres e.g. collection of data from the sensors, storing the data appropriately and processing and analyzing the data on real time basis. Sensors can also be used to track the vehicles and enable speedy recovery of the stolen items.

The **Smart Home** is a part of the Smart City. Here the services are defined as per the need of the user. The Smart Home architecture consists of different sensors inside the home. The sensors mainly divided into three different kinds: i. Electrical sensor, Gas sensor and Water sensor. Electrical sensors are connected to different electrical appliances for example, refrigerator, television, air conditioner, microwave oven, washing machines, tube lights and fans. The Gas sensor can be connected to the cooking gas service and water sensor can be connected to the water taps. The gateway controller collects the data from the sensors; a cloud server will receive the data from the gateway and it will store, process and analyze. When the mobile devices inside the home connected to the gateway, they will be notified when they are outside of the home network.

Message Queue Telemetry Transport (MQTT), which is the state-of-the-art IoT protocol, can be used for communication between devices and also from device to internet/ gateway controller [6]. Solar cell can also be used for homes, depending on how much power can be obtained from the solar cell and the electrical appliances can be prioritized according

to their power consumption. A switch is used between the solar cell and the grid power supply. If the power in watts obtained from the solar cell is sufficient to provide supply to the electrical devices then they can be connected to the solar cell instead of grid power supply. It will reduce the power consumption and energy saving will happen [6]. As one of the objectives of this research work is to increase the efficiency using Green communication hence energy usage from natural resources can be carried out.

All the data collected from the sensors will be updated in the cloud server with some predefined threshold, if there is any abnormality or any data exceed the threshold it will be immediately updated in the server and will be notified.

The objective of this research work is to examine and discuss the role of small cells for indoor solutions in smart city. To enhance energy efficiency using green communication technique i.e. enabling sleep mode technique for the small cells which are not in use or the number of users are very less is analysed.

This paper is organised as follows. In section II overview of small cell, section III system model and indoor channel model, section IV Green SBS Switch off algorithm and flow chart, section V results and discussion, section VI is Conclusion.



Fig. 2 Smart Building [4]



Fig. 3 Smart Home [4]

## II. OVERVIEW OF SMALL CELL NETWORKS

As wireless technology revolution happens in every five years, now the world has entered towards convergence. It means device to device communication, connecting the devices to the cloud server and remotely monitoring the behaviour of the devices is taking place. If there is any abnormality then necessary action have to be taken immediately and can be notified on real time basis to the user. This is only possible with high speed internet service, lower latency and higher security of the data.

The above services can be started from smart home where all the devices can talk with each other as well as the gateway controller and data can be automatically updated in the cloud server and abnormalities can be notified.

As we are moving towards 5G technology which promises higher capacity (1000 times increased data volume per area), higher data rate (10 to 100 times increased user data rate), lower end to end latency (5 times reduced end to end latency), Massive device connectivity (10 to 100 times increased number of connected devices), 100 times less energy consumption in comparison to the current cellular network, reduced cost and assured Quality of experience (Consistent) [7]. The promising nine enabling technologies for 5G network are identified as [7]: i. Heterogeneous network (HetNet) ii. Device-to-device (D2D) communication iii. Massive multiple-input multiple-output (MIMO) iv. Millimetre wave (mmWave) v. Full duplex communication vi. Energy aware communication vii. Energy harvesting viii. Cloud-based radio access network (C-RAN) and ix. Virtualisation of network resources

High bandwidth consuming applications e.g. downloading of data, streaming application, online gaming and chatting and video call service are mainly done by fixed users inside the home. These kind of users can be separated from outside

mobile users and can be shifted to indoor solutions e.g., Home eNB or, small cell. **Small cell** gain popularity because of its very low energy consumption and can provide broadband coverage capacity. The HetNet integrates Macro, micro, pico and femto cell. The different types of cells can be differentiated by their transmission power ( $P_t$ ), coverage capacity and user association. The deployment of small cells has a great potential to improve the spatial reuse of radio resources and also to enhance the transmit power efficiency and in turn, the network EE.

## III. SYSTEM MODEL

Consider a 3\*3 indoor grid model, where 9 Small cell Base Stations (SBSs) are located at each of the centre of the 10\*10 m room. There are 10 User Equipments (UEs) located in random manner. The simulation is done by using homogenous spatial Poisson point process (PPP) in MATLAB. As shown in fig.4 there are no users under SBS 2 and 5. Hence these SBSs can go for sleep mode to save energy.

## VII. INDOOR CHANNEL MODEL

The path-loss between the UE and SBS is assumed equal to,

$$PL_{i,j,dB} = 38.46 + 20\log_{10}(d_{ij}) + qL_w \quad (i)$$

Where  $d_{ij}$  is the indoor distance between the UE ( $i$ ) and SBS ( $j$ ),  $qL_w$  accounts for loss due to walls,  $q$  is the number of walls between the apartment, and  $L_w$  is the wall penetration loss. (For simplicity,  $q = 1$ ,  $L_w = 5dB$ ).

The signal to interference plus noise ratio (SINR) of SUE ' $k_m$ ' over subcarrier ' $i$ ' in cell ' $m$ ' in the Downlink is expressed by,

$$\gamma_{k_m,i,m} = \frac{P_{i,m}g_{k_m,i,m}}{I_{i,k_m} + \sigma_{i,k_m}^2} \quad (ii)$$

Where  $\sigma_{i,k_m}^2$  is the noise power over subcarrier ' $i$ ' in the receiver of SUE ' $k_m$ '. The expression of interference is given by,

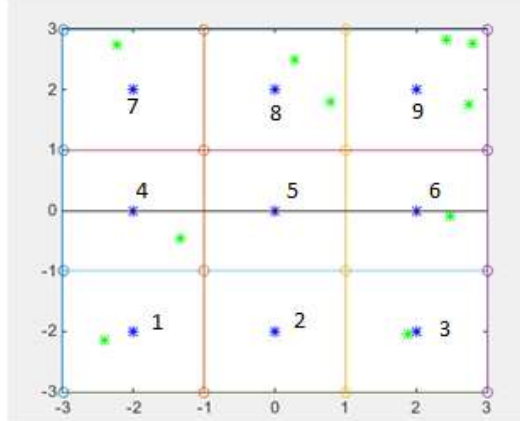
$$I_{i,k_m} = \sum_{j \neq m, j=0}^M \left( \sum_{k_j=1}^{K_j} \alpha_{k_j,i,j} \right) P_{i,j} H_{k_m,i,j} \quad (iii)$$

Where ' $K_j$ ' is the number of SUEs served by SBS ' $j$ ' and  $\alpha_{k_j,i,j}$  is a binary variable representing subcarrier allocation.  $\alpha_{k_j,i,j} = 1$ , if the subcarrier ' $i$ '

$i$  is allocated to SUE ' $k_j$ ' in cell ' $j$ ' and  $\alpha_{k_j,i,j} = 0$  otherwise. The following condition is to be verified in each cell ' $j$ '.

$$\sum_{k_j=1}^{K_j} \alpha_{k_j,i,j} \leq 1 \quad (\text{iv})$$

The term corresponding to  $j = 0$  in (iii) represents the interference from the Macro Base station (MBS), the term  $j = 1$  to  $j = M$  represents the interference from the other SBSs in the building.



**Fig. 4** Indoor system model using SBS  
Blue star: SBS  
Green Star: Small cell User (SUE)

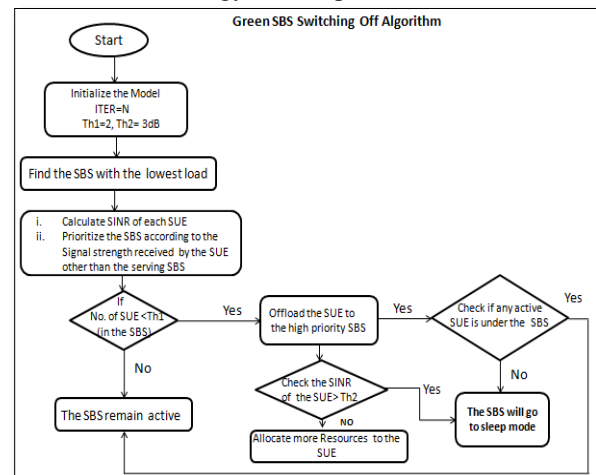
#### IV. GREEN SBS SWITCHING OFF ALGORITHM

To enhance the energy efficiency operation of the Small cell network, the following algorithm is implemented in centrally controlled manner. This algorithm find the SBS with lowest load. It then switch off the SBS by moving its served SUE to the neighbouring active SBS. Each SUE finds the next best serving SBS other than the current SBS, in terms of received signal strength. If the SUE successfully handover to the target SBS (if it can achieve the data rate above the threshold level after adequate radio bearer (RB) allocation). If all the SUEs under the SBS are successfully handed over, then the SBS can go to the sleep mode. If atleast one SUE will remain then the SBS has to remain active to serve it.

The algorithm will execute by the following steps.

- Step 1: Initialization: Threshold1=2, Threshold2=3dB  
Step 2: Find the SBS with the lowest load.  
Step 3: Calculate the SINR of each SUE and prioritize the SBS according to the signal strength received by the SUE  
Step 4: If Number of SUE less than the threshold1 defined

Step 5: If YES, then offload the SUE to the high priority SBS  
Step 6: If NO then the SBS remains active  
Step 7: After offloading check the SINR of the SUE whether it is greater than the threshold2 as defined  
Step 8: If not then allocate more RBs to the SUE  
Step 9: Now check if any active SUE is under the SBS  
Step 10: If NO then the SBS will undergo sleep mode to reduce energy consumption



**Fig. 5** Flow chart for Green SBS switching off Algorithm

The following Table I represent the distance of each user(SUE1 to SUE10) from SBS1 to SBS9. Each column represent SBS1 to SBS9 and Each row represents distance of each individual SUE from all the SBSs i.e SBS1 to SBS9.

Note: All the distances between the SUE and the SBSs are measured in meters.

Table I. Distance of the SUE from SBS

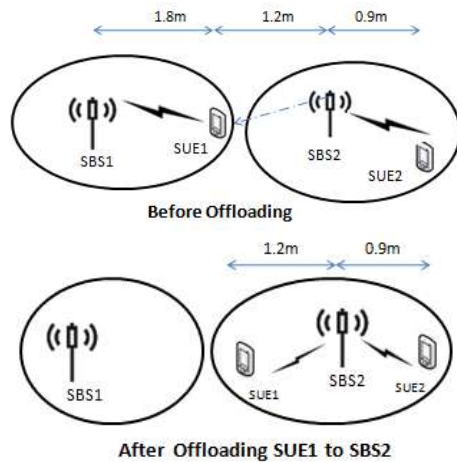
SUE	SBS1	SBS2	SBS3	SBS4	SBS5	SBS6	SBS7	SBS8	SBS9
1	1.9856	1.3938	0.4074	2.4378	1.9856	1.4717	2.8183	2.4378	2.0411
2	3.0427	2.6941	2.2931	2.6941	2.2931	1.8051	2.2931	1.8051	1.1217
3	2.2318	2.6422	2.9968	1.7266	2.2318	2.6422	0.9905	1.7266	2.2318
4	2.5283	2.0958	1.5468	2.1373	1.6025	0.7537	2.5628	2.1373	1.6025
5	2.5682	2.1438	2.2378	2.1438	1.6112	1.7342	1.7299	0.9962	1.185
6	0.7506	1.6011	2.1362	1.6011	2.1362	2.5619	2.1362	2.5619	2.9263
7	1.4838	1.691	2.2044	1.0679	1.341	1.949	1.7721	1.949	2.408
8	2.603	2.1853	2.4926	2.1853	1.666	2.0526	1.666	0.8807	1.4877
9	2.9152	2.5492	2.1209	2.5492	2.1209	1.5806	2.2342	1.7297	0.9959
10	3.0897	2.7471	2.3551	2.7471	2.3551	1.8832	2.3551	1.8832	1.2435

The following Table II represents user association of the SUE from SBS according to the minimum distance of the SUE from the SBS.

SUE	SBS1	SBS2	SBS3	SBS4	SBS5	SBS6	SBS7	SBS8	SBS9
1	0	0	0.4074	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	1.1217
3	0	0	0	0	0	0	0.9905	0	0
4	0	0	0	0	0	0.7537	0	0	0
5	0	0	0	0	0	0	0	0.9962	0
6	0.7506	0	0	0	0	0	0	0	0
7	0	0	0	1.0679	0	0	0	0	0
8	0	0	0	0	0	0	0	0.8807	0
9	0	0	0	0	0	0	0	0	0.9959
10	0	0	0	0	0	0	0	0	1.2435



As shown in table II there are no users under SBS 2 and SBS5. Hence these SBS can go for sleep mode to save energy. As per the algorithm, SUE4 is having the 2nd minimum distance from SBS1 and UE6 has the 2nd minimum distance from SBS3. Hence UE4 can offload to SBS1 and UE6 can offload to SBS3. After offloading SBS4 and SBS6 have no UE under it as shown in table III. Hence they can also go to sleep mode. Number of users in SBS1 and SBS3 is increased, hence proper resource allocation to be done to maintain the QoS level.



**Fig. 6** Small cell Network Before and after mobile traffic offloading

As shown in the fig. 6 SUE1 at a distance 1.8m from SBS1 and at 1.2m from SBS2. Hence SUE1 is nearer to SBS2 and is getting better signal strength from SBS2. SUE1 can be offloaded to SBS2. After offloading it's found there is no user under SBS1. Hence it can go to sleep mode to save energy consumption and to improve EE.

**Table III.** User association after offloading

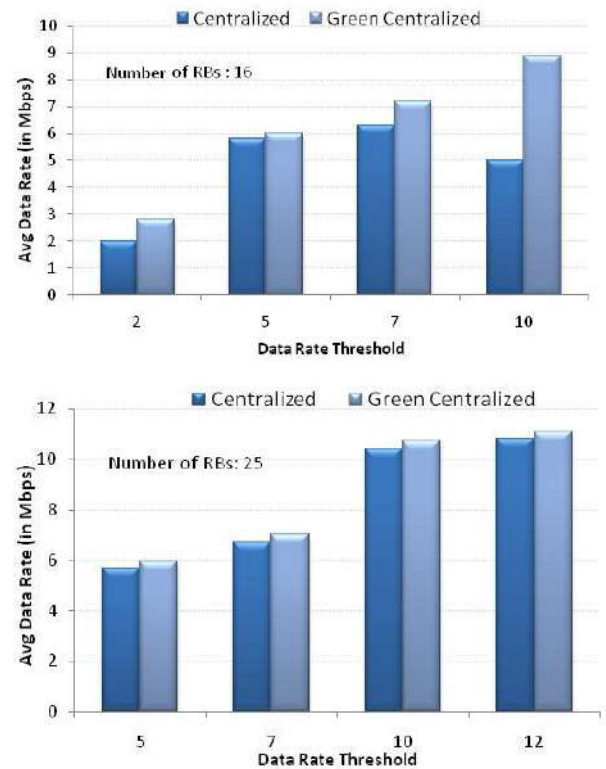
SUE	User Association with								
	SBS1	SBS2	SBS3	SBS4	SBS5	SBS6	SBS7	SBS8	SBS9
1	0	0	0.4074	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	1.1217
3	0	0	0	0	0	0	0.9905	0	0
4	0	0	1.5468	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0.9962	0
6	0.7506	0	0	0	0	0	0	0	0
7	1.4838	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0.8807	0
9	0	0	0	0	0	0	0	0	0.9959
10	0	0	0	0	0	0	0	0	1.2435

## V. RESULTS AND DISCUSSION

This research work proposes SBS in sleep mode after handover of the associated SUEs to the active SBSs that maintain the QoS. In comparison to the centralized method the green method reduces considerable amount of energy consumption. As it is using only 5 SBSs for providing service to 10 SUEs (hence the value 0.5 corresponds to the ratio 1/2). This result is quite interesting, as it explains

that SUEs in nearby areas can be covered by a single SBS, which **saves around 44.4% of energy consumption.**

In Fig. 7 average data rate for total number of RBs i.e. 16 and 25 are compared for both traditional centralized and proposed Green centralized method. It's found that the average data rate is greater in Green method then the centralized method.



**Fig. 7** Average Data rate vs. Data rate threshold for centralized and Green centralized scenario

## VI. CONCLUSIONS AND FUTURE SCOPE

With the proposed green method, the purpose is to offload SUEs in order to switch SBSs to sleep mode.

By switching off some of the SBSs for reducing energy consumption has an advantage of decreasing inter tier interference which helps to increase the SINR and EE.

This work can be further extended to multiple numbers of floors in the building in a co-ordinated multipoint (CoMP) manner. Resource allocation need to be investigated for proper utilization of resources and guaranteed QoS.

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## FAULTS DETECTION IN ACTIVE ANALOG BANDPASS FILTER USING OBIST METHOD

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(Pillai College of Engineering<sup>1 2</sup>)

### **Abstract:**

*The main objective of this paper is to explain the principal of different analog circuit testing methods to examine the difficulties present in the analog circuit testing i.e. to test the analog parts in a mixed signal circuit. In this paper all possible catastrophic and parametric faults present in the analog bandpass filter are tested by OBIST method which does not requires test vector generator which reduces the test development. Bandpass filter is examined for all possible fault detection and verifying that OBIST approach can improve the overall percentage of fault detection.*

### **Keywords:**

*System-on-chip (SOC), Oscillation based in-built self test (OBIST), Circuit under test (CUT).*

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### **I. INTRODUCTION**

Ever demanding application of the analog/mixed signal circuit implanted system-on-chips (SOCs) in modern years, have motivated system architecture designers and test engineers to switch their direction of research to grab this particular area of VLSI and system to develop efficient testing methodologies to test component of analog part in mixed signal circuits. In the process of production of semiconductor, testing is actually a serious issue. For testing and finding source of fault in the sub part of the whole assembly, IC test is required. The technology of high volume product manufacturing requires considerable efforts must be taken toward the prototypes design, test and evaluation before the start of the actual production process.

The products which are manufactured should be defects free and ensure that all the required specifications are fulfilled through testing, is the main objective. The fabrication process of integrated circuit (IC) includes different steps like photolithography, printing, etching, doping and metallization. None of these fabrication steps in the real world situation is ever perfect or flawless, and the subsequent defects may in the long run prompt disappointments in the individual ICs operation. Specially, if the fabrication process possesses any kind of defects or even smaller imperfections then these circuits being extremely sensitive the mixed signal ICs performance quality will be reduced very much. In the domain of digital circuit, in any case, a few of these might be somewhat irrelevant, however

in mixed signal circuits, small capacitance defect between the traces can show a considerable variation of circuit-parameter, in this manner behaviour of circuit changes considerably. Due to shrinking circuit geometry, the sensitivity of circuit is likewise improved. That's why before the IC dispatched to its respective client it is thoroughly tested. The final manufactured product overall quality is enhanced by the testing, despite the fact that it has no impact on the ICs' assembling brilliance [1].

One evident cause is a lack of acknowledged testing principle, for example, standard fault model for components of analog circuit. All the techniques of digital test depend on single stuck-fault model for fault detection, and the algorithms of generation of test are assessed by percentage of their fault coverage. Despite the fact that the functional test stuck fault model is worthy, a model for test performance is not acknowledged effectively. The fundamental source of test difficulties are also different in digital and analog circuits; for instance, the nature of complexity and size are the measure of test difficulty in digital circuits, while the behaviour of circuit signals are more critical than size of circuits in analog/mixed signal circuit.

The serious issue in the analog and mixed signal circuit testing is in defining the borderline between the circuit which are fault free and faulty, bringing about vulnerability of quantification of the product production yield. Be that as it may, analog and mixed signal circuits fault coverage can in any case be defined as the percentage ratio of the total number

of faults identified in the circuit to the aggregate number of possible fault present in the circuit. Clearly, the mixed signal technology is in the process of enhancement by simultaneous advances in the electronic packaging field, other than the shrinking ICs sizes. The interfacing procedure of any system or framework with the outside world puts extra demand on circuit of mixed signal.

Analog circuit parts are so closed to their digital counterparts in mixed signal environment that make a circuit and system design challenging with related testing issue. The mixed signal test demand is accordingly expanding as mixed signal IC demand is increasing. The test methodology of Analog and digital circuit had been an examination point for a long time in academia and industry. Right now, there is an immense requirement for the advancement in test method of mixed signal. As a rule, testing is a process of verification and decides if the specifications of required circuit-design are reached or not. The mixed circuit testing is constantly challenging and complex, and henceforth, industry of semiconductor attempts to search for appropriate methods for testing in order to bring down the test cost, especially for analog circuit part in devices of mixed signal type. Out of total cost of testing 85% of the testing cost is committed to the analog function, even though only 10 % of chip area is occupied by analog part [1]. Cost significantly raises the testing cost of digital circuit, that's why test cost reduction for analog part is an essential issue.

## II. PROBLEM DEFINITION OF TESTING

There is a rapid growth in scale and complexity of electronic circuit and system with the increase in their demand in modern technology. Availability, consistency and cost efficiency are the main features of quality with the rapid growth in importance of electronic circuit and system. Therefore, testing of manufactured product is most significant in order to attain required product quality. In general Testing is product evaluation, to ensure that designed product functions and exhibits all the properties and capabilities. To detect malfunctions of the product and locate their cause so that they can be removed are the main principal of testing. Availability, consistency and cost efficiency are the main features basis on which the test system quality can be evaluated. Testing is not only important but also difficult, costly and complicated in for VLSI system. Testing of electronic circuit can be classified into digital circuit testing and analog circuit testing.

There is quite rapid advancement in digital circuit testing in recent years by the significant contribution of excellent research results. Digital circuit testing already has well defined fault model. That's why in digital circuit, fault detection is simple and easy. Whereas, analog circuit testing is more complicated and difficult than that of digital circuit testing because of the many reasons:

1. Specific accept/reject criteria in terms of well defined threshold are not available in analog circuit.
2. Well defined fault model like the stuck-at or stuck-open fault are broadly accepted in digital circuit testing unlike testing of analog circuit do not have good fault model.
3. Tolerances and signal noise factor increase the complexity and difficulty of analog circuit testing.

## III. FAULTS PRESENT IN ANALOG CIRCUITS

Fault present in the analog and mixed signal circuits can be of two type catastrophic faults and parametric faults. A catastrophic fault model is also called hard fault analogue to the stuck-at fault model which present in the domain of digital circuit in that circuit component terminal can be either stuck-open or stuck-short. Catastrophic or hard faults cause the circuit performance to differ catastrophically from normal condition.

Stuck-open faults are also called hard faults which creates high resistance at the event of fault when the terminals of the circuit component are not in contact with the main circuit. By adding a high resistance value of  $100M\Omega$  in series with the circuit component to be faulted is simulated. On the other hand, terminals of the circuit components are short in stuck-short fault. Stuck short fault can be simulated by adding a small resistor of value  $10\Omega$  in parallel with the circuit component.

Parametric faults are also called soft fault is variation of component value which do not affect its circuit connectivity, makes performance of circuit out of tolerable limits. Parametric faults present in the circuit can be simulated as a component parameter variation from its nominal specified value.

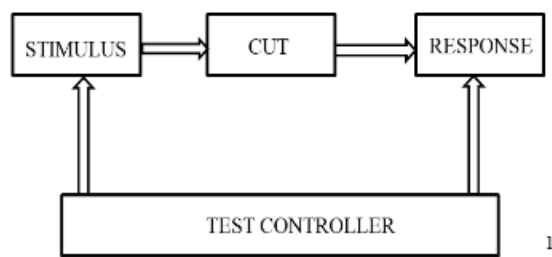
## IV. METHODOLOGY

This test methodology is used to detect the fault present in analog circuit part of mixed signal circuit involves dividing the analog/mixed-signal circuit into its basic building blocks like filter, amplifier and comparator etc. This block is transformed into circuit which oscillate by connecting proper feedback network from circuit output to its input

such that overall loop gain and phase cause circuit to oscillate in order to implement test mechanism for filter based on oscillation [2]. The frequency of output oscillation from the amplifier is measured. The circuit's output oscillation frequency is compared with fault free circuit's the nominal oscillation frequency. The output produced is in the form of oscillation is converted into pulses using CMOS inverter connected to output. If the pulse count lies outside tolerance range then circuit is found to be faulty. Such faulty circuit is rejected from the production cycle of product decreasing the manufacturing expenditure.

### A. Principal of BIST Mechanism

BIST design procedure gives the capacity of taking care of huge numbers of the issues generally experienced during analog, mixed signal, and digital systems testing. In BIST methodology, test pattern generation, test signal application, and response signal verification are altogether refined through inbuilt equipment, which enables diverse parts of the circuit to be tested or tried simultaneously, in this manner lessening the required time of testing, by eliminating external test equipment requirement [2]. BIST combines the ideas of both the built-in test (BIT) and ST. As the testing cost is more significant component of new product manufacturing cost, in this manner BIST has a tendency to decrease cost of manufacturing and maintenance by better diagnosis. BIST circuitry is situated in the digital part of the mixed-signal circuit to minimize chip area overhead. The principle of BIST mechanism is explained in the figure 1 given below.



**Fig. 1** BIST mechanism

Built-in self-test (BIST) mechanism allows the circuit or machine for self testing, which ensure high

reliability and reduced test cycle duration requirement.

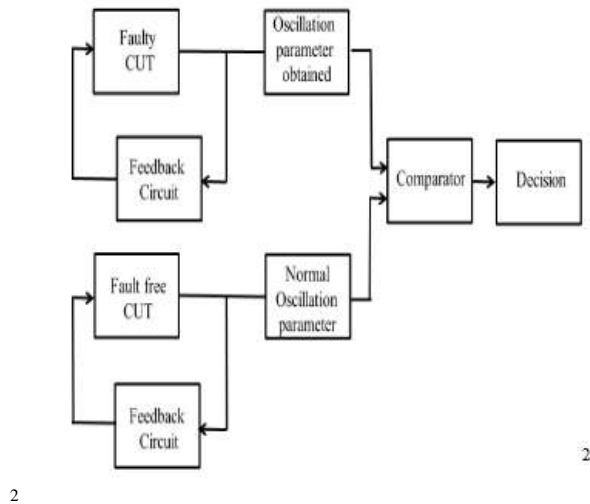
### B. Implementing an Oscillator

To design the oscillator from its transfer function the output pin of the circuit is connected to the input pin for the sustained oscillation. The output of the circuit is feedback to its input with proper phase and magnitude are the basic requirement to start the oscillation. The denominator of the transfer function of the circuit is examined methodically to determine the oscillator's design equation. The time domain behaviour and stability of the system is determined by the poles of the characteristics equation. The oscillator's magnitude and phase equation must be examined whether it satisfy the Barkhausen oscillation criteria. According to this criterion the loop-gain magnitude must be greater than unity with zero phase shift, exponentially increases the amplitude of oscillation. But building general oscillator is different than process of building oscillator for testing. In general oscillator designing process, well-defined, stable oscillation frequency and constant amplitude are required [4]. But an oscillator designed for testing purpose is constructed from CUT is designed such that the changes in the CUT's component value can be identified by measuring the frequency and amplitude of oscillation.

### C. An idea of OBIST Strategy

A complicated analog circuit is divided into its basic building blocks like filter, amplifier and comparator etc. Each building block is transformed into circuit which oscillate by connecting the proper feedback network from circuit output to its input such that overall loop gain and phase cause circuit to oscillate in order to attain sustained oscillation. The output oscillation parameter is measured. The circuit's output oscillation parameter is compared with fault free circuit's the nominal oscillation parameter. A circuit is faulty or fault free is identified from a variation of its oscillation frequency from its nominal value. The oscillation parameters are not dependent on the CUT type and analog testing [5]. The OBIST approach schematic diagram is explained in fig 4.2

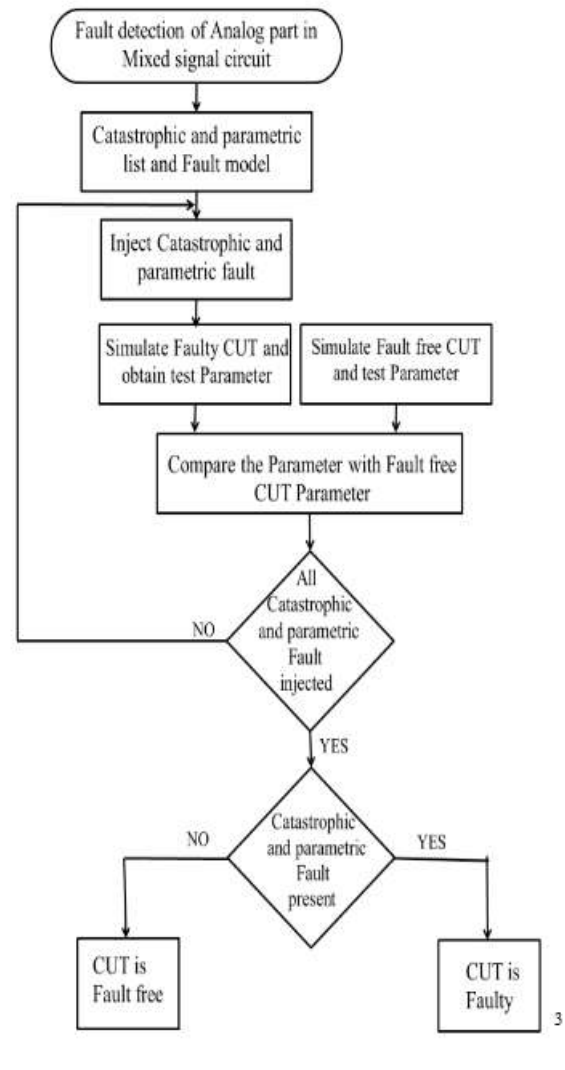
<sup>1</sup> BIST mechanism



**Fig. 2** Schematic Diagram of OBIST approach  
Many literatures on fault-based test strategies have been proposed for analog and mixed-signal circuits testing. The OBIST is theoretically simple and does not need much modifications of the CUT for testing [5].

#### D. Flow of Test Process

To detect the presence of catastrophic and parametric faults in the analog bandpass filter, first all types of faults are injected in it. As the analog circuit is transformed into oscillator by connecting inverter circuit in the feedback path of the filter circuit which provides the number pulses are compared with the pulses of fault free circuit. If the number of pulses lies outside the fault free range with fixed simulation time, then the circuit is faulty. So the circuit is rejected. This procedure is repeated until all analog faults present in the circuit are identified [6]. Flow chart representation of OBIST approach based test process is given in the fig. 4.3.



**Fig. 3** OBIST approach based test process

#### V. FILTER DESIGN

A bandpass filter can be designed by choosing the value of frequency  $f_0 = 1\text{KHz}$  and Bandwidth  $BW = 100\text{Hz}$ . To simplify the design calculations use the equal component option with  $C_1 = C_2 = C = 10\text{nf}$  and  $R_1 = R_2 = R_3 = R = \sqrt{2}/2\pi f_0 C = \sqrt{2}/2\pi \times 10^3 \times 10 \times 10^{-9} = 22.5\text{K}\Omega$ . As  $Q = f_0/BW = 1 \times 10^3/100 = 10$  and  $K = 4 - \sqrt{2}/Q = 4 - \sqrt{2}/10 = 3.858$ . Pick  $R_A = 10\text{K}\Omega$ , then  $R_B = (K-1)K A = (3.858-1)10 \times 10^3 = 28.58\text{K}\Omega$ . The Resonance gain is given by  $K/(4-K) = 3.858/(4-3.858) = 27.16$ .

<sup>2</sup> Schematic Diagram of OBIST approach

<sup>3</sup> OBIST approach based test process



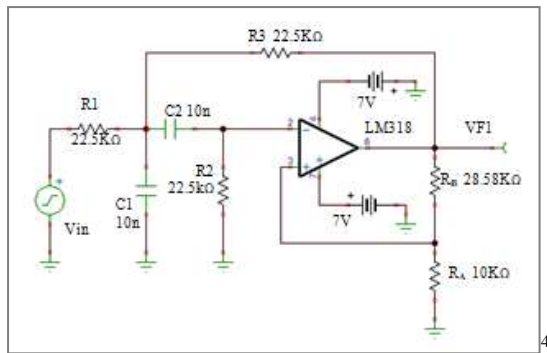


Fig. 4 Active bandpass filter

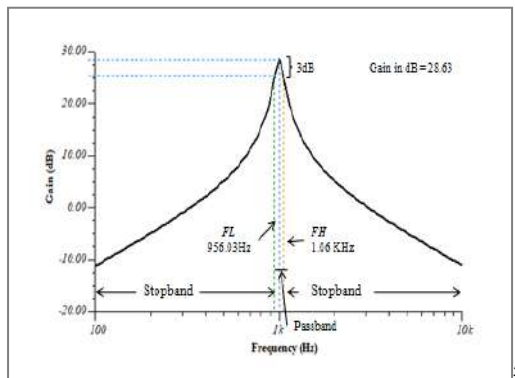


Fig. 5 Frequency response of active bandpass filter

## VI. SIMULATION RESULTS

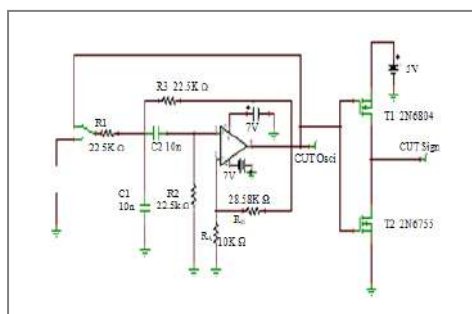


Fig. 6 Active bandpass filter under test mode

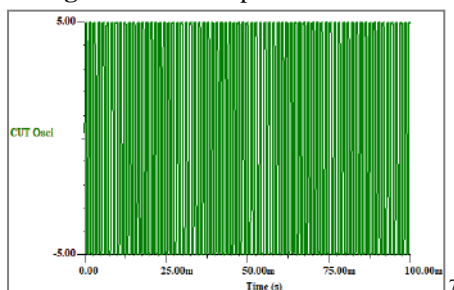


Fig. 7 Output pulses of fault-free circuit in test mode

Table 1 Fault Table of Bandpass filter for Catastrophic Faults

Sr. No.	Fault <sup>8</sup>	No. of Pulses	Simulation Time	Status
1	Fault free	75	100ms	...
2	R1 Open	62	100ms	Identified
3	R1 Short	119	100ms	Identified
4	R2 Open	0	100ms	Identified
5	R2 Short	0	100ms	Identified
6	R3 Open	62	100ms	Identified
7	R3 Short	119	100ms	Identified
8	RA Open	0	100ms	Identified
9	RA Short	24	100ms	Identified
10	RB Open	24	100ms	Identified
11	RB Short	0	100ms	Identified
12	C1 Open	105	100ms	Identified
13	C1 Short	0	100ms	Identified
14	C2 Open	0	100ms	Identified
15	C2 Short	0	100ms	Identified

Range of pulses for which circuit is fault free is determined by variation in the values of all the components of bandpass filter. Decreasing and increasing the value of all components by 5% gives fault free range of pulse count (Range by considering tolerance value).

Table 2 Fault Free Range with Tolerance value

Variation in <sup>9</sup> values of all component	No. of pulses in 100 ms
+5%	68
-5%	83

The fault free pulse count range for bandpass filter is (68, 83). If the pulse count lies outside this range then circuit is found to be faulty and it is rejected [7]. Similarly the undetectable range or fault free range of every component is determined by changing the values of each component individually by keeping other component value constant.

<sup>4</sup> Active bandpass filter<sup>5</sup> Frequency response of active bandpass filter<sup>6</sup> Active bandpass filter under test mode<sup>7</sup> Output pulses of fault-free circuit in test mode<sup>8</sup> Fault Table of Bandpass filter for Catastrophic Faults<sup>9</sup> Fault Free Range with Tolerance value

**Table 3** Fault Table of Bandpass filter for Parametric Faults

Sr. No.	Component <sup>10</sup>	Undetectable Range	Undetectable $f_o$	Undetectable Freq. Band in Hz	$\Delta f/f_o$	Q Value at Undetectable Limits
1	R1	-54%, 146%	1260, 835.81	937.98, 323.09	0.26, -0.16	1.34, 2.586
2	R2	-12%, 14%	1090, 957.31	298.91, 87	0.09, -0.04	3.65, 11.003
3	R3	-54%, 146%	1270, 826.41	2956, 1298	0.27, -0.17	0.429, 0.637
4	RA	-22%, 42%	1000, 1000	475.99, 698.01	0, 0	2.101, 1.432
5	RB	-29%, 30%	1000, 1000	693.73, 516.35	0, 0	1.44, 1.936
6	C1	-42%, 43%	1320, 834.53	350, 285.75	0.32, -0.17	3.77, 2.92
7	C2	-13%, 14%	1100, 956.96	214.15, 36.52	0.1, -0.04	5.136, 26.204

## VII. CONCLUSION

In this paper all possible catastrophic and parametric faults present in the analog bandpass filter are tested by OBIST method which does not require test vector generator. OBIST method can improve overall percentage of all possible fault detection without experiencing large test development value.

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<sup>10</sup> Fault Table of Bandpass filter for Parametric Faults

# ANALYSIS OF FREQUENCY RECONFIGURABLE ANTENNA FOR WLAN APPLICATION

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(PVG's COE)

## Abstract:

*A new technique has been implemented for frequency reconfigurable antenna for WLAN application. Square ring slot is incorporated in ground plane for achieving the frequency reconfigurable antenna. The proposed antenna contains rectangular slots which are incorporated in square patch. RT duroid 5870 substrate is used for simulation purpose. Extensive simulations are performed in CADFEKO for antenna design and analysis. Copper slits are used as ideal switches in the rectangular slots to achieve the frequency reconfigurability. The improved gain has been achieved.*

## Keywords:

Frequency reconfigurable, PD(PIN Diode)

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## I. INTRODUCTION

Nowadays technology demand has been increased tremendously and to fulfill its functionality within compact handheld devices which places great burden on antenna design [1]. At higher frequencies, use of traditional hardware on individual platform is increased which gives rise to many problems such as co-site interference, larger mutual coupling, high cross-polarization etc. [2]. In order to solve these problems the design of multifunctional antennas for newly developed systems are of practical interest. Frequency reconfiguration, radiation pattern and polarization technique are the three fundamental parameters that can be reconfigured. The ability of antenna to tune to different operating frequencies is used to avoid unwanted interference. The emergence of cognitive radio technology has enhanced the growing of reconfigurable antennas. Frequency reconfigurable antennas offer significant advantages over wideband antennas and are also used for spectrum allocation in cognitive radio. Pattern reconfigurable antennas are mainly responsible for improving the communication link. Various types of active switches are used for switching purpose such as PIN diodes [4, 5], RF-MEMs (Radio Frequency Micro-electromechanical) switches and varactor diode etc. Ideal switches are also used for simulation purpose which includes the use of copper metal strips instead of active switches.

Polarization is one of the important aspects taken into consideration while designing antenna at microwave frequency especially WLAN & space applications. In recent papers antenna design demonstrates dual-band multiband polarization performance [6, 7]. Switching between polarizations is highly recommended in the modern technology.

The main objective of the proposed antenna is to cover the entire U-NII (Unlicensed National Information Infrastructure) bands. U-NII radio bands are used by IEEE 802.11 devices as well as internet service providers. Strict out of band emission rules for users in this range have encouraged the use of narrowband antennas instead of wideband antennas. (5.150-5.250)GHz band is used for indoor communication purpose in wireless devices while the (5.25-5.35) GHz band is used for indoor as well as outdoor communication. These bands were used for dynamic frequency selection. The (5.25-5.35) GHz band was approved by FCC to align the frequency bands used in USA to the other parts of the world. (5.725-5.850) GHz band is referred as the U-NII/ISM band because of the overlap created by ISM band. The proposed work in current paper emphasis on switching between three different bands.

## II. ANTENNA DESIGN

The proposed antenna consists of square patch with rectangular slits incorporated into its each side. Diagonal co-axial feed is given for simulation purpose. Simulations are performed using RT-Duroid as substrate ( $\epsilon_r=2.33$  loss tangent=0.0012, height=1.575mm). Defected ground surface is used for achieving frequency reconfigurability. A square ring slot is incorporated in the ground surface. Copper strips are deployed in that ground square ring slot to work as an ideal diode. When the ideal diode is in ON state copper strip is present and to show that diode in OFF state copper strip is removed.

The figure 1 shows the top view of proposed antenna.  $W_s$  and  $L_s$  are the dimensions of the substrate. Whereas  $S_l$  and  $S_w$  are the dimensions of

rectangular slots.  $L_p$  and  $W_p$  are the dimensions of the square patch. Square ring incorporated slot is shown in the bottom view of antenna structure. The antenna dimensions are summarized in table 1.

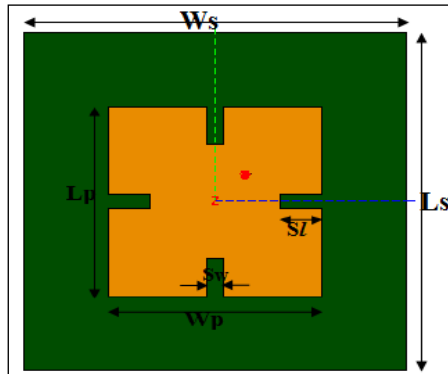


Fig.5. Top View of proposed antenna design.

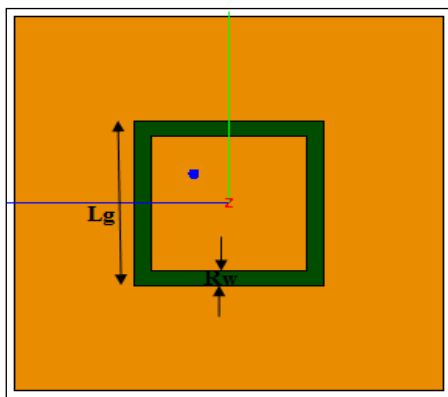


Fig.6. Bottom view square patch

Table 3

Parameter	Dimension (mm)	Parameter	Dimension (mm)
Ls	50	Sw	2
Ws	50	Rw	2
Lp	28	Lg	22
Wp	28	Sl	6

### III. ANTENNA ANALYSIS

The square slot incorporated in the ground of the proposed structure plays an important role in deciding the operating frequency of the antenna.  $L_g$  is the length of the square part that is removed from the copper of ground plane whereas  $R_w$  is the width of the square ring slot. Each parameter plays very important role in deciding operating frequency of antenna.

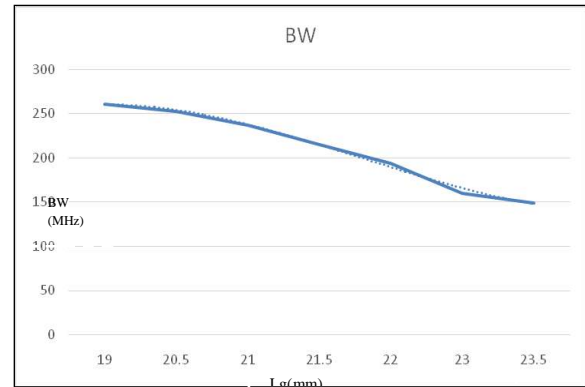


Fig. 7 Variation of BW with respect to  $L_g$ .

Figure 3 shows the variation of bandwidth with respect to  $L_g$ . as  $L_g$  increases bandwidth decreases which are governed by the following equation.

$$BW = 0.6667L_g^3 - 9.2262L_g^2 + 16.964L_g + 251.86 \quad (6)$$

As  $L_g$  is increased from 19 to 23.5 mm the resonant frequency decreases from 6.53 to 4.78 GHz.  $L_g$  is varied keeping in mind the position of diagonal co-axial feed. Equation 7 governs the variation of resonant frequency with respect to  $L_g$ .

$$\text{Freq.} = 0.0028L_g^5 - 0.0634L_g^4 + 0.5298L_g^3 - 1.9518L_g^2 + 2.7022L_g + 5.315 \quad (7)$$

Table 4

L.	$L_g$ (mm)	M.	Frequency (GHz)	N.	$R_w$ (mm)
O.	19	P.	6.53	Q.	2
R.	20	S.	6.25	T.	2
U.	21	V.	5.47	W.	2
X.	21.5	Y.	5.32	Z.	2
AA.	22	BB.	5.16	CC.	2
DD.	23	EE.	4.88	FF.	2

GG.

HH. Table 2 shows the variation of resonant frequency when  $L_g$  is increased. The S11 parameter is computed when  $L_g$  is varied. Figure 4 shows the S11 parameter for different cases of slot variation.

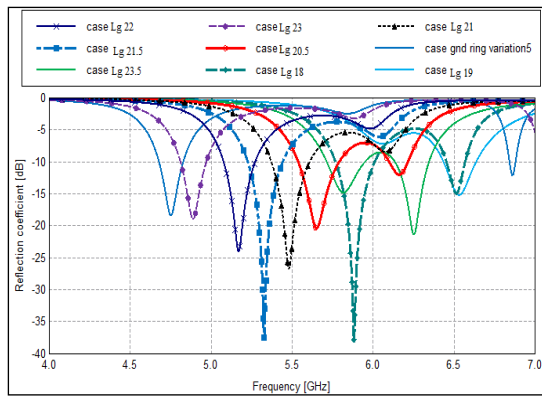


Fig.8 S11 for different cases of Lg

The above figure shows that any band in U-NII can be covered by varying the ground slot dimensions. U-NII low, U-NII mid, U-NII-2B, U-NII upper these are some of the widely used bands that are covered by the proposed antenna.

#### IV. FREQUENCY RECONFIGURABLE ANTENNA

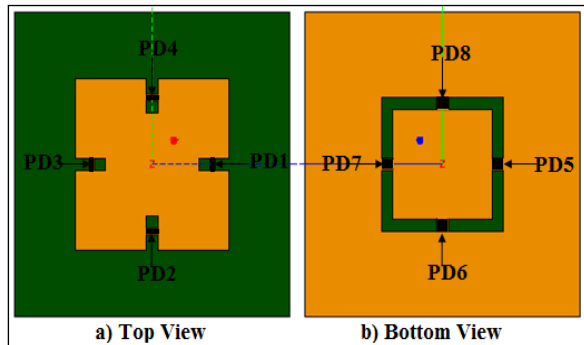


Fig. 9 Copper strips as ideal diode and diode position

The ideal diodes are used in the rectangular slots of square patch and square ring slots of ground plane. By keeping the ideal diodes in the ON state and OFF state frequency reconfigurability is achieved.

Table 5

Case	No	Frequency (GHz)	Gain (dBi)	BW (MHz)
PD2 PD3 PD4 PD7 ON	1	5.142	6.97	132
PD2 PD3 PD4 PD6 ON	3	5.38	3.89	161
PD2 PD3 PD4 PD5 ON	2	5.89	5.69	151

The following figure shows the simulated reflection coefficient for these cases

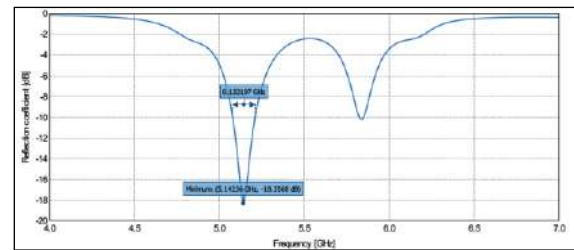


Fig. 6 Reflection coefficient for case 1

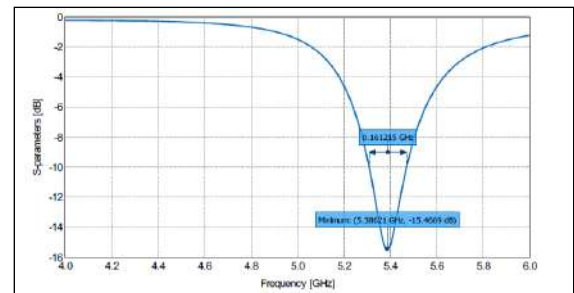


Fig. 7 Reflection coefficient for case 2

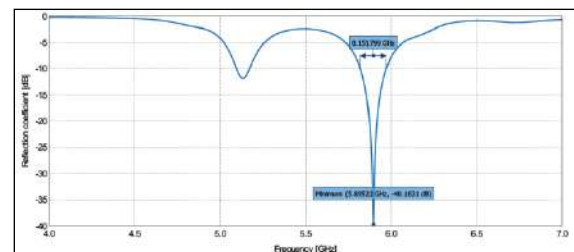


Fig. 8 Reflection coefficient for case 3

Case 1 & Case 2 covers the entire U-NII low band while the Case 3 covers the entire DSRC U-NII band as shown in figure 6, 7 and 8 respectively. The other cases are reserved for future purpose. The radiation patterns in XZ and YZ plane for above cases are shown in the following figure.

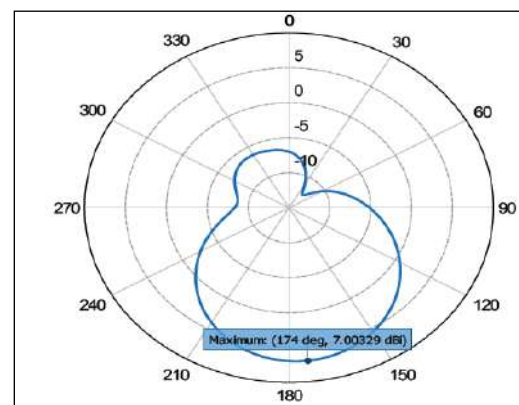


Fig.9 Radiation pattern in the XZ plane



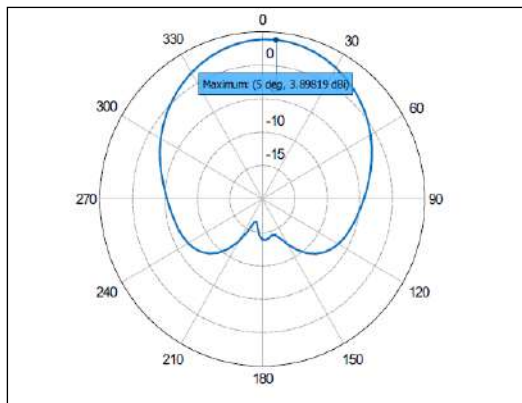


Fig.10 Radiation pattern in the XZ plane

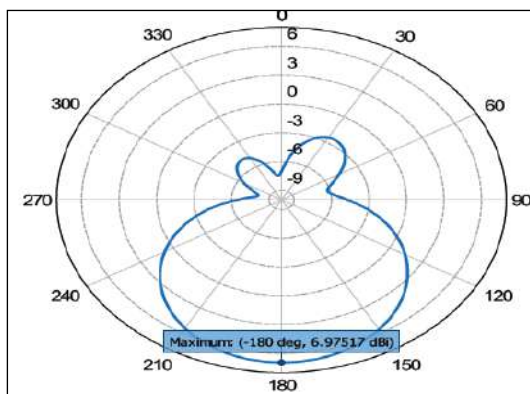


Fig.11 Radiation pattern in the YZ plane

The radiation patterns showed in the above figures shows very good gain of approximately 7 dBi in XZ and YZ plane. These high gains are observed due to the use of RT-duroid substrate which has very low loss tangent of 0.0012 as compared to FR4 substrate.

## V. CONCLUSION


The proposed antenna is designed for WLAN application which is able to cover three different bands in U-NII depending on the dimensions of square ring slot. Furthermore, the deployed copper strips used as ideal diodes are used for obtaining frequency reconfigurability. The proposed antenna is capable of switching its frequency from 5.14GHz to 5.89GHz depending on the condition of the ideal diodes and gain up to 7dBi has been achieved. The governing equations for bandwidth as well as

operating frequency with respect to Lg are derived so as to obtain desired operating frequency.

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## EXPERIMENTAL ANALYSIS FOR THE VIBRATION REDUCTION OF STEERING WHEEL ASSEMBLY OF AGRICULTURAL TRACTOR

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(B.R. Harne College of Engineering and Technology<sup>1</sup>)  
(D.J. Sanghvi College of Engineering<sup>2</sup>)

### **Abstract:**

*Steering wheel vibration is one of the primary contemplations in choosing the operator comfort in a agricultural tractor. This project manages investigation of vibration related issues in controlling wheel of tractor. The design and investigation of controlling system plays a major part to determine the main cause for the issue. Steering vibration study conducted on power trac 439 DS. Tuned mass damper idea is utilized for vibration decrease. various damping materials are tried for vibration lessening and analysis is done in MATLAB Simulink with two degree of freedom model with base excitation.*

*After providing the isolation between steering box and steering wheel, the vibration level in the tractor is essentially reduced and the operator additionally feel more comfort as the HAVS are likewise reduce because of utilization of isolation. The vibration in the steering wheel of agricultural tractor can be decreased by the utilization of damper.*

### **Keywords:**

*Steering Wheel, Vibration, Frequency, Damper*

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### **I. INTRODUCTION**

Operator comfort is most essential criteria in the present day in any vehicle plan. Before this tractor operator comfort was not given much significance. But now a day's situation has changed and tractors operator also wants equal level of comfort. In current situation tractors operates in various environmental condition. Because of this the vibration generated which is transferred towards hands through steering wheel via steering box. Generally, the operators subjected two types of vibrations:

- Whole body vibration which is transferred through seat, floor and foot pedal control.
- Hand transmitted vibration which is transmitted through a steering wheel and hand control knobs.[3]

Excessive intensity of vibration may lead health issues. The term Hand-arm vibration disorder is used to utilized to various disorders. In our paper our effort is to made demonstrate reduction of tractor vibration by using damper and simulation done in MATLAB Software.

### **II. LITERATURE REVIEW**

Detailed literature overview was conducted to understand the work did so far in related field. Tiwari V.K, Vidhu K.P [1] uses Piezo-crystal material for

reduction of hand transmitted and whole-body vibration. In this they use two isolators which were made from piezo electric- materials. Kyuhyun sim, Ji won Yoon [2] demonstrate the assessment of hydro-pneumatic and semi-dynamic taxi suspension for the enhancement of ride comfort in agricultural tractor. Kandavel Govari Shankar, Shrikant Samant [3] demonstrates the systematic approach in reducing the steering wheel vibration of agricultural tractor. In that they used Design of six sigma for reduction of vibration. Anant Sakthivel, Rakesh B.Verma [4] test technique of decrease of vibration. Study was conducted on various tractor (40-50Kw). In that two damper radial and axial were used and simulation done in ADAMS software.

### **III. EXPERIMENTAL PROCEDURE**

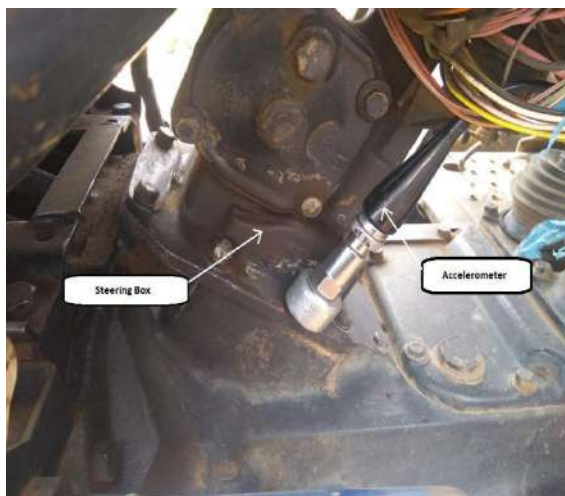
We know that vibration transfer towards hand contains contributions from three directions. Because of that Estimation were made in all three direction like  $X_h$ ,  $Y_h$  and  $Z_h$  axes are named as vertical, longitudinal and transverse axes individually. In steering wheel, the vibration measured only in vertical direction (X-Direction) because intensity of vibration is high in vertical direction. The tractor was parked on a farm and engine was started. Estimation were taken with the gear in neutral position. Initially the engine speed was increased from idling (750 rpm)

to maximum speed (3000 rpm) slowly and steadily over a period of one minute and the measurements were made. [4]

The Intension of the examination was to characterize the vibration presentation level of the hand-arm-transmitted vibration from the tractor steering wheel to the driver's hands. The exploration was done on the agricultural tractor. The vibration levels transmitted to the driver's hands were estimated under two working conditions:

- At Neutral Condition
- At Running Condition

The estimation system was as per ISO 5349-2001. The levels were estimated in each of the three axes simultaneously.



**Fig.1.** Accelerometer mounted on steering box



**Fig.2.** Accelerometer mounted on steering wheel

#### IV. FREQUENCY WEIGHTING AND CALCULATION

Essential amount used to describe the magnitude of the vibration transmitted to the driver's hands is root-mean square (r.m.s.) frequency weighted acceleration expressed in  $m/s^2$ . The r.m.s. acceleration values from 33% octave band investigation can be utilized to get

the relating frequency weighted r.m.s. acceleration up  $a_{h, w}$ . It is acquired utilizing:

$$a_{h, w} = \left[ \sum_{j=1}^n (W_{hi} a_{hi})^2 \right]^{1/2} \quad (1)$$

where  $W_{hi}$  is weighting factor for  $i^{th}$  33% octave band and  $a_{hi}$  is the r.m.s. acceleration estimated in the  $i^{th}$  33% octave band the assessment of vibration exposure as per ISO 5349-1:2001 [5] depends on an amount that combine all three axes. This is the vibration total value  $a_{hv}$  and it is characterized as the root-mean-square of the three component values

$$a_{hv} = \sqrt{a_{hwx}^2 + a_{hwy}^2 + a_{h wz}^2} \quad (2)$$

where  $a_{hwx}$ ,  $a_{hwy}$  and  $a_{h wz}$  are the frequency weighted acceleration in x, y and z axes respectively. The vibration total value and the term of the exposure. Day by day exposure time is the aggregate time for which the hands are exposed to vibration during the working day. The everyday vibration exposure will be expressed as far as the 8-hour energy weighted vibration total value as

$$A(8) = a_{hv} \sqrt{\frac{T}{T_0}} \quad (3)$$

where T is the aggregate every day term of the exposure expressed in seconds to the  $a_{hv}$  and  $T_0$  is the reference length of 8 hours (28800 seconds). If the work is such that the aggregate every day vibration exposure consists of a few activities with various vibration magnitudes, then the daily vibration

$$A(8) = \sqrt{\frac{1}{T_0} \sum_{i=1}^n a_{hvi}^2 \cdot T_i} \quad (4)$$

exposure, A (8) will be gotten utilizing condition: (4)

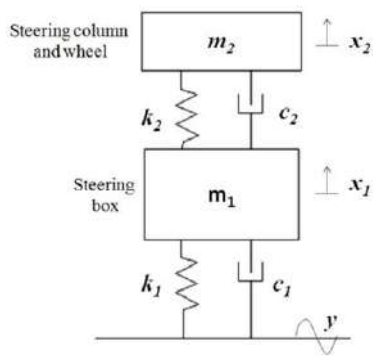
where  $a_{hv}$  is the vibration total value for the  $i^{th}$  operation, n is the number of individual vibration exposures and  $T_i$  is the duration of the  $i^{th}$  operation in seconds.[4]

#### V. MATHEMATICAL MODEL

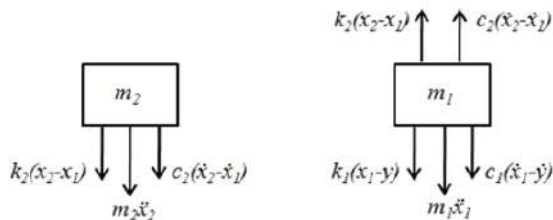
The axial and radial dampers were used in the steering box mounting points at the engine adapter plate and at the transmission case. There were four dampers used in parallel and these are represented by a parallel arrangement of spring with stiffness  $k_1$  and damper with damping coefficient  $c_1$ . Rubber cushioning pad was used between the steering box and the steering column base which is represented by a parallel arrangement of spring with stiffness  $k_2$  and damper with damping coefficient  $c_2$ . Hence this system is modelled as a 2-DOF vibration problem as shown in Figure 3. As the engine vibration motion is the input to this system, this can be considered as a support excitation problem. Transmissibility expression for 1-DOF support motion system

derived by Thomson, it was taken as the basis for this derivation. As the engine vibration motion is the input to this system, this can be considered as a support motion problem. Transmissibility expression for 1DOF support motion system derived by Thomson, it was taken as the basis for this derivation. The expression for amplitude transmissibility from engine to steering wheel is derived as follows:

Let  $y$  and  $x_1$  be the harmonic motion of support base and displacement of steering box respectively. Let  $x_2$  be the displacement of steering column and wheel assembly.  $m_1$  and  $m_2$  are the masses of steering box and steering column-wheel assembly respectively. The free body diagrams of masses  $m_1$  and  $m_2$  are shown in below figure:



**Fig.3.** Two DOF Support Motion



**Fig.4.** Free body diagrams of masses  $m_1$  and  $m_2$

Equation of motion for  $m_2$  is given by Eq. (5),

$$m_2\ddot{x}_2 + c_1(\dot{x}_2 - \dot{x}_1) + k_2(x_2 - x_1) = 0 \quad (5)$$

Similarly, equation of motion for  $m_1$  is given by Eq. (6) and Eq. (7),

$$m_1\ddot{x}_1 + k_1(x_1 - y) + c_1(\dot{x}_1 - \dot{y}) = k_2(x_2 - x_1) + c_1(\dot{x}_2 - \dot{x}_1) \quad (6)$$

$$m_1\ddot{x}_1 - k_2(x_2 - x_1) - c_2(\dot{x}_2 - \dot{x}_1) + k_1x_1 + c_1\dot{x}_1 = k_1y + c_1\dot{y} \quad (7)$$

Combining equations (5), (6) and (7) into matrix form,

$$\begin{pmatrix} m_1 & 0 \\ 0 & m_2 \end{pmatrix} \begin{Bmatrix} \ddot{x}_1 \\ \ddot{x}_2 \end{Bmatrix} + \begin{pmatrix} c_1 + c_2 & -c_1 \\ -c_2 & c_2 \end{pmatrix} \begin{Bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{Bmatrix} + \begin{pmatrix} k_1 + k_2 & -k_2 \\ -k_2 & k_2 \end{pmatrix} \begin{Bmatrix} x_1 \\ x_2 \end{Bmatrix} = \begin{Bmatrix} k_1y + c_1\dot{y} \\ 0 \end{Bmatrix} \quad (8)$$

Assuming,

$$y = Y e^{i\omega t}, x_1 = X_1 e^{i(\omega t - \phi)} \text{ and } x_2 = X_2 e^{i(\omega t - \phi)}$$

$$-\omega^2 \begin{pmatrix} m_1 & 0 \\ 0 & m_2 \end{pmatrix} \begin{Bmatrix} X_1 \\ X_2 \end{Bmatrix} + i\omega \begin{pmatrix} c_1 + c_2 & -c_1 \\ -c_2 & c_2 \end{pmatrix} \begin{Bmatrix} X_1 \\ X_2 \end{Bmatrix} + \begin{pmatrix} k_1 + k_2 & -k_2 \\ -k_2 & k_2 \end{pmatrix} \begin{Bmatrix} X_1 \\ X_2 \end{Bmatrix} = \begin{Bmatrix} k_1Y + i\omega c_1Y \\ 0 \end{Bmatrix} \quad (9)$$

Dividing both sides by  $Y$ ,

$$\begin{pmatrix} k_1 + k_2 - m_1\omega^2 + i\omega(c_1 + c_2) & -k_2 - i\omega c_2 \\ -k_2 - i\omega c_2 & k_2 - m_2\omega^2 + i\omega c_2 \end{pmatrix} \begin{Bmatrix} X_1/Y \\ X_2/Y \end{Bmatrix} = \begin{Bmatrix} k_1 + i\omega c_1 \\ 0 \end{Bmatrix} \quad (10)$$

Solving for  $X_2/Y$ ,

$$\frac{X_2}{Y} = \frac{\begin{vmatrix} k_1 + k_2 - m_1\omega^2 + i\omega(c_1 + c_2) & k_2 + i\omega c_2 \\ -k_2 - i\omega c_2 & 0 \end{vmatrix}}{\begin{vmatrix} k_1 + k_2 - m_1\omega^2 + i\omega(c_1 + c_2) & -k_2 - i\omega c_2 \\ -k_2 - i\omega c_2 & k_2 - m_2\omega^2 + i\omega c_2 \end{vmatrix}} \quad (11)$$

$$\left| \frac{X_2}{Y} \right| = \frac{\sqrt{(k_1k_2 - c_1c_2\omega^2)^2 + ((k_1c_2 + k_2c_1)\omega)^2}}{\sqrt{(k_1k_2 - (m_1k_2 + m_2k_1 + m_2k_2 + c_1c_2)\omega^2 + m_1m_2\omega^4)^2 + ((k_2c_1 + k_1c_2)\omega - (m_1c_2 + m_2c_1 + m_2c_2)\omega^3)^2}} \quad (12)$$

From above equations we can obtain the value of transmissibility from engine to the steering wheel. Hence, we can evaluate the amplitude at the steering wheel by giving all values of stiffness and damping coefficients to the equation [4].

## VI. ANALYSIS AND TRACTOR TESTING

Analysis was carried out in two stages:

- Stage 1: Measure the actual vibration produced in steering wheel and steering box by using FFT analyser
- Stage 2: Measure the vibration level when damper is provided by producing given level on electrodynamic shaker machine. In first stage the accelerometer was mounted on steering box and steering wheel and the analysis was done by using FFT analyser.

The second stage was carried out on electrodynamic shaker machine. In this stage use of estimated values of velocity and frequency from chosen tractor were examined and from this peak and RMS values were chosen and inputs are given to the electrodynamic shaker machine. Final values after the use of dampers were measured by using FFT analyzer.

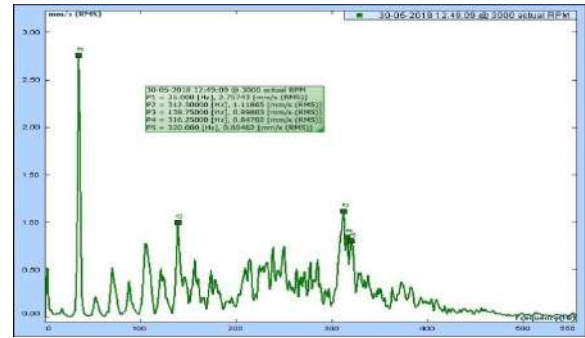
Below is the reading at different conditions for with and without damper for each measuring parameters:



Position and Direction	Type	Tractor ideal condition (Without damper)	Tractor running condition (with out damper)	Tractor ideal condition (with damper)	Tractor running condition (with damper)
Steering wheel (X axis)	A ( $\text{m/s}^2$ )	6.27	5.19	3.59	3.31
	V ( $\text{mm/s}$ )	6.05	29.52	4.20	17.84
	D ( $\mu\text{m}$ )	17.01	59.62	12.56	29.15
Steering box (X axis)	A ( $\text{m/s}^2$ )	15.89	11.67	3.57	6.36
	V ( $\text{mm/s}$ )	4.20	24.73	3.15	13.59
	D ( $\mu\text{m}$ )	12.56	61.41	7.15	35.03
Steering box (Y axis)	A ( $\text{m/s}^2$ )	8.63	14.42	1.71	5.88
	V ( $\text{mm/s}$ )	1.01	7.44	0.88	4.14
	D ( $\mu\text{m}$ )	2.83	27.45	2.00	11.76
Steering box (Z axis)	A ( $\text{m/s}^2$ )	3.43	12.45	1.02	4.99
	V ( $\text{mm/s}$ )	0.59	14.23	0.37	8.40
	D ( $\mu\text{m}$ )	1.84	29.89	1.01	13.15

Why RMS value chosen for velocity for analysis?

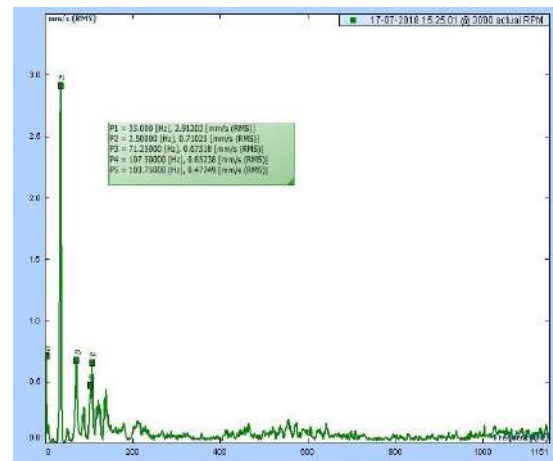
The r.m.s velocity is always non zero because it is the square root of mean of the squares of all quantities. This can only be positive quantity. That's why r.m.s value chosen for velocity.



**Fig.5.** Reading at steering wheel when vehicle is at neutral condition (without damper)

Figure 5 shows the RMS values of velocity in vertical direction without damper when vehicle is in neutral condition. The maximum RMS values obtained are 6.05 m/s.

Figure 6 shows the RMS values of velocity in vertical direction with damper when vehicle is in neutral condition.



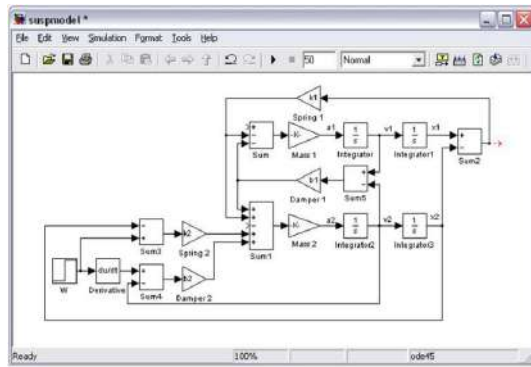
**Fig.6.** Reading at steering wheel when vehicle is at neutral condition (with damper)

The maximum RMS values obtained are, 4.20 m/s. The vibration levels are found less compared to the vibration level at the steering wheel vibrations without damper

## VII. SIMULATIONS USING MATLAB

The damper parameters like mass, stiffness and damping coefficient which are used while designing the damper are as it is provided to MATLAB for simulation purpose.



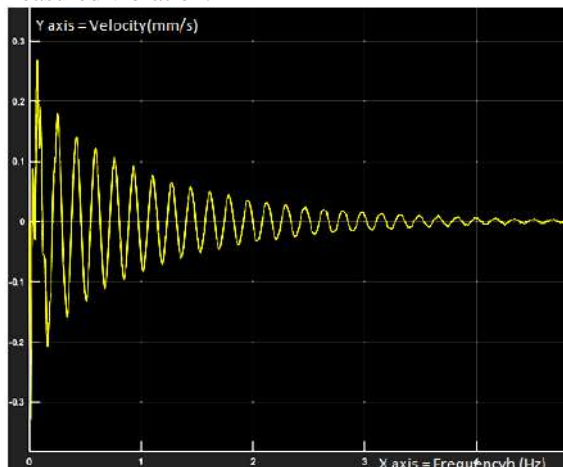


**Fig.7.** Simulations using MATLAB

Table shows the system parameters given to the MATLAB model for damper concepts.

Input	Value
Mass of steering box $m_1$ (kg)	4 kg
Mass of steering column and steering box $m_2$ (kg)	11 kg
Stiffness of cushioning pads, $k_1$ (kg)	1700 N/m
Stiffness of damping material, $k_2$ (kg)	550 N/m
Damping coefficient of cushioning pads, $c_1$	1 Nm/s
Damping coefficient of cushioning pads, $c_2$	0.79 N m/s

The results were compared with those of the measured vibration.



**Fig.8.** MATLAB Simulation Output

## VIII. VALIDATION OF RESULTS

The maximum displacement shown by the graph obtain from the FFT spectrum Analysis is 0.2815 mm and the value of displacement obtain from the MATLAB is 0.27 mm.

## IX. EXPERIMENTAL RESULTS

The vibration level on steering wheel and steering box has measured and analysed and the acceleration

and frequency spectrum for the chosen working conditions were obtained. It is found that acceleration of steering wheel at neutral condition is about  $6.27 \text{ m/s}^2$  and after providing isolation it is decreased to  $3.59 \text{ m/s}^2$  that means decrease in acceleration by about  $2.68 \text{ m/s}^2$ . Similarly, it is found that acceleration value of steering box at running condition is about  $11.67 \text{ m/s}^2$  after providing isolation it is decreased to  $6.36 \text{ m/s}^2$  that means decreased in acceleration about  $5.31 \text{ m/s}^2$ .

## X. CONCLUSION

The damper provides 44.76% reduction of Steering box and 63.97% reduction of Steering wheel respectively in total daily vibration exposure and the reduction of 54.49% and 63.77% respectively in peak acceleration. The developed 2-DOF mathematical model and MATLAB simulation predicted the Steering wheel vibration to an accuracy level of approximately 85% to 90% respectively.


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## DEVELOPMENT OF PROGRAMMED ROBOT SCAVENGER

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(Pillai College Of Engineering<sup>1 2</sup>)

### Abstract:

The proposed programmed automation has been devised keeping in mind the choking of drainage channels due to sludge formation leading to flooding of streets during natural calamities or because of incessant rains. This project also aims at preventing occupational hazards to sewer cleaners. This device will be placed into the drainage system using a telescopic handle. The device has caterpillar track manoeuvre. It has a spraying head for water. An elevated conveyor belt will be attached to bring the sludge till the inlet of the vacuum. The suction mechanism collects the debris in a septic treatment bin outside.

### Keywords:

Robot Scavenger, Programmed automation, Software Interface, Sewage cleaning system, Radio frequency module

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### I. INTRODUCTION

In developing countries the cleaning of sewage waste is done manually by the labourers. This is indeed hazardous to health of the people involved in the cleaning process. Many workers have lost their lives during this process. Hence to save the lives of these workers and prevent occupational hazards we can deploy robots for cleaning these wastes and thereby preventing choking of drains.

### II. METHODOLOGY

The efforts have been to devise an automated robot which will be released into the manhole or sewage system for the cleaning purpose. Major components of the robot scavenger system are as follows

1. Main body
2. Spraying head
3. Robotic Wheels
4. Suction Head
5. Conveyor belt
6. Power Supply
7. Control system (single board microcontroller)
8. Waste collection and septic treatment bin.

The exact process after releasing of bot into the manhole can be represented graphically as below.

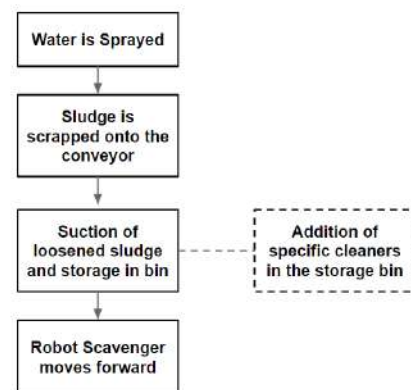


Fig.1. Working process of the Robot

### III. WORKING

The Robot Scavenger would be released manually into the manhole or sewage drainage system by means of a telescopic handle. It would manoeuvre on robotic wheels and would have a camera mounted on the frame front at the top with artificial lighting system for remote monitoring. It can be controlled remotely through a teaching pendant; the automation is made more sophisticated with IoT (microcontroller). The process would commence with spraying of water on the drainage walls followed by the suction cycle. In this, sludge lying in front of the robot will be scrapped and carried towards the inlet of the vacuum with the use of a conveyor belt. Suction takes place and the sludge is stored in a bin.

### IV. FABRICATION

The main main body of the prototype is made from wood. For the maneuvering of the prototype, robotic wheels are provided. It will help in

providing easy movement in rough conditions underneath the manhole. The conveyor belt attached in front of the vacuum mouth is made up of wood and belt is made of rubber. The main body has a detachable portion at one face for easy inspection and timely maintenance of the prototype.

## V. DIAGRAM REPRESENTATION

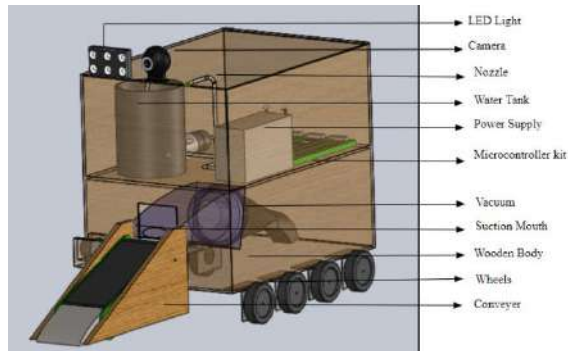


Fig.2. Components of the Robot

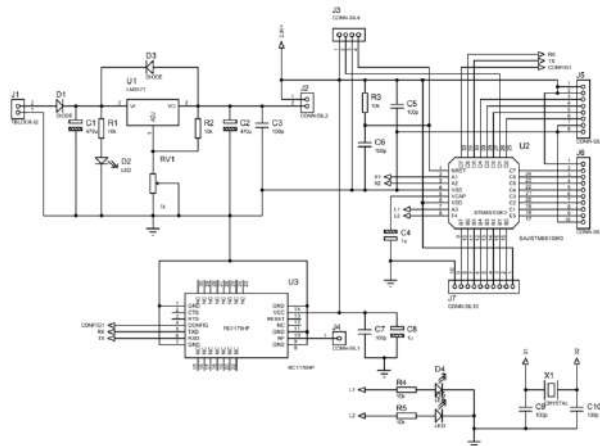


Fig.3. Circuit Diagram

## VI. CONCLUSION

We have successfully made a prototype model which can be used to loosen the sludge and suck it with the help of the vacuum attached. The sucked matter can then be processed using specific filters and chemicals so that it can be further used as fertilizers and be helpful for farmers. The loosening and suction of sludge cleans the sewage system which in turn reduces the probability of occurrence of floods. The robot can be improved by increasing the range it can cover, the suction abilities. The maneuvering of the robot can be improved by adding the caterpillar wheels. The main main body of the robot will be made from material like FRP or Kevlar so that it can withstand forces with the help of its strength.

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	<p><b>Saish Oak</b> is currently pursuing BE in Mechanical Engineering from Pillai College Of Engineering. He is a student who has been a good performer in his academics. Being a part of the Student Council he has organized various college events and activities. His team is currently a finalist in the Youth Innovation Challenge 2018 and have also got the idea published in the World Urban Campaign website which is coordinated by United Nations Human Settlements Programme.</p>

	<p><b>Vignesh Menon</b> is currently pursuing BE Mechanical from Pillai College of Engineering. His interest and management skills gave him the opportunity to be in the organizing team. His dedication and sincerity towards achieving his goals have let the idea of his team member to be published in the World Urban Campaign website which is coordinated by United Nations Human Settlements Programme.</p>		<p>The same idea was also published in the World Urban Campaign website which is coordinated by United Nations Human Settlements Programme.</p>
	<p><b>Mukil Vasudevan Nair</b>, currently pursuing BE in Mechanical Engineering from Pillai College of Engineering is an academics oriented student. He has also been part of student bodies in college and has done many practical projects as well. One of his projects have also found a place in the finals of Youth Innovation Challenge 2018.</p>		<p><b>Aishwarya Thorve</b> is currently pursuing BE Computer from Pillai College Of Engineering. Along with her involvement in extra curricular activities from organising fests as a part of student council, she is also doing well in curricular and co-curricular activities. She has participated in various competitions with her team and have also got an idea published in the World Urban Campaign website which is coordinated by United Nations Human Settlements Programme.</p>



## INVESTIGATION ON EXTRACTION OF WASTE THERMAL ENERGY FROM SOLAR PV PANELS

Manoj kumar Sharma <sup>1</sup>, Sandeep Joshi <sup>2</sup> (Professor<sup>2</sup>)  
(Pillai College of Engineering <sup>1 2</sup>)

### Abstract:

The temperature of PV modules increases when it absorbs solar radiation, causing decrease in its efficiency Because of negative temperature coefficient. The Efficiency drops with the rise in temperature, with a magnitude of approximately 0.5 % per °C [6]. This present paper gives the possibilities of extraction of waste thermal energy from the solar panel to maintain its efficiency and to obtain hot water as by product. The extracted heat can be used for many domestic applications. The outlet water temperature is observed with significant rise in temperature. Experiment was performed on test model of 0.12m<sup>2</sup> area of solar cells and similar results can be predicted for full scale model.

### Keywords:

PV modules, thermal energy, negative temperature coefficient, temperature rise

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### I. INTRODUCTION

Solar energy is most remarkable, vital, clean and environment affable renewable energy source. Now a day's solar photovoltaic (PV) is swift developing technology. The photovoltaic cell converts only 6% - 18 % of solar energy into electricity rest 88 – 85 % of the energy is wasted in the form of heat. A photovoltaic cell specialized semiconductor diode. PV cells operate on photovoltaic effect i.e. conversion of light energy (photons) from the Sun to generate electricity. The PV modules are connected in specific order forming a series of cells called an array. During the operation heat is generated due to which temperature of the system increases, if the generated heat is not removed the efficiencies decreases because of its negative temperature coefficient. With increase in cell temperature efficiency of cell reduces with enormity about 0.5 %/°C [6]. So to maintain the system at working temperature, generated heat in the system must be extracted for its efficient working. The extra generated thermal energy in the system can be used for many domestic applications.

This thermal energy is mainly due to two factors. First, due to  $I^2 R$ , as denouement of the current (I) which flows pass through the resistance of the solar cell. Second, the thermal energy which represents the disparity between the absorbed photons and the output electrical energy generated due to electron–

hole pairs. Temperature of Cell is vital parameter which affects PV cells performance of in a panel. Lot of work has been reported in this field of performance parameters, Temperature dependence

and energy conversion in solar PV panels. Thus, it can be proclaimed that the thermal energy generation in panel is more than electrical energy. The solar PV cell absorbs the photons (light particle) from the incident solar radiation due to the photon absorption negative particle (electron) is knocked out from silicon atom, and a hole is created. Nature of combination of positive hole and the free electron is neutral. Therefore, generation of electricity requires the separation of electron and the hole from each other. PV cell consist of p-n layer which is also known as artificial junction layer. The available free electrons are not allowed to come again to fill positive charged holes.

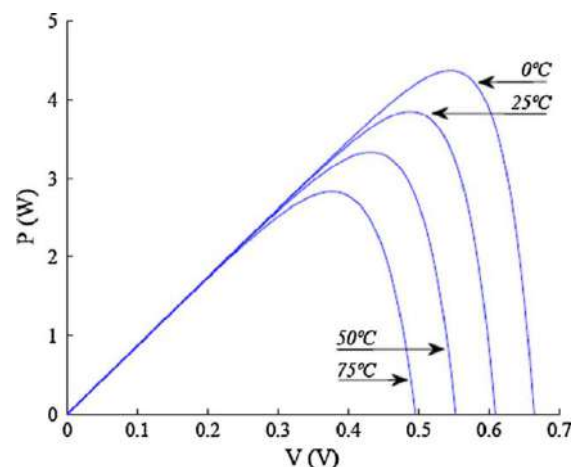


Fig. 6 for different temperatures, PV cell Power versus Voltage curves. [4]

An external circuit is required for the connections of the electric contacts present in the front and rear, this external circuit allows the available free electrons to flow through and come back to positively charged holes, results in current.

## II. LITERATURE REVIEW

Recently, many researchers have been studying solar panel and possible ways of extracting thermal energy from them. Hiren D. Raval et al [1] in 2014 presented the possibility of extraction of thermal energy from the panels using water. Their research shows the potential to tap thermal energy from Solar PV panel while increasing the efficiency. The energy in the form of heat was transferred with heat exchanger direct contact type, installed on the front side of the cells. K.A. Moharram, et al. [2] in 2013 reported performance enhancement by cooling of photovoltaic panels. System for cooling was designed and developed using water as coolant. The cooling system was combined through solar photovoltaic panels to form hybrid system. Cooling agent for cooling the solar cells i.e. water, was continually circulated in the region of the PV panels. The high temperature water generated from the system can be used for variety of household applications. Akbarzadeh et al. [3] in 1996 planned and developed a hybrid type PV/T solar system and established that 50% increase in solar cells output power by means of water cooling of solar photovoltaic panel. It was reported that solar photovoltaic panel cooling for a period of 4 h results in maximum solar cells surface temperature of 46 °C. Chaniotakis [4] in 2001 designed and developed a hybrid type PV/T type solar system. He investigated both water as well as air as cooling agents in the integrated system. With the rise in temperature the efficiency dropped, with a magnitude of approximately 0.5 % per °C. Based on active water and air cooling numerous cooling techniques have been tried, as these are the simplest naturally available coolants. Phase-change material cooling, conductive cooling, etc are the alternatives that can be used. Many parameters such as cooling techniques, type and size of the module, geographical location and the season of the year affects the electrical efficiency. E.M.G. Rodrigues et al. [5] in 2013 presented comprehensive simulation studies. In their research they have studied the relation of solar cell efficiency and operating temperature. The p-n junction absorbs some of the solar radiation which is composed of different energy level photons. Lower band gap solar cells are useless since no voltage or electric current is generated by them. Electricity is generated by Photons which are having superior energy level corresponding to the band gap. The rest of the energy is converted as heat in the body of the solar cell. Y M Irwan, et al. [6] in 2015 compared air and water cooling

methods and found out that water as cooling agent is much better compared to air. For constant air movement they used fan and water pump was used to maintain circulation of coolant on the reverse side and front side of PV module respectively. Temperature detection of PV Temperature was carried by sensors which were installed on the PV module. To automatically switch ON or OFF fan and water pump was connected to PIC microcontroller. H. Bahaidarah et al [8] performed experiment using water as coolant for the cooling of the panel. Experiment was performed in the Middle East, for the electrical and thermal performance of the solar panel. It is clear from literature review that Solar cells are sensitive to temperature and Extraction of waste thermal energy from the solar PV systems plays vital role in efficient working of solar cells. Only 12% to 15% of the sunlight that strikes the PV cells gets converted into electricity rest 88 – 85 % of the energy is converted into heat. The temperature of PV modules increases when it absorbs solar radiation, causing a decline in its efficiency Because of negative temperature coefficient. The thermal energy accumulated in PV module is not utilized and can be recovered. Major part of solar radiation is not converted into electricity and results in increase in PV system temperature which leads to reduced efficiency and thus requires a heat extraction system. Many cooling techniques have been tried and compared, water as coolant works most efficiently. Extraction of thermal energy from the back of the solar PV cells ensures no disturbance to incident radiation. Thermal insulation is important to prevent heat loss to surroundings.

## III. METHODOLOGY

Direct contact heat exchanger system is designed. Mono crystalline Silicon solar cells were mounted on the u bend tube. To avoid heat loss to the environment, tubes were insulated using poly-isocyanurate foam .Water at room temperature used as coolant, is circulated in closed loop with the help of submersible pump, located at the bottom of the storage tank .Submersible pump and tube are connected with help of pipe. To avoid any leakage of water during the experimentation all the connections were fixed using multipurpose sealant. K type thermocouple with indicator is used to note the readings during the experiment.

## IV. EXPERIMENTATION

Monocrystalline Silicon 145 \*145 mm solar cells used for the experiment. U bend aluminium elliptical tube of ½ inch, 1mm thickness and 40mm thick poly-isocyanurate foam for thermal insulation is used. Direct contact heat exchanger system was designed with the coolant being water to transfer heat from solar cells. Heat extraction system must be

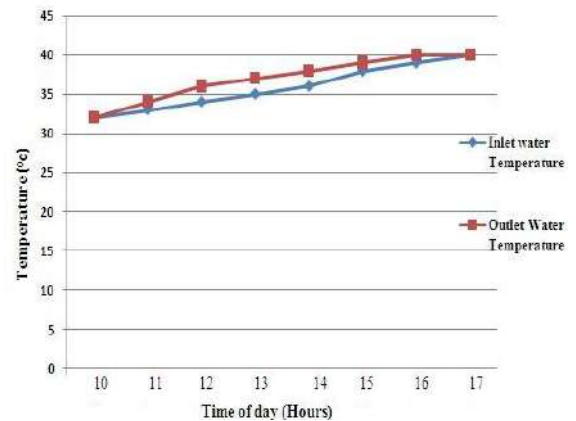
such that it should increase the solar cells efficiency and should not create any obstruction for incident solar radiation. Back side of the cells will be suitable for extraction of heat energy. Water is continually circulated at 1 LPM with the help of 5W water pump. Five litres water is used for the experimentation; K type thermocouple is used to measure the inlet and outlet water temperature with indicator. Experiment was performed for seven hours starting from 10:00 am till 5 pm.



**Fig. 2** Experimental Setup

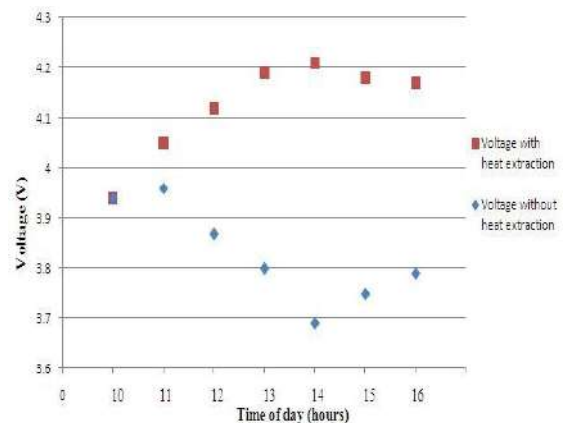
## V. RESULTS AND DISCUSSION

The Experiment was performed on 5th June 2018 at Pillai College of engineering, having closed water circulation system maintaining flow rate of 1LPM. Detailed result is plotted in figure no. 3 where inlet and outlet water temperature is plotted for every hour from 10.00am to 5.00 pm. It is clear from figure no. 3 that raises in water outlet temperature shows the potential to tap the thermal energy from the solar cells. Figure no. 4 shows the comparison between with and without heat extraction system rise in solar cell voltage shows that the efficiency of the system is improved with the waste heat extraction system.



**Fig. 3** Variation in Inlet and Outlet water temperature.

It's clear from figure no. 3 that the system is successfully extracting significant amount of heat. The red colour line shows the water temperature after extracting heat from the solar cells i.e outlet water from elliptical tube and blue colour line shows the inlet water supplied to the elliptical tube. Red colour line is above the blue one and shows that water is absorbing heat from the solar cells and getting itself heated up. There is 2°C rise in output temperature at 12:00, 13:00 and 14:00 hrs and water temperature at end of the experiment i.e. at 17:00 hrs was recorded 40°C. (8°C rise in water temperature). Thus circulating water in closed loop extracts good amount of heat from the solar cells.



**Fig. 4** Comparison of voltage with and without heat extraction system

It is evident from the fig 4 that Significant rise in voltage is achieved during the experimentation. At 14:00 hrs maximum voltage difference is seen. System efficiency is enhanced due to thermal energy extraction. . It is observed that solar cell performance was increased by 13.44% .which shows that the efficiency of the system is improved with the waste heat extraction system. Thus system efficiency is

increasing and generating hot water as by product. Experimental setup was efficiently able to heat five litres of water during 7 hrs of duration to 40°C. Thus we can say that an integrated Solar PV and water heater system is real possibility. In which efficiency of the solar panel increases with hot water as by product.

## VI. CONCLUSIONS



1. It is clear from the experimental result data that the significant amount of heat can be absorbed from the back side of the solar cells with increase in Efficiency. Thus the integrated solar PV panel- water heater system generates electricity with hot water as by-product.
2. The hot water at the outlet of elliptical tube indicates that there is a potential to tap the thermal energy.
3. With low flow rate of 1 LPM solar cell temperature can be effectively controlled by transferring heat from the back side of the solar cells.
4. Efficiency of solar cells increased as we are controlling the operating temperature of the panel.
5. With reduced flow velocity we can achieve higher outlet water temperature. The high temperature water can be used for domestic purposes.

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	<p><b>Dr Sandeep M Joshi</b> is currently Principal of Pillai College of Engineering, New Panvel. He has over 23 years of teaching experience. His field of research includes Utilisation of Solar Energy, Heat Transfer, Heat Exchanger Design, Waste Heat Recovery, Energy Conservation and Renewable Energy Recourses. He has about 25 publications in national as well as international conferences and journals of repute and one Indian patent are at his credit.</p>



## VEHICLE COMMUNICATION SYSTEMS: TECHNOLOGY AND REVIEW

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### Abstract:

Transportation Engineering has been developing technologically since the inception of electronics in vehicles. With advancement of electronics the computers aboard vehicles are getting smaller in sizes with enhanced capabilities. Transportation in future cities will be about self driven vehicles with communications between them as well as between infrastructures. This paper reviews technologies available globally in reference to communication between vehicles which comes under purview of dedicated short range communication (DSRC) and its status in India as of today. It also talks about challenges in implementation of this technology with recent architecture. Different Programs and protocols are discussed with reference to connected vehicles. It has potential to improve vehicles in terms of safety, pollution and overall driving experience of the user.

### Keywords:

DSRC, V2V, V2I, CAN

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## I. INTRODUCTION

Vehicle communication is categorized into two basic types of communications i.e. Vehicle 2 Vehicle and Vehicle 2 Infrastructure .It falls under dedicated short range communication (DSRC) which has been assigned bandwidth of 75MHz at 5.9GHz to provide communication only between Vehicle to Vehicle and Vehicle to Infrastructure. The range is around 1000 meters. It provides data transmission rate between 3 Mbps to 27 Mbps at 10 MHz's .It h to exchange information between other vehicles and road infrastructure such as signals and nodes installed on roads. The aim is to build Intelligent Transport System in cities of future to address problems based on safety, pollution and driving experience of user. Out of the above Vehicle safety is one of the major areas which required immediate attention as number of accidents have grown over the last decade in developing as well as developed countries. IEEE has developed standard 802.11p for vehicular network communication. It is also termed as Vehicular ad-hoc network (VANET).Realizing the importance of vehicle communication automotive OEM's; academia and car manufacturers have

initiated projects for V2V communication. Figure 1 shows visual representation of V2V communication in which vehicles communicate to each other information such as vehicle size, position, speed, signal status etc. The paper presents the History of Intelligent Transport system and presents a review on technologies available globally in vehicle communication system. It will also present barriers in implementation of technology and its status in India as of today



Fig.1 V2V communication [9]

## II. LITERATURE REVIEW

Different areas in which the work is carried out in rest of world to bring V2V communication into reality is summarized below:



Luo et.al [11] presented an Inter vehicular communication survey keeping V2V communication as key area. The author presented proposed V2V techniques at various software and hardware levels in vehicles. Yang et.al[12] worked on Real time traffic monitoring using V2V communication and using it to guide other vehicles in re routing to minimize travel time. It was done by comparing historical and present traffic information. The aim was to minimize time and not the shortest route. Uichin et.al [13] presented work on development of vehicular sensor network. The paper discusses use of data gathered from various sensors mounted on vehicle; storage and retrieval of data in inter vehicle communications. Chen et.al [14] suggested safe distance between two vehicles using V2V communication so that a particular vehicle brakes at proper distance from other vehicle in case of emergency situations. Fonue et.al [15] proposed a system which automatically sends signal to nearest point when an accident is detected so that emergency services can be communicated immediately. It utilizes both V2V and V2I infrastructure. In India V2V communication is still in nascent stages of development. Thus a lot of ground work is required to be done in India before V2V and V2I technology can be implemented. V2V and V2I technology has a lot of potential to address traffic and safety related issues prevalent in Indian subcontinent.

V2V communication is sub classified into Intra and Inter Vehicle communication and is discussed in next section. Also for this technology to be successful in Indian sub continent the low cost version of it has to be worked upon as the existing technology is very costly due to equipment and infrastructure cost.

### III. INTRA VEHICLE COMMUNICATIONS

The Intravehicle communication deals with wireless communication inside vehicle to perform different functions. These communication networks and protocol are classified by SAE in three classes A, B and C. Class A is low speed and supports data rate (<10 kbps) usually used for body and comfort event driven message transmission of sensors and actuators. It supports operations such as windscreen wiper, door lock; seat position etc. It is also useful to reduce automotive wiring harness system. Class B is medium speed and supports data rate between 10 kbps to 125 kbps used for non diagnostic and not so critical communications and information sharing. The delay

of receiving/transmitting any information does not cause any harm to the system functioning. Class C is high speed and supports data rate between 125kbps and 1Mbps. It is used for real time and critical system control such as engine, suspension, brake, traction and transmission control. Example of Networking protocols for Class A is LIN (Local interconnect network), for Class B is Low Speed Controller Area Network (CAN) and high speed CAN for Class C. Most recently developed Networking Protocols such as Flexray combines time triggered and event triggered messaging. It supports data rate of 5 Mbps. Used basically in safety critical embedded systems and advanced control functions. Media orientated system transport (MOST) is developed for audio video transfer which can be used in applications like GPS navigation and entertainment system. It supports data rate of 28.4 Mbps. Most recently developed network protocol is Ethernet which is capable of data rate of 100 Mbps. Figure 2 shows Automotive Intravehicle network architecture.

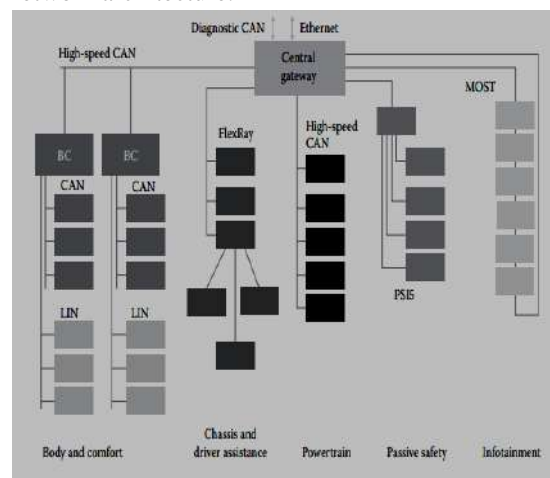


Fig.2. Intravehicle network architecture [10]

### IV. INTER VEHICLE COMMUNICATIONS

Managing and controlling communication between vehicles and vehicles and networking infrastructure is one of important challenge in world of vehicle networking. The lists of applications are as follows:

- Safer driving due to warnings and hazards on roads
- Better monitoring and controlling traffic by detecting traffic jams

- Software updates automatically as in mobile devices
- Entertainment applications such as video streaming and GPS updates

Though mobile networks and vehicular network may sound similar but vehicular network requires altogether different approach to security and privacy. Due to high speed of vehicles, wireless communication may not remain constant for majority of time. Also efficient use of available infrastructure such as road side poles or even mobile towers is not done.

In recent years, integration of telecommunication and informatics has given rise to use of Telematics in vehicles which has promoted use of wireless communication in vehicular networks. It has led to development of IEEE 802.11p standard also called as Wireless access in vehicular environment (WAVE) standards which comes under DSRC. V2V communications are DSRC based which may warn about impending collision, lane change, pre crash sensing and violation in traffic.

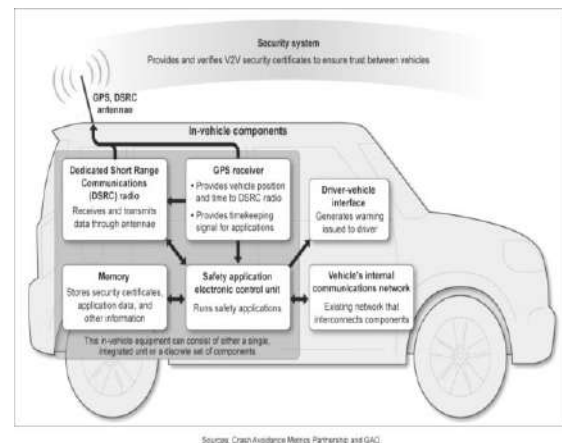
The Potential applications which can be addressed by V2I are as follows:

- Red light breach warning
- Curve speed warning
- Reduce speed zone warning
- Oversized vehicle warning

**Vehicle Based Hardware:** V2V system requires component placed in vehicles as well as along the road to begin with. In terms of Vehicle based Hardware, V2V device would require 2 DSRC radios and GPS receiver with a suitable processor to take information such as speed of vehicle and path taken by driver. In addition a User interface is also required for issuing audio/video warning to end user. Figure 3 explains basic components required in V2V system.

**Non Vehicle Based hardware:** Along with V2V vehicle based hardware, the system also requires devices to be located along road side or if we are looking at V2I capabilities, devices embedded in roadside infrastructure such as traffic signals or signs. For V2V communication system to be successful, the information should be received should be timely and in some standard format. In short different devices manufactured by different OEM's should

communicate with each other in dependable and timely manner. If they don't operate smoothly it will hamper V2V communication. In V2V communication the vehicle talks to each other with two types of messages viz. safety messages and certificate exchange messages. Safety message includes information about vehicle such as GPS position, predicted path; yaw rate etc. The can be used by other vehicles to avoid crash.



**Fig.3 Components in V2V [7]**

Inter vehicle communication can be further classified into Single hop and Multi Hop. In Single hop the message is relayed only to vehicle which is in range whereas in multi hop it can be relayed to many at a same time and hence Single hop system can be used for short ranges such as lane departure, cruise control etc whereas multi hop can be used for long ranges such as monitoring of traffic.

## V. PROJECTS UNDERTAKEN FOR V2V ACROSS THE GLOBE

Many projects were undertaken worldwide to check feasibility of V2V communication. In this section we present a few projects undertaken across various continents.

**DRIVE:** It was undertaken in Europe in late 80s to make drive in region safer, economical and environmental friendly.

**PATH:** It was undertaken in collaboration with California Department of transportation (DOT), public and private universities and industries. The aim was to apply most recent technologies to increase existing capacities of highways, reduce traffic, pollution and energy consumption. Many prototypes were developed under this program one of them traffic

simulator which incorporated communication components.

**FLEETNET:** It was setup in Germany in partnership of six companies and three universities in early 2000. The objective was to develop a policy for Inter vehicle communication. This project was further extended and many researchers are working on problems in communication protocols and security of data in V2V communication.

**CARTALK2000:** Founded in Europe for development of driver assistance program and radio network for developing future communication standards.

Apart from this, programs such as E-road, SAFESPOT, PReVENT and Come safety were also recently launched in European continent to make V2V and V2I project a reality.

## VI. INDIAN SCENARIO

India presents huge opportunity for connected car market as only 1-2% cars are connected. The basic problem in India as far as Connected cars are concerned is lack of Infrastructure. To some extent players like Ola and Uber have started there India operations with much fanfare the V2V and V2I technology still remains a distant dream. India requires basic infrastructure like good road connectivity, proper warning signs as a first step towards vehicle communication. Though India has very high potential in this technology, India as of today does not have any programs as far as V2V communication is concerned. The government is keen to implement Electric Vehicles all over India by 2030. We can say that connectivity is heart of change if India wants to provide safer roads for its people.

## VII. CONCLUSION

V2V has potential to change the face of automotive industry all over the world with incorporation of Telematics and 4G V technologies but it still remains distant dream because of lack of industry standards and poor infrastructure. It can definitely make roads safer to travel, reliable and efficient. Thus despite a lot of work in this area there is a large scope of research required in networking and transmission of signals and protocols to be adopted for the same. As far as India is concerned, V2V communication is its nascent stage and it is need of the hour that academic institutes and government come together to start Programs for implementation of at least a Pilot program based on

V2V technology. In simple words it's like a Jigsaw puzzle where significant amount of work is required to piece together all information's (V2V network, protocols, data security etc) to evaluate the performance of the entire system.

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# DESIGN AND OPTIMIZATION OF VEHICLE DYNAMICS SYSTEMS OF FORMULA SOCIETY OF AUTOMOTIVE ENGINEERS (FSAE) CAR

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## **Abstract:**

*We aimed to increase the performance and stability of the car, to design and optimize the vehicle's suspension system that is able to withstand all the forces that are acting on it during different range of scenarios which includes cornering, accelerating and braking. The design of the vehicle dynamics system must not only be comfortable for driver because his response is necessary for validation but also follow the FSAE rules given by the officials.*

## **Keywords:**

*A-arms, Rockers, Pull-rod, Pushrod, Formula SAE, Dampers*

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## **I. INTRODUCTION**

Vehicle Dynamic system is very important system in a car that connects your car's body to the tire which is on the ground. It is important because the relative motion of the tire from ground to the body is constrain by the vehicle dynamics system [5]. The vehicle Dynamic system of a vehicle controls the way the chassis reacts with the road surface and a good design is critical for optimal performance, especially in racing environments. The system is comprised of sprung and un-sprung masses and must react safely in a range of scenarios, including acceleration and cornering over a smooth or potentially rough track surface. The suspension shall help to keep the tires in the constant contact with the ground so that the tires can be used to the limit of their capacity. When designing a suspension there are a number of factors that influence the behaviors of the suspension and a lot of these factors also interacts in one way or another. The safety and speed of the car hugely depends upon the vehicle dynamics system, so a proper design will results in better control of tires with the ground also overall better performance of car.

## **II. METHODOLOGY**

The design of this system is driven by the formula SAE 2019 rules mentioned in the references, which

determine several design parameters. According to rule T1.3.1," The vehicle must be equipped with fully operational front and rear suspension system including shock absorbers and a usable wheel travel of at least 50mm with driver seated(25mm jounce and 25mm rebound). According to rule T1.3.2, "The minimum static ground clearance of any portion of the vehicle, other than tires, including a driver, must be minimum 30mm. According to rule T1.3.3, "All suspension mounting points must be visible at technical inspection, either by direct view or by removing any covers [4]. The first phase of designing the system began with the development of suitable ergonomics followed by finding out the weight distribution on each tire and getting the approximate value of center of gravity using Racing aspiration which is an online software. Then after that we fixed certain parameters that would require to calculate the weight transfer forces and calculating ride and roll rates. Further from the former values we will design the suitable suspension geometry that will give an optimize performance using LOTUS software. And before heading towards manufacturing phase we have to decide the types of rims, tires, dampers, springs, bearings that going to use. Last but not the least we will be designing the rockers, A-arms, bearing tube on



Solidworks Modelling software using suitable materials.

### III. EXPERIMENTATION

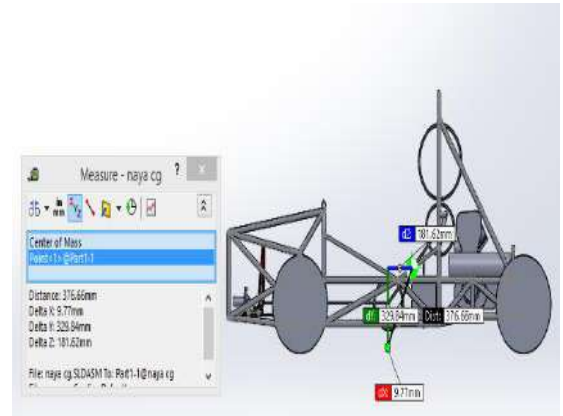
Our main aim was to keep chassis compact as well as giving driver enough space so as to operate the car comfortably. After carrying out ergonomics, car's wheelbase and track-width was decided. The car wheelbase was kept short. The advantages of relatively short wheelbase are reduced overall weight and increased maneuverability. Our front track width remains the same, but our rear track width has been increased by 100mm, due to the fact that we needed longer A-Arms, so as to decrease the roll camber gain. After finishing off with the ergonomics and deciding the track-width and wheelbase of the car, the next step was finding of the Center of Gravity of the car, as it was very much needed for our ride and rolls rates calculations. Center of gravity of the car was found using 3D CAD Software SOLIDWORKS and Racing Aspiration. To all departments a certain amount of weight was distributed according to their requirements and then it was placed accordingly in the chassis and cg was calculated. Our aim was to keep C.G as low as possible as well as to maintain minimum distance between the C.G and the roll center so that there is less roll moment during rolling. As compared to previous car, this car's C.G was decreased by 10mm



**Fig. 01** putting the weights of each department to get the weight distribution and center of gravity using racing aspiration software



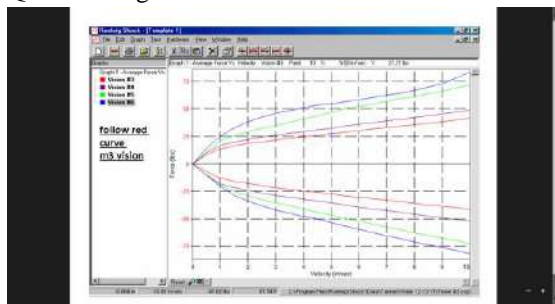
**Fig. 02** Weight distribution on each tire



**Fig. 03** Co-ordinates of center of gravity in Solidworks

After deciding the wheelbase and track-width of the car and also calculating its C.G, our next step was to perform ride and roll rates calculation. Following the Optimum-G, we took standard value of 0.9deg/g as the roll gradient and assumed 60% roll at front and 40% roll at rear end of the car. Through these given parameters we calculated the desired roll rates of the car at the front and rear. Also deciding suitable ride travel for the car, we calculated the ride rates. Through this we got our required roll rate to be provided by the springs and roll rate to be provided by anti-roll bars. After ride and roll rates calculations we can now manufacture spring of desired stiffness. Before heading towards the development of suspension geometry, our job was to decide rims to be used for the car. We opted Keizer 10" rims instead of Capricorn rims due to the certain flaws created by it. Some of the reasons of replacing Capricorn rims was they had less inner space for wheel assembly as compare to Keizer rims because of which the wheel assembly was very much compact and even brake disc size was constrained. For the new car as Keizer rims were selected as they had bigger inner diameter because of which wheel assembly size was also increased and also the brake disc size was increased to overcome errors. For the financial reason, we switched from Hoosier to Avon

A92 10inch medium compound tires. Tire data is currently unavailable for team and will be removed from suspension calculations other than research based assumptions. Shock absorber place a vital role in suspension system. The role of shock absorber is to keep the tires in permanent contact with the road, helping to provide optimum grip when cornering and braking. If at all the shocks are worn, the vehicles ride and comfort is compromised because of which proper selection of shocks is necessary. We selected shock absorbers with proper calculations. DNM RCP Burner-2s , Tanner M3 Vision and Olhins Dampers were short listed . After short listing Dyno plot of each dampers were ordered from their respective company's and then they were compared against calculations carried for ride and roll rates. Olhins and Tanner M3 vision where selected by this method. Further the team decided to use Tanner M3 Vision Quarter Midget Shock instead of Olhins because of its lower weight, less hysteresis loss and also because of low cost. Hence Old DNM RCP burner-2s is replaced with new Tanner M3 Vision Quarter midget shock.

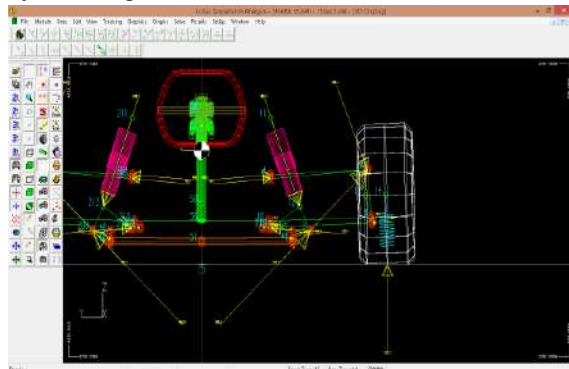


**Fig. 04** Dyno plot of Tanner M3 vision

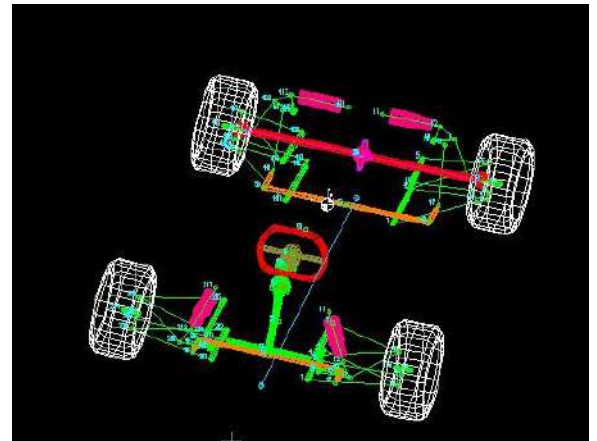
The next phase of the suspension design began with the development of suitable rear geometry. It was immediately decided that an unequal length double wishbone suspension should be employed. This suspension type was chosen for its ability to meet the most desired performance objections with the minimum amount of compromises. Its use is almost universal in not only FSAE cars but also road racing cars. The unequal length design features shorter upper A-Arms, which put the wheels in negative camber under bump. This is desirable under cornering, where the roll of the body typically increases the positive camber of the outside wheel; with the short long arm design, the outside wheel's camber is kept at a more consistent value under cornering. Lotus suspension software was used to place the upper and lower pickup points of the upright and the chassis in order to determine dynamic properties of the suspension. Initial design focused on keeping roll camber as low as possible.

Roll camber is the change in tire camber as the chassis rolls. While cornering the chassis will roll to the outside of the turn, and due to lateral weight transfer the outside wheels will become more heavily loaded than the inside wheels. Making sure the roll camber stays low is especially important for the outside wheels since they will provide the most lateral force, and a change in camber could greatly reduce the lateral forces the tires are capable of reaching. Also important with the suspension geometry is to insure that the roll center stays relatively consistent both vertically and laterally under roll. A low roll center was desired in order to reduce jacking forces on the chassis and suspension. However, it was quickly found that a compromise would have to be made between roll camber gain and roll center height. For the rear suspension system we followed the same suspension geometry as used in our previous car, which was a pushrod suspension geometry. It was used because of its easy packaging and mounting of dampers. With rear track, wheel size and rim diameter known, a suitable lower ball joint and toe link ball joint could be found. The toe link replaces the steering link in a front double wishbone suspension and further constrains the motion of the wheel. The toe link was designed to be attached to the lower A Arm instead of the upper A-Arm for two reasons. First, the upper ball joint was designed to be as far away from the lower ball joint as possible to distribute the loads more evenly. Second, after conducting an FBD of the suspension member forces, it was seen that more force would exist in the lower A-Arm members. The extra support of the toe link on the bottom was expected to lower the maximum force seen in each lower A-Arm member, allowing for smaller and lighter A-Arms. As mentioned earlier the software used for iteration of suspension geometry was lotus software. In lotus software the values of camber, caster, toe and kingpin were set according to the behavior and within limits. For 2 degree roll and 30mm rebound and bump the iterations are carried out on geometry. The geometry at which the camber, caster and toe change are within limits is selected. We also have considered wheelbase and track-width change with them. The geometry used in the car has camber, caster, toe, wheelbase and track-width change and we also obtained a certain amount of anti-squat at rear. As more force act on lower A-Arms due to push rod being attached to the lower arms, 6mm spherical bearings were being used and for the upper A-Arms 5mm spherical bearings are used at the pickup

points. Similarly at ball joints due to low forces at upper ball joints the spherical bearing used is of 6mm and at lower ball joint due to higher forces the spherical bearing used here is of 8mm. The forces on the ball joints and pickup points where obtained by lotus software directly. Similar to the previous car pull-rod suspension geometry was selected. It was due to the fact that we wanted to lower the center of gravity (C.G) of our car at the front. Front geometry is complicated by the fact that it must take into account steering parameters including the effect of bump steer on the car. The lower A- Arms is generally longer than the upper A-Arms in order to produce desired tire curvature towards negative camber during roll. The suspension member's tube size was then calculated based on yielding and buckling criteria. Similar to rear suspension geometry the front suspension geometry is also finalized by doing iterations on the software. The geometry that is finalized for the car has camber, caster, toe, kingpin, wheelbase and also track-width change within the set limits. Also the geometry has anti dive property. Due to pull rod suspension at the front, more load of chassis will act on the upper A-Arm as compared to lower A-Arm, therefore 6mm spherical bearings are used at upper arms pickup points and 5mm spherical bearings are at lower a-arm. The forces are obtained by lotus software and by this we get the size of the bolt.

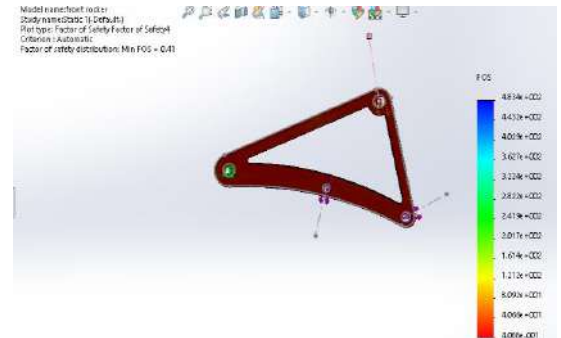


**Fig. 05** Front suspension geometry using Lotus



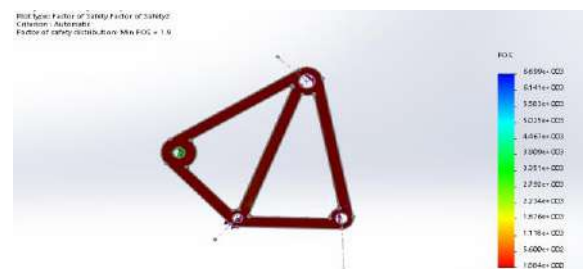
**Fig. 06** Suspension geometry of whole car

The design of rocker is based on the push/pull rod mounting i.e whether it is placed at upper a-arm or lower a-arm. The rocker is different for both front as well as rear.



**Fig. 07** Analysis of front rocker

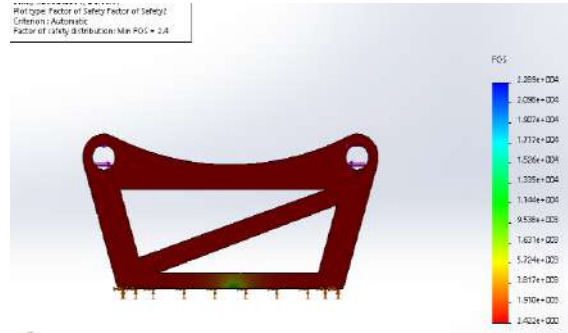
Hence by observation we can select the material for front rocker as SS because it has more FOS than both and also cost is low and easily available.



**Fig. 08** Analysis of rear rocker

**MOUNTING PLATE:** At the rear portion of the car the 2 dampers are fixed by placing a mounting plate in between them the design of the mounting

plate is given below with 2 different materials.



**Fig. 09** Analysis of mounting plate

#### IV. RESULT AND DISCUSSION

The system that we designed gave us more stability during cornering at high speed because of negative camber on the front tires that provided us with high tractive force with tire and ground and also increase the contact patch of tires. The rolling effect was reduced because we kept the center of gravity close to the ground and also because the distance of center of gravity and roll center was less. The use of Anti-dive geometry helped us to reduce the longitudinal weight transfer during braking. The use of Anti-squat geometry helped us to keep the front tires on the ground during acceleration. The system was convenient for us because ease of installation and adjustment.

#### V. CONCLUSION

The purpose of this paper was to design and manufacture the optimized vehicle dynamics system of the formula SAE car and also the method and process involved to develop the final system. The analysis of the components proved that they are able to withstand the forces acting on it and work safely on the race track with improved performance and effective.

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**NAME: PROF. AJAY KASHIKAR**



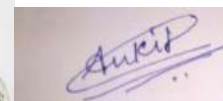
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**NAME: MITESH DESHPANDE**



**NAME: ANKIT DOSHI**



## DATA IN FUTURE CITIES - IMPROVING THE QUALITY OF ANALYTICS THROUGH SIMPLIFIED DATA QUALITY ASSESSMENT FRAMEWORK

Dr.Preeti Ramdasi \* (A&I, Tata Consultancy Services), Smita Salgarkar (A&I, Tata Consultancy Services), Aniket Kolee (A&I, Tata Consultancy Services).

### **Abstract:**

*With ample data floating in and around enterprises today, Analytics has become an integral part of almost every business process, decision, and action. However, the effectiveness, efficiency, and reliability of analytics services is governed by the quality of data in information systems. Also for a smart city environment, a huge amount of data is generated from heterogeneous sources such as individuals, social media, hospitals, financial institutions, power and gas companies, water services, transport areas, and government institutions, etc. The solutions to smart/future city projects are based on such nonuniform type of data to make the city 'future smart'. However, the systems, methodologies, processes, and tools are highly complex in nature. The aim of this paper is to propose a simplified data quality framework, method, and tools to ease future cities participants and information management stakeholders to monitor data quality towards improving the overall quality of analytics. This paper illustrates a prototype for implementation, usage and concept reusability by relevant stakeholders in the future cities program.*

### **Keywords**

*Big Data Governance, Data Quality assessment framework*

### **Abbreviations**

*DOE- design of the experiment, BASOA- Business Analytics Service Oriented architecture,*

*MDM- Master Data Management, ETL- Extract, Transform, Load, DQ – Data Quality*

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## I. INTRODUCTION

'Smart city' is a broad concept that is high on everybody's agenda. Gartner [2] defines the smart city as an urbanized area where multiple sectors cooperate to achieve sustainable outcomes. This is done through the analysis of contextual and real-time information. According to IEEE [3], a smart city brings together government, society, and technology to enable smart economy, smart mobility, smart environment, smart governance, and overall smart living.[10] Future of smart cities is to enable a holistic customized approach that accounts for their city culture, long-term planning, economic sustainability and citizen needs. This is to be achieved by making different city sectors shake hands with other relevant sectors to exchange data and develop a collaborative work culture. The foundation will be a collective intelligence it can harness out of Big Data Analytics through integrated data stores, data lakes, having the ability to intelligently produce predictions and enable intelligent decision support system. Thus, a smart city is viewed and monitored purely in terms of data. Further, for future cities program, it is expected that this data is openly available to researchers and data scientists for analysis and for

discovering new knowledge, thereby suggesting improvements and adding value.

As future cities program would be to scale up successful smart city project, it is noteworthy that data 'quality' is a crucial first step that cannot be ignored. Though, more challenging, must be well thought of before processing. Data quality evaluation must be done prior to any big data analytics to have enough trust in data and quality confidence. On the other hand, when its quality degrades, the consequences are unpredictable and can lead to incorrect insights and false predictions. While dealing with the challenge of volume and velocity of big data, it is required to have robust mechanisms and strategies to evaluate and assess data quality.

The proposed approach in this paper may facilitate the future city's data office, developing big data quality assessment platform and enhancement of data services fostering 'very close to correct' predictions and successful decisions. The approach may be referred for reusability as well.

## II. BACKGROUND

Data quality is a complex problem to be solved for all data-driven organizations. Due to data issues, the quality indicators are not computed reliably



reflecting the loss of trust in the data.

In the smart city and future cities projects, the problem becomes critically complex due to the wide variety of information sources, multiple ways the data are collected and stored, transformed and used, incompatible data formats and definition [1]. etc.

We propose a simplified Data Quality framework that offers an opportunity to deal with this complexity in the area of Smart city and Future cities.

The domain-specific DOE for relevant customization and refinement, such as smart health care, smart education systems, smart resource management, digital corporation systems, smart banking and finances, to name a few, will help to design a generalized quality process framework. This framework will address the complex data quality management problems in every industry, enterprise, institute, organization and local government offices and for an integrated data model for future cities as well.

As the paper focuses on data quality assessment, the targeted user group consists of information managers, CDOs, CIOs and subject matter experts who supervise data quality in individual systems and integrated version of it.

### III. SMART CITIES: A DATA PERSPECTIVE

#### A. Application areas and data points

The smart city concept involves various application areas. As per Lim and Maglio (2018) following 12 application areas contribute majorly to smart cities; [5] these are 'smart device', 'smart environment', 'smart home', 'smart energy', 'smart building', 'smart transportation', 'smart logistics', 'smart farming', 'smart security', 'smart health', 'smart hospitality', and 'smart education'. These areas form a hierarchical structure of smart cities referring to data being generated in and around these systems.

In smart cities, local resources, government, companies, citizens, and visitors are connected by smart devices and smart environments, key resources that facilitate the collection of data from the resources and stakeholders and the delivery of various smart services to the stakeholders. The stakeholders interact with each other and co-create value through the services. Smart cities incorporate all these elements at the top of the hierarchy [5].

#### B. Data governance for data democracy in future cities

As per Gartner [11], The increasing complexity and volume of smart city data force to focus on the development of a comprehensive smart city data governance.

Data governance is the formalized discipline of ensuring accountability for the management of an enterprise's core information assets. Data

governance includes the following:

- A defined process
- An organization structure
- Well defined roles and responsibilities
- Access controlled, published and democratized repository of guidelines, standards, rules of engagement and escalation.

Data governance creates a culture where creating and maintaining high-quality data is a core discipline of the organization. [15] making it good for use. It makes the data consistent. Adopting and implementing data governance results in improved productivity and efficiency of an organization.[7][12]

Effective data governance meets quality and management requirements irrespective of where data reside and where they are acquired or consumed.

Numerous benefits that can be reaped out of effective data governance becomes a necessity for the future city programs; thus they are considered as a subset of overall goals for the smart city to future city program. As per one of the internet sources [cio-wiki.org], benefits are stated below for better understanding (but not limited to):[13]

- Provide standardized data systems, data policies, data procedures, and data standards.
- Ensure accurate procedures around regulation and compliance activities.
- Increase transparency within any data-related activities.
- Increase the value of an organization's data.
- Aid in the resolution of past and current data issues.
- Decrease the costs associated with other areas of data management.
- Help with instituting better training and educational practices around the management of data assets.
- Facilitate improved monitoring and tracking mechanisms for Data Quality and other data-related activities.

Therefore, data governance in smart city initiatives is about the utilization of data and new technologies to identify, collect, generate, share and employ data to create smart and sustainable solutions.

#### C. Understanding Data Quality

Few of the definitions drawn from literature survey are:

"Data is considered high quality to the degree it is fit for the purposes data consumers want to apply it". "Fit for a purpose. Meets the requirements of its authors, users, and administrators." (adapted from Martin Eppler) (Peter Aiken). "Reliance on accuracy, consistency, and completeness of data to

be useful across the enterprise.” (Michelle Knight, DATAVERSITY®)

Data Quality Management is one of the most important tasks within Data governance. It includes the following:

- Define data quality requirements and business rules,
- Actively profile and analyze data quality in partnership with data experts.
- Identify proactive ways to solve the root causes of poor data quality, promote data quality awareness, and ensure data quality requirements are met.
- Assist in the analysis, certification, and auditing of data quality, lead data clean-up effort.

Data quality depends on context and the data consumer's needs. [4] It is defined in terms of quality dimensions. It often has the following dimensions:

- Accuracy
- Completeness
- Consistency
- Integrity
- Reasonability
- Timeliness
- Uniqueness/ Deduplication
- Validity
- Accessibility

[4]Data quality dimensions is a useful measurement approach for comparing data quality levels across different systems (or tables/business functions).

#### IV. DATA QUALITY ASSESSMENT

The most critical requirement while talking about data quality is to provide innovation and ways to assess data for applicable quality dimensions, further manage and optimize the quality assessment process.

Due to the increasing complexity and processing logic required to manage, control and utilize data quality dimensions, explained in section II-C above, every smart city project needs special attention ensuring high-quality data. This suggests incorporating complex data quality rules into data quality dimensions. These can then be reused and applied across new data sources and futuristic smart projects.

It is very important to understand the main components of the quality assessment process. These are referred to as a directive for further study and reference for the future city program. They are mentioned below.

Knowing the client/s: Understand details of all data consumers, their exact requirement, more about the data currently being used by client/s. etc.

Business Drivers: Analyze existing data quality issues, specific pain areas, their nature and inclusion/exclusion of quality dimensions for every client.

Technologies: Study existing technology stack and feasibility of additional proposal for new relevant technology.

The potential for automation: Once the execution methodology and process workflow is designed, identify the possibility of machine first approach where process automation is aimed at minimal manual intervention, thus reducing the risk of overall quality degradation.

Predicting future needs: the quality assessment design must be flexible enough and adaptable to upcoming needs and technology changes.

#### A. About TCS DQ Framework

The framework is simplified through optimized integration of available and latest technology, process automation, result analysis, and informatics.

The following is an outline of the process that needs to be followed for an overall data quality management:

- Metadata: Basic metadata information needs to be captured by analysis of data source definitions or interface documents
- Data Profiling: Production data samples analyzed and profiled to familiarize with the data contents, constructs, patterns for developing a business glossary.
- Definition of DQ Standards and Rules: Critical data elements identified, business rules around them formulated. Each business rule associated with DQ dimensions and acceptable quality thresholds defined.
- DQ Monitoring: Scheduled DQ Monitor processes using Data Profilers, ETL code or DQ Tools.
- DQ Reporting: Recorded DQ statistics from operational logs represented into comprehensible data quality and data exception reports. These are systematically tracked for a holistic enterprise data quality pulse over a period of time for improvement of DQ health
- DQ Improvement: Data of unacceptable quality should be reverted to source application for correction.

### A. Deep dive into TCS DQ Framework

The TCS DQ Framework comprises of 3 main components:

1. Identify/Set Up – A database layer that holds business rules, data quality, data reconciliation, metadata aspects and technical details of the same.
2. Perform/Analyze - An ETL execution layer for executing the various rules and capturing their results
3. Monitor - An user interface to display the quality assessment results and quality trends over a pre-determined period of time.

The quality dimensions are selective in nature. The framework allows selection referring to a given set of data/clients need. Four of the major dimensions are defined as below.

Uniqueness - Refers to the characteristic that there should be no data duplicates, that is, data values/information should be distinctive.

Accuracy - Indicates the extent to which data reflects the real world object or an event. Inaccuracy can be reflected by incorrect values, whether numbers or descriptive data (gender, location, preferences etc.) or other information that is not updated correctly.

Consistency - Refers to whether all available data is evenly placed for the same object to determine if the data has any internal conflicts.

Sufficiency - Refers to whether all available data is present and the information is ample/adequate.

## V. TCS CASE STUDY

### A. Introduction

Within our organization, TCS offers analytics-as-a-service that is a backbone across different business units for internal and client facing operations.

After sufficient research and evaluation efforts, TCS has come up with simplified architecture referring to enterprise requirements focusing its reusability across different functions and domains.

About Our client:

Our customer is TCS CIO, one of the important function units, TCS Data Office and other internal stakeholders. All potential data consumers are identified and their function specific data requirements are studied. This study along with analysis of the database structure currently being used has helped to design futuristic data model.

Business drivers:

The stakeholders wanted accurate advanced analytics and predictions for their functional unit. This requires trustworthy data. Thus, the need to improve data quality by identifying and resolving quality issues around vital attributes has emerged out

Challenges in data:

- Poor quality in source data
- Lack of data quality policy and processes.
- Unclear accountability of data
- Lack of agility
- The absence of matured governance policy on security for data silos.

Technologies:

Various in-house solution accelerators and third-party tools are incorporated in developing the framework.

- SAP HANA: A relational database management system as a database server. This brings ease in operations for its ETL capabilities.
- QlikSense: A Visualization tool for monitoring the analysis results.

### B. Execution Methodology

The information manager holds the responsibility of defining, managing and executing the data quality process.

The data quality measures and its quality criteria for each system are collated and are defined in metadata associated with the framework. The acceptability and/or rejection rule for every criterion is executed to determine compliance with the defined measuring technique. A score of the level of acceptability is recorded in the master database. Integrated visualization tools consume these results.

It is to be noted that the assessment is a subjective matter. In terms of future cities program, every stakeholder and functional domains have their own quality definitions and quality thresholds.

A high-level workflow is explained below.

- a) The data quality and reconciliation rules are run via an automated batch run. The results are stored in the database.
- b) Data quality assessment results are captured for each rule, while data is at rest.
- c) Assessment results are stored on a daily basis over a period of time.
- d) Analytics is performed and trends are made available for maintaining/improvement data quality.

- e) The process is repeated and dashboards are refreshed till the quality index comply acceptability rule.

### C. Quality assessment process

The execution frequency of the quality assessment process is defined in the scheduler. This varies for different stakeholders within the organization.

Table 1 describes the data quality assessment tasks that are carried out while executing the assessment process.

Table 1: List of data quality assessment tasks

Data Quality Task	Definition
Identify & Capture	Identify the landscape to be profiled. Basic metadata information needs to be captured by analysis of data source definitions or interface documents.
Profile & Measure	Production data samples analyzed and profiled to familiarize with the data contents, constructs, patterns based on which the business glossary may be associated to the data elements, or extended
Establish Rules	Critical data elements identified, business rules around them formulated by data stewards, each business rule associated to DQ dimensions and mapped to data quality scores and relative weightages for aggregation and acceptable quality thresholds defined
Monitor	Regular DQ Monitor processes (using scheduled Data Profilers, ETL code or DQ Tools) Data Reconciliation Processes, Data Exception Management Processes laid down and scheduled
Report	Recorded DQ statistics from operational logs represented into comprehensible data quality and data exception reports that may be grouped on source applications, business lines, DQ dimensions or similar enterprise operating units of measurement and systematically tracked for a holistic enterprise data quality pulse over a period of time for improvement of DQ health
Correct & Improve	Data of unacceptable quality that may be of operational nature should be reverted to source application for correction, to ensure such correction consistently gets cascaded to all subscribing applications and help reconcile cross application data. Reporting-specific poor quality data may be corrected either manually using Data Stewards corrective workflows with auditability or programmatically by formulating data correction rules and applying on the defaulter dataset.

- A data validation batch job in the ETL pick up and execute the validation rules every time there is an incremental/full load.
- The data validation rules and the results from each batch run along with the score of the failed rules are stored in a simple reference table and results table. Quality index for each dimension (Sufficiency, Accuracy, Consistency, and Uniqueness) is captured for each rule.

A web-based data quality monitoring and reporting portal was created using QlikSense technology for the business user across the globe. This is a self service dashboard that allows to apply customized filters and check the scores for various validation scenarios.

Given below snapshot of sample data and an example of data validation rule.

Table 2: Metadata of the data validation rules

FNCTNL_AREA_NAME	QUTY_DIM_NAME	SCHEMA_NAME	TAB_NAME	COL_NAME	VALDTN_LEVEL_NAME	VALDTN_NAME	VALDTN_SQL_TXT
TCS_FN1	Uniqueness	REPMAGNE	Account	NAME	All Accounts	Duplicate account names	INSERT INTO ANALYTICS
TCS_FN1	Sufficiency	REPMAGNE	Account	row_id	All Accounts	Accounts with no owners	INSERT INTO ANALYTICS
TCS_FN1	Accuracy	REPMAGNE	Opportunity	ROW_ID	Open Opportunities	Opportunities with Opportunity value 0 or...	INSERT INTO ANALYTICS
TCS_FN1	Consistency	REPMAGNE	Opportunity	ROW_ID	Open Opportunities	Opportunities with retired or no offerings	INSERT INTO ANALYTICS

FNCTNL_AREA_NAME	VALDTN_STG_NAME	SCHEMA_NAME	TAB_NAME	COL_NAME	VALDTN_LEVEL_NAME	VALDTN_NAME	VALDTN_SQL_TXT
TCS_FN1	Source to HANA	REPMAGNE	TOFFERING	OFF_IDN	Active Offering	Offerings in Source and Target	INSERT INTO ANALYTICS
TCS_FN1	Source to HANA	REPMAGNE	TOFFERING	TOU_CODE	Active Offering	Offerings by Business Unit	INSERT INTO ANALYTICS
TCS_FN1	Source to HANA	REPMAGNE	TOPPOR...	OPTY_L...	Active Offering	Opportunities in Source and Target	INSERT INTO ANALYTICS
TCS_FN1	Source to HANA	REPMAGNE	TOPPOR...	OPTY_...	Active Accounts	Total Opportunity amount for opportunity...	INSERT INTO ANALYTICS

### D. The integrated quality visualization tool

A well-known and widely available business intelligence tool has been integrated with the master data model within the framework. Metadata combined with the results table gives complete insight through analytics dashboards. CIOs, CDO, information managers make relevant use of these dashboards as per their roles and objectives. Sample assessment dashboards can be seen in below figures.



Fig 1: Sample Dashboard\_VValidation Overview  
Following dashboard shows the results of all quality rules for a selected timeline. The dashboard also displays overall statistics of assessment.

Run Date	Table	Scope	Validation Rule	Validation Stage	Schema	Result	Count	Total in Scope	% Impact	Criticality	Quality Dimension
15/01/2018	Employee	Active Employees	Duplicate Employee Names	Target Level	Organization	PASS	0	10000	0.00%	High	Uniqueness
15/01/2018	Employee	Active Employees	Employees with missing DOB	Target Level	Organization	FAIL	10	10000	0.10%	High	Sufficiency
15/01/2018	Employee	Active Employees	Employees showing incorrect age as compared to DOB	Target Level	Organization	FAIL	30	10000	0.30%	High	Accuracy

Run Date 15/1/2018	Validation Rules 390	Rules Passed 226	Rules Failed 164	Pass% 58%
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Fig 2: Sample Dashboard\_VValidation detail

For every reconciliation that has failed, the dashboard shows the deviation from the source.



Overall Reconciliation									
Validation	Quality Dimension	Step	Last Upd	Status	Table	Column	Step	Run	Order
Overview of All Business Data Quality Rules									
Run Date	Table	Scope	Validation Rule	Validation Stage	Schema	Result	Count Diff	Quality Dimension	
15/10/2018	Employee	Active Employees	Total Employee ids	Source to Target	Organization	PASS	0	Consistency	
15/10/2018	Emp Salary	Active Employees	Total of Employee Salary	Source to Target	Organization	FAIL	1000	Consistency	
15/10/2018	Department	All Departments	Total Department Names	Source to Target	Organization	FAIL	5	Consistency	
Run Date 15/10/2018		Validation Rules 390		Rules Passed 226		Rules Failed 164		Pass% 58%	

Fig 3: Sample Dashboard\_Reconciliation

The Trend charts are studied to closely monitor change in the level of quality over multiple executions of assessment process post relevant corrective actions.

Due to integrated approach, information managers finds ease in frequent monitoring and addressing complex quality issues on regular basis. For subject matter experts to take corrective measures, this framework allows controlled continuous data quality evaluations. Thus, the effectiveness of the quality assessment process through a simplified framework is observed in terms of process integration, automation, and overall cycle time reduction. .

### RECOMMENDATION

In nutshell, what drives data governance success in future city initiatives, is the quality of data. Therefore, thoughtful efforts must be planned to resolve the issues of meaningful data or data relevancy and quality of data.

Referring to the proposed data quality assessment framework, future cities information managers and data offices may create a data governance layer across entire data landscape to discover measure, improve and continuously monitor the quality of the requested information sources.

The framework allows further integrated of other pre-processing tasks under the umbrella of data governance. Example, regulatory compliance, etc.

Echoing Gartner[14]: As an essential element of a smart city service, data organizations, institutions government and smart city stakeholders have to collaborate for further research and design solutions towards providing "Quality Data"-as-a-Service' across future city's data lakes for faster and cost-effective services.

### CONCLUSION

Our aim for this paper and TCS DQA framework, is to develop a simplified quality assessment process prototype for the smart city and related enterprise data that can be scaled up and customized to be able

to deal with all stakeholder projects towards future city's integrated data store/data lake.

Thus referring to TCS's simplified DQ assessment framework a process can be derived to manage big data quality in a complex, heterogeneous information environment typically like future cities projects. The framework design principles can be further refined through multiple iterations. The proposed framework and concept of analytics-as-a-service can be easily extended as a part of BASOA for the future city program.

### ACKNOWLEDGMENT

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Dr.Preeti is one of the senior members of TCS data office, contributing to Data Analytics and Visualization function. She has worked on large projects dealing with automotive data, HR function etc.

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Aniket is a founder member of TCS Data Office and leads its Data Fabric function. He has worked on 'Data Driven' projects all his career for large international banks. He seamlessly embeds Yoga in learning and at workplace.

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## PERFORMANCE EVALUATION OF HELICAL COIL IN CONDENSATION HEAT TRANSFER

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### Abstract:

*This research work presents experimental investigation of condensation heat transfer characteristic of steam flowing inside the helical coil with cooling water flowing in shell in counter direction. The experiments were performed using steam saturation temperature ranging from 103 – 115 Degree Celsius and pressure 0.2 – 1 bar gauge. The experiments were performed with cooling water flow rate 3 l/min and 8 l/min. The effect of mass flux, heat flux and heat transfer coefficient for three different curvature ratio of stainless steel helical coil have been investigated. It is concluded that the experimental results of the helical coil are more superior to straight tube.*

### Keywords:

*Heat transfer, condensation, steam, helical coil*

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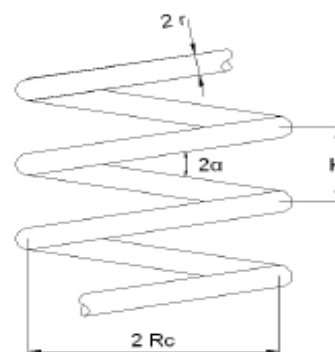
**Phone:** 8693036166

### I. INTRODUCTION

The heat exchanger is a broad term related to devices designed for exchanging heat between two or more fluids with different temperatures. There are two types of heat transfer enhancement technique active technique and passive technique. Active devices include surface vibration, mechanical aids and electrostatic field. In passive devices treated surfaces, rough surfaces, extended surfaces and coiled tube etc. Helical coils are indirect contact or passive heat transfer devices. Coil tubes are essentially swirl flow devices, which facilitate forced convection heat transfer by creating secondary flow inside the tube. Due to the compact structure and high heat transfer coefficient, helical coil heat exchangers find extensive use in industrial applications such as power generation, nuclear industry, process plants, heat recovery systems, refrigeration, food industry, etc. The increase in heat transfer in helical coil due to curvature shape of the coil induces the centrifugal force which develops the extent of secondary flow.

#### The terminology of the helical coil

Pipe inner diameter  $2r$ . Coil diameter  $R_c$ . pitch is  $H$ . The coil diameter is also called as pitch circle diameter (PCD). Curvature ratio ( $r/R_c$ ).



**Fig.1: Terminology of helical coil**

#### Condensation Heat Transfer

Condensation is the process of conversion of vapor phase to the liquid phase. When the temperature of vapor goes below its saturation temperature condensation occurs. A certain amount of subcooling required for condensation.

## Literature Review

Liang Zhao et al, 2003 [1] has performed an experimental investigation on forced convection Boiling heat transfer inside the small helical coil. In this paper flow boiling heat transfer coefficient was proposed to better correlate the data. It was found that boiling heat transfer dependent on both mass flux and heat flux. This implied that nucleation mechanism and convective mechanism have the same importance to forced convective boiling heat transfer for the small coil. It was found that heat flux does not have an obvious effect on the two-phase pressure drop multiplier. In this paper experimental result compared with predicted result.

Somchai Wongwises et al (2006) [4] has performed experimentation on The two-phase heat transfer coefficient and pressure drop of pure HFC-134a condensing inside a smooth helically coiled concentric tube-in-tube heat exchanger are experimentally investigated.

Akhavan-Behabadi, 2012 [6] has performed a study on heat transfer and pressure drop of CuO base Nanofluid in the horizontal helical coil. In this study developed a correlation to relate different parameter to heat transfer such as the effect of Reynolds number, fluid temperature, etc. The analysis was done for both straight and helical coil. It was found that Nanofluid has better heat transfer characteristics when flow in helical coil then straight tube which is 18.7% and 30.4% respectively.

S.S.Pawar et al, 2013 [7] have performed a study on isothermal steady state and non-isothermal unsteady state conditions were carried out in helical coils for Newtonian and non-Newtonian fluids. Water, glycerol-water mixture as Newtonian fluids and dilute aqueous polymer solutions of sodium carboxymethyl cellulose (SCMC), sodium alginate (SA) as non-Newtonian fluids were used in this study. Several correlations for the first time are proposed based on heat transfer data generated from the experiments performed for Newtonian fluids under isothermal and non-isothermal conditions (total 138 tests). Further, comparison of overall heat transfer coefficient  $U_o$  and Nusselt numbers for Newtonian and non-Newtonian fluids under isothermal and non-isothermal conditions (total 276 tests) is presented in this paper.

Kahani et al, 2013 [8] studied forced convective heat transfer and the pressure drop of Nanofluids inside horizontal helical coiled. The effect of heat transfer coefficient observed different concentration as well as various Reynolds number. The range was 0.25-2% concentration and 500-4500 Reynolds number. The heart of experimental set up was straight tube and a helical coil which connected in parallel. It was found that the max HTC is observed 1330 and 4720 at highest Reynolds number of 2% volumetric concentration of Nanofluids flow inside the straight tube and helical tube respectively.

Gupta et al, 2014 [9] have performed an experimental investigation on condensation of R-134a inside the helically coiled tube. In this study, the correlation has been developed to predict two-phase Nusselt number and pressure drop multiplier during condensation. This analysis was done for vapor saturation temperature, mass flux, and vapor quality. The mass flux, vapor quality, and saturation temperature has a significant effect on the heat transfer coefficient. The flow regimes observed during condensation of R134a was investigated.

Akhavan-Behbadi et al (2015) [10] have studied on condensation heat transfer and pressure drop characteristics of R600a in a Tube in tube heat exchanger at different inclination angles. The inclination has a significant effect on heat transfer. Author has performed an experiment for different inclination angle. The diameter, pitch, height and the number of coil turns were 305 mm, 35 mm, 210 mm and 6, respectively. The average vapor quality varied between 0.11 and 0.78. The effects of inclination angle, mass flux and average vapor quality on the heat transfer coefficient and pressure drop are discussed.

**Summery** It is revealed that most of the study has been carried out on heat transfer characteristics of coil configuration and flow configuration, but the extent of work done in condensation heat transfer.

## II. PROBLEM DEFINITION

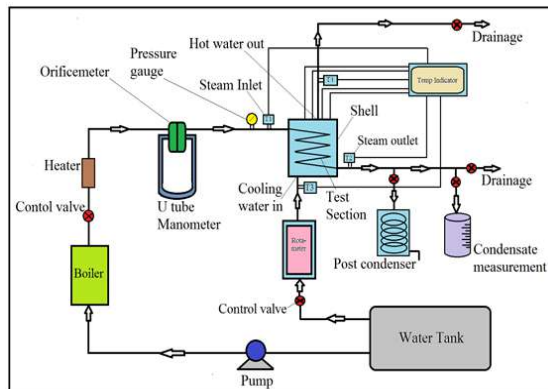
Extensive work is reported in the literature on helical coil made of copper. The literature on stainless steel helical coil is scarcely available. Working fluid used inside the helical coil in the majority of work was refrigerant. The work on steam as the condensing fluid is not reported. In the present experimental study, steam is chosen as condensing fluid which flows inside the helical coil.

## JJ. PROJECT OBJECTIVES

- The objective of this project is to investigate condensation heat transfer of steam inside helical coil.
- To study influence of coil curvature ratio (0.05268, 0.061467 and 0.07376) on heat transfer coefficient.
- To study effect of saturation temperature, mass flux and heat flux of steam on condensation heat transfer for 3 l/min and 8 l/min water flow rate.

## II. EXPERIMENTATION

The experimental set-up was designed and fabricated to study condensation of steam inside a helical coil. The schematic diagram of the experimental set-up is shown in Fig.2



**Fig. 2 Schematic Diagram of experimental setup.**

The test-section was a condenser having a helical coil placed in a shell. The experimental set up consists of electric Boiler, heater, orifice meter, manometer, temperature indicator, Thermocouple sensor, RTD sensor, Rotameter, measuring flask, test specimen, and tank. The electric boiler working on 27watt and 4 bar pressure having 35Kg/hrs capacity. The manometer place across the orifice meter to measure the discharge of steam. There are seventeen T type (copper-constantan) thermocouple sensor are attached on the surface of the coil to measure the average surface temperature. The RTD sensor is used to measure the temperature of water inlet and outlet temperature and condensate temperature. The thermocouple and RTD sensors are calibrated using calibration test rig. The rotameter used to control the flow rate of water 3 and 8 l/min from the supply. The range of the rotameter is 0 to 20 l/min. The condensate coming out of the coil is measured by measuring flask having capacity 1litre. The tank is made of cylindrical mild steel

vessel having diameter 295milimeter, height 450milimeter and vessel has a capacity approximately 30litre. It's made from the MS sheet of 3mm thickness by rolling the sheet in the rolling machine. The heater is used after boiler to convert the wet steam into dry steam. The steam is passing through coil control by a valve called as throttling process. All the data has collected and graphs are plotted.

### Test specimen

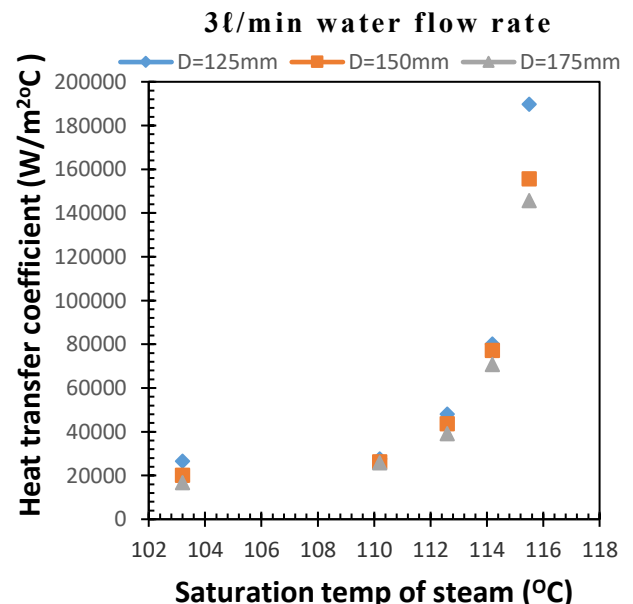
The helical coils are made from the ¼ inch S.S seamless pipe having outer diameter of 13.7 mm and an internal diameter of 9.22 mm. Three helical coils are made of coil diameter of 175, 150, and 125 mm respectively. The number of turns is 5.5. Pitch is kept 20mm.

## III. RESULTS AND DISCUSSION

The experiment has done for the three coil diameter helical coil, from the experiment reading are taken at the different flow rate of steam and keeping constant water flow rate. The finding from the experiment different graph and result are plotted for the three helical coils at 3l/min and 8 l/min water flow rate.

### A) Effect of saturation temperature of steam on heat transfer coefficient.

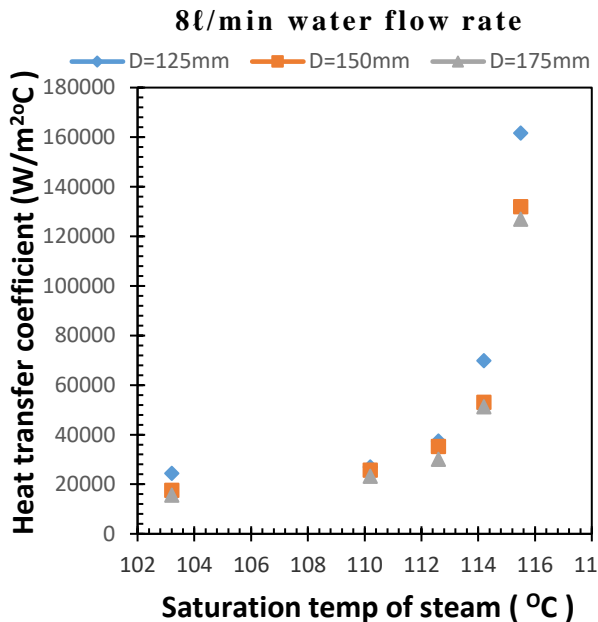
In this section, the effect of saturation temperature of steam on heat transfer coefficient has studied.



**Fig. 3 Saturation temp V/s HTC at 3l/min**

The variation of heat transfer coefficient due to inlet temp of steam as shown in Fig.3. at 3l/min. The heat transfer coefficient increases with an increase in inlet steam saturation temperature. As the saturation temperature increases the velocity of vapour

increases which tends to greater effect of secondary flow and shows increase in heat transfer. The heat transfer coefficient higher for smaller coil this is due to smaller coil diameter coil shows more turbulence and centrifugal force which gives stronger secondary flow and heat transfer rate. The bigger diameter coil shows opposite trend.

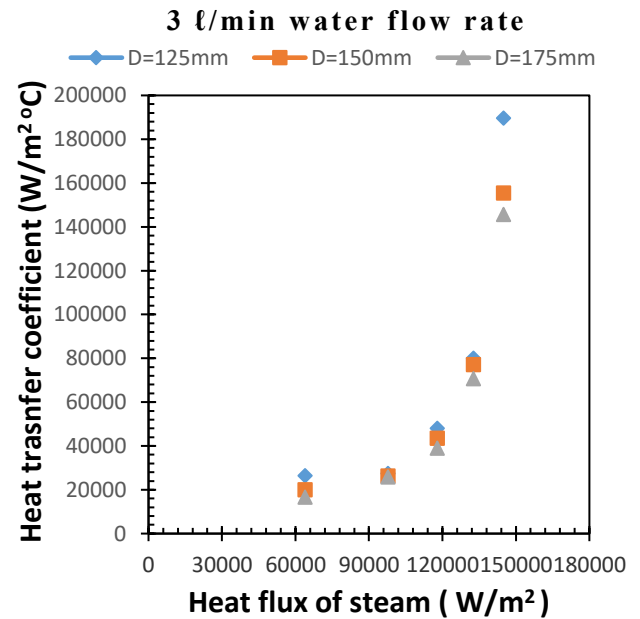


**Fig. 4 Saturation temp V/s HTC at 8 l/min**

The variation of heat transfer coefficient due to inlet temp of steam as shown in Fig.4.at 8l/min. The heat transfer coefficient increases with an increase in inlet steam saturation temperature. As the saturation temperature increases the velocity of vapour increases which tends to greater effect of secondary flow and shows increase in heat transfer. The heat transfer coefficient higher for smaller coil this is due to smaller coil diameter coil shows more turbulence and centrifugal force which gives stronger secondary flow and heat transfer rate. The bigger diameter coil shows opposite trend.

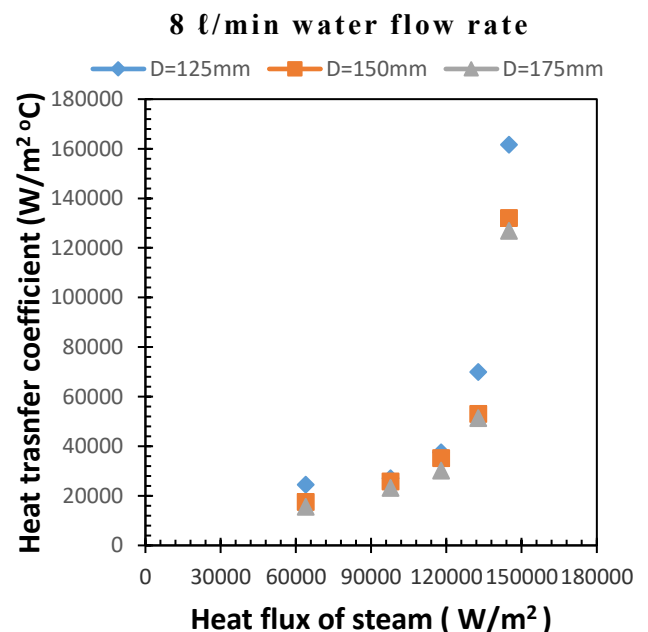
#### B) Effect of heat flux on heat transfer coefficient

In this section, the effect of heat flux of steam on heat transfer coefficient has studied.



**Fig. 5 Heat flux V/s HTC at 3 l/min**

The variation of heat transfer coefficient due to a heat flux of steam as shown in Fig.5 at 3 l/min. The heat transfer coefficient increases with increase in heat flux of steam. Due to more turbulence and secondary flow in coiled devices which shows increase in heat transfer with heat flux of steam. Also the small coil diameter coil has more turbulence and centrifugal force tends to increase in heat transfer in smaller coil diameter as compare to bigger coil diameter.



**Fig. 6 Heat flux V/s HTC at 8 l/min**

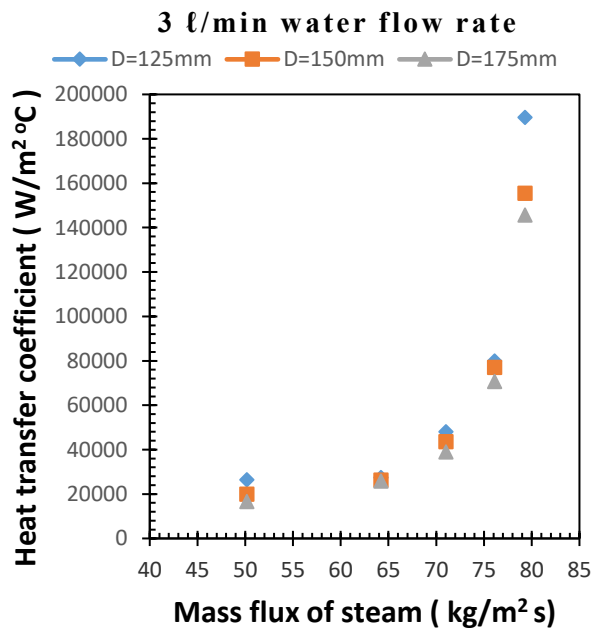
The variation of heat transfer coefficient due to a heat flux of steam as shown in Fig.6.at 8l/m. The heat transfer coefficient increases with increase in heat flux of steam. Due to more turbulence and



secondary flow in coiled devices which shows increase in heat transfer with heat flux of steam. Also the small coil diameter coil has more turbulence and centrifugal force tends to increase in heat transfer in smaller coil diameter as compare to bigger coil diameter.

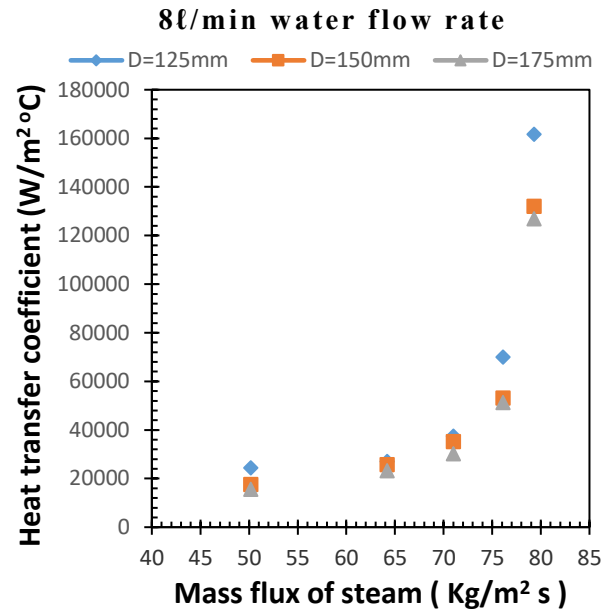
### C) Effect of mass flux of steam on heat transfer coefficient.

In this section, the effect of mass flux of steam on heat transfer coefficient has studied.



**Fig. 7 Mass flux V/s HTC at 3 l/min**

The variation of heat transfer coefficient due to mass flux of steam as shown in Fig.7 at 3 l/min. The heat transfer coefficient increases with the increase in the mass flux of steam. As the mass flux increases more is the vapour flow inside tube which increase the velocity of steam and increase the turbulence and extent of secondary flow gives increase in heat transfer rate. Also the small coil diameter coil has more turbulence and centrifugal force tends to increase in heat transfer in smaller coil diameter as compare to bigger coil diameter.



**Fig. 8 Mass flux V/s HTC at 8 l/min**

The variation of heat transfer coefficient due to mass flux of steam as shown in Fig.8 at 8 l/min. As the mass flux increases more is the vapour flow inside tube which increase the velocity of steam and increase the turbulence and extent of secondary flow gives increase in heat transfer rate. Also the small coil diameter coil has more turbulence and centrifugal force tends to increase in heat transfer in smaller coil diameter as compare to bigger coil diameter.

## IV. CONCLUSIONS

From the experimental study, it has been observed that there is a significant effect on the heat transfer coefficient of various coil diameters. Hence the helical coil heat exchange more effective compared to straight tube heat exchanger.

- 1) The experimental results show that the condensation heat transfer coefficient increases with increases in saturation temperature of the steam. This is due to increase in vapour velocity which turns to increase turbulence and secondary flow.
- 2) The heat flux higher in smaller coil diameter and lower in bigger coil diameter. The condensation heat transfer increases with an increase in heat flux. The smaller coil diameter shows more turbulence and greater secondary flow which increase in heat transfer coefficient.
- 3) The condensation heat transfer increases with the increase in the mass flux due to increase in velocity and secondary flow.

- 4) The coil curvature ratio has a significant impact on the heat transfer coefficient.
- 5) The condensation heat transfer coefficient higher in 3 l/min cooling water flow rate and lower in 8 l/min cooling water flow rate.

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## GREEN BUILDINGS: A NEED OF FUTURE CITIES

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### **Abstract:**

*Growing population, urbanisation, consumption of energy and building construction are directly proportional to each other. Urban expansion scale in India is enormous and this has enhanced building construction sector in many folds, resulting into tremendous pressure on natural environment. Urbanisation in India is less advanced than many other countries. This shows lot of opportunities to change ourselves from energy intensive and resource intensive users to smart and efficient energy users. Such energy and resource efficient infrastructure development will lead towards green buildings. Green building promotion has already begun in India. This work presents authors understandings and learnings about India's green building initiatives, aspects of green building and the need of green buildings in connection with future cities.*

### **Keywords:**

*Green building, Energy, resource, Environment.*

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## **I. INTRODUCTION**

India is experiencing tremendous infrastructural growth due to increasing population and massive urbanisation. Availability of space, addressing ever demanding energy as well as water requirements, proper utilisation of resources like water, sanitation are few serious issues inherent in urbanisation. Promoting and developing green buildings is one of the solutions to address these issues and environmental degradation as well.

Rating systems like Leadership in Energy and Environmental Design, LEED-India provided by the Indian Green Building Council, IGBC and Green Rating for Integrated Habitat Assessment, GRIHA provided by The Energy and Research Institute, TERI are popularising green building construction. These agencies are developing standards for sustainable design practices and to award and certify the buildings as green.

Despite having very high potential of growth, the general awareness about the green buildings in India is very poor. The major obstacles may be cost. In fact, Recent technological developments in construction material as well as energy efficient equipment the cost of developing green buildings has come closer to that of traditional buildings.

Green building is defined as the complete process of design, construction, operation as well as demolition

of a building in a way which causes least negative impact on the environment as well as on its occupants throughout its lifetime. Green building is essentially a building or a township or an industrial premises which is energy efficient and environmental friendly not only during its planning and construction but also during its service and demolition. Thus green building concept becomes very important component of future cities in sustainable urbanisation.

## **II. GREEN BUILDINGS**

Besides the environmental benefits green buildings have real as well as elusive benefits too. As the structure follows sustainability principles, such buildings are more comfortable and raise the living standards of its residents/users. Energy efficiency in terms of both, use as well as production of the material used for construction of the building, is well addressed in green buildings. Green buildings are having potential to conserve about 20 to 30% energy as compared to conventional buildings, apart from efficient energy use, using recycled building material resulting in savings of 12 to 40% of the total energy used during production of the material. Carbon credits awarded is an added benefit from green buildings.

In general the benefits of a green building can be categorised as Fig. 1

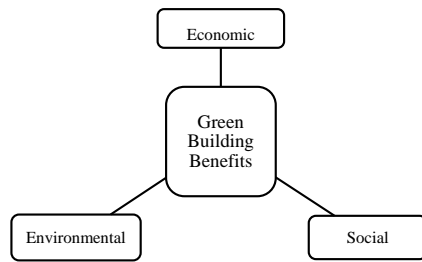


Fig. 1- Benefits from Green Buildings

- i. Environmental benefits
  - a. Conservation of natural resources
  - b. Reduced waste
  - c. Improved air and water quality
  - d. Protected ecosystem
- ii. Economic benefits
  - a. Optimised economic performance
  - b. Reduced operating cost
  - c. Higher asset value
- iii. Social benefits
  - a. Improved lifestyle
  - b. Enhanced comfort
  - c. Aesthetically pleasing structure

Initial motivation for green buildings was desire to achieve positive impact on environment. Recognising business potential and opportunities, green building concept now a days is market driven. This profit oriented approach may become dominant over the basic desire.

Fig.2 depicts general barriers identified in swift penetration of the green building concept in all corners.

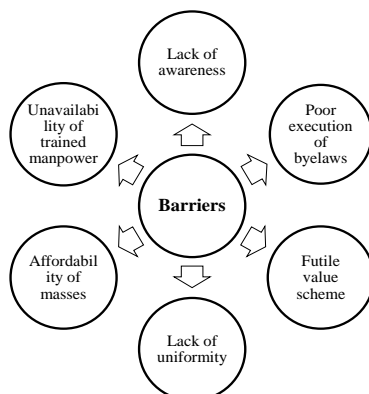


Fig. 2 –Barriers in Promoting Green Buildings

One can predict that steps taken towards increasing awareness among the people, concern about the environment and ever changing accommodative

policy framework by the government will help overcome these barriers and flourish green building concept in near future with sufficient pace.

### III. CASE STUDY

In India currently 810 green building projects are either completed or ongoing. Table 1 presents state wise details of all such reported projects.

**Error! Reference source not found.** Green Building Projects in India (1,4,7)

State	Green Building Projects	% of Green Building Projects
Maharashtra	284	35.06
Tamilnadu	92	11.35
Karnataka	67	8.27
Andhra Pradesh	59	7.28
Uttar Pradesh	46	5.67
Haryana	43	5.30
Delhi	41	5.06
Gujrat	36	4.44
West Bengal	22	2.71
Rajasthan	21	2.59

Maharashtra is the leading state in India in the contexts of green building projects. Majority of the projects in Maharashtra are located in Greater Mumbai region. The main driving force reported for this comparatively large number is the state government initiatives towards green buildings. Similarly Chennai in the state of Tamilnadu has significant number of green buildings projects. The reasons are high returns on investments and low operating cost. Though union territory Delhi has the second largest population in India and having significant number of government projects, must satisfy the green building standards, is surprisingly at number seven. No information about remaining states of India about green building projects. Many of these areas/states are either away from urbanising regions or located near the boundaries of the country.

Following are few case studies of green buildings in India

#### a. Suzlon One Earth, Pune

This is a three floor building located on 10.1 acres and capacity to host 2300 people received platinum certificate from Indian Green Building Council and

5 star certification by Green Rating for Integrated Habitat Assessment.

During the development of this project special focus was given on ensuring good health of its inhabitants as well as the environment; efficient usage of resources like water and energy, proper waste disposal methods, ensuring good indoor air quality, eco-friendly material and resource selection and innovation. This approach has resulted in a lower cost for the construction of this building as compared to other facilities of a comparable size.

Specific features of Suzlon 'One Earth'

- i. Low-energy materials: the materials used during construction are energy intensive having a high recycled material content and are renewable. More than 70% material has a reduced carbon footprint.
- ii. Renewable energy: About 25% of the lighting load is reduced due to the usage of LED lighting site streets and exteriors which are powered entirely by renewable energy systems. To save artificial lighting, 90% of regularly occupied spaces have daylight exposure.
- iii. Daylight and occupancy sensors: Workstations have daylight sensors to reduce the unnecessary use of artificial lighting. Occupancy sensors help identifying unoccupied workstations to control artificial lighting. About 20% energy costs is saved due to these efforts.
- iv. Efficient ventilation system: There are jet fans in the basement that push out contaminated air intermittently and bring in fresh air. This saves 50% more energy as compared to ducted ventilation systems.
- v. It has system for storm and rainwater management.

b. CRISIL House, Hiranandani Business Park  
Mumbai

This project is a mixture of residential, commercial and office areas. This 211,000 square feet project having occupancy of 1600 people has successfully reduced its energy use by 40% and water use by 30%. About 70% of the office space utilises natural light. Interior gardens provides an improved work environment and roof top gardens help reduce the building temperature

Key features:

- i. Open lobbies of about 60% of the building footprint lights 70% of the office space naturally
- ii. Solar panels are fulfilling 50% of the hot water requirements.
- iii. Rooftop garden and heat reflective paint cool down the building

- iv. About 30% water is conserved using water efficient fixtures and rain water harvesting
- v. Sewage treatment plant treats and reuses grey water for flushing and landscaping

c. Indira Paryavaran Bhavan, New Delhi

Indira Paryavaran Bhavan is the new office building for Ministry of Environment and Forest in New Delhi. It is spread over 9565 sq m of area. Owing to its GRIHA 5 Star and LEED Platinum rating, it is the highest rated Green Building in India. It has a 6000m<sup>2</sup> solar PV system, 50% more efficient HVAC load than ECBC requirements, adequate utilisation of daylight to reduce artificial lighting loads and also exhibits use of eco-friendly building materials.

Key Features

- i. It has more than 50% area outside covered in plantation. Soft paved pathways better enable the seepage of water thus recharging the ground water.
- ii. 75% of building floor space is daylit apart from which there is energy efficient lighting, 50% more efficient than the ECBC standards. Rest of the lighting load is met by building integrated photovoltaic. Sensors are used to optimise artificial lighting use.
- iii. 160 TR oh heat rejection is obtained without using a cooling tower due to their special geothermal heat exchange system.
- iv. Usage of cool roofs made up of high reflectance terrace tiles to provide high strength, heat ingress and hard wearing.

d. CII – Sohrabji Godrej Green Business  
Centre, Hyderabad

This building is world's best exhibition of passive architectural design. At the time of its inauguration, it was the first building outside the US to be awarded LEED platinum certification. The building recycles almost everything within and doesn't let out any waste. Building is made up of only recycled material.

Key features:

- i. Site area 5 acres whereas built up area is 20,000 sq ft, i.e. just 9.2% of site area
- ii. Large area for landscape also the roof is 60% covered by roof garden
- iii. Zero water discharge, 100% waste water recycling
- iv. 100% day lighting, eco-friendly air conditioning plants help reduce total energy consumption by 55%
- v. Solar PV panel are utilised to generate 20% of power requirement of the building
- vi. About 60% material used for construction, servicing, maintenance, furniture and fixtures is recycled material



#### IV. CONCLUSIONS

A city is defined by the buildings that it houses. It is important for our future cities to be defined and represented by energy efficient green buildings to ensure an overall pleasant life for their inhabitants. While construction of new buildings abiding by the green standards is the goal, it is equally important to gradually transition the existing buildings into eco-friendly green structures to the maximum extent possible.

With ever increasing urbanisation more and more people join the cities, subsequently increasing the demand for construction of new buildings and straining the city resources. To tackle this, it is important to have a sustainable outlook on development which is the very essence of green buildings. Keeping ambient temperature in control can be achieved by incorporating green technologies and objectives in the process of building construction as well as its operation over its lifetime thus preventing formation of urban heat islands.

Having said all this, it is equally important to educate the inhabitants of these buildings about green practices, efficient energy usage and extracting optimal usage from the installed infrastructure.

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Photograph of Author A



Biographical Statement for Author A

Tanavi S. Joshi is Second Year Under Graduate student of Mechanical Engineering at SIES Graduate School of technology, Nerul, Navi Mumbai.

Photograph of Author B



Biographical Statement for Author B

Dr Sandeep M Joshi has over 23 years of teaching experience. His field of research includes Utilisation of Solar Energy, Heat Transfer, Heat Exchanger Design, Waste Heat Recovery, Energy Conservation and Renewable Energy Recourses. He has about 25 publications in national as well as international conferences and journals of repute and one Indian patent are at his credit.

## EXPERIMENTAL ANALYSIS OF SOLAR ASSISTED LIQUID DESICCANT COOLING SYSTEM

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### **Abstract:**

*Dehumidifier is that the most vital unit in liquid drier air conditioning system, this paper experimental analysis of solar assisted liquid desiccant cooling system (SALDCS) by Li Cl-H<sub>2</sub>O as a desiccant. A capable solar energy and cooling technique is through the employment of a liquid drying agent system, wherever humidness is absorbed directly from the method air by direct contact with the drying agent, the desiccant is then regenerated by solar hot water or air. The solar assisted desiccant dehumidifier system is operated variable operating conditions, air flow rate (0.05 to 0.11 kg/sec), desiccant concentration (30% to 40%) and desiccant temperature (maximum 40°C). Effectiveness of dehumidifier verified by experimentally, it results effectiveness decreased by the air flow rate & desiccant temperature, increased by desiccant concentration, the same process done with inter cooler (Indirect evaporative cooler) better dry-air cooling rate observed.*

**Keywords:** Liquid desiccant, indirect cooling system, solar energy.

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### **I. INTRODUCTION**

The dehumidifier is one in every of the essential elements of the air conditioning system, in this process the air is dehumidified by a desiccant agent. Its performance greatly influences the performance of the total system. In Practical application different types of dehumidifier are exist, the packed bed dehumidifier is greatly effect for comparison with other types [1]. The heat and mass transfer method within the packed dehumidifier is littered with several parameters, like the relative flow direction of the air to the drier, type of material of the packing, and also the body of water parameters of the air and drier.

The dehumidification method is therefore complicated that pure theoretical study typically fails to allow satisfactory results [2]. The interface temperature and concentration were assumed to be the majority liquid temperature and desiccant concentration. Overall, heat and mass transfer coefficients were used. The model was valid with the experimental results, for CaCl<sub>2</sub>, LiCl and price effective liquid drier solutions, the individual phase heat and mass transfer coefficients were calculated and correlated for various packing materials [3,4]. Analytical expressions of the air and drying agent parameters within the counter flow dehumidifier among the model, the analytical

resolution of the air total heat and liquid drying agent equivalent total heat, that expressed the ability of the combined heat and mass transfer method, is initial calculated, then, the solution of the air humidness quantitative relations and drying agent equivalent humidness quantitative equivalent humidness quantitative relation, that expresses the capacity of sopping transfer, are given, finally the air and liquid drying agent temperature may be calculated according to the on top of total heat and humidness quantitative relation calculated result, a way for locating the analytical resolution, the coupled heat and mass to conventional vapour compression system transfer performance for the dehumidifier and regenerator was reportable [6,7], wherever the air and drying agent aren't mixed breadth wise (which means that the transfer processes of the air and drying agent cube measure each 2 Dimensionally).

The total heat field gained from the analytical solutions compares well with numerical solutions, and therefore the analytical total heat potency compares well with experimental results of the cross-flow dehumidifier.

Liquid desiccant air-conditioning system driven by solar power or different heat sources was emerged as a potential different or as a supplement

for air-conditioning system. Dehumidification and regeneration measure the key processes of liquid desiccant air conditioning system. Many literatures were dedicated to the investigation of performance of liquid desiccant dehumidifiers and regenerators [8,9].

In this work, solar assisted(heat source) Indirect evaporative cooler dehumidifier with LiCl as Liquid desiccant has been administrated, method air is sanely cooled mistreatment .The process parameters affecting the effectiveness of dehumidifier, namely, air flow rate , chemical agent concentration and temperature humidity, have been considered in this work.

## II. EXPERIMENTATION SET UP

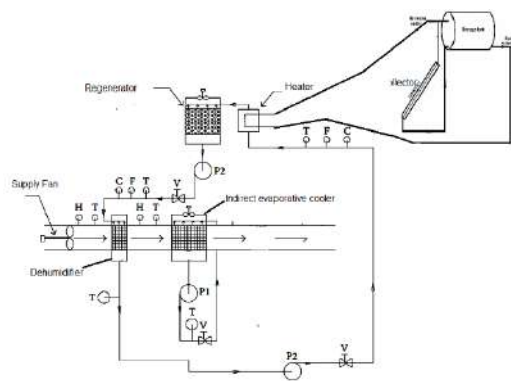


Fig 1. Solar assisted Liquid Desiccant dehumidifie

(T) Temperature (F) Flow meter  
(C) Concentration meter (H) Humidity  
sensor  
(A) Anemometer (V) Flow control  
valve (P1) Water pump (P2) Desiccant pum

The fig.1 shown three components dehumidifier, indirect evaporator and regenerator .The generator operated by solar water heating system .The dehumidifier arranged (30cm x 30 cm x 15 cm) is made with number of fibre glass sheets. By avoiding corrosion effect of chlorine to prepare indirect evaporator by Poly vinyl chloride sheet providing the wall of the indirect evaporator (30cm x 30 cm x 10 cm). A liquid desiccant jet is sprayed over a packed structure. Where the processes air is meets at that location like cross flow. Here strong solution is converted to weak solution converted to mixture of water and desiccant solution end of the stage at bottom the weak solution is collected. Regenerator prepared by 2 inch diameter PVC balls, the outer casing 550 mm and 750 mm height. The weak solution from the dehumidifiers sprayed

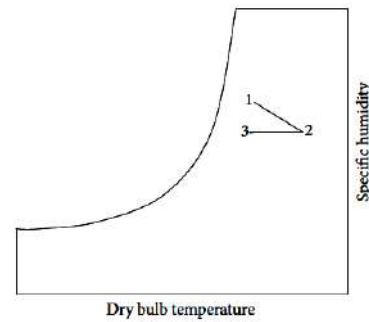


Fig 2. Specific humidity vs Dry bulb Temperature (Psychrometric process.1-3)

at the top the regenerator through heater here heater temperature source is solar energy the effect of regenerator depends on the temperature of the solar energy and surface contact. The outside air contact like cross flow and collect moisture through and final result strong solution at bottom most point.

The process represents line 1 to 2 is constant enthalpy dehumidification taken place by applying the chemical dehumidification effect. The process 2 to 3 is represents the constant temperature cooling added to the fluid .Then dehumidified air is distributed through indirect cooling system where ever temperature is reduced from state a pair of to state three at constant specific humidness shown in fig 2.

### A. Indirect Evaporative cooling system

The indirect evaporative cooling system is acts as a major role for cooling effect; the dehumidified air is passes trough indirect evaporative cooling system, it results cool dry air at the output. In this process the air is doesn't direct contact with air, the cooling source is depends on the need, generally it is collecting from the waste heat recovery systems like binary fluid cycles.

### B. Solar hot water heater

Solar energy is free energy available in nature and eco friendly to the environment, dehumidifier required drying agent for desiccant; the solar heat source is effectively used.

$$\text{The system energy} = m c_p (T_f - T_i)$$

$m$  = mass of the fluid kg

$c_p$  = specific heat of the fluid kg/kg K

$T_f$  = final temperature K

$T_i$  = initial Temperature K

### Numerical Calculation for The effectiveness of dehumidifier

$$\text{The effectiveness of dehumidifier } \eta = \frac{\phi_i - \phi_o}{\phi_i - \phi_e}$$

$\phi_i$  = Specific humidity at inlet

$\phi_o$  = Specific humidity at outlet

$\phi_e$  = specific humidity of air at contact between liquid desiccant and air

$$\phi_e = \frac{0.622 P_{vs}}{P_a - P_{vs}}$$

$P_{vs}$  Vapour pressure is vital properties which confirm the air wetness in equilibrium with liquid chemical agent (Desiccant) at surface [10].

### III. RESULTS AND DISCUSSION

The liquid desiccant dehumidifier is run by various operating parameters flow rate of air 0.05 to 0.11 kg/sec by 0.02 differences, desiccant concentration minimum 30% to maximum 45% kg/kg by water and desiccant treated at maximum temperature range 40 degree centigrade.

#### A. Air Flow rate

The effectiveness of the system operating variable inlet air flow by variance, the effectiveness of the system is verified experimentally with and without intercooler, The performance is better with inert cooler than checked with without inter cooler, the flow rate of air increased(0.05 to 0.11 kg/sec) in the flow field the effectiveness of the system acts inverse action(decrease).The experiment results clearly checked by fig 3,It is decreased by increasing the flow rate of air,because of moisture condensation rate will increase with the increasing air specific humidness to increase of partial pressure level of air and distinction in pressure level between air and desiccant solution.

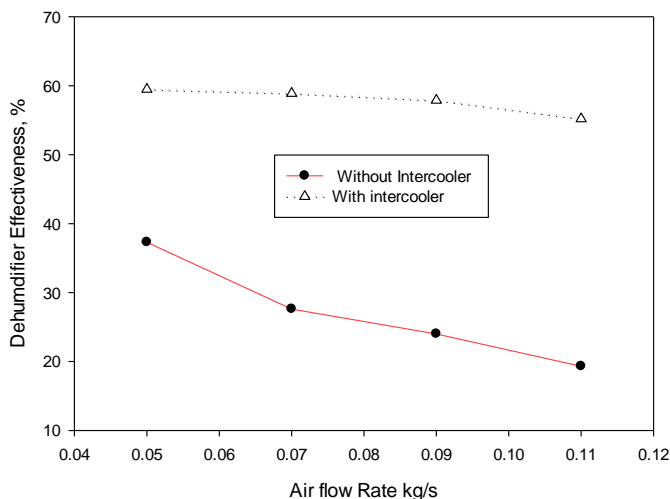


Fig 3. Effect of air flow rate on dehumidifier Effectiveness

#### B. Desiccant concentration

The effectiveness of dehumidifier along with intercooler checked with variable concentration of desiccant solution(30% to 45 % fig 4. The variation of effectiveness increased due to increase in the concentration, the high concentrated solution absorb the more amount of moisture content in the air when at the desiccant and fluid contact in cross flow. Same experiment done by indirect evaporative

cooler (IDEC), observed and comfort cooling rate increased.

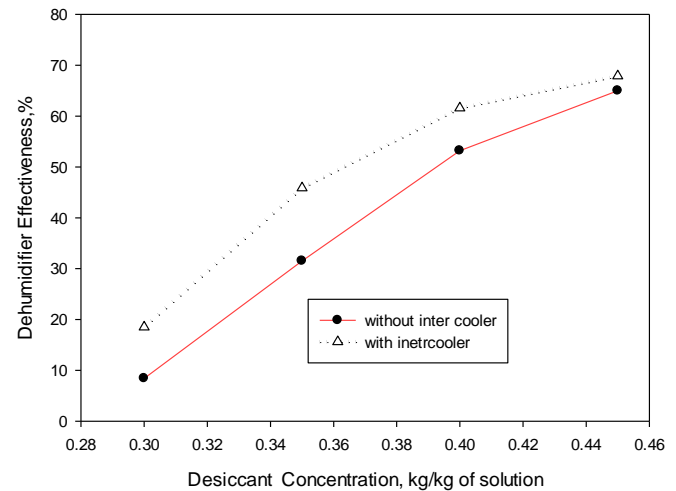


Fig 4. Desiccant concentration on dehumidifier Effectiveness

#### C. Desiccant Temperature

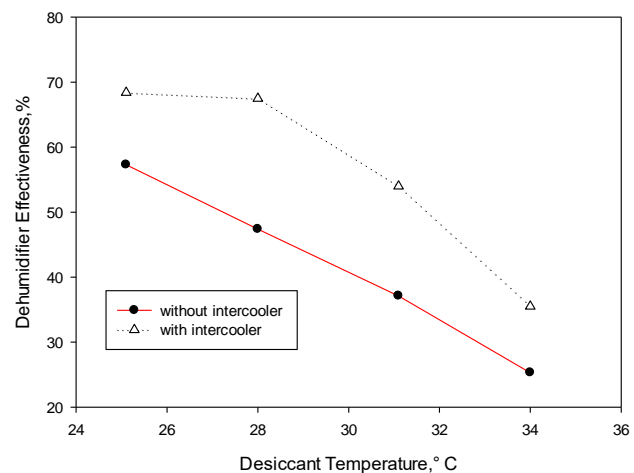


Fig 5. Effect of desiccant temperatures on dehumidifier Effectiveness

The setup operated with variable desiccant temperature (maximum 40° C) using solar heat energy as a source for variable desiccant temperature, the concentration of the desiccant solution change with temperature. From fig 5, the result inversely proportional to effectiveness because the absorption capacity of the humidity content in the air decreased, the same result checked with indirect evaporative cooler the comfort cooling capacity also decreases.

### IV. CONCLUSION

The experimental analysis of solar assisted liquid desiccant cooling system(SALDCS) having indirect evaporator cooler was investigated

experimentally operated variable parameters, air flow rate, desiccant concentration and desiccant temperature.

The following result

- The effectiveness of SALDCS decreased by air flow rate due to less moisture condenses.
- The SALDCS effectiveness proportionally acts with desiccant concentration with indirect cooler the cooling rate increase, because of more moisture condense at the contact surface of desiccant solution and air.
- The desiccant temperature effected on cooling rate because the desiccant concentration effect on moisture absorption capacity ,the effectiveness of the system decrease due to increase in desiccant temperature.

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## EXPERIMENTAL STUDIES ON PERFORMANCE PARAMETERS OF FINNED TUBE HEAT EXCHANGER FOR WASTE HEAT RECOVERY.

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### **Abstract:**

*The demand for energy is rising significantly due to growth of nations. The use of diesel engines for the purpose of transportation is increasing because of their high efficiency and robustness. Around 30% of the input energy is carried by the engine exhaust gas, which in turn reduces thermal efficiency and increases environmental pollution. With an objective of waste heat recovery and reduction in pollution due to engine exhaust, this work focuses on the theoretical and experimental analysis of performance parameters of continuous plate fin-tube heat exchanger for waste heat recovery at simulated engine conditions. From the experimental data it was observed that fin tube heat exchanger is one of the best heat exchangers for recovery of waste heat at lower fluid flow rates and higher inlet temperatures. The heat recovered is calculated to be 110W, 60W and 52W at hot gas flow rates of 150, 170 and 190LPM respectively.*

**Keywords:** Finned-tube, heat-exchanger, waste heat, exhaust, efficiency.

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## I. INTRODUCTION

The basic requirement for the development of a nation and human life is energy. The main commercial energy sources are fossil fuels like coal, oil, natural gas, hydroelectric power plants and nuclear power plants which provide the daily energy needs of a country as well as human life. Now a days, use of fossil fuels is increasing but their sources are limited. Due to these limitations which are associated with the conventional energy sources, the main focus is now shifting to conservation of energy and efficient utilization of energy. In any system due to its inability to convert /transfer complete energy, some amount of the energy is lost in the form of heat. This leads to a reduction in the overall efficiency of the system. For efficient utilization of energy waste heat can be recovered and that recovered energy can be utilized for other suitable thermal application.

In any thermal application, a heat exchanger is one of the main components for transferring heat between two working fluids. Different types of heat exchangers are mostly used as heat recovery equipments in the process industries based on the process requirements, space constraints, cost, availability etc. For example; a condenser is one

type of heat exchanger which is used to condense the process fluid. In process industries or in automobile engine, some of the thermal energy is lost in the form of heat to the surroundings. In process industries the heat is lost in process off gas, from automobile engines it lost from the exhaust gas. Heat exchangers in automobiles engines are used to cool the engine jacket coolant, used to cool the engine. To increase the overall efficiency waste heat recovery technique can be used. There are various sources available in the process industries; this waste heat can be utilized for other thermal applications like feed water heater, pre-air heater and some cooling applications.

Various studies on performance of fin tube heat exchanger are carried out by various researchers as mentioned in [3], [4] and [5]. Fin tube heat exchangers are used for various types of applications like condenser in a refrigeration system, radiator in a car, heat exchangers in waste heat recovery. Now a days, the use of transport vehicles is growing. In vehicles about 30% of the input energy is lost to the exhaust gases [1]. Due to this heat loss the efficiency of the system gets reduced since heat energy in the exhaust is directly sent to the atmosphere unused. Electrical turbo-compounding (ETC), mechanical turbo-compounding (MTC),

thermo-electric generator (TEG) and the Rankine cycle (RC) or organic Rankine cycle (ORC) are some of the relevant waste heat recovery systems used. Out of the above, the best solution for heavy duty Diesel engine (HDDE) vehicle applications is the Rankine cycle Waste Heat Recovery Systems (RC-WHRS). A heat exchanger is one of the components in an organic Rankine cycle. The recovered heat from the heat exchanger can be utilized for thermal application [2]. There are various types of heat exchangers available, but compact heat exchangers are preferred for waste heat recovery since they have higher heat transfer rate for the same volume as well as very low pressure drop [1]

With increasing importance on energy saving, extensive efforts are being made to enhance the heat transfer performance of a heat exchanger. This can be done by focusing on and improving the liquid side or the gas side heat transfer [3]. There are various types of heat exchangers such as shell and tube, double pipe, compact type such as gasketed plate, finned tube etc. The performance of a finned tube heat exchanger is limited by the gas side since the gas side heat transfer coefficients are very low as compared to the liquid side. So, this has led to the development of many active and passive methods which can be used to enhance the heat transfer performance on the gas side [4]. This would also help the designer to make the heat exchanger more compact by reducing the total heat exchanger volume and would lead to reduction in the associated costs. Finned tube heat exchangers find applications in refrigeration and air conditioning, electrical and chemical industries, cryogenics and other cooling processes [5].

It is observed that the use of compact finned tube heat exchanger for the purpose of waste heat recovery from engine exhaust gases is very rare. The focus of the present study is to determine the performance parameters and effectiveness of finned tube heat exchanger for such an application.

The specifications for the given finned tube heat exchanger setup are as given below-

#### Nomenclature

$L_1$  = Tube Length = 210 mm  
 $L_2$  = Length of fin = 160 mm  
 $L_3$  = Height of Fin = 110 mm  
 $N_f$  = No. of fins = 7  
 $N_t$  = No. of Tubes = 10  
 $N_s$  = Number of Spaces = 8  
 $S$  = Spacing Between fins = 30mm  
 $L_t$  = Total Length = 260 mm  
 $d_o$  = Tube Outer Diameter = 10 mm  
 $d_i$  = Tube Inner Diameter = 8 mm  
 $X_t$  = transverse tube pitch = 30 mm  
 $t$  = Fin Thickness = 1 mm  
 Fin and Tube Material: Copper

$k_{cu}$  = Thermal conductivity = 385 W/m-K  
 $T_{hi}$  = hot air inlet temperature  
 $T_{ho}$  = hot air outlet temperature  
 $T_{ci}$  = Coolant water inlet temperature  
 $T_{co}$  = Coolant water outlet temperature  
 $Q$  = heat transfer rate (W)  
 $m$  = mass flow rate (kg/s)  
 $V$  = volume flow rate (m<sup>3</sup>/s)  
 $v$  = velocity (m/s)  
 $P$  = pressure (N/m<sup>2</sup>)  
 $c_p$  = specific heat (J/kg-K)  
 $Pr$  = Prandtl number  
 $Re$  = Reynold's number  
 $R$  = capacity ratio =  $C_h/C_c$   
 $C$  = heat capacity =  $m \cdot c_p$  (W/K)  
 $NTU$  = number of transfer units  
 $\Delta$  = difference  
 $j$  = Colburn factor  
 $f$  = friction factor  
 $G$  = mass flux (kg/m<sup>2</sup>-s)  
 $h$  = heat transfer coefficient (W/m<sup>2</sup>K)  
 $U$  = overall heat transfer coefficient (W/m<sup>2</sup>K)  
 $A_{min}$  = minimum free flow area (m<sup>2</sup>)  
 $D_h$  = hydraulic diameter (m)  
**Greek symbols**  
 $\epsilon$  = effectiveness  
 $\rho$  = density (kg/m<sup>3</sup>)  
 $\mu$  = dynamic viscosity (kg/m<sup>2</sup>-s)  
 $\eta_o$  = overall surface efficiency  
 $\eta_f$  = fin efficiency

## II. METHODOLOGY

### A. Objectives

Considering the need for waste heat recovery from engine exhaust gases the following objectives have been defined in order to capture maximum possible heat energy.

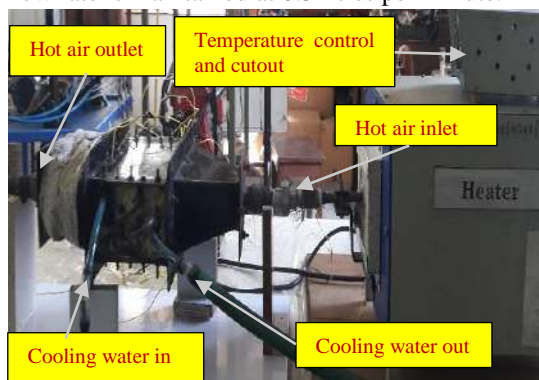
- Literature study on various heat exchangers for recovery of engine exhaust heat.
- Experimental studies on compact finned tube heat exchanger to recover heat at simulated engine exhaust conditions.
- Analysis of performance parameters of compact finned tube heat exchanger at various hot air flow rates

The theoretical calculations are first carried out for the required air and water flow rates at simulated engine conditions. The experiments are carried out using an air heater setup in order to simulate the engine exhaust conditions. The analysis of the performance parameters is done based on the air and water temperatures measured experimentally.

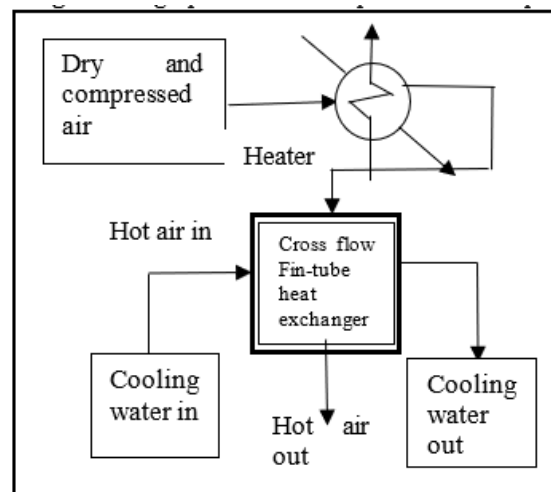
### III. EXPERIMENTATION

In order to conduct the experiments at a simulated engine conditions a reciprocating compressor is used to generate the air at controlled pressure and then required air is heated in an air heater after drying in an air dryer. The flow rate of air is maintained at 150, 170, 190lpm respectively to simulate laminar conditions in the tube at air inlet temperature of 160, 260 and 360°C respectively, similar to an engine at various loading conditions. The readings are taken for air flow rates of 150, 170, 190lpm respectively. Compressed air after drying is heated to temperatures of 160, 260 and 360°C respectively. This hot air then flows between the rectangular plate fins. The water at room temperature is made to flow through the tubes as a cold fluid to recover the heat from the hot air.

There are 21 thermocouples attached to the setup-twelve for measurement of fin temperatures, five for measuring water temperature inside the tubes, two for air and water inlet temperatures and the remaining two for air and water outlet temperatures respectively. At each of the mentioned air temperatures and the mass flow rate the water inlet flow rate is maintained at 0.5 litres per minute.



**Fig 1** Photograph of Actual Experimental Setup



**Fig. 2** Line Diagram of Bench Scale Experimental Setup

### IV. RESULTS AND DISCUSSION

The calculations for the geometrical parameters for the finned tube heat exchanger such as minimum area, hydraulic diameter, frontal area are calculated using relations mentioned in [6]. The calculations for thermal and hydraulic parameters are carried out using the procedure described in [7]. The relations used for different parameters are mentioned below. The mass flux of the gas is calculated by using the below equation;

$$G = \frac{m}{A_{min}} \dots (1)$$

$$\text{where } A_{min} = [(X_t - d_o) \times L_1 - (X_t - d_o) \times t \times N_f \times L_1] \times L_3 / X_t \dots (2)$$

The Colburn j factor is given by the equation

$$j = \frac{h}{G \times c_p} \times Pr^{(2/3)} \dots (3)$$

The value of j factor is obtained from the graphs and is used to find the air side heat transfer coefficient.

As the water side flow condition is laminar the Sieder and Tate correlation is used to find the heat transfer coefficient. The Nusselt number is given as

$$Nu = 1.86 (Re \times Pr \times \frac{dh}{L})^{(1/3)} \times \left( \frac{\mu_b}{\mu_w} \right)^{0.14} \dots (4)$$

$$hi = \frac{Nu \times k}{d} \dots (5)$$

The overall heat transfer coefficient is calculated from the equation below by considering the air and water side resistance along with the wall conduction resistance. Both the plate fins and tubes are made of copper for achieving higher rate of conductive heat transfer.

$$\frac{1}{U} = \frac{At}{Ai} \frac{1}{hi} + (At \times R_w) + \frac{1}{\eta_o \times ho} \dots (6)$$

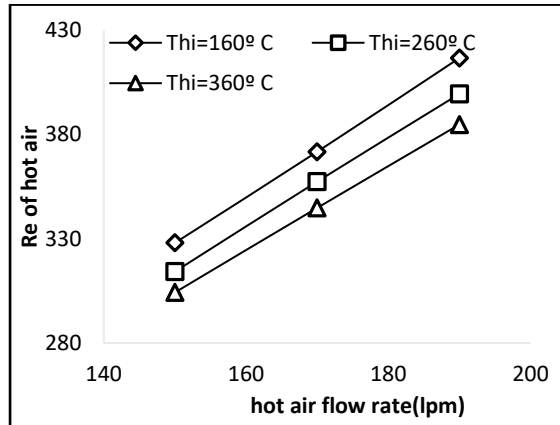
The value of pressure drop was found to be very small (of the order of  $10^{-4} \text{ N/m}^2$ ) and hence is neglected. It is found by using the below formula:

$$\Delta P = \frac{G^2}{2 \times \rho i} \left[ f \times \frac{At}{A_{min}} \frac{\rho i}{\rho} + (1 + \sigma^2) \left( \frac{\rho i}{\rho_o} - 1 \right) \right] \quad (7)$$

The value of 'f' is obtained from the graphs available in [7].

Based on the results obtained as per the experimental matrix following plots are drawn and are as discussed below.

**(a). Influence of hot air flow rate on Re number at various air inlet temperatures**

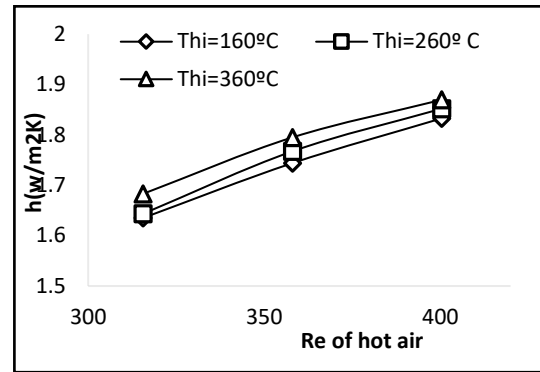


**Fig. 3** Influence of hot air flow rate on Reynold's number at various air inlet temperatures

Figure 3 shows the relation between air flow rate and Re at various gas inlet temperatures. Flow rates are decided to maintain laminar flow in the tube. Compressed air is first passed through a dryer and then heated and sent to the finned tube heat exchanger. The air side Reynolds number increases linearly with flow rate due to increase in air velocity. From the figure it is clear that with an increase in air flow rate there is increase in Re.

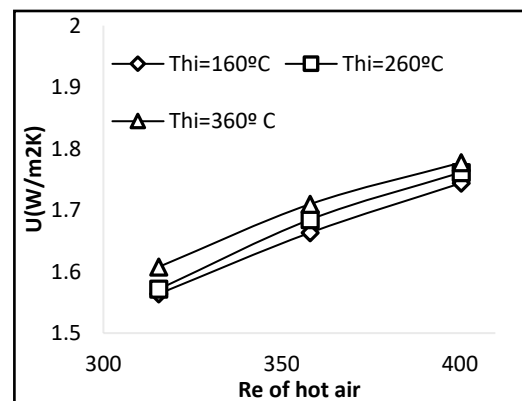
**(b). Influence of hot air flow rate (Re) on Heat Exchanger Performance Parameters.**

It is necessary to analyse the heat exchanger performance parameters to ensure its application for recovery of engine exhaust heat. In this study using experimental data, performance parameters such as heat transfer coefficients and effectiveness of the heat exchanger are analysed which are discussed in below paragraphs.



**Fig. 4** Influence of gas Re on heat transfer coefficient at various hot gas inlet temperatures.

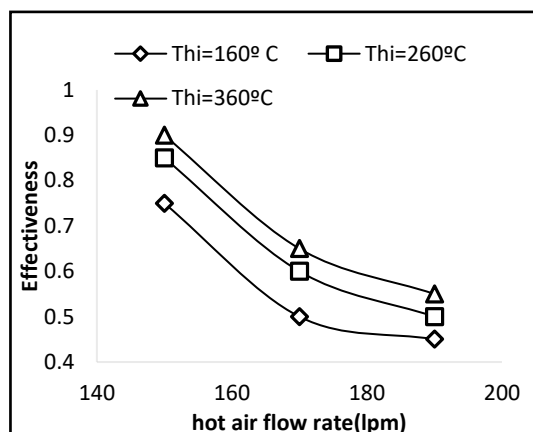
Figure 4 shows the effect of gas flow rate on heat transfer coefficient. At a particular Re the heat transfer coefficient increases with increase in inlet air temperatures due to increase in volume of gas which in turn increases the velocity of the fluid flow. From the graph it was also observed that increase in mass flow rate results in increase in heat transfer coefficient which is also due to increase in dynamic property of the fluid and turbulence in the pipe flow.



**Fig. 5** Influence of air side Reynold's number on overall heat transfer coefficient.

Figure 5 shows the effect of gas flow rate on overall heat transfer coefficient. At a particular Re the heat transfer coefficient increases with increase in inlet air temperatures due to increase in volume of gas which in turn increases the velocity of the fluid flow. From the graph it was also observed that increase in mass flow rate there is increase in heat transfer coefficient which is also due to increase in dynamic property of the fluid and turbulence in the pipe flow. It was observed that the value of overall heat transfer coefficient is too much lower due to low value of outer heat transfer coefficient of the gas as

compared to heat transfer coefficient of the liquid water flowing through the pipe.



**Fig. 6** Influence of hot air flow rate on heat exchanger effectiveness at various air inlet temperatures

Figure 6 shows the relationship between the effectiveness of the heat exchanger and gas flow rate. From the figure it is observed that at a particular flow rate and various inlet gas temperature there is increase in effectiveness due to more temperature difference between hot and cold fluid and increase in heat transfer rate due to increase in specific volume of gas at higher temperature.

It was also observed from the figure that with an increase in gas flow rate there is a decrease in effectiveness due to lesser time available for the fluids to exchange the heat and hence we obtain lesser outlet temperature of cold fluid and higher outlet temperature of the hot fluid.

## V. CONCLUSIONS

Experiments are conducted at various gas flow rate and inlet gas temperature at a 0.5 lpm cold fluid flow rate to analyze the performance parameters of the fin tube heat exchanger. Results of the study are summarized as below;

1. In this study the heat transfer coefficient on the air side of a finned tube heat exchanger is found to vary from 1.6 to 1.9 W/m<sup>2</sup>K due to laminar flow on the fluid side.
2. The heat transfer coefficient inside the tubes was observed to be in the order of 1030 W/m<sup>2</sup>K, which in turn increased the effectiveness of the heat exchanger.
3. The pumping power required for the tube side fluid is less due to minimal pressure drop.
4. This type of compact heat exchanger is found to be more effective for low flow rate and higher temperatures of exhaust gas from any source.

Thus, a finned tube heat exchanger can be used to effectively extract waste heat from processes or from engine exhaust gases due to its compactness and good heat transfer characteristics.

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# SUSTAINABLE WATER HARVESTING TECHNIQUE BY CONDENSATION OF WATER THROUGH ATMOSPHERE IN AN OPTIMIZED APPROACH FOR FUTURE CITIES IN INDIA

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## Abstract:

Water is one of the vital needs of humans. Many rural areas lack the water infrastructure to fulfil their basic needs. About 8-10% of the people lack safe drinking water which causes health issues and deaths. Water harvesting structures (WHS) is a vertical conical structure designed to harvest potable water from the atmosphere. In this research work, WHS is constructed by using material such as bamboo, polyester mesh which absorbs the water molecules from humid mist present in atmosphere. This absorbed water passes through the mesh and forms water droplets through condensation and is collected under the action of gravity. Considering the effect of large formation of fog, seasonal rain and dew during majority of the seasons in a year, WHS was constructed keeping Rasayani (Maharashtra) as the study area. Due to the geographical assistance provided by this study area, it was possible to extract water from air at high altitude hence proved to be a sustainable method for the collection of water from atmosphere. Water harvested in this WHS was pure and can be utilized for various domestic purpose like drinking, cooking, etc. This research signifies that by constructing WHS by locally available material, a sustainable low initial cost structure was constructed with less maintenance and zero energy requirement.

## Keywords:

Condensation, Sustainable material, Water scarcity

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## I. INTRODUCTION

Water is a transparent, tasteless, odourless, and almost colourless chemical substance, which is easily found in streams, oceans, lakes, rivers, canals, pond, or puddle and in various forms like ice, liquid, vapour. Water is covering 71% of the Earth's surface, mostly through the sea and ocean. Remaining water is only 3% which is divided in groundwater 3%, ice 68%, surface water 0.3% and other water 0.8%. Surface water is further divided into lakes 87%, rivers 2%, swamps 11%. Rainfall is a major component which is responsible for making the fresh water on the Earth. Water gets transferred in all water reservoirs by the physical processes like evaporation, condensation, precipitation, infiltration, surface and subsurface runoff altogether which is called as the water cycle.

The population is growing inversely proportional to the amount of water currently present on the Earth.

Water scarcity is when sufficient quantity of water is not available for community people to fulfill their basic needs like drinking, cooking, etc. around 68% of country is subjected to inaccessible clean water and drought condition problem.

## A. Problem statement

India is affected by water scarcity problem from last several years and affects around 600 million peoples all around India. And it is fact that around 2lacs people dies every year due to unavailability of clean drinking water. India is also susceptible drought prone country around the world as from last five decades, a drought has been take place at least once in every three years.

In the isolated rural areas, people had to walk far away to collect potable water, which was often contaminated with animal and human waste. Women in those areas usually carry a large container of water whose size and weight is almost unmanageable. Some of the natives are even

unaware that the bacteria present in the water is very harmful that can make them sick, causing water borne illnesses and can spread among communities. In some cases, it can also cause death, especially in young children as they are viable to various diseases.

To overcome such Water scarcity problem, many policies are adopted by government (such as provision of funds for ground water extraction through bore well and tube well, provision of funds for drip and sprinkler irrigation). But provision of such free utilities, have not had the expected result. And only wells results in uncontrolled exploitation and wastage of resource.

## B. Literature Review

The related papers were referred to study water harvesting techniques on different projects and summary of papers has been written as follows:-

**Duygunur Koç Aslan et al. (2018)** [1] This research paper is about collecting, storing and reusing rainwater in buildings which are designed with biomimetic approaches in terms of rainwater harvesting methods to contribute to the solution of water related problems. Also, they have mentioned about different techniques to water obtain water from the secondary sources like rain, fog, dew, etc. There are different techniques and principles to make the water in this research paper.

**Fahad Sultan Al suwaidi et al. (2017)** [2] The aim of paper is to increase the accessibility of clean water by making use of fog and clouds at a reasonable cost. This research is based on the material and energy balance calculations necessary to design a fog harvesting collector. They have concluded that there is a need to select the right place and materials to design of a suitable and reliable fog harvesting system.

**Fog Harvester (2018)** [3] Fog can be an alternative source for production of water with the help of sustainable collection systems. This technique can only be used in high altitude between 400 to 1200 m. and areas where the chances of foggy weather will be more and we can get more amount of water with less hard work. A net of desired shape and size is attached with a setup and left at an area where it can collect the water molecules from the fog and can make water droplets from it. Later, that water droplets get collected in the container attached below.

**Gudrun Eriksen Havsteen-Mikkelsen (2016)** [4] This thesis is about mutual symbiosis between people and water, which are important for both to survive longer if they bonded with each other. It also says about different water resources, our water cycle and the droughts. Also they have mentioned about the research regarding different structures which can obtain water from different sources.

**Ho-Gul Park et al. (2016)** [5] This research paper says about a workshop conducted make different designs of Warka Tower project which was invented by Arturo Vittori to make people understand about the geometry of the Warka Water tower and understand its water harvesting technique, which is based on collecting water from the air.

**R. A. K. Eswari (2018)** [6] This research paper is about all the problems that people are facing around the world like water scarcity and water crisis. Also they have mentioned the causes of the impact on the health and water. It is saying about the research done on an economical, easy to make structure which can become a secondary choice of water resource where potable water from the rivers, wells and tube wells are not available.

**Rainmaker by Piet Oosterling (2018)** [7] They have invented a technology which consists of an Air to Water unit which uses a turbine that suck surrounding air and let him pass through heat exchanger, where the air is cooled and condensation takes place. A hybrid solution which uses solar power / wind power / electricity can be deployed to the same effect by driving a ventilation system. When the temperature falls down about its dew point, water molecules will form water droplets. They have made three different types of units which can make 5,000, 10,000 or 20,000 litres of drinking water per day.

## II. METHODOLOGY

The aim and objective of this research is to make economical and efficient water source (WHS) for rural or urban area.

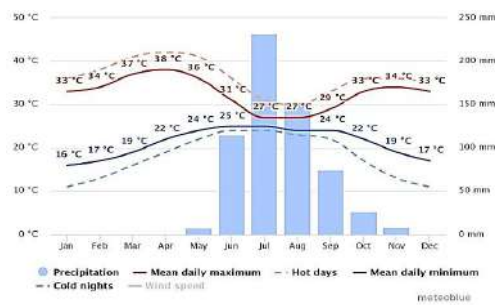
### A. Objectives

- To increase clean water availability for domestic purpose.
- To improve the life of the villagers by creating opportunities for growth and development, as more water available for gardening and other purpose.
- Using atmosphere as a viable source of potable water.
- Eliminate the use of any energy source for producing water.
- Increase groundwater table in area.

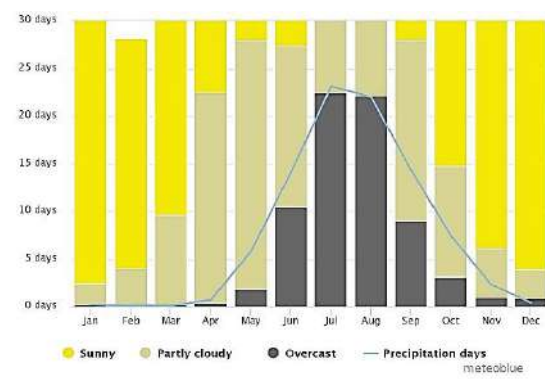
### B. Meteorological Characteristics of Rasayani

Result from structure is mainly depending upon atmospheric conditions (such as temperature, wind, humidity, precipitation) meteorological condition of the study area which plays a vital role. Various above said parameters are shown graphically below (Source:

<https://www.meteoblue.com/en/weather/forecast/modelclimate/18.900N73.176E>



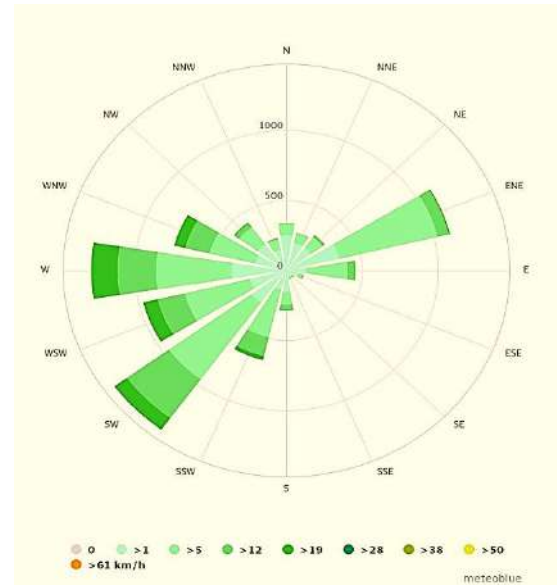
**Fig.1** Bar Graph of Temperature & Precipitation



**Fig.2** Bar Graph of Climate



**Fig.3** Bar Graph of Wind speed



**Fig.4** Wind rose diagram

### C. Site location

The area for which we are designing the WHS is village Rasayani, Taluka: Panvel, Dist.: Raigad, state: Maharashtra. Latitude and longitude of the location are 18.9004° N, 73.1763° E. This village has a primary and secondary school and Pillai HOC Educational campus Fig.5 shows the study area (i.e. Rasayani village) obtained from Google maps. (Source: <https://www.google.co.in/maps/>)



**Fig.5** Satellite view of study area (Pillai HOC educational campus)

### D. Material Description

The materials used are locally available, easy to reuse and are economical.

- **Bamboo:** - Bamboos are used in the framing of the structure. It is used for the stability purpose.
- **Mesh Fabric:** - Mesh fabric is most vital component of the tower. It should be made up of polyester fabric which has the tendency to absorb moisture from the atmosphere. The test were conducted on various types of mesh having different properties like the cohesive inter molecular force of attraction between the water molecules and polymers should be less and It should not react with water.

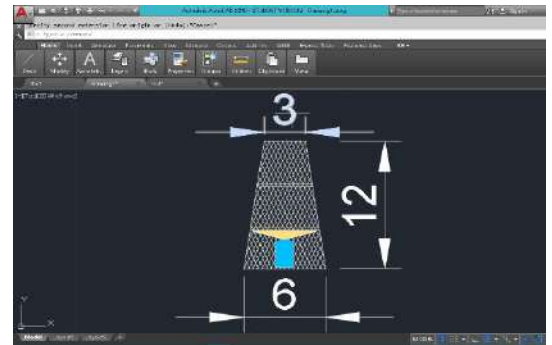


- Hemp ropes: -Hemp ropes are used to tie bamboos and the mesh fabric together.
- PVC Sheet: - it is sheet which act as an impermeable surface for the water molecules to travel down under the impact of gravity.
- Storage container: - It is used for storing water and distribution purpose



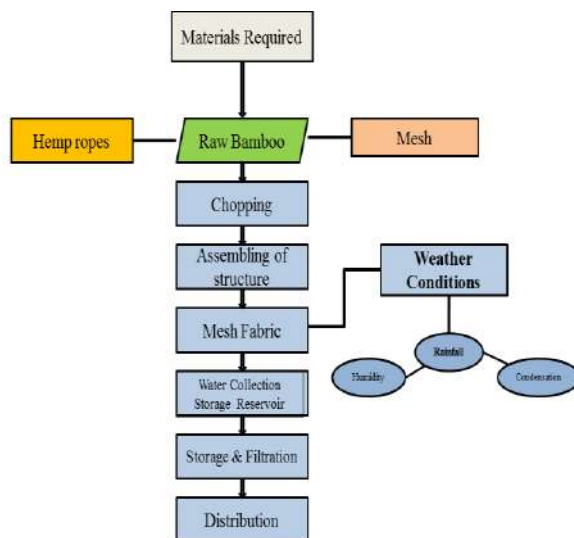
**Fig.6** Mesh Fabric

- The mesh fabric is been assembled at the inner peripheral circumference of the tower which is connected to the storage reservoir.
- Thus the tower harvests the potable water from the atmosphere. It collects rain, harvests fog and dew.
- It functions only by natural phenomena such as gravity, condensation & evaporation and doesn't require electrical power



**Fig.8** AutoCAD drawing of Structure

### III. PROCEDURE



**Fig.7** Flow Chart of the process

- Locally available traditional bamboos are being sorted out as per the sizes.
- Bamboos are chopped in different shape and sizes as per required dimensions of the structure.
- The framing of bamboo structure is carried out and assembled with the help of hemp ropes which are tied at different joints.
- The total height of the structure is 12ft, out of which is been divided into two parts. i.e. 5ft and 7ft consisting of varying diameter 6ft at the bottom and 3ft at the top.



**Fig.9** Vertical structure

### IV. RESULTS AND CONCLUSION



The WHS is vertical structure created by the locally available materials in rural areas. It is designed to harvest potable water from the atmosphere providing sustainable and affordable water sources to remote communities in the rural villages that are facing water scarcity issues. It is constructed with






biodegradable materials with aim to collect an average up to 50 litres of potable water per day which depend on weather conditions. It is designed to be easily built and maintained by local villagers without electrical tools. Beyond providing potable water, the target is to strengthen the local economy through manufacturing the towers locally and provide women and children opportunities to invest their time in care and other productive activities.

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## STUDY OF DIELECTRIC AND STRUCTURAL PROPERTIES OF POLYIMIDE-NANOCOMPOSITE FILMS

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### **Abstract:**

*Efforts are being made, world over, to develop low dielectric (say  $\kappa < 2.0$ ) materials for microelectronic applications. Polyimides (PIs) are among the most promising candidates for above applications as, in addition to low  $\kappa$ , they are thermally stable and have good adhesion to metal which is a requirement for fabricating microelectronics devices. Pure PI films, however, cannot be used as PI has dielectric constant of about 3.4. Thus, we have synthesized nanocomposite PI films having nano-pores or silica nanoparticles embedded in them as it is known that porosity leads to lowering of dielectric constant. This involved chemical modification of PI at precursor's stage using Siloxanes modifiers. The films have been characterized for their thermal stability, structure and dielectric behaviour using techniques such as TGA, FTIR, AFM and impedance analyzer. This paper reports the details of synthesis and characterization of above films.*

### **Keywords:**

*Polyimide films, Siloxanes Structure, Dielectric constant, FTIR, AFM*

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### **I. INTRODUCTION**

Microelectronics based devices are of interest to future cities for several different applications. The fabrication of these devices and their smooth functioning is greatly hindered by the resistance–capacitance (RC) delay and the cross-talk noise between metal interconnects, especially when one reduces the sizes of the devices. It is thus of interest to develop materials having low dielectric constant ( $\kappa$ ). This paper deals with synthesis and characterization of suitably modified Polyimides (PIs) films which are among the most promising candidates for use as next-generation interlayer dielectrics.

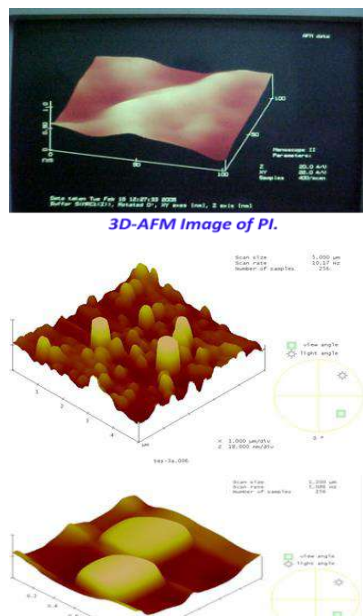
The semiconductor industry is in urgent need of materials having low dielectric constant ( $\kappa$ ). Efforts are being made, world over, to develop low dielectric (say  $\kappa < 2.0$ ) materials for microelectronic applications. In addition to low dielectric constant, the above materials should have high-thermal stability, chemical stability and good adhesion to metals. Polyimides (PIs) are among the most promising candidates, which meet above requirements and can

be used in microelectronic devices. Normal PI is, however, of not much use as it has dielectric constant of about 3.4. Fluorinated PIs having dielectric constant  $\kappa$  of about 2.4 are better than normal PIs for above applications. However, fluorinated PIs give out fluorine vapors at high temperatures and hence, they have poor mechanical properties at high temperature. We have synthesized nanocomposite PI films having nano-pores or silica nanoparticles embedded in them. These films are expected to have  $\kappa < 2$ , especially as it is known that porosity in a material leads to reduction in dielectric constant [1-3].

There are several different routes for synthesis of low- $\kappa$  nanocomposite PI films [4, 5], though most of above approaches result in loss of one or more of the desired features (mechanical strength, thermal stability etc). We have generated silica nanostructures using Siloxane Interacted Polyimide Precursor (SIPP) technique [6, 7]. This involves chemical modification of Polyimide i.e PAA poly (Amic acid) backbone chain at precursor stage and subsequent thermal imidization. It seems, it is



is not surprising that intensity of this peak increased with the TEOS concentration. The absorption spectrum at 3400  $\text{cm}^{-1}$  arises from OH groups [13-14].



**Fig. 2** AFM images of neat PI film, PITEOS-1 and PITEOS-20

The AFM topographic image of pure PI and PITEOS nano-composite films are shown from Fig. 2. It is seen that while films containing higher concentration of TEOS, show aggregation of silica particles (sizes in range of 200-400 nm), the low concentration films show dispersion of silica nano particles (sizes in range of 80-100 nm) within PI matrix.

Table 1 reports the decomposition temperature for neat PI and PITEOS and PIHS nano-composite films. The decomposition temperature of the nano-composite films, especially having higher TEOS content, has been found to be lower than that for neat PI. The initial weight loss for the nano-composite film occurs at about 517°C, which shows that nano-composite films are thermal stable at room temperature [15-8].

The high decomposition temperature of nano-composite films having low concentration of TEOS and Silicic acid, suggests a favourable reinforcing effect and a uniform dispersion of in-situ formed silica nano-particles within the PI matrix. The above studies clearly show that we have successfully incorporated silica particles in nano-composite films.

**Table 6-** Thermal Stability of PI and PITEOS and PIHS films.

S.No	Initial Decomposition Temperature	Final Decomposition Temperature)
PI	517°C	627°C
PITEOS-20	510°C	589°C
PITEOS-1	512°C	600°C
PIHS-20	511°C	592°C
PIHS-1	512°C	610°C
PIHS-0.001	514°C	617°C

The dielectric studies have been carried on four films (neat PI and PI containing 0.001, 0.01 and 0.20 silicic acid as modifier). All the samples had thickness of about 100 $\mu\text{m}$  and they were cured at 350°C for 2 hrs. The measured dielectric constants at different frequencies are shown in Table 2. It is noted that measured value of  $\kappa$  for neat PI is 3.26, which is in reasonable agreement with the literature value of  $\kappa=3.2-3.4$  at 1 KHz for commercially available PI films [19-21]. Further it is seen that the dielectric constant of samples containing 1% silicic acid is definitely lower than that for neat PI samples at all frequencies.

**Table 2-** Effect of frequency on dielectric constant of PI and PITEO films.

Frequency (KHz)	Neat PI	PITOS-20	PIHS-1	PIHS-0.001
5000	3.35	2.71	2.07	3.92
1000	3.21	2.65	2.00	3.76
100	3.23	2.75	2.02	3.78
10	3.25	2.95	2.07	3.80
<b>1</b>	<b>3.26</b>	<b>3.17</b>	<b>2.14</b>	<b>3.82</b>
0.1	3.28	3.39	2.22	3.84

## CONCLUSIONS

The new method of preparing siloxanes interacted PI nano-composite films by using TEOS and silicic acid as silica precursor has been reported and their relationships to silica contents were investigated. Incorporation of both precursors within PI matrix has been proven to be effective. The controlled incorporation of 1% PITEOS showing promising result for dielectric constant at 1Khz while the lower concentration of silica content 0.001% showing good Thermal and low water absorption which is a requirement for low dielectric. Thus this study needs further detailed analysis over wide



frequency ranges for dielectric behavior and the effect of varying concentrations on Dielectric constant of the PI films.

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Photograph of Author A

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Photograph of Author B

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Photograph of Author C

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## A REVIEW ON BIO COMPOSITES IN INDUSTRIAL APPLICATIONS

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### **Abstract:**

*Today biological materials science is one of the most rapidly growing areas. It mainly focuses on natural materials, synthetic materials in biomedical applications and bio inspired materials. Composites are developed based on the requirement. In India natural fibres and agricultural waste are available in large. Hence, today the focus is to make progress in composites to explore value-added application possibilities. This paper presents a review on development of different types of bio composites in variety of applications. It also includes coverage of recent publications in the literature pertaining to bio composite focusing on improvement in their mechanical properties. This paper outlines the success of bio composites in practical application, which has led to improvement in strength, shape, function, and behaviour of material.*

**Keywords:** Bio composite, natural fibre, agricultural waste, Polymer matrix Composite, Mechanical properties

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### **I. INTRODUCTION**

Now a day's engineers and material scientists are working hard to produce composites which are totally new materials compared to traditional materials. A composite material gives unique properties by combining two or more materials. In composite discontinuous phase is called reinforcement which is stronger and harder than continuous phase known as matrix. Composite properties are based on constituent materials properties and their distribution. Today the research is going on to prepare natural fibre composites due to its ample availability in India. Compared to synthetic fibres natural fibres have low density, low cost and low durability. Reinforcement provides strength and rigidity, helping to support structural load. The matrix or binder maintains the position and orientation of the reinforcement. The reinforcement may be particles or fibres and are usually added to improve mechanical properties such as stiffness, strength and toughness of the matrix material. Long fibres that are oriented in the direction of loading offer the most efficient load transfer.

Environment consciousness inspires the researchers to study natural fibre reinforced polymer composite and cost efficient option to synthetic fibre reinforced composites. The simplicity of manufacturing and accessibility of natural fibres have convinced researchers to try easily available low cost fibres. The strength and stiffness limitations of bio composites can be overcome by structural configurations and better arrangement in awareness of placing the fibres in specific locations. Combining the useful properties of two different materials make them useful in various high performance fields of engineering applications. Composites have proven their worth as weight

saving materials. The current challenge is to make them long lasting in tough conditions to replace other materials and also to make them cost efficient. This has resulted in evolution of many new techniques currently being used in the industry.

Due to low noise, unique self-lubrication capabilities the fibre reinforced plastic composites are better substitute over conventional metallic materials for tribological application. The different application areas are bearings, bush, seals, gears, wheels, cams, impellers, brakes, artificial prosthetic joints etc. Failure of these mechanical components occurs due to different types of wear mechanism. However failure due to abrasive wear is a major concern today. There is a growing trend to use bio fibres as reinforcement in plastic composites. Their flexibility during processing, highly specific stiffness, and low cost make them attractive to manufacturers. Bio fibre reinforced plastic composites are gaining more and more acceptance in structural applications.

There is a growing need to convert agricultural by products and excess of the crops into new, cost effective products. To succeed the technology allied with environmental conservation has created a renewed interest in the scientific world to study the possibility of using agriculture waste as reinforcement agents. Normally such fibre based composites show better mechanical properties and reduces the dependence on materials obtained from non-renewable source directing to both environmental and economic benefits. Also agricultural wastes can be used to prepare fibre reinforced polymer composites which have commercial use. Composites, plastics and ceramics are most powerful engineering materials from last few decades. But today use of natural fibre

composite has received progressively more attention by the industry and academic sector.

## II BIO COMPOSITES

Agricultural wastes include wheat husk, rice husk and shells of various dry fruits. These agricultural wastes can also be used to prepare fiber reinforced polymer composites for commercial use. D. Verma et al. [6] discusses the use of bagasse fiber and its current status of research. For certain applications, the use of composites rather than metals has in fact resulted in savings of both cost and weight. With this perspective authors focuses on the use of waste product from sugar factories the bagasse fiber as filler in composite material. Authors conclude that future of bagasse fiber composites is bright as they are cheaper, lighter and environmentally superior to glass fiber or other synthetic fiber composites also. Sachin Yadav et al. [18] present a review on the properties and chemical composition of bagasse fiber composites. The objective of this review is to explore the potential of the bagasse fiber polymer composites and to study the mechanical properties of composites. Pankaj Tripathi et al. [21] fabricated epoxy based composites reinforced with sugarcane bagasse waste fiber. Authors prepared composite using sugarcane bagasse fibers, epoxy and hardener. The samples are prepared in different volume fractions. The tensile test, flexural test and hardness test were carried out on samples. The authors concluded that tensile strength and flexural strength is maximum when the volume fraction is 20% and decreases with further increase in volume fraction. Also hardness increases with increasing volume fraction of sugarcane bagasse fiber. Such composites have wider applications in automobiles and railway coaches & buses. The experimental results of mechanical properties with varying fiber content % with random orientation are given in Table 1.

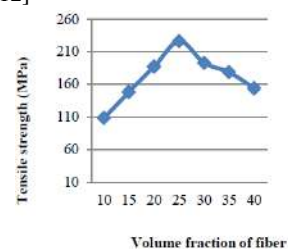
**Table-1:** Mechanical properties with varying fiber content % [21]

Fiber Content (%)	Tensile Strength (MPa)	Flexural Strength (MPa)	Hardness (HRL)
5	27.03	24.2	58
10	46.87	32.97	72
20	58.36	59.6	93
25	52.68	53.36	97
30	46.07	51.42	98

Although glass and other synthetic fiber-reinforced plastics possess high specific strength, their fields of application are very limited because of their inherent higher cost of production. With consideration of this an investigation has been carried out to make use of coir; a natural fiber abundantly available in India D. Verma et al. [7] present the review on development

of a polymer matrix composite using coir fiber as reinforcement to study its mechanical properties and environmental performance. The composites were prepared with different fraction of coir fibers. Prakash Reddy et al. [12] prepared composites with coir fibres by varying the fibres volume fraction from 10% to 40%. Authors concluded that the 25% volume fractions of the coir fibers composite have the maximum mechanical properties and the fiber length plays an important role in the manufacturing of composite. Devendra Prasad et al. [13] describe the development and characterization of coconut coir reinforced polymer composite. Authors prepared composite sample with coconut coir fiber, epoxy resin and hardener. The experiments are carried out to study the effect of fiber length on mechanical properties of these epoxy based polymer composites. Authors concluded that tensile strength and flexural strength increases slowly till 25% of volume fraction of coconut coir fiber and then starts decreasing. Also hardness increases slowly with increasing volume fraction of coconut coir fiber. Length of fibers and placing fibers at different angles affect the mechanical properties of the composites.

**Fig.1** Effect of tensile properties of coir fiber reinforced composites [12]



Madhusudhana et al. [15] in their research prepared polymer composite with resin, sisal fibre as the major reinforcement and rice husk as an additional fiber to improve the mechanical property of it. They prepared test sample with different % weight of sisal fiber and a small percentage of rice husks. The authors concluded that the ultimate tensile strength and ultimate flexural strength is maximum with 10 wt% and 5wt% of sisal fibre respectively. Ultimate flexural strength of composite decreases with increasing wt% of rice husk. Ufuoma Peter et al. [23] prepared hybrid polymer composite using sisal/jute at 1:1, 1:2 and 2:1 mixture ratio. The authors concluded that at fiber ratio of 2:1 sisal to jute for Bisphenol A resin maximum tensile strength is 38MPa while sisal/jute hybrid fibres reinforced in unsaturated polyester resin, gives highest tensile strength of 31.7MPa on sample laid at 90°/45° fibre orientation. Anaidhuno et al. [26] have done the research work to evaluate the performance behavior of sisal/jute fiber reinforced in polyester based hybrid composites compared to mild steel material. Authors prepared composite samples with sisal/jute

hybrid polymer composite at 1:1, 1:2 and 2:1 mixture ratio, 0.25, 0.35 and 0.45 volume fraction mixtures using unsaturated polyester resin. The authors concluded that highest tensile strength of 31.7MPa, highest flexural strength of 78.9MPa and highest compression strength of 93.7MPa is obtained on sample with 2:1 mixture ratio at 90°/45° fiber orientation. The simulation results are very close to that obtained from experiment. The sisal jute composite has a mass density of 1400kg/m<sup>3</sup> compared to 7858kg/m<sup>3</sup> of mild steel. This results in a major advantage of light weight application in automobile body. S. Rajeshkanna et al. [22] prepared the composite material of polyester matrix reinforced with jute fibers arranged in discontinuous randomly oriented configuration. The volume fraction varies from 15% to 45%. Authors concluded that for volume fraction is 20% and fiber length 50 mm maximum tensile strength obtained is 342MPa. Compressive strength values are gradually increased up to 30% volume fraction.

**Table-2:** Mechanical properties of Sisal/ Jute/Polyester Composite [26]

Mechanical properties	Sisal/Jute Composite
Max.Tensile Strength	31.654 MPa
Max.Flexural Strength	78.894 MPa
Max.Compression Strength	93.743 MPa
Brinell Hardness Number	198.2 MPa

Due to many health problems it is very necessary to replace asbestos cement roofing sheet which is a carcinogenic material. As plant fibres are renewable, eco-friendly and have good mechanical properties they can be a proper alternative to asbestos. Sisal plant can survive in almost all soil types. The alternative found by Dr Shipra Roy [25] is to use sisal fibre cement sheet in buildings where presently asbestos cement sheets are used globally as they are non-carcinogenic and cost effective. Jacob Olaitan et al. [17] have developed three different samples of roofing sheets using groundnut shell particles and epoxy resin as composite material with weight ratio of 30:70 and particle length of 0.5, 1 and 1.5 mm. They have conducted water absorptivity test, flexural test, tensile test and impact test. Authors concluded that % of water absorption increases with increase in particle length. Flexural strength increases with grain size up to maximum of 1 mm. P.Srinivasakumar et al. [8] concluded that as sisal has superior mechanical properties, it is an excellent material that can be used in application such as marine, automotive, construction etc. Gurmeet Singh et al. prepared twin layer and triple layer composites with Luffa- cylindrica (sponge-gourd) fiber reinforcement in polymer. The composites

were tested to study mechanical properties such as tensile and flexural strength the composites are prepared with 20% Luffa- cylindrical fiber in twin layer sample and 30 % in triple layer sample. Authors concluded that tensile strength 12.77MPa and flexural strength 33.85 MPa is maximum for twin layer sample than triple layer sample.

Animesh Agarwal et al [11] prepared the composite with Lantana-Camara fiber (LCF), reinforced in epoxy resin to improve the mechanical properties such as tensile, flexural and impact strength. The authors conclude that if the fiber content is increased the strength and modulus increases and the best combination are found with 30 vol% of fiber. Modification of fiber surface by chemical treatments significantly improves the fiber matrix adhesion, which in turn improves the mechanical properties. Failure of many mechanical components occurs due to different types of wear mechanism. With consideration to this Dr. Chittaranjan Deo et al. [27] have prepared the composite with Lantana-Camara fiber (LCF), reinforced in epoxy matrix to improve the abrasive wear behavior considerably. The authors concluded that in untreated fiber epoxy composite the optimum wear resistance property was obtained at the fiber content of 40 vol%. For reducing the wear Benzoyl-Chloride treatment gives best results compare to Alkali and Acetone treatment.

**Table-3:** Mechanical properties of treated lantana- camara fiber epoxy composite with 30% fiber content [11]

Type of fiber	Tensile Strength (MPa)	Flexural Strength (MPa)	Impact Strength (KJ/m <sup>2</sup> )	Young's Modulus (MPa)
Untreated	19.08	55.49	34.69	1132
Acetone treated	20.07	58.35	36.24	1435
Alkali treated	23.45	69.52	42.36	1542
Benzoylated	25.62	72.04	45.42	1631

Banana fiber is used as a raw material in industry for production of papers, tea bags, currency and reinforced as a polymer composite. Ravi Bhatnagar et al [19] provides information about chemical composition and mechanical properties of banana fiber. In this paper, banana fibers are compared through their applications, use and properties. Banana fiber is used in currency notes in Germany and trial run in India also. Polypropylene reinforced with banana fiber is used by automobile companies for making under floor protection panels in luxurious cars like Mercedes. During the research it was found that paper made out of this fiber has long life of over 100 years. Navin Chand et al [20] in their



paper measure strength, elongation and surface properties of extracted bamboo fibers. The experimental results show that fiber extracted by alkali treatment followed by steam blasting attains the best mechanical strength as well as uniform micro structure. The authors conclude that bamboo fibers obtained from an untreated bamboo strip gives tensile strength of 157.7MPa and % elongation as 8.

R.M. Government et al [9] have presented modeling and statistical analysis of groundnut shell flour composites for its ultimate tensile strength. The authors conclude that ultimate tensile strength of groundnut shell flour composites is a function of filler content and particle size. S. I. Durowaye et al [10] have studied mechanical properties of composite prepared from polyester resin reinforced with palm fruit and coconut shell particles. The authors concluded that ultimate tensile strength decreases beyond 20 wt% and 10 wt% for palm fruit particles reinforced and coconut shell particles reinforced polyester composite respectively. S. Muthukumar et al [14] prepared coconut shell and groundnut shell reinforced polymer composite. The mechanical properties such as flexural strength, tensile strength and impact strength are evaluated for varying wt % of reinforcement and matrix material. The experimental results shows that composite prepared with 40% and 50% volume fraction of coconut and groundnut shell gives maximum tensile and flexural strength respectively. R. Pragatheeswaran et al [16] prepared natural fiber based polymer composite. It consists of groundnut shell powder and calcium carbonate reinforcement in the vinyl ester polymer. The effects of calcium carbonate on the mechanical properties of this composite were studied. The authors conclude that maximum tensile and flexural strength is obtained for 20% ground nut powder and 15% calcium carbonate combination. Also tensile and flexural strength increases with increase in calcium carbonate.

Animesh Borah et al [28] in the present work, made an attempt to design, develop and explore the possibility of utilization of fish scale in the form of flakes or short fibers in polymer composites. This bio-waste is used for LAPOX L12 resin based composites fabricated with random orientations of the flakes. The authors conclude that fabricated composites are bio-degradable and have engineering applications for better wear out properties. To obtain useful information for the design and manufacture of composite materials Xian Jia et al [1] have studied the microstructures and the friction-wear properties of three species of bivalve shells. In this paper three species of bivalve shells and grey cast iron HT200 were used as test materials. With experimental results authors conclude that friction coefficient of bivalve shells is distinctly smaller than that of grey

cast iron HT200. Also the shell has lower volume wear loss than grey cast iron HT200.

Molluscan shells are bio composites, results in a lightweight product of highly intricate morphologies, with unique structural properties. The survey done by Silvia Maria et al [2] deal with microstructural aspects of molluscan shells. Shell presents superior mechanical properties such as stiffness, fracture toughness, tensile strength compared to other composites. This will considerably contribute to the development of new "biomimetic" materials. W. Yang et al [4] have investigated strength and fracture behavior of *Saxidomus purpuratus* shells and correlated with the structure. Authors conclude that flexural strength of dry specimens is little higher than the strength of the wet ones. Also cracks propagate preferentially along the interfaces between lamellae.

Amar Patnaik et al [3] reviewed solid particle erosion behavior of fiber and particulate filled polymer composite. The paper discuss about implementation of design of experiments and statistical techniques in analyzing the erosion behavior of composites. The authors conclude that though the much work has been carried out on erosion wear characteristics of polymers and their composites the incorporation of both particles and fibres in polymer could provide better wear resistance which has not been addressed so far.

### III CONCLUSIONS

The literature survey presented above shows that most of the authors have fabricated composites with available natural fibres with varying wt% of it. The experimental results reveal that the mechanical properties of composites are affecting a lot as wt% of natural fibres changes. Some of the mechanical properties such as fatigue strength, hardness have not considered much. Today the research is going on fibre surface treatment to see its impact on mechanical properties of composites. The more contribution to this area leads to get more beneficial composites in future. As animal fibres are also available in lot its effective utilization will improve the properties of composites. Wear is a serious issue in most of the applications which has still not considered to the required depth. It appears that erosion characteristics of polyester and hybrid composite have also remained less studied areas.

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# A SUSTAINABLE SMART TECHNIQUE FOR GENERATING WATER FROM ATMOSPHERE FOR FUTURE CITIES - A THERMAL ELECTRIC COOLING APPROACH

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## **Abstract:**

*Worldwide poor management of the available water sources in urban cities has been affecting the water quantity and quality for decades. In the future, water scarcity will result in a hike in the price of drinking water. Consequently, we might have limited access to it. There has been an extensive research in the production of water, which predominantly requires an external power, additional maintenance cost, and complex operations. This research provides an experimental approach for a sustainable and economical production of water from condensation of atmospheric moisture based on the principle of heat flow and Peltier effect and secondarily generating electricity. Research suggests that voltage thus developed isn't substantial enough which can be amplified further. The results show that an ample amount of water has been produced, which can be increased by installing multiple units that can lead to mitigating water scarcity in future cities.*

## **Keywords:**

*Atmospheric water generation, Condensation, Thermoelectric cooling, Thermal Conductivity*

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## **I. INTRODUCTION**

According to reports by World Health Organisation, in India, around 76 million population do not have access to clean drinking water. In addition, India only possesses approximately 4 per cent of all freshwater on earth. This is significantly insufficient to feed 1.35 billion populations. Water scarcity has been a major concern and crisis throughout the globe especially in developing countries where the population is in billion numbers. Considering, water being an essential element for survival, water scarcity can cause adverse effects on human health like dehydration, the agriculture sector which contributes the most to the country's economy. With the aid of advanced technology, it is utmost important to sustain the world and find alternative ways to produce drinking water.

For decades, rigorous research has been made in the domain of desalination, condensation, and reverse osmosis to extract purified water. However, most studies comprised of complicated and expensive experiment setup to extract water where there is an

additional cost for maintenance. According to thermodynamics, heat transfer is the movement of heat within the body which occurs due to the temperature difference between the body and the surrounding. A potential temperature difference causes a flow of heat called flux. This research provides a holistic view of the economic aspect of the design setup and gives more emphasis on thermoelectric cooling approach: Peltier device and finding ways to optimize its efficiency which can result in more production of water. A Peltier is a heat pump which transfers heat from one side of the ceramic plate to the other side. Such transfer of heat is aided by an external electrical energy. When heat is transferred, a difference in voltage on the two sides of the device is created. Also, in addition, few meteorological parameters are considered to study the amount of water production. This paper put forward an approach to generate electricity as a by-product which can be further detected.

## **II. LITERATURE REVIEW**

According to **Olivia Jensen et al. (2018)**, stated about urban water security indicators. Urban water

security indicators aid in solving complex water-related phenomenon into quantifiable results which inform policymakers about the current situation. Hence indicators help in identifying problems, alternatives and assessing adjustments for policymakers. The researchers selected two cities Singapore and Hong Kong to test the development of UWSI. Because of the presence of insufficient water resources, both cities are noted as being highly water insecure. Various indicators like water resource availability, water storage capacity, raw water quality, water contamination incidents were taken into consideration for formulating appropriate policies to ensure sustainability and prevent water crisis and insecurities. Another insightful research has been done by **Farhad Mukhtarova et al. (2018)** where they analysed the role of information and communication technology between government and public engagement. ICT improved the effectiveness and efficiency in the urban water service facility. In addition, ICT tools increased the scope of participation and involvement of the public with the government to discuss and formulate appropriate policies about urban water services across the city. **Anna Magrini et al. (2015)**, in her perceptive research made an incisive research and case study of a hotel in Abu Dhabi on extraction of water that primarily uses the cooled air for the purpose of water production. In her research, the dew point of the humid air to cause condensation of the surrounding air is considered. She further stated that in order to maintain high performance, the flow of condensed water should be maximise and simultaneously ensuring minimum pressure losses. In her study she made a comparative analysis between a typical HVAC system and an integrated system to maximise the drinking water production. In the typical HVAC system, the condensed water in the dehumidification process is lost while in the second case, the integrated system is optimised to produce water. In an economic point of view the daily production of water and energy consumption of the two designs is calculated. The purpose of this analysis is to study and highlight the electrical energy cost of the two systems. The energy consumption by the typical and integrated system is calculated on the basis of energy consumption by chillers, pumps and fans. According to the observation made, the typical plant produces significant amount of water but it is wasted in general, where the integrated system, the water production is about 56.4% of the total water demand

of the hotel. Hence, after the comparison, it can be concluded that the integrated system produce air with a cost reduction and proves to more economical and sustainable. In 2017, another insightful research, design Optimization of Atmospheric Water Generator by **R.S Desai et al. (2016)**, attempts to use the principle of latent heat and dew point to convert water vapour molecules into water droplets with help of computational fluid dynamics, analysis. According to the extensive research done in the past, AWG units are more efficient when the relative humidity is high. The research aims to attain a specific dew point temperature to condense surrounding water vapour molecules. The study attempts to optimise the system by changing the number and location of Peltier devices. The research concluded that in addition with five Peltier devices, an atmospheric temperature of 35 °C, relative humidity greater than 45%, the system will start condensing into water droplets. **Xiuyuan Hao et al. (2017)** cited and analysed operation characteristics of producing water from air using a desiccant wheel. The result is optimised when the temperature is at 100 °C, rotation speed is 5r/h and an angle at 180 degrees. The system is feasibly designed to produce water in high temperature and low humidity areas like Gobi and desert. **Wufeng Jin et al. (2015)** cited and tested the effect on condensation time by analysing temperature of a radiant panel and relative humidity of the surrounding atmosphere. With a decreasing rate of temperature the condensation process accelerates. Hence condensation time depends upon the distance between the panel and the source

### III. OBJECTIVE

The fundamental intent of this paper is to provide an alternative sustainable and cheaper source for production of water with doesn't influence on surface and sub-surface water.

This could be achieved if the moisture which is in abundance in the atmosphere could be efficiently withdrawn. So, following are the prime objectives of this approach

- To test the water generated for drinking quality as per Indian standards.
- To establish an economical approach for production of water.
- To identify factors affecting water production as a sustainable approach.

•To generate electricity to run low energy requirements devices.

#### IV. PROBLEM STATEMENT

With rapid growing population, the need of water demand is directly proportional. At the same time, unethical discharge of the effluents and poor management of the water sources available is posing a great threat for deteriorating water quality. For instance, residents of Shimla are pleading tourist to stay away in the awake of severe drinking water shortage. In May 20, 2017 Shimla faced critically low water supply. In such situations, 172,000 residents are forced to line up for hours each day to collect water from tankers provided by the government. At the peak tourist season in June, number of visitors reaches up to 30,000 each day. Analyst blame the unethical management by state government, endemic pollution of existing water sources as well as inefficient and uneconomical farming methods by the agriculture sectors which uses 90% of the country's water supply. According to meteoblue, refer Fig 1 from January to May, water requirement in Panvel region is the greatest with increasing temperature. During this span of time, population of Panvel demands more water and hence the proposed device will be more in demand for domestic and industrial practices.

This research particularly addresses the potential application of Peltier device and condensation principle for production of water. However, an initial installation cost is required for setup. In addition, few parameters are considered to optimise the amount of water production with greater efficiency.

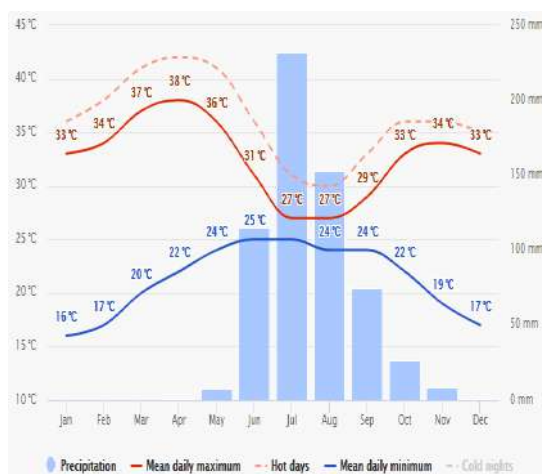


Fig 1 Average temperature of Panvel region

Source:

[https://www.meteoblue.com/en/weather/forecast/modeclimate/panvel\\_india\\_1260434](https://www.meteoblue.com/en/weather/forecast/modeclimate/panvel_india_1260434)

#### V. METHODOLOGY

The generation of water from atmospheric moisture is proportional to the atmospheric humidity. That means if the humidity is more the dew formation would be much greater as compared to a dry arid area. The principle of condensation states that when atmospheric air is cooled below its dew point surrounding a particular surface, water droplets formed on its surface. Dew point is a temperature below which the moisture in the air starts to condense on the surface of any cool object. Peltier effect is the inverse of Seebeck effect and it states that heat is evolved at one junction and absorbed at other junction when two dissimilar metals are welded and current is passed through it refer to Fig 2.

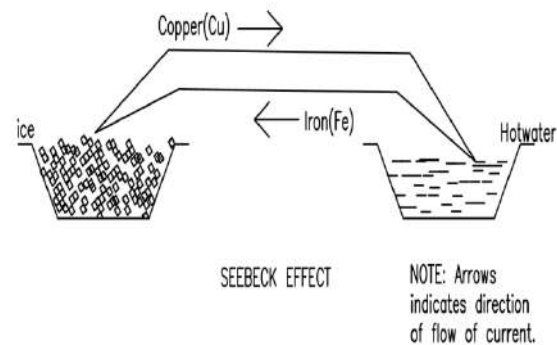


Fig 2 Seebeck effect

Heat is absorbed in junction 1 and evolved at junction 2 when the EMF i.e. voltage is applied in the direction. Seebeck gave a thermoelectric series of different pairs of metals after examining the thermoelectric properties of various metals as shown in the chart below refer to fig. 3. The current flows in the direction at a hot junction from the metal occurring earlier in the series to the metal occurring later in the series.

83	28	46	78	29	25	80	82	50	79	47	30	48	26	51
Bi	Ni	Pd	Pt	Cu	Mn	Hg	Pb	Sn	Au	Ag	Zn	Cd	Fe	Sb
208.98	58.68	106.42	195.08	63.55	54.94	200.59	207.2	118.71	196.97	107.87	65.39	112.41	55.85	121.76

Fig 3 Seebeck thermoelectric series

Source: <https://youtu.be/yK2DwMTja1Q>



Refer to Fig 4, when an external voltage is connected to it, P-N-P semiconductors inside the Peltier device get biased and thus formation of the cold and hot surface takes place on the Ceramic surface of the Peltier.

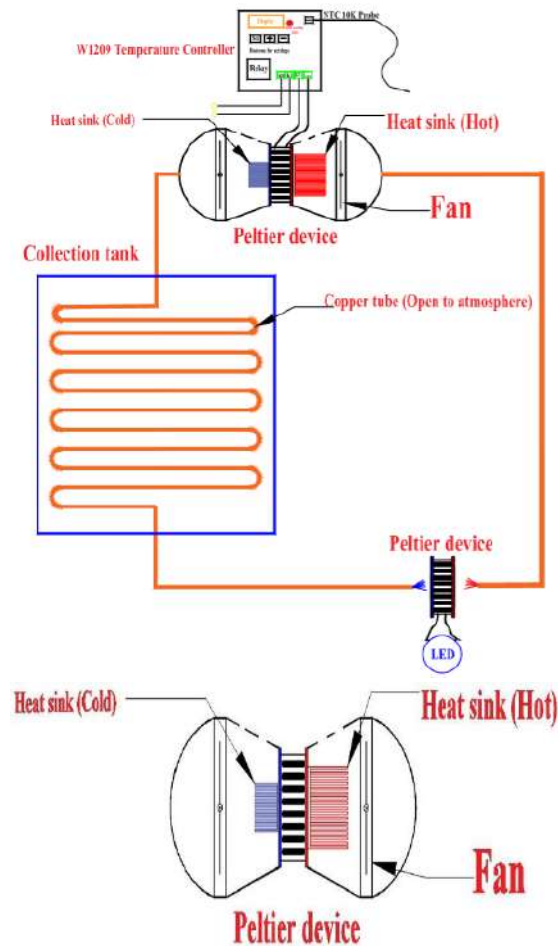


Fig 4. Block Diagram of model.

Typically, Peltier device has a large number of thermocouples Arranged in rectangular form and packed within two ceramic plates. An external DC voltage is applied at the terminals of the Peltier module. As a result, when DC current flows, the electrons of P-N-P semiconductors excite and create a temperature difference phase such that one side of the plate of the Peltier turns cooler and another side turns hotter depending on the potential difference that is applied to it. Refer to Fig 4, A small heat sink and an exhaust fan have been attached to both, cold side and hot side of the Peltier. Further, a rubber funnel is attached to that side such that it delivers the generated cold air to the copper tube without any leakage. Furthermore, this cold air is used and it is being diffused through the copper tube. Copper being a material with high thermal conductivity becomes an efficient material to use it as a media to develop water on its surface. Now, when the copper

tube gets sufficiently colder due to the cool air that has been given as input, it starts to form dews on its surface. This is because the air in the surrounding has more energy and when it comes in contact with the cold copper tube surface, it loses its energy and the conversion of gas into liquid is done.

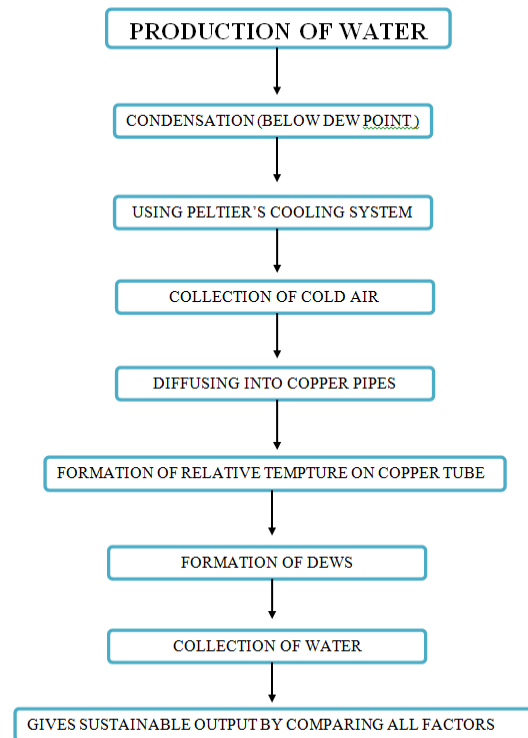


Fig. 5 Flowchart for production of water

To make it more sustainable, the hot air that is collected from the hot side of Peltier which is done to cool the heat sink is collected through a rubber funnel. Without any leaks, it is transferred to another Peltier with the help of another Copper tube which is insulated from all sides. The cold air which comes from the cold side is given to another Peltier as a feedback while, the hot air which is carried by another tube is given to another face of Peltier, so as to make a relative temperature difference. According to the Peltier effect, when a potential difference is created on Peltier device, it being a semiconductor is heavily doped which causes one side of it to cool relative to other side which could turn super-hot. If the heatsink isn't provided it could even damage the Peltier. Conversely, when the relative temperature is applied to both the surfaces of Peltier, the current is generated at the output of the Peltier. Though its voltage obtained at the output isn't considerable enough it could be amplified further. So, creating a relative temperature difference, current is also generated at the output of

Peltier which makes it further more efficient without any considerable loss of energy in the system. Various factors like Temperature of the room, Humidity, Amount of voltage applied to the Circuit, Voltage of Peltier device are considered while analysing and ways to optimize the water Quantity. Eventually, it is further tested for quality for drinking purposes as per Indian Standards.

## VI. RESULTS AND DISCUSSION

The water which was obtained at the relative humidity of 22% was over 500ml when the system was run for about 5 hours and the amount of voltage produced was over about 1volts keeping all the constraints under normal conditions. The rate of water production is found to be proportional to humidity of atmosphere. As the humidity increases the rate of production was found to increase as well. The pH of water obtained was found to be in the range 6.5 to 8.5 depending upon the air outside.

## VII. CONCLUSIONS

The water scarcity and water pollution have an adverse impact on the life of every creature in the earth. This research draws an approach wherein the water can be generated from the abundant resource of atmospheric moisture which is generally neglected as a source. The water is formed by thermoelectric condensation that initiates when the air reaches below dew point. The water thus obtained is potable and could be used in mega infrastructures if multiple units of it is installed. The electrical energy which is produced is secondary and it needs to be amplified further since, the output voltage isn't substantial enough.

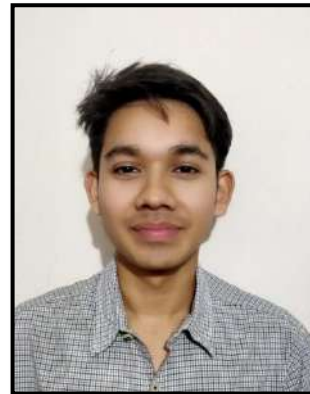
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## DISASTER MANAGEMENT FOR FUTURE CITIES

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### Abstract:

India is one of the disaster vulnerable countries in the world and has experienced variety of natural disasters due to the high population density, the typical geographic location, and poor preparedness towards handling these disasters, resulting loss of thousands life, property, opportunities and drop in the annual Gross domestic product (GDP) of the country. The present paper is an attempt to review the challenges and gaps of present disaster system, establishing of the root cause for failure and evolves the way forward to have an effective mitigated disaster management system in place, which may be a milestone guideline while perceiving a project of safe and disaster resilient future city in partnership with all concerned stakeholder.

**Keywords:** Disaster, Mitigation, Hazards, Preparedness, Emergency Preparedness Response Function.

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### 1. Introduction:

The International Federation of Red Cross and Red Crescent Societies defines disaster as a “sudden, calamitous event that interrupts the functioning of a community or a society causing harm to humans, material, infrastructure, and economic or environmental losses that is beyond the community’s ability to cope using the available resources.” There are two major kinds of disaster including – natural and manmade. The natural disasters are caused due to natural processes including earthquakes, tsunami, cyclones, Flood, drought and epidemics. Refer (Fig 1). Recent Kerala flood in Aug. 2018 resulted an estimated loss of Rs 40,000 crore, costing the lives of 483 people and 33000 people were rescued in 3000 relief camps [1]



Fig 1. An aerial view of the Kerala flood in August- 2018.

On the contrary, the manmade disasters are caused due to the involvement of humans, human errors, and

human intent that includes accidents, chemical spills, industrial accidents, terrorist attacks, environmental pollution and many more.

Post-independence, our country has experienced a gradual increase in the number of floods and other natural calamities, deaths and loss of opportunities. It caused drop in the annual Gross Domestic Product (GDP) of the country by 1.26 percent [2]. According to the International Disaster Database (IDD), the casualties and affected loss in India are shown in Table 1. The table depicts an event count which accounts for disasters, when more than 10 people are killed, more than 100 people are affected, a state of emergency is declared and international assistance is requested.

Disasters	Events count	Total deaths	Total affected	Total damage (million USD)
Drought	13	1,500,320	1,391,841,000	5,441
Earthquake	29	51,915	285,656,623	5,297
Epidemic	63	20,874	421,473	-
Extreme Temperature	59	17,600	-	544
Floods	283	70,343	861,462,744	58,332
Landslides/Avalanche	51	5,083	3,848,421	54
Storm	166	56,991	106,839,232	21,416
<b>Total</b>	<b>664</b>	<b>1,723,126</b>	<b>2,650,069,743</b>	<b>91,086</b>

Table 1: Natural disasters in India in last 17 years (Adapted from [4], source: International Disaster Database)



## 2. Present Scenario of Disaster Management System in India:

### 2.1 Legislation:

Due to the high vulnerability of India to frequent disasters, the Government of India took a key step in 2005 and defined the Disaster Management Act, 2005 that envisioned the creation of the National Disaster Management Authority (NDMA). They published the National Policy on Disaster Management with the following key objectives [5]:

- i) Establishing technological infrastructure and organizational frameworks that will facilitate compliance and create a regulatory environment. These can include building chain of commands and providing training programs to the people at various levels within the organization. This training will facilitate quick response at all levels and help the faster mitigation of the losses caused due to the disasters.
- ii) Integrating disaster management as the mainstream process within the developmental planning pipeline.
- iii) Ensuring that efficient mechanisms are employed for the identification, assessment and monitoring of the disaster risks involved.
- iv) Updating and maintaining the latest disaster forecasting and early detection and warning systems. These should be equipped with the proper fail-proof communication systems and maintained through the trained information technology, support staff within the organization. Additionally, the relief codes need to be revised and updated to disaster management manuals ensuring the documentation of the planning process required for mitigation and preparedness during a disaster. Safeguarding an efficient response with a caring approach towards the requirements of the vulnerable sections of the region.
- v) Utilizing reconstruction as an opportunity in order to build disaster resilient structures and environment to ensure and promote safer living. Further, regular evaluation of the buildings such as the hospitals, railway stations, fire station buildings, administrative centres and schools located in the seismic zones III, IV and V should be conducted.
- vi) Safeguarding a proactive and productive collaboration with the media for the dissemination of information that can aid the disaster management process.

- vii) Utilizing reconstruction as an opportunity in order to build disaster resilient structures and environment to ensure and safer living. Further, regular evaluation of the building such as the hospitals, railway stations, fire station buildings, administrative centres and schools located in the Seismic zones III, IV and V should be conducted.
- viii) Engaging a proactive and productive collaboration with the media for the dissemination of information that can aid the disaster management process.

### 2.2. Existing disaster management system:

Existing system and related phases of action is described below:

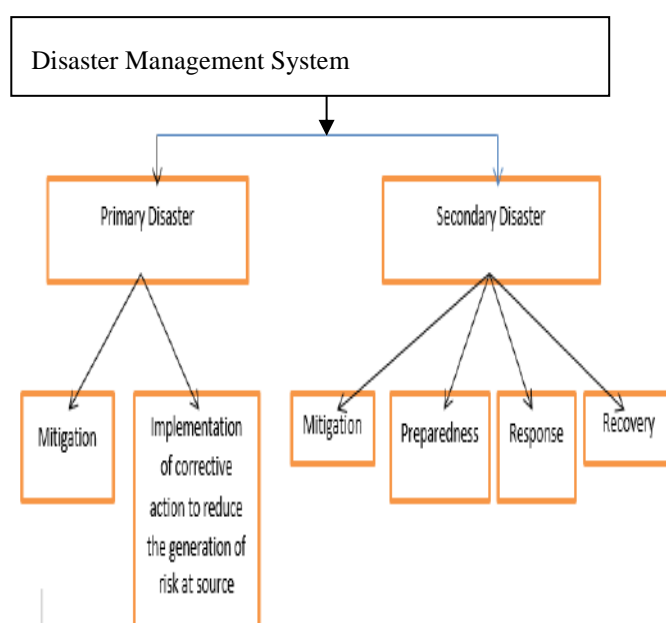


Fig. 2 Disaster management system

#### 2.2.1. Primary Disaster Management.

The **primary** disaster management include mitigation of risk or hazards that provides corrective measures to reduce hazards at source itself before the disaster occurs through proactive measures. Such proactive measures include quantitative structural resilience during construction of building and dams, against earthquakes, floods, and thunder storms.

#### 2.2.2 Secondary Disaster Management:



The *secondary disaster* management include the strategies and implementation of mitigation, preparedness, response and recovery during and post-disaster. The measures that deals with the implementation of these four phases are normally termed as effective emergency response function (ERF), which helps to minimize the effect of disaster. Federal Emergency Management Agency (FEMA) of the United States Department of Homeland Security highlighted the four phases of emergency response function management.

It is described and shown in Fig 3 below:



**Fig 3.** Phases of emergency response function management.

**1). Mitigation** – The first phase includes strategies employed to prevent any future emergencies or minimize their effects. These preventative strategies aim to reduce the occurrence of an emergency, or the damaging consequences due to any inevitable emergencies. Thus, these are inclusive of activities that can take prior and after emergencies towards their preparedness. Some examples of *mitigation* activity includes proposal for shifting to safe location on receipt of warning, buying flood, medicine, essential, insurance for your home. These acts will reduce the dangers and damaging effects of the disaster.

**ii) Preparedness** – The second phase relates to the preparation required to handle an emergency. These strategies are implemented before an emergency occurs. The activities include developing plans, preparation for where to go, who to call for help and training drills to ensure the safety of lives and aid the smooth operation of rescue operations. The examples for preparedness include posting emergency contact numbers, conducting fire drills, installing and maintaining smoke detectors. Evolving escape routes from disaster. A disaster kit with essential supplies for family and animals during evacuation are also part of the preparedness phase.

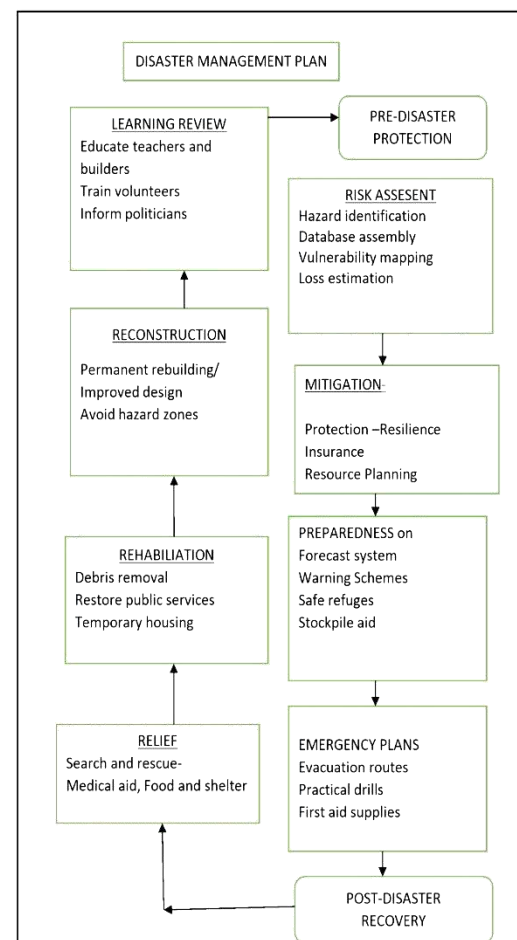
**iii) Response** – The response phase is typically comprised how to respond safely to an emergency. The success of this phase as reflected in your safety and well-being which is defined by how prepared one is and how

one responds to the crisis. Typically, response is when preparedness plans are put into action that can save lives and prevent property damage and ensure minimum potential loss on account of the disaster. The key is to act responsibly and safely; protect yourself, people and animals around you. Examples of responses include, taking shelter from a tornado, earthquake and turning off gas value in an earthquake. It is one of the crucial phases that can save lives.

**iv) Recovery** – The *recovery* phase includes the actions taken after the disaster and helps to resume to normal operations. After an emergency, the life safety and well-being will depend on how well one copes with stresses and reset to normal life. This phase may include getting financial assistance to start and pay for the repairs of the damaged property. Further, it is important to take care of oneself and their family to prevent stress-related illnesses.

### 2.3 Flow chart of existing disaster management System

Disaster management plan that is conventionally followed and documented is detailed in Fig. 4



**Fig. 4.** Existing Strategies of Plan (Adapted from [6])

### 3. Present scenario of disaster management system:

### **Challenges and gaps of above system:**

- 3.1 Repetitive loss of life and property damage due to the similar nature of disaster such as recurring floods, train accidents, earthquakes in the same geographical location. A recent study released by United Nation office on disaster risk Reduction (UNISDR from 1998-201 revealed that economic losses, poverty and disasters have risen of 151 percent. India suffered a total loss of \$ 80 billion and was ranked in the top five countries of the world in absolute economic loss. [7]
- 3.2 During and after the implementation of emergency preparedness response unction (EPRF) in each disaster, post scenario analysis reveals the repetitive technological and system gap for failure in compliance.
- 3.3 NDMA Centralised team effectiveness during emergency response has limitation on local resource mobilisation, non- awareness of local situation and difficulties encounter during rescue.
- 3.4 Lack of culture of preparedness, disaster prevention and resilience through education, awareness on use of technology, and mitigation measures against the known risk is common ground reality of any present and future city in India.
- 3.5 Estate (Regulation and Development) Act, 2016 (RERA) is an act passed by the Indian Parliament primarily that covers broadly the commercial terms and conditions and reactive measures of the construction for five years .However it is silent/inactive towards the proactive measures on quality control and audit compliance against any disaster.

### **4. Root cause of challenges and gap in present system:**

The root because analysis of above listed challenges and ineffectiveness in system and workflow reveals the following gaps/missing links in policies and implementation of system:

#### **4.1 RISK ASSESSMENT:**

The local database hazards and their risk analysis are rarely available to map in the project or construction except the few mandatory data as enforced by the legal authority. Provision of utilizing data monitoring, root cause analysis of repetitive hazard/disaster are also not available to stakeholders while selecting an area for urbanization.

#### **4.2. MITIGATION:**

Averting Source or minimization in reduction of severity: Disaster mode effect analysis (DEMA) and proactive way forward plan are not available in reducing the severity of disaster or averting the source by all stakeholders.

#### **4.3. PREPAREDNESS:**

Root-cause elimination is one of the most effective long term solutions to any disaster. Lack of planning and time bound action plan based on past historical data and lesson learnt from repetitive loss of life and property results in the poor preparedness against any disaster .

#### **4.4. EMERGENCY PLANS:**

As the term implies emergency planning for any hazard is most challenging situation. It worsens, when the apportioned resource mobilization is not done timely. The lack of planning, evacuation route and competency in handling the disaster is commonly cause of failure .

#### **4.5 RELIEF:**

Inadequacy in local trained teams for search and rescue work during post disaster due to the lack of knowledge local hazards. and non availability of past records on resources and the gaps.

#### **4.6. REHABILITATION:**

Major challenges in rehabilitation are lack of hygiene and safety due to lack of resource planning in project stage of future city.

**4.7. RECONSTRUCTION:** Many reconstruction are still observed in hazardous zone with due permission of authority.

It is crucial to spread awareness about the compliance on resilience of construction against hazardous zones.

#### **4.8. LEARNING REVIEW**

Lack of opportunities for the competency development of the stakeholders to meet the challenges for their respective area .

#### **4.9. REVIEW OF FEEDBACK AND UPDATING:**

Updating of records based on failures in planning, mitigation, recording and updating of the system are missing.

### **5. Way forwards on mitigation of disaster management:**

Based on analysis of challenges and gaps, the system and workflow is updated (with italicized text in Fig. 5A and 5B) to improve the effectiveness of system.

#### **5A) Updated work flow in pre- disaster phases:**

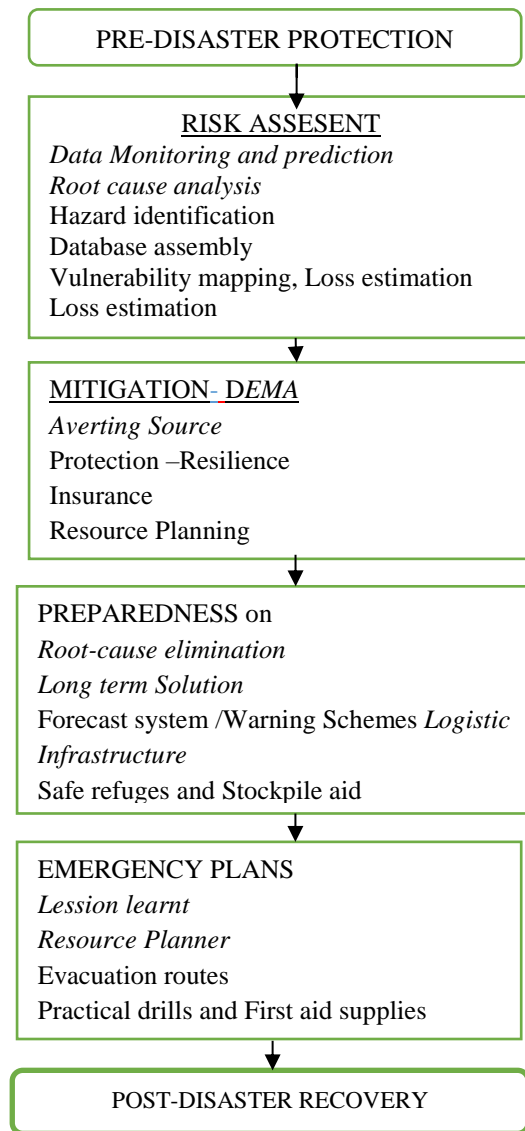


Fig. 5. An updated work flow in Pre- disaster System.

## 5. B) Updated post disaster management plan:

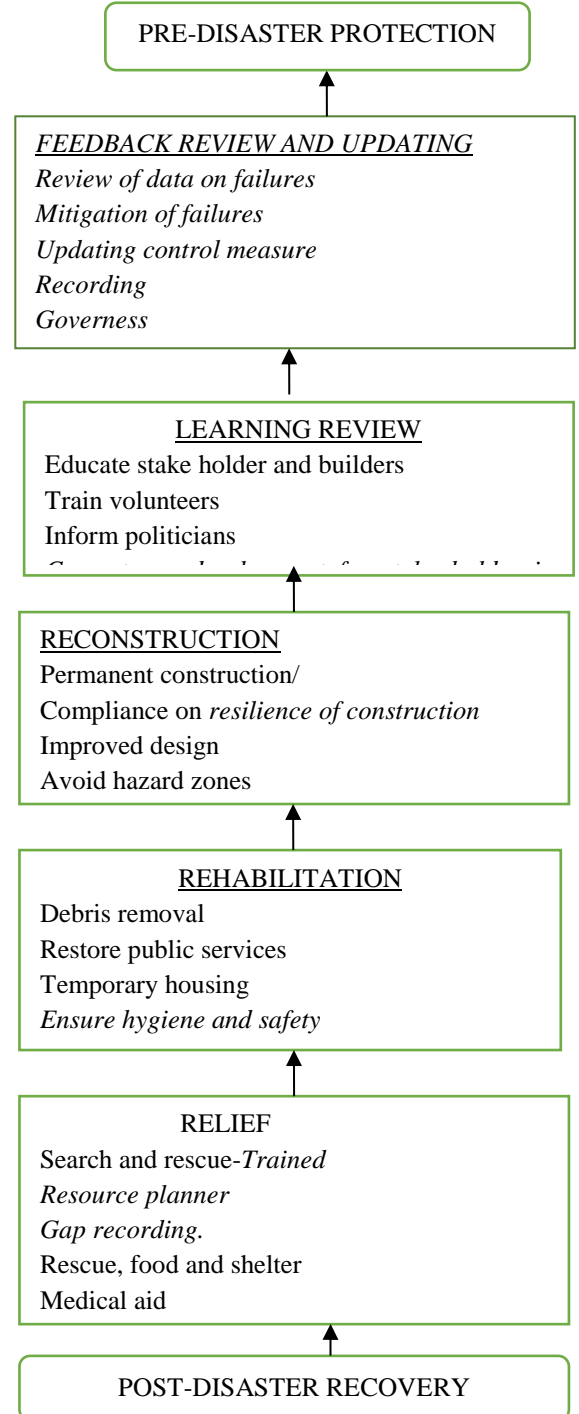


Fig.5.B updated workflow for post disaster management

## 6. Conclusion:

6.1 The mitigation of disaster can be implemented by having a strategic planning affiliated to specific geographical condition. The planning should dynamic and provision of updating with change scenario in nature and surrounding of any future city.

6.2. The provision of strategic planning on mitigation should be a part in planning stage of future city by city Development Authority (CDA). All stakeholder related with project should be made familiar about the risk and mitigated action plan of the concerned project.

6.3 The city developing authority should ensure compliance from developers and builders to implement the proactive measures and make provision post disaster mitigated action plan while developing their project for future city.

6.4 The post emergency preparedness plan should be made available to all stakeholders through their sale deed as a part of annexure and made mandatory to be compliance by housing society in dealing and purchasing property for any future city.

6.5. The details related to the availability on required potential resources, availability and mobility for relief and rehabilitation services, required to restore a reasonable level of public life, hygiene and safety needs to be published for the respective stake holder.

6.6 The liability on provision of reconstruction, resettlement, design improvement and resilience to construction should be an integral part of the sale deal between all stake holders.

6.7 The records on disaster management for future city should be updated regularly based on monitored parameter and change in nature of risk /hazards experienced on in any part of the world by the disaster management team.

6.8. A third party audit should be carried out on regular basis at least once in year covering risk mitigation, planning, logistics and infrastructure, competency of concerned stakeholder, records, and governness of system. The suggested corrective measures should be completed within the given timeframe by auditor.

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## DEVELOPMENT OF FEEDER ROUTE SYSTEM FOR MUMBAI METRO LINE 2A & 7 USING QGIS

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### **Abstract:**

*Government of Maharashtra is pursuing to improve urban mobility in Mumbai through MMRDA, responsible for planning and implementation of Mumbai Metro Masterplan. To begin with, the GoM has approved 118 km metro corridors for implementation, out of total 275 km of metro corridor under consideration. Implementation is inclusive of multimodal integration initiatives to create ease of intermodal transfer between suburban railway-bus-IPT (Intermediate public transport) and metro. Multimodal integration is meant to provide safe, easy and affordable access to metro station leading to increase in metro ridership and an enhanced travel experience. one of the most efficient ways to facilitate multimodal integration is to strengthen a well-planned feeder bus system connecting the metro stations to the neighbourhoods and business areas which are key traffic generators in catchment areas of the metro stations. This paper provides a detailed overview on planning and design of feeder bus system for Mumbai Metro line 2A & 7. Understanding unique travel patterns in the areas around existing suburban stations of Mumbai, modal share of commuter accessibility, origin and destination patterns around the station areas, study and analysis of existing BEST (Bombay Electric Supply Transport) routes in station areas and projection of future demands forms the basis of the design. Demand for each bus stop is identified and priority is given to higher demand nodes by considering metro station as a potential demand node. Before finalizing feeder route system, the existing routes of BEST are also identified, and Demand Deviated Feeder routes are developed for BEST using QGIS.*

### **Keywords:.**

*Public transport, route, metro, multimodal integration*

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### **I. Introduction**

The problem addressed in this the paper is integration of surrounding areas to proposed metro station and existing railway stations with public transport buses, as a part of a larger multimodal integration planning for proposed Metro Stations in Mumbai. Metro corridors under consideration in this study are Metro Line 7, along Western Express Highway and Metro Line 2A along Link Road. Both the corridors are north-south corridors running parallel to the western railway line. BEST is the only agency which provides public bus transport in Mumbai (MCGM area and some parts of MMR like Thane, Navi Mumbai, Meera-Bhayinder etc). There are three predominant types of bus routes in Mumbai operated by BEST – i) North South Trunk Routes, ii) East-West Connectors iii) Feeder Routes. BEST provides last mile connectivity to the sub- urban train commuters and has been the most preferred choice of commuters in the past. However, over a period of time, preference of commuters to use BEST for last mile connectivity has been reduced. As per modal share studies conducted in 1999, 59% commuters used BEST

bus to access suburban station, where as this share has dropped down to 12% in 2018. One can say that there is 47% decline in the bus users in 19 years and this is taken over by other IPT options like auto rickshaws, taxis and private cabs. This reduction of bus percentage is due to several factors like high travel time, congested station approach roads, distant locations of bus stops from sub urban stations etc. In order to overcome this decline of bus share and strengthen the use of bus system, the feeder system needs to be planned meticulously.

Government of Maharashtra is pursuing to improve urban mobility in Mumbai through MMRDA, responsible for planning and implementation of Mumbai Metro Masterplan. To begin with, the Government of Maharashtra has approved 118 km metro corridors for implementation, out of total 275 km of metro corridor under consideration. Implementation is inclusive of multimodal integration initiatives to create ease of intermodal transfer between suburban railway-bus-IPT (Intermediate public transport) and metro. Multimodal integration is meant to provide safe, easy and affordable access to metro station leading to increase in metro ridership and an enhanced travel experience. one of the



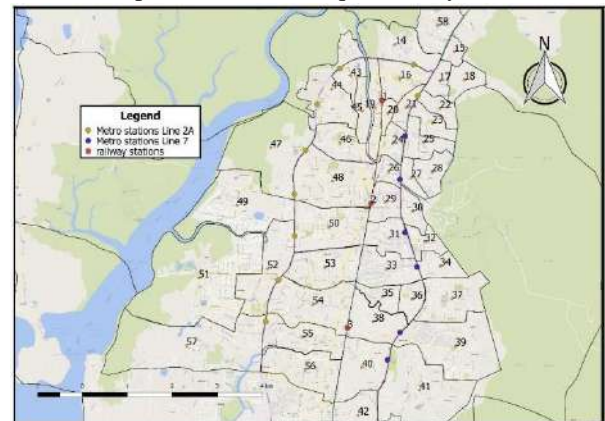
most efficient ways to facilitate multimodal integration is to strengthen a well-planned feeder bus system connecting the metro stations to the neighbourhoods and business areas which are key traffic generators in catchment areas of the metro stations. In this cases study, BEST are developed for selected new metro stations on Line 2A and Line 7. The current bus routes connect surrounding areas with railway station but in future, same routes may not be sufficient to service the metro stations. New feeder route system needs to be designed in such way that it transport share can be enhanced. The feeder routes are designed keeping in mind the constraint of manoeuvrability of buses, which may be very difficult at proposed metro stations due to space constraint.

connects surrounding areas with metro stations so that more number of passenger will prefer to travel by feeder buses from metro stations and thus public Thus, feeder routes have been designed with origin at railway stations, where buses are able to negotiate their movement and connectivity to proposed metro stations is provided as prime criterion. In order to achieve better connectivity, some of the existing bus stops have been shifted and routes are deviated so that a greater number of passengers can be served. For maintaining east and west connectivity Ring Ring type of routes have also been designed in which start and end points are the same. In this Paper, feeder route system has been designed for 15 proposed metro stations of line 2A and 7 which are indicated in figure 1.

## II. Literature review

scheduling problems is discussed. In this paper process of Public feeder route is discussed. The objective of was to present descriptive analysis and classification of past research dealing with Past feeder network design and scheduling Problems (FNSDP) the study is firstly grouped by Problem description and Problem Prabhat and O'Mahoney(2007) have developed feeder routes using Genetic Algorithm and after that specialized heuristic algorithm works as a repair algorithm to satisfy the demand of all nodes. Feeder routes are designed in two step first step is to develop feeder system and second step is scheduling of feeder route system, Many Research studies have been conducted for design and development of new bus Prabhat. and S.L. (2001) have developed routes and scheduling of bus routes. developed feeder route system have also been developed for railway stations using heuristic shows that the proposed procedure performs better than existing technique. compared result of Proposed genetic algorithm technique with existing technique,

A mathematical model was developed for design of feeder route systems for urban rail transit stations. Zhenjun et. al. (2017) have developed Potential demand model of roads by opening feeder bus services and applying a logit model for passenger flow distribution. Based on a circular route model, a route starting and ending at urban rail transit stations was generated, and a genetic algorithm was then applied to solve it. Amita, et. Al (2015) have discussed the application in transit network designing and scheduling time. They found that due to the involvement of several Parameters the designing and scheduling of transit network by means traditional optimisation technique is very difficult for



overcoming this problem several researchers have applied genetic algorithm for designing and scheduling of transit network. After reviewing various technique, they found that genetic algorithm is most efficient technique for optimization

Partha and Tathagat (2014) has discussed Genetic Algorithm, an evolutionary optimisation technique is used to develop the optimal set of routes. The result Mohammad, et. al (2014) have discussed Feeder route design algorithm, the algorithm is developed for operational integration of sub urban railway stations and Public buses. The first Part is for development of feeder route system for buses and the second part is for co-ordinated schedule of buses.

## III. Data Collection

In order to develop feeder routes for 15 Metro stations of Mumbai metro line 2A & 7 three existing suburban railway stations i.e. Dahisar, Borivali and Kandivali have been identified which are in the study area and indicated in figure 1. Feeder route system is developed in such way that metro station connects the nearest sub urban railway station and the surrounding areas. Entire catchment area of Mumbai metro line 2A & 7 has been divided in smaller zones and zones have

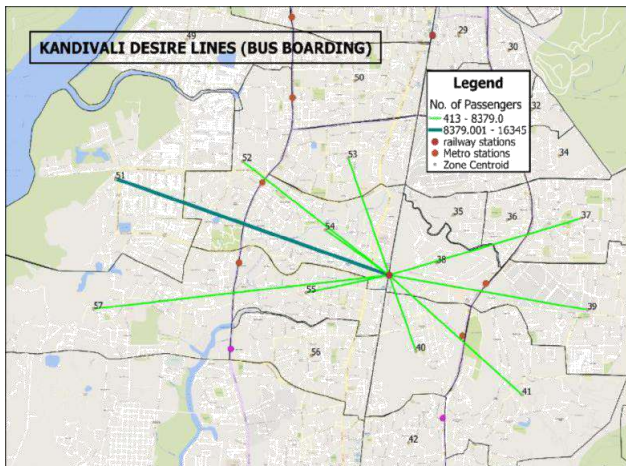
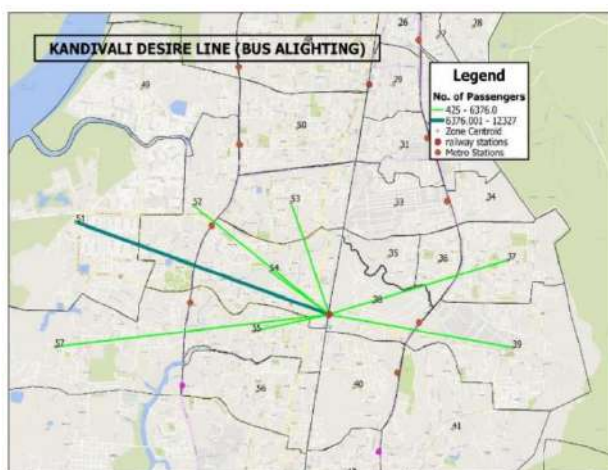


Figure 1: Proposed Metro lines, existing railway stations and Zonesbeen numbered. Figure 1 indicates identified zones and Table 1 shows the names of zones. Zoning is done by keeping in mind major areas and major roads. The zones have been developed from the ward maps and later modified as per requirement of project objectives. In existing BEST bus route system most of the buses start from railway stations and few buses pass through proposed metro stations. Existing route system is designed to cater the demands which generates from railway stations. In future, the travel pattern scenario will change due to development of metro stations. In order to capture existing travel scenario and characteristics Origin and Destination (O-D) Surveys have been conducted at the three above mentioned Railway Stations mentioned above. The sample survey was started from morning at 8:00 AM to evening 8:00 PM at entry and exit points of railway stations, enquiry was made from railway commuters regarding their origin, destination, purpose of trips, frequency etc. Passengers exiting and entering from various gates were also counted. Following table 2 shows number of passengers entering and exiting the railway stations during 8.00 am to 8.00 pm at various entry and

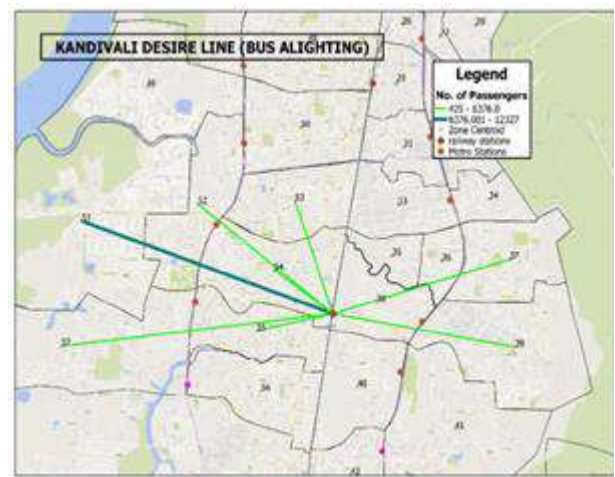


exit locations.

Fig 2: Kandivali Railway Station Desire Diagram

Railway station	Number of Passengers	
	Entry	Exit
Kandivali	160976	154739
Borivali	205515	210268
Dahisar	67181	76012

Table 2: Number of commuters exiting and entering from various railway stations



On the basis of sample interviews during O-D surveys and number of passengers exiting and entering the railway stations O-D matrices were developed, on the basis of these data desire line diagrams have been plotted for boarding and alighting for each railway station, in addition to origin and destination surveys at railway stations these surveys were also conducted at major bus stops on link road and Western Express Highway to identify the potential demand locations for each bus stop. On these bus stops enquiry was made from commuters regarding their origin, destinations, purpose of trip etc. Number of commuters boarding and alighting from buses have counted. Number of commuters present in each bus were also assessed as part of occupancy survey. This survey was also conducted between 8:00 am to 8:00 pm. Thus, potential demand of various destinations was identified from O-D surveys at railway stations and bus stops. Sample O-D surveys information were expanded using number of passengers entering and exiting at railway stations and number of boarding and alighting commuters at bus stops. Desire line diagrams were developed for each mode of transport, for all modes of transport taken together for three railway stations. Similarly, desire line



Zone No.	Description/Details
1	Dahisar Railway Station
2	Borivali railway station
3	Kandivali Railway station
14	NL Complex,Sambhaji Nagar
15	ketkipada
16	Gaondevi, avdhut nagar,Brahmakumari Hall
17	Vaishali Nagar
18	Dharkhadi
19	Mahtre wadi, dahisar station area
20	Maratha Colony
21	Mumans, shanti nagar
22	Dyneshwar Nagar, Konkani Pada
23	Rawalpada, Ekta Nagar
24	Parvat nagar,Ovripada, Ambewadi
25	Nagar
26	Daulat Nagar
27	nancy colony
28	KajupPada,chogle nagar
29	station
30	Kulupwadi
31	dattapada, khande rao dongri, asra colony
32	Tata Power House, Magathane Bus Depo
33	Food Corporation of India
34	Kahatau Estate,Siddharth Nagar
35	School, St.Lawrence High School
36	Thakur Complex
37	Samta Nagar
38	Defence Colony, Akurli Industrial Estate,Growel Mall,
39	Singh Estate, Laxmi Nagar, Damu Nagar, Gautam Nagar, Narsi pada,anita nagar,Mahindra and Mahindra Company, lokhandawala township
40	Authority of India, ramesh yadav nagar, khajuriya nagar
41	anandwadi,tanaji nagar, kranti nagar, aapapada, aagaman
42	Shantarampada,kasam baug, shiv bagh,pratap nagar
43	navagaon kandarpada
44	IC Colony
45	Mandapeshwar,
46	Mount Poinur, Devki Nagar, LIC Colony
47	eksar,mhada colony
48	Pai Nagar, Yogi nagar,Mazgaon, , Maharashtra Nagar
49	Gorai 1 & 2, Essel World
50	society
51	Charkop
52	kanti nagar, padma nagar, bander pakhadi,sai nagar
53	mahavir nagar, Mulji nagar, Poisar, dev nagar
54	paresh nagar
55	anand nagar, shankar pada,abhilash nagar
56	goras wadi, kailash nagar, khajuriya nagar
57	complex
58	Dogari, Penkarpada, Pandurang wadi

**Step 1:** Identify the demand of various nodes (bus stops/localities) from O-D data and desire line diagrams and assess their demands.

**Step 2:** Identify the nodes having more than average demand, take those nodes as potential demand and identify origin and destination of buses, it is identified on the basis of parking/ manoeuvrability facility/railway stations. Proposed Metro Stations are considered as a potential demand node.

**Step 3:** Develop the shortest Path between Origin (Railway station) to Various Potential Destination using Road Graph Plugin QGIS.

**Step 4:** Remove all nodes which are connected by shortest Path and arrange remain nodes in decreasing order. The highest demand node will be at the top and lowest demand node will be at the bottom. first priority will be given to highest demand node. Highest demand node will be chosen first for Deviation and insertion strategy.

**Step 5:** Identify the nodes which are not in shortest path and are already arranged as per their potential demand.

**Step 6:** Based on the location of nodes, shortest paths are converted into routes based on node selection and insertion strategies as discussed below. The major criterion for development of routes is not to delay demand of potential nodes which are having high demands.

**Step 7:** Check the lengths of routes according to time criteria mentioned below.

**Step 8:** Insertion of nodes continue one after the another as per their locations and demand till all nodes are connected.

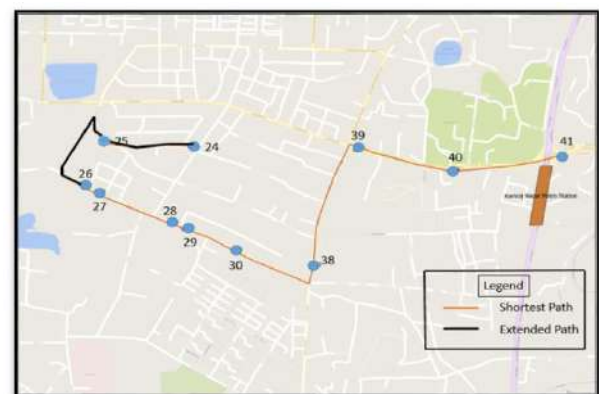


Figure 4: Shortest Path deviation strategy

## Methodology

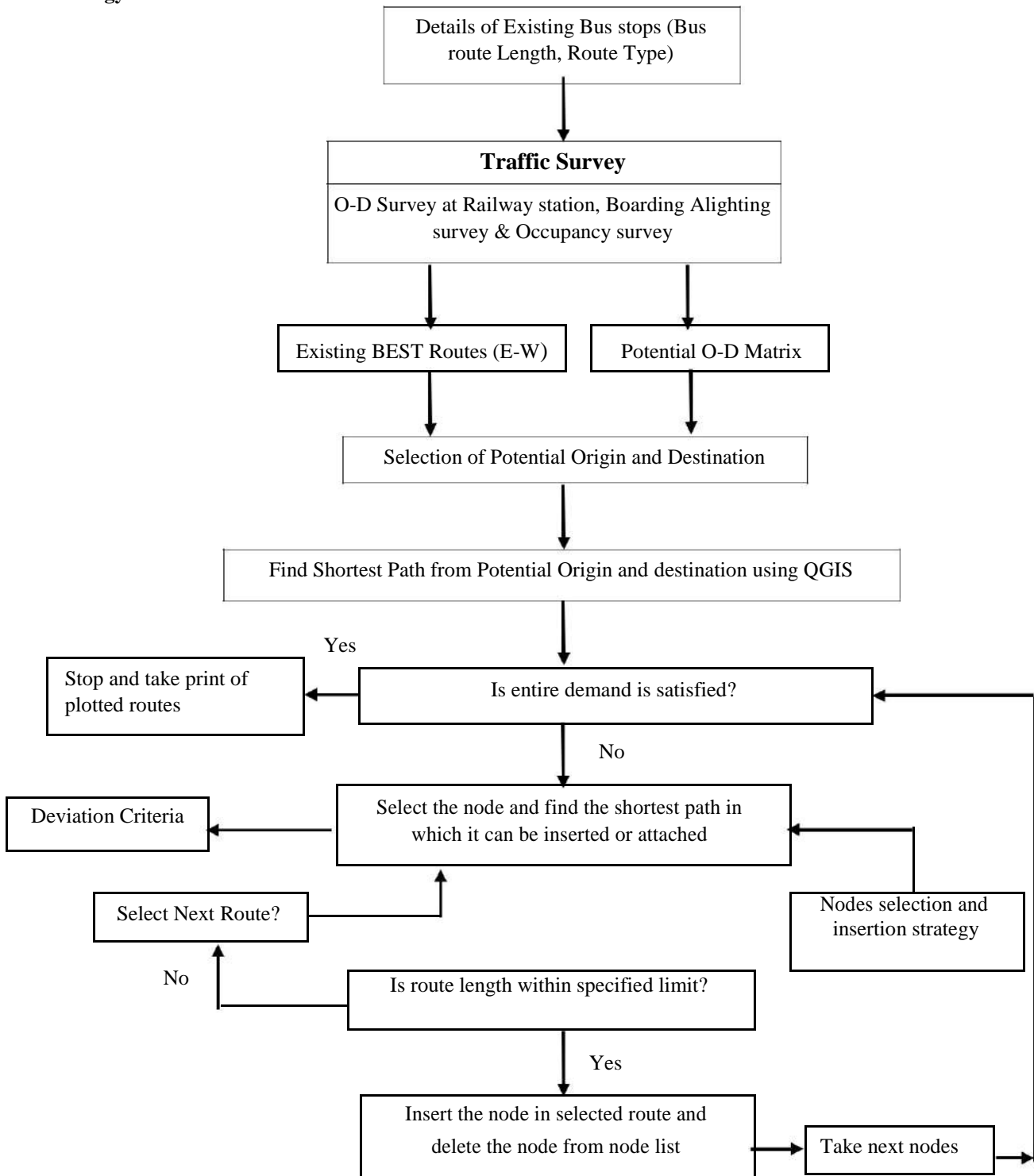


Figure 3: Flow Chart for development of Feeder routes

The methodology, as mentioned above **figure 3** can be summarised in following **steps**.  
The methodology for development of feeder routes can be explained in the following steps

### Strategies and Criteria for development of feeder routes

Various strategies and criteria used for development of feeder routes are given below.

**Shortest Path Deviation Time Criteria:** Whenever any node is inserted by deviating the shortest path. The length of developed route should not exceed the acceptable limit. The acceptable limit for this study is 1.4 times the length of shortest path. This consideration is taken as passenger at destination node should not be delayed beyond 1.4 times the time taken on shortest path. This is to be noted that deviated path will satisfy greater demand, but it will be difficult to maintain the scheduling of buses and thus higher demand nodes passengers will be subjected to delays. So, this maximum demand deviated shortest Path deviation criteria will allow the deviation up to the acceptable limit as mentioned above

**Path Extension Time Criteria:** If nodes to be inserted at the end of the shortest path then the maximum time of route should not exceed the ascertained limit. Its adopted 50 minutes for this case. If the route length increases, it will satisfy larger number of demand without delaying passenger of higher demand nodes. Based on traffic it is decided 50 minutes or 10 Km. Time criteria for extension will fix upper limit for extension of shortest Path.

#### Route Plotting Strategies

##### Case I: Shortest Path Deviation Time strategy.

Path can be deviated in different possible ways. The option shown below is the best selected option among all on the basis of shortest Path deviation criteria to satisfy unconnected demand by deviating the shortest path.

In the above figure 1-5-6-7-9-10-12-13-14 this is the Shortest Path.

Deviated Path 1-2-3-4-5-6-7-8-9-10-12-13-14  
Travel time (minutes) of any link  $i-j$  " $l_{i,j}$ "  
Demand from 'i' (source) to destination 'j' is  $D_{i,j}$   
Before inserting the node in any route best possible routes and way where nodes can be inserted is identified with the help of QGIS.

##### Case II: Shortest Path Extension Time Criteria

If series of nodes are to be inserted at the end of shortest path the shortest path extension time criteria is used.



Figure 5: Path extension strategy

In the figure 5:

Shortest Path: 41-40-39-38-30-29-28-27-26

Extended Path 26-25-24

Travel time (minutes) of any link  $i-j$  " $l_{i,j}$ "

Demand from i (source) to destination j is  $D_{i,j}$

Extension of shortest path is done using QGIS, before extension of any path the best possible way is selected among all available alternatives using QGIS.

##### Case III: Partial Skeleton of shortest Path

When a series of node exist near the shortest path then it became difficult to insert the nodes. In such cases part of the shortest path is used and series of nodes are inserted at the end of part of shortest path. Again, the route extension time criteria are followed for keeping the route length below the upper limit.



Figure 6: Use of Partial Skelton of Shortest Path strategy

In the figure 6,

Shortest Path :1-2-3-4-5-7-6-8-15-16-17

Travel time (minutes) of any link  $i-j$  " $l_{i,j}$ "

Demand From 'i' (source) to destination 'j' is ' $D_{i,j}$ '

In this case node no. 9 will be inserted first after insertion each node time criteria will be checked. If the time criteria are met, then partial skeleton of shortest path is chosen and new routes are plotted.



### Case IV: Ring Ring Bus Routes

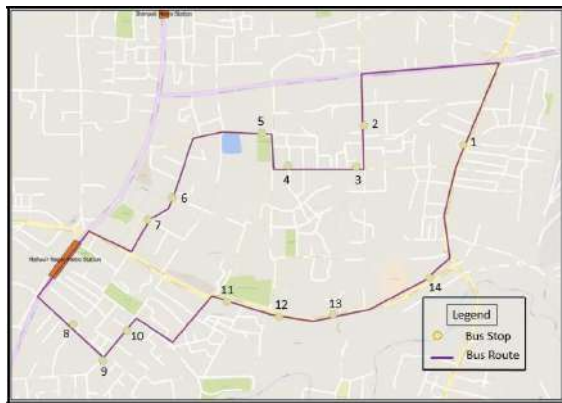


Figure 7. Ring Ring Bus Route

In order to have better east west connectivity ring ring routes have also been developed. These routes are developed only if other routes are not able to provide efficient connectivity, for developing Ring Ring routes time and distance criteria are used. It is considered that travel time does not exceed 50 minutes and distance does not exceed 7 km. In ring ring type of routes source and destination are kept same. If parking and manoeuvring facility is not available, then ring ring type routes are Plotted.

Ring Ring Route: 1-2-3-4-5-6-7-8-9-10-11-12-13-14.

### I. Result & Discussion

Using the above criteria and strategies feeder routes have been developed for Mumbai metro line 2A & 7 using QGIS. Feeder route system is developed in such a way that it connects metro station & suburban railway station with potential areas in the study area where demand exists for metro stations / railway station. Once the metro lines are operational the longer north south distances can be performed by metros and public buses can feed the east west localities. In this paper focus is given to east and west connectivity rather than north and south connectivity. In this paper main focus is given to east and west connectivity and feeder routes according to above strategies have been developed and there are total 34 routes he been plotted. The Figure 8 indicates developed feeder routes for the proposed metro stations. Figure 8a indicates feeder routes for Kamraj Nagar and Mahavir Nagar metro stations. There are total 10 feeder routes for these metro stations. Figure 8b indicates 5 feeder routes for Bandongri, Mahindra & Mahindra and Magathane metro stations.

Figure 9. shows Feeder routes of all Metro stations, there are total 36 routes. The routes have been Plotted using above mentioned cases.

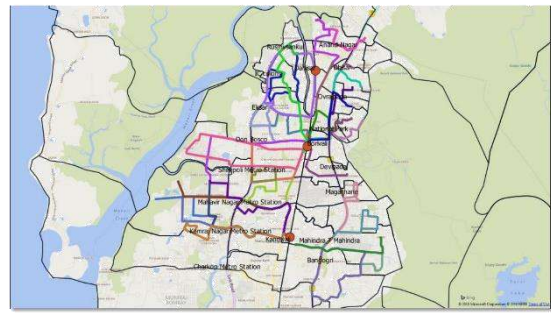


Figure 9: Developed feeder routes

### I. Conclusion

The Proposed strategy is able to develop feeder route system that will satisfy all demands which is generated in the study area. The main focus of this research work is to connect the existing area with railway and metro station, most of studies are limited to satisfy the demand of only one mode, such as bus or train. In this study the demand which will be generated at railway stations and also at metro stations will be satisfied by proposed feeder routes. Since priority is given to higher demand nodes and metro stations the delays to higher demand nodes is restricted to specified limit in development of feeder routes. Since metro stations are considered as potential demand nodes the priority in development of feeder routes is given to connectivity with metro stations. First of all, shortest Path is developed using QGIS then to satisfy demands of remaining nodes shortest Path deviation criteria is used. Shortest path deviation limit is considered 1.4. This criterion is not valid for Ring Ring type bus Routes, in case of Ring Ring bus routes time and distance criteria is used, time does not exceed 50 minutes and distance does not exceed 7 km. Thus the developed feeder routes are quite efficient in satisfying the demands which will be generated at metro stations.

### I. Acknowledgement

Authors express their deep gratitude to MMRDA for providing an opportunity to work for their project on Multimodal Integration. Sincere thanks are due to Dr. D L.N Murthy from MMRDA for valuable inputs at various stages of project. Authors are grateful to BEST officials Mr Victor and Mr Shetty for providing necessary data and suggestions.

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## A COMPRESSIVE REVIEW ON FLY ASH CHARACTERISTICS AND CURRENT UTILIZATION STATUS IN INDIA

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### **Abstract:**

*The paper discusses various characteristics of fly ash and the possibility of its utilization in the various sectors. During the last decade, India saw about 70% increase in the production of fly ash but roughly 130% increase in the utilisation. About 60% of Indian demand of electricity is fulfilled by coal fired thermal power plant. Fly ash is micron-sized powder obtained by burning of coal.*

*At present 170 million tonnes of fly ash is produced in India annually. Environmental pollution by fly ash is a major concern all over the world. Not many people know the fact that the major factor of much talked air pollution in New Delhi is because of fly ash originating from the thermal power plants of Badarpur and Rajghat. As per the Court orders, now both the plants are shut down and consequently there should be reduction in the pollution.*

*Disposal of large amount of fly ash is a serious matter to address. With the appropriate characterization, it can be used as substitute material in various sectors, conserving the resources like soil, sand. Many government agencies have been employed and regulatory framework has been devised for a compressive research and development of potential usage of fly ash.*

### **Keywords:**

*Fly ash, Air Pollution, Utilization, Generation, Thermal Power*

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## **I. INTRODUCTION**

Fly ash may be defined as “fine solid particles of ash carried into the air during combustion, especially the combustion of pulverized fuel in power stations.”

Combustion is the most common process in power plants to obtain electricity and this combustion of coal in thermal power stations produces fly ash. The high temperature during combustion in power plants converts the clay minerals into fused fine particles primarily consist of aluminium silicate. Fly ash possesses both ceramic and pozzolanic properties.

The name “Pozzolan” comes from the volcanic ash mined at Pozzuoli, Italy. It is a siliceous or siliceous and aluminous material possesses little or no cementitious value. However it reacts chemically with calcium hydroxide at ordinary temperature in finely divided form and in the presence of water to form compounds possessing cementitious properties.

The burnt pulverized coal produces 80 % fly ash and 20 % bottom ash. Fly ash is carried away by flue gas collected at ESP hoppers. Bottom ash, the clinker

type ash collected in the water-impounded hopper below the boilers [1].

## **II. PROPERTIES OF FLY ASH**

### **NN. Chemical Properties**

The properties of fly ash depend on type and nature of coal, combustion conditions, nature of pollution control devices, storage and handling system. As it is a coal combustion residue, it shows a wide variation in their properties [2].

Si, Fe, Al, Ca, Mg are the major elements in fly ash. All these elements are present in oxidized state. A normal range of composition of fly ash is given below;

**Table 1: Normal range of chemical composition of Indian fly-ash based on different coal types (expressed as percent by weight) [3].**

S. No	Component	Bituminous	Sub-bituminous	Lignite
1.	SiO <sub>2</sub>	20-60	40-60	15-45
2.	Al <sub>2</sub> O <sub>3</sub>	5-35	20-30	10-25
3.	Fe <sub>2</sub> O <sub>3</sub>	10-40	4-10	4-15

4.	CaO	1-12	5-30	15-40
5.	MgO	0-5	1-6	3-10
6.	SO <sub>3</sub>	0-4	0-2	0-10
7.	Na <sub>2</sub> O	0-4	0-2	0-6
8.	K <sub>2</sub> O	0-3	0-4	0-4
9.	LOI	0-15	0-3	0-5

### OO. Physical Properties

The physical properties of Indian flyash are as follows:

Table 2: Physical properties of Indian flyash [4]

Properties	Avg Values
Mean particle size, $\mu\text{m}$	30
Bulk density, Kg/m <sup>3</sup>	0.897
Brightness, % ISO	28.5
pH	8.5
Sp. surface area, m <sup>2</sup> /gram	1.45
Refractive index	1.7
Colour	grey-brown

For reference, the XRD results of fly ash samples collected from two different places Bokaro Thermal Power Plant (situated in Jharkhand, India) and Dishesgarh thermal power plant (situated in West Bengal) have been shown below;

Table 3: Results of XRF analysis

Chemical Constituent	BTPS Fly ash (%)	DTPS Fly ash (%)
Silicon Dioxide	51.41	50.4
Aluminium Oxide	25.62	19.1
Iron Oxide	3.89	13.1
Manganese Oxide	-	0.121
Magnesium Oxide	0.23	0.803
Calcium Oxide	0.42	5.6
Sodium Oxide	0.13	0.17
Potassium Oxide	0.97	3.58
Titanium Oxide	1.74	3.8
Phosphorus Oxide	0.61	2.11

### III. GENERATION & UTILIZATION OF FLY ASH IN INDIA

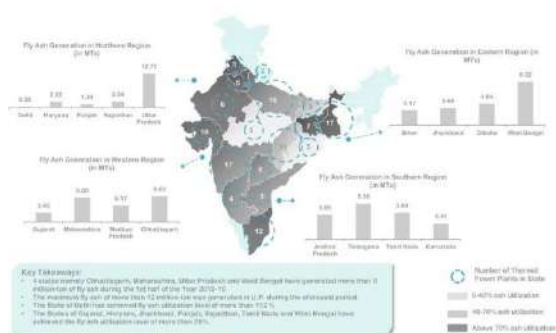


Figure1: State wise Fly ash Generation and Utilization status

Source: CEA (Central Electricity Authority)

A large number of Coal/Lignite based thermal power plants is setup to quench the ever increasing thirst of electric power of a fast growing nation to feed its rapidly growing industries, agriculture and other consumer classes. 57% of the electricity generating capacity is controlled by coal fired power plants [5]. To target the growth rate of India above 8%, the country's total coal demand is expected to increase from approx. 730 MT in 2010-11 to approx. 2000 MT in 2031-32 [6].

Indian coal contains approximately 35-38 % of ash content while imported coal ash content 10-15%. Washing of coal helps reduce the ash content by 7-8 %. Light weight small Fly Ash particles from 0.5 to 300 micron can be airborne easily and pollute the environment [7].

Technologies are developed for productive utilization and safe and sound management of fly ash under the concerted efforts made by Fly Ash Mission/Fly Ash Unit under Ministry of Science & Technology, Government of India since 1994 and the utilization of fly ash has increased to a level of 107 million-ton in 2016-17 [8]. This shows the kind of effort and discipline of Indian industries and monitoring and evaluation of policy makers in ministry and regulatory bodies.

A lot of research has gone into conversion of by-product of coal into wealth by means of exploring viable avenues for fly ash management. Oxide rich fly ash can be used as the raw material for different industries and construction.

Many research reports have strongly suggested that fly ash have good potential for use in highway applications. Its low specific gravity, freely draining nature, ease of compaction, insensitiveness to changes in moisture content, good frictional properties, etc. can be profitable in the construction of embankments, roads, etc. The alkaline nature of no corrosion of steel makes it a perfect mix for use in reinforced concrete construction.





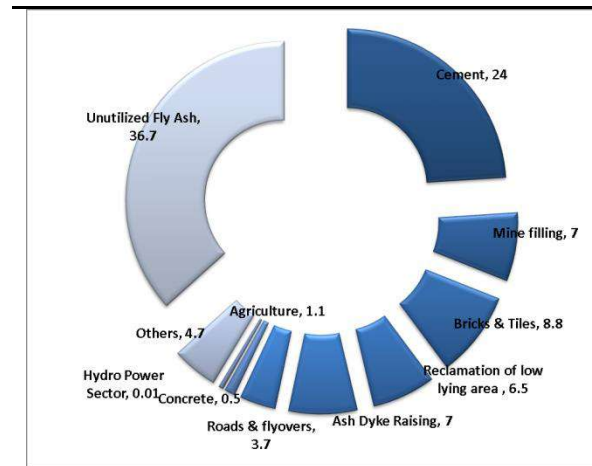
**Figure 2: Fly ash Scenario in India: Production v/s Utilisation [8]**

The fly ash generation in 2016-17 is approximately 170 MT due to combustion of about 510 MT of coal. 178 MT of fly ash was generated in 2015-16 due to combustion of 537 MT of coal. However, the fly ash utilizations during both years remained the same as 107 MT approximately. So, the absolute quantity of fly ash utilization remained same however, the percentage utilization of fly ash has increased. But miles to go before we could barely be satisfied with the utilization level of fly ash in India.

**Table 4: Utilization mode of Indian flyash [9]**

S No	Mode of utilization of Fly Ash	% Usage
1	Cement	24
2	Mine filling	7
3	Bricks & Tiles	8.8
4	Reclamation of low lying area	6.5
5	Ash Dyke Raising	7
6	Roads & flyovers	3.7
7	Agriculture	1.1
8	Concrete	0.5
9	Hydro Power Sector	0.01
10	Others	4.7
11	Unutilized Fly Ash	36.7

As per Central Electricity Authority, Govt of India, fly Ash utilization during the Year 2016-17 is as given in the table 3 which is also presented in the following pie chart in figure 4. Highest 24% of total fly ash utilization was in the cement sector, 8.8% in bricks & tiles, 6.5% in reclamation, 7% in mine filling, 7 % in ash dyke raising, 3.7% in roads & flyovers, minor in Agriculture, Concrete and Hydro Power Sector. But approximately 37% of Indian Fly Ash produced in 2016-17 remained unutilized and that's the bane of the coal-fired mode of electricity production which gives a great opportunity too.



**Figure 4: Fly Ash Utilisation in 2016-17 [10]**

Therefore annual fly ash utilization still remains 64% and it has become a matter of concern in view of its environmental effect [11]. Looking at the importance of utilization of fly ash & slag to offset its impact on the environment, NITI Aayog has taken cognizance of the policy framework. Propagation of the new technologies developed by the efforts of Govt of India by establishing 'Self-sustaining technology demonstration centers' would facilitate and accelerate the fly ash utilization in the country.

A web based monitoring system with a mobile application (**Ash Track**) has also been developed. One can track the monthly data of fly ash with the help of the new app. Power Plants may also seamlessly upload their monthly production data for government to monitor and review.

#### IV SUMMARY

107 million tons of effective utilization of fly ash out of the 170 million tons produced in India shows the dedicated effort of government of India and its machinery. However, there is a need to further improve the numbers close to 100%. It needs many a steps by policy makers as well as the power plant owners, in particular and the society, in general, for acceptance of the concept of fly ash usage.

To scale it to the next level, we must encourage 'Industry-Institute Interactions' for incubating entrepreneurs, creating awareness and organizing extensive trainings and workshops. Introduction of 'Fly Ash' as a subject in academic curriculum of Engineering and Architecture is one of such desirable option looking at the environmental



commitments of India on numerous global platforms.

To further encourage the utilization level of fly ash in India, we may recommend the following concepts:

- A. Up-gradation of Coal fired Power Plants as a drive to meet or exceed the global emission norms.
- B. Large scale utilisation of fly ash in the embankments construction to lay railway lines and roads.
- C. Confirmation of utilization of fly ash as per Environment (Protection) Amendment Rules 2014.
- D. Allocation of the specified fund for research and development in power plants for various new means of utilization of fly ash.
- E. Encouraging agriculture and waste land management to go for higher usage of fly ash.
- F. Providing grant initially by Government to fly ash beneficiation plants.
- G. Preference to the fly ash products by the prospective fly ash users and core industries.

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#### Author Biographical Statements



Dr. Surabhi is currently working as Assistant Professor of Applied Chemistry in Pillai College of Engineering, New Panvel. She has done her Ph.D. on Fly ash Utilization at Indian Institute of Technology (IIT) (Earlier ISM) - Dhanbad, in 2010. Her research at IIT, Dhanbad, was on recovery of unburnt carbon present in Indian Fly ash and its utilization as adsorbent. Based on the Ph. D experience, she also successfully completed a project with University of Mumbai, "Conversion of fly ash into sand". Dr. Surabhi has long been associated with the research in the area of Fly ash utilization. She has significant contribution in several research papers and national and International conferences.



Dr. Arun Shridharan Pillai is employed with Pillai College of Engineering, New Panvel since 2000. He is a Doctorate in Physics from University of Mumbai in 2008. He was associated with industries such as John Deere, KPIT, SPARK India with design of instruction based processors for various applications. He has presented papers in several National and International Conferences and Journals of repute. He is the Director for Trendset Power and Technology Consultants Pvt. Ltd. TRENDSET is into manufacturing of LEDs, Dental LOUPES, Industrial Automation, machine customisation and management of critical power solutions of leading data centers, banks, IT industry and TELCOS.

## HUMAN-LIKE INTERPRETATION OF LINES USING EMBEDDED GPU

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### **Abstract:**

*In the applications where human like interpretation of shapes are required, the Hough Transform is popular because of its noise immunity and simple algorithm. Due to the computational capabilities and power consumption, the real time implementation of this algorithm on a standard CPU is not a good practice. In this paper, we have done line detection using Hough transform which is implemented on NVIDIA Jetson TK1 GPU in order to achieve less execution time with low power consumption. We have used the property of GPU to accelerate the process of line detection and compared the performance of CPU and GPU. We have shown different application of line detection which is implemented on Embedded GPU.*

### **Keywords:**

*GPU, Hough Transform, Image processing, NVIDIA Jetson TK1, Speedup.*

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## I. INTRODUCTION

The need of shape detection in image processing is increasing every day. It is currently being used in many applications. Basic need for the real time image processing in any application is detection of different geometrical shapes. Going for manual extraction of image will end up consuming more time and power as well [1, 2]. The GPU which we are using in this work is NVIDIA Jetson TK1. Basically this kit is ideal for real time image processing applications like driverless car, object recognition, object tracking, underwater cable tracking, traffic and transport applications etc. It is ideal wherever low power consumption and less execution time is required. It also supports number of ports to connect additional peripherals or the device. Jetson TK1 has some important features which make it suitable for real time image processing applications. It has 192 parallel CUDA cores which results in two advantages [10]. In a real time application, the response time of the system plays a crucial role. Generally, the GPU responds faster than the ordinary CPUs. When it comes to a specific application, power consumption is an important factor to be considered. The power consumption of this GPU is comparatively less as it uses parallel computing [1].

The interpretation of lines is done in a similar way, a human brain does. First, it detects all the different grayscales present in the image. Depending on the difference in grayscale for different pixels, it determines the information signal and noise signal. Wherever there is an instant change in gray levels of an image, it is detected as an edge. Once the edge is detected, it detects the pixels which are in a straight

alignment. This combination of pixels arranged in a straight manner is recognized as lines [3]. In this paper we are doing interpretation of lines by using hough transform. Hough transform is the best method for shape detection in real time image processing by using a less complex algorithm [7, 12].

Hough transform converts the colorful image into a grayscale image and detects the shapes needed. As the gray scale image is used for image processing less number of bits are required to represent the picture and hence it consumes less time to for its operation and it also saves the memory required [7, 8]. V. Kamat et al. used hough transform for vehicle detection in their work using DSPs. The purpose of using Hough Transform was that it can easily detect the lines from different orientation and areas as well [6]. Similarly, J. Illingworth et al. identified hough transform suitable for the blur images or images with incomplete data. In his survey he also stated the reason for slow adoption of this transform as memory requirement is high for real time implementation [7]. K. Alexiev et al. used this concept for track initiation when moving objects are present in the radar space which made track detection easy [12].

The paper is organized as follows Section 2 informs about General Purpose Graphics Processing Unit (GPGPU) technology and its features. The Section 3 gives scope of our work. Section 4 explains the design steps for implementation of line detection on GPU. At the end, Section 5 states the results and Section 6 concludes the work.

## II. GRAPHIC PROCESSING UNIT (GPU)

After the GPU was introduced, it was being used in 3D graphics rendering. But the use of GPU is now increased to various gaming consoles and general purpose applications wherever high performance is essential. It is also easily available in the market and costless compared to other dedicated or special processors. Therefore GPU is considered as a cheap parallel supercomputer with utilized processing power [5, 7, 13]. Below is a table enlisting the features of NVIDIA Jetson TK1.

1. **Table 7** Features of NVIDIA Jetson TK1[10,11]

Features	Description
Processor	NVIDIA Tegra K1 Mobile Processor Quad-core, 4-Plus-1™ ARM® Cortex-A15 MPCore™ processor
Memory	2 GB DDR3L system RAM
Max CPU cores	4
Graphics	Low-power NVIDIA Kepler™ based GeForce® graphics processor with 192 CUDA cores.
Mass Storage	16 GB eMMC 4.51 storage
Power Supply	External 12 V AC adapter

## III. SCOPE OF WORK

The objective of this work is line detection on NVIDIA Jetson TK1 and to perform it for various applications and compare the performance of GPU with CPU. In this work, the line detection process is distributed among different cores of GPU. Implementing this parallel process of line detection can reduce the execution time of GPU and give an excellent speedup [1, 13]. We have executed the line detection process on different images having different resolution and different number of straight lines and obtained the advantage of GPU over CPU. The GPU which we are using in this work is NVIDIA Jetson TK1. We have considered various applications like lane detection, platform safety line detection, floor count of building, etc. and successfully implemented this method for all the above applications.

## IV. METHODOLOGY

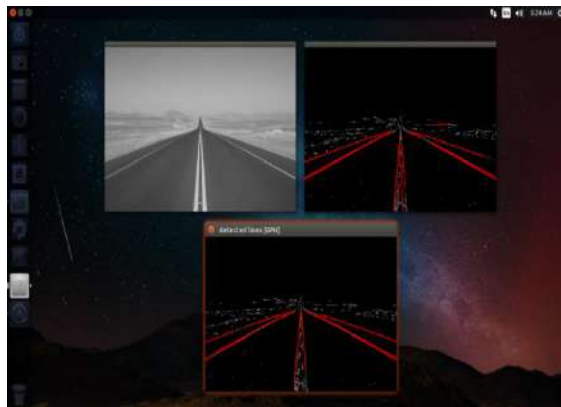
### DESIGN STEPS FOR IMPLEMENTATION OF LINE DETECTION

1. Read the image from the source. The image can be a file stored in database or a real time image through a camera.
2. The colorful image requires more number of bits to represent a single pixel. So, the image is converted into a grayscale image. It saves the memory required to process and results in faster execution.
3. The grayscale image has all the required edge pixels. Canny edge detection is performed on the image to detect the edges using canny edge mask in the range of 0-255 [14, 15].
4. The data is copied to GPU. Further process is done parallelly in CPU and GPU. Calculation of execution time is started after this.
5. The value of houghlines is set, which determines the number of pixels required to be in a straight alignment in order to be detected as a line. Generally, this value is set between 40 and 80. Depending on the application this value can be increased or decreased whenever required.
6. Once the program is ready, it is compiled through terminal and the libraries required are declared. After compilation, an object file is created which can be then run through terminal.
7. We cannot change the parameters for edge detector or houghlines in run time as the object file is already created and cannot be modified.
8. During run time the hough mask is superimposed on the image which has the

predetermined value of pixels as houghlines. We have calculated the execution time for CPU and GPU till this step.

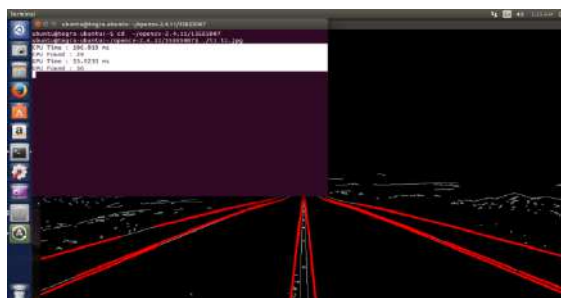
9. A window gets opened with the image with detected lines along with a window having grayscale image on which line detection is performed.
10. The detected lines are highlighted in the image. The number of lines detected and time required for execution is displayed on terminal for both the CPU and GPU.

## V. RESULTS AND DISCUSSION



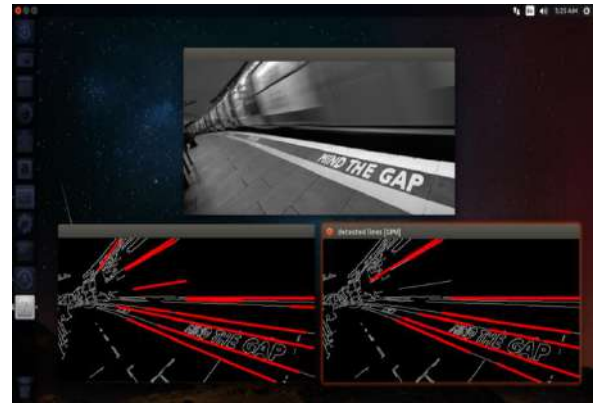
**Fig. 7** Lane detection (Grey scale image with detected lines)

In driverless car systems, most important part is detection of lane in real time and ignoring other lines which are detected. The Fig. 1 shows both the grey scaled image and the image with detected lines by CPU and GPU. It can be clearly observed that apart from the lane, other lines are also present in the image. These lines are treated as a noise in this process. Selection of the line length helps preventing these lines to be ignored. Hence we can make this system to detect only the lines present in the lane.



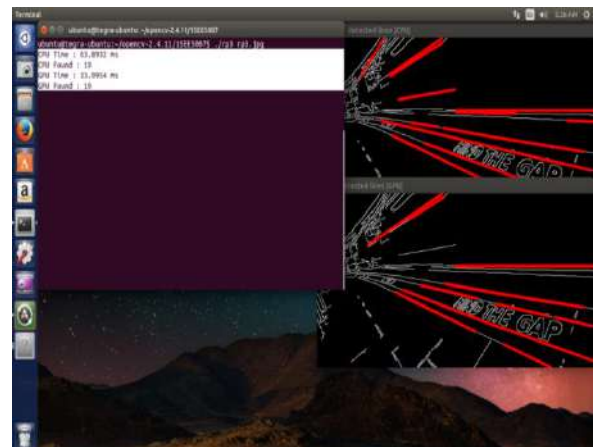
**Fig. 2** Comparison of CPU and GPU time for lane detection (getting the speedup)

By observing the time of CPU and GPU, we get to know that GPU efficiency is approximately twice as of CPU. Hence it saves a lot of time when implemented on real time applications.



**Fig. 3** Railway platform safetyline detection (gray scale image and image with detected lines).

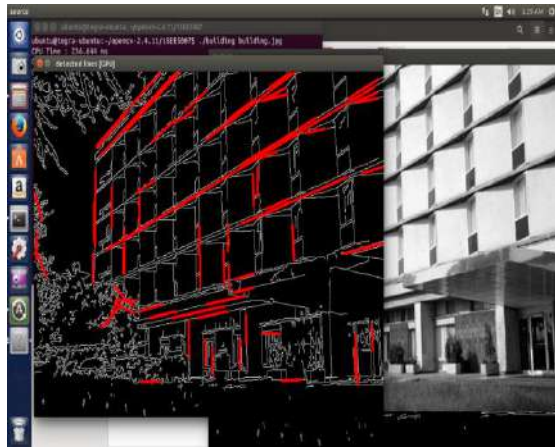
On a railway platform there is a line marked as a safety line to maintain a gap from trains to prevent accidents. Cameras are installed near every platform to continuously observe the safety. But, this kind of surveillance needs a continuous human observation. By directly detecting the lines and the movement, it is possible to automate this surveillance process. As shown in the fig. 3 above, the lines can be detected in real time and hence the safety mark can be detected easily.



**Fig. 4** Railway platform safety line detection with speedup.

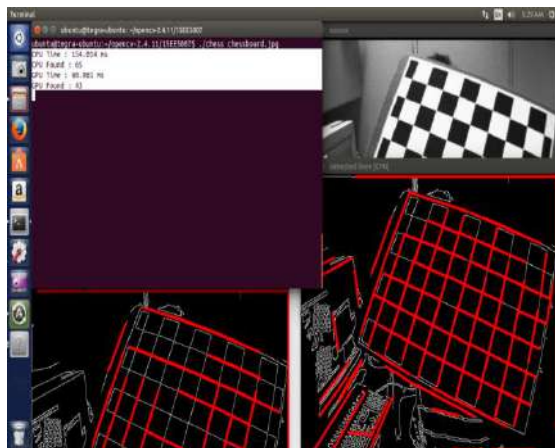
In this case also, the execution time of GPU is less than that of CPU. In real time applications, where safety is a major concern, the execution time should be as low as possible in order to prevent any accidents and also to respond faster.





**Fig. 5** Line detection to count floors or structure of a building.

As shown in the fig. 5 above, in an image of a structure or a building, apart from the required lines other things are also present. It can be a tree, other building or anything else, which we don't want to detect. In such case, we can decide the length of line according to the structure can get the required data even in the presence of noise. The number of lines detected in this image is greater than other applications. Hence, it takes more time to detect the lines in the image. In this application, response time is not an issue. The response time for GPU is better than CPU.



**Fig. 6** Speedup for a chessboard image.

The speedup for ordinary image line detection is also similar as that of dedicated applications. Following is a table which represents basic parameters of an image as well as it shows the speedup. By observing the output for different types of images we can conclude that the GPU takes less time as compared to CPU, which results in a faster execution of a process and requires less time to respond. Hence the GPUs can replace the conventional CPUs in dedicated real time applications where lesser execution time is required.

**Table 2** Result of Images on which Line detection Features of NVIDIA Jetson TK1[10,11]

Sr. No.	1	2	3	4
<b>Image</b>	Lane	Platform	Chessboard	Building
<b>Resolution</b>	1280 X 854	650 X 300	640 X 486	868 X 600
<b>Lines detected by CPU</b>	29	19	65	47
<b>Lines detected by GPU</b>	36	19	43	98
<b>CPU Exe. Time (ms.)</b>	106.019	63.893	154.01	236.644
<b>GPU Exe. Time (ms.)</b>	53.5233	33.995	60.961	143.025
<b>Speedup</b>	1.9808	1.8794	2.5264	1.6545

## VI. CONCLUSIONS

The Hough transform is an essential way of detecting shapes in an image. The GPU is being used in wide range of applications such as gaming consoles and surveillance systems and hence is easily available in the market. Therefore it can be used in less costly image processing applications. By observing the results obtained we can conclude that parallel architecture of GPU can be utilized in line detection using Hough transform. The implementation of Hough transform on GPU results in faster execution, low power consumption, and gives better efficiency compared to conventional CPU.

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## PERFORMANCE REVIEW OF VENTURI SCRUBBER

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### Abstract:

Radioactive emissions are released from the molten core into reactor containment during the failure of nuclear power plant (NPP) due to severe accident. The technology called "Filtered Vented containment system (FVCS)" is the necessity in nuclear power plant for the removal of gaseous pollutants. The Self – Priming venturi scrubbers are the most efficient scrubbing device for the collection of gaseous pollutants and fine particles. Venturi Scrubbers frequently collect gaseous pollutants and particulate matter from the contaminated gas stream in the form of droplets formed due to liquid atomization. The main purpose of this literature review regarding the Venturi Scrubber to make modified optimum design to improve the performance of Venturi Scrubber as per the required safety regulation standards.

### Keywords:

Nuclear power plant, Filtered vented containment system, Particulate matter, Venturi Scrubber.

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### 1. INTRODUCTION

Air pollution problems are major concern due to rapid industrial development. Recently the enormous efforts have been made to develop new technologies to control the pollution and to improve the old technologies. When the severe accident in Nuclear Power Plant takes place, the highly radioactive fission products are released from the molten core into the containment which creates health issues of human being and is the hazard for the environment due to its release to atmosphere. In the severe accident of nuclear power plant (NPP), the fission products are released from the molten core into the containment (Feng and Xinrong, 2009)[1]. FVCS is used to reduce the intensity of radioactive effects. The gaseous pollutants and Particulate matter can be removed by using the different designs of FVCS from the contaminated region (Schlueter and Schmitz, 1990)[2]. Venturi is the most competent device from 20<sup>th</sup> Century to remove the gaseous pollutants and particulate matter from the contaminated region. This kind of scrubber uses an appropriate liquid (commonly water) to capture various contaminants from the contaminated in gas stream (Guilbert et al., 2007)[3]. There are

three main sections of venturi scrubber as shown in figure 1.

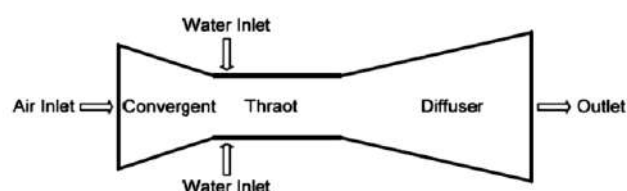


Fig.1: Schematic Diagram of a Venturi

The convergent part accelerates gas for atomizing the scrubbing liquid. The interaction of liquid and gas takes place in throat. There is some amount of pressure recovery due to deceleration of gas in a diffuser. The venturi scrubber can be rectangular or circular in cross section. There are two ways for the injection of liquid into venturi scrubber; force feed methods by using pumps or self – priming methods due to pressure variation in between scrubbing liquid pressure and gas pressure (Lenher, 1998)[4]. In Pease – Anthony venturi scrubber, the liquid is injected at throat through the orifices and liquid spray is used in an Ejector venturi scrubber (Gemisan et al., 2002)[5]. The venturi scrubber is one of the most prominent wet scrubbers because of simple structure, easy to install, no moving parts, can handle flammable and explosive

dust and low maintenance. It has more power consumption for its operation. The main objective is to report the detailed review of research carried out by the previous researchers regarding the performance of Venturi Scrubber.

### **Important Parameters Considered In Venturi Scrubber Performance**

Pressure drop, atomization, size of droplets, droplet dispersion, and injection method and collection mechanism are important parameters for Venturi Scrubber Performance. It is necessary to predict these parameters more accurately for the optimization.

**Pressure Drop:** Pressure drop is the one of the integral parameter of Venturi Scrubber. There are many models are developed to predict pressure drop experimentally and theoretically.

Calvert model(1970)[6] explains the significance of change in momentum of droplets and pressure drop.

Assumptions in Calvert model:

- Droplet entered with zero velocity (axial)
- Negligible Liquid fraction at any cross section
- Uniform size of droplet
- Atomization of liquid
- Flow was on dimensional, incompressible and adiabatic

Calvert model (1970)[6] does not contain the geometry variations and its effect on the performance.

Mathematical model developed by Boll (1973)[7] constituting simultaneous equation of momentum exchange and drop motion. The important assumption made by Boll is disintegration of liquid forming tiny droplets.

Hesketh (1974)[8] explained the importance of gas velocity at and L/G ratio to estimate the pressure drop. Hesketh assumed that the energy required for droplets acceleration is equal to gas velocity at throat.

Yung et al., (1974)[9] developed model for pressure drop and he assumed that the droplet did not achieve the velocity of gas. Yung et al.,(1978)[10] obtained Nukiyama and Tanaswa correlation for identical droplets and also gives drag coefficient correlation of droplets.

Vishwanathan (1984)[11] model obtained pressure drop in Pease – Anthony venturi scrubber in the form of L/G ratio, gas velocity at throat, venturi geometry and liquid film flow rate and

compared the data with Calvert, Hesketh and Boll's correlation. Different losses are considered in this model.

Allen et al.,(1996)[12] estimated the total pressure drop is a function of operating conditions separately for dry and wet situations.

Goncalves et al.,(2001)[13] considered all previous models and compared the experimental results of different venturi scrubbers and concluded that selection of model is important and more attention must be paid for the same.

Gamisan et al.,(2002)[5] revealed the effect of throat diameter, throat span and spray angle on pressure drop of Ejector.

Silva et al.,(2009)[14] predicted the pressure drop for different liquid penetration and studied the effect L/G ratio and gas velocity at throat.

Vishwanathan (1998)[15] model predicted the effect of orifice diameter, gas velocity at throat and film thickness.

There are several correlations available, both theoretical and experimental to predict the pressure variation. The mathematical model for pressure variation by each investigator is different as all of them considered different parameters to calculate pressure drop.

### **Particle Collection Efficiency**

The particle collection efficiency of Venturi Scrubber is affected by various parameters like particle size and size distribution, gas velocity; Liquid-to-Gas ratio etc. The basic approach for the collection of small particles is through the evaluation of unit mechanisms that can occur in the control device. The "Scrubber Handbook" by Calvert, et al. (1972)[17] describes various mechanisms of particle collections. The collection by drops is the predominant mechanism occurring in the venturi scrubber. Particle collection by liquid drops may arise through several mechanisms or phenomena, such as inertial impaction. The inertial impaction occurs as a result of a change in velocity between particles suspended in a gas, and gas itself

Ekman and Johnstone (1951)[18] studied different parameters to enhance the venturi scrubber performance.

Calvert (1970)[6] predicted the collection efficiency by developing mathematical model.

Boll (1973)[7] developed model and calculated collection efficiency which includes effect of geometry and drag coefficient.

Hesketh (1974)[8] predicted collection efficiency relied on pressure drop, throat area and L/G ratio.

Yung et al. (1978)[10] used Calvert equation with modification and predicted the particle collection.

Placek and Peters (1981)[19] predicted that the throat length, venturi design, location of injection liquid and operating variable parameters (L/G ratio and velocity of gas at throat) affect the efficiency.

Cooper and Leith (1984)[20] developed model and studied the various parameters to enhance the scrubber performance

Rudnick et al. (1986)[21] found that Yung's model performed better compared to other models.

Allen (1996)[12] predicted grade efficiency for variable geometries.

Pulley (1997)[22] predicted the venturi scrubber performance on the basis of liquid injection method and revealed the pressure drop and collection efficiency.

Gamisans et al., (2004)[23] predicted the absorption of the contaminants in venturi through hydrodynamic model. Experimentally it was found that the removal efficiency varies with the liquid film thickness.

The computational model by using Eulerian – Langrangian for three phase flow developed by Pak and Chang (2006)[24] estimated the venturi performance.

Monabbati et al. (1989)[25] model estimated the efficiency of venturi scrubber. This model predicted the effect of particle size, liquid and gas flow rates.

Goel and Hollands (1977)[26] developed design procedure for optimization of venturi scrubber. In order to optimize Venturi design, the charts were developed.

Mayinger and Lehner (1995)[27] studied the operating conditions. It was found that multistage injection of liquid affects the improvement of separation efficiency.

#### **Droplet Dispersion:**

Lehner (1998)[4] observed the disintegration of liquid via photography in a self – priming venturi scrubber. It was found that the liquid penetration was more sensitive to velocity of gas at throat. There was no difference observed on the basis of method of feed.

Roberts and Hill (1981)[28] studied liquid disintegration process in different designs of venturi.

Viswanathan et al (1983)[29] predicted the liquid penetration is important for uniform coverage of throat. It was found that the dust collection efficiency was increased with increase in L/G ratio. It was also found that liquid flux distribution is highly dependent on L/G ratio.

#### **Size of Droplet:**

The collection efficiency of drop depends on its size and hence to model the particle collection by a venturi scrubber, one should know the atomized liquid drop size. Several correlations are available for estimating the average liquid drop size. Each of this correlation is applicable to a certain range of operating conditions and properties like surface tension, viscosity and density. The Nukiyama and Tansawa correlation gives the mean droplet diameter for standard air and water in venturi scrubber.

Over the last 30 years a plenty of research have been done which report drop size data for venturi scrubbers. The correlation of Nukiyama and Tanasawa (1938)[30] has been used extensively over many years to find average liquid drop size. Parker and Cheong (1973)[31] presented drop size data in a venturi where liquid film is considering for the wetted approach. Azzopardi et al.,(20010)[32] and team estimated the drop sizes in venturi scrubbers with higher accuracy and concluded that gas velocity is the main factor influencing drop size in venturi scrubbers where the liquid to gas (L/G) ratio plays a negligible role.

## **II. CONCLUSION:**

This report gives the detailed review of research carried out in the last few decades regarding the Venturi Scrubber performance to make modified optimum design to improve the Venturi Scrubber performance as per the required safety regulation standards. It also revealed that the performance of venturi scrubber depends upon so many parameters namely Venturi geometry, Pressure drop, liquid flow, gas flow rate, injection method, droplet dispersion, atomization and collection mechanism

## **III. ACKNOWLEDGMENT**

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# IOT BASED AUTOMATED ROOM USING GOOGLE ASSISTANT

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**Abstract:**  
*IOT based automated room using Google assistant is an innovative idea in which the room appliances like fan, lights and air conditioner can be controlled using our voice command through Google assistant using internet from anywhere in the world. Our aim is to connect, monitor and control the different appliances with the internet utilizing portable devices like smart phones which millions of people already using. In this work, there will be manifestation of a room in which appliances could be controlled using our voice commands. In this concept, sensors will be connected to the internet through different hardware and software and then we can give a command on the internet from anywhere and command will be followed.*

**Keywords:**  
IOT, voice commands, Google assistant , Internet.  
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## I. INTRODUCTION

The Internet of Things (IOT), is a new technology which is one of the most important areas of future and is gaining vast attention from a scientific world and industries. As the smart phones and internet are widely used ,the main idea aims at connecting appliances present in room with internet and further monitoring and their controlling through smart phones using Google assistant.[2]

## II. TECHNOLOGY USED

### A. SOFTWARE COMPONENTS

#### 1. ARDUINO SOFTWARE (IDE)

The Arduino IDE (Integrated Development Environment) is basically a text editor for writing codes. It also contains a message area, a text console, a toolbar with buttons and a series of menus. It is capable of connecting to the Arduino and Genuine hardware and uploading programs on it. The Programs are written in the text editor using Arduino(IDE) .[3]

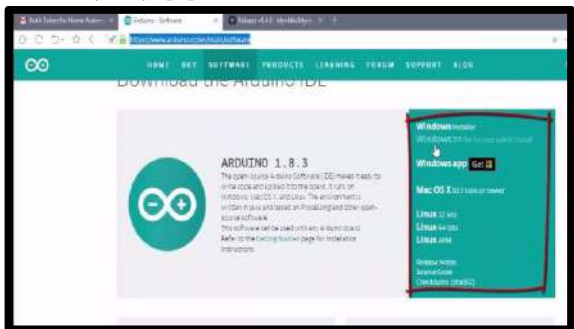


Fig. 1 Arduino Software

### 2. BLYNK APPLICATION

BLYNK is a platform available with iOS and Android systems to control the hardware capable of connecting to the internet. It is capable of controlling hardware remotely, displaying, storing and visualizing sensor data. The three major components in the platform are: BLYNK App- It allows to add different widgets and create an interface. BLYNK Server- It acts as a communication link between the Smartphone and hardware. BLYNK Libraries- It enables communication, for all the popular hardware platforms, with the server and process all the incoming and outgoing commands. [4]

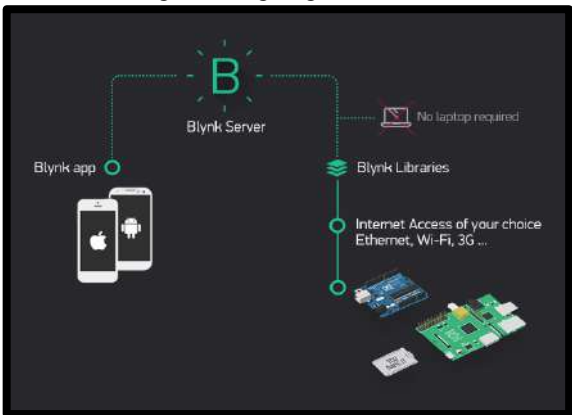


Fig.2 BLYNK cloud Architecture [4]

### 3 IFTTT

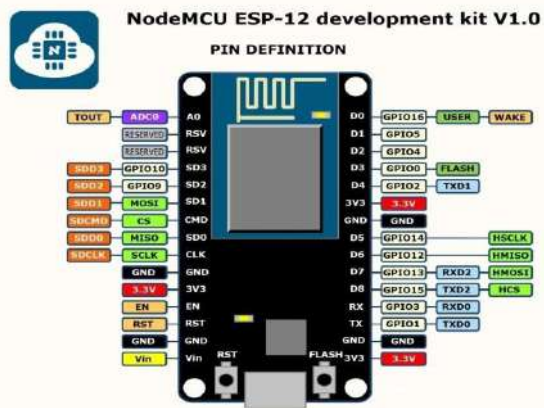
The term IFTTT stands for If This, Then That. It is free web tool that puts the internet to work for us and is capable of automating all our tasks. It was launched in 2010 and is an automation service for all the internet-connected things. There are various ways in which we can connect all our services - and the resulting combinations are known as "Applets". Applets are basically used to automate our

daily workflow from managing our smart home devices or apps to websites.[5]

## B. HARDWARE COMPONENTS

### 1 NodeMCU

NodeMCU is an open source platform with ESP8266-12 chips which is used for developing IOT applications. NodeMCU firmware comes with ESP8266 Development board/kit i.e. NodeMCU Development board



Fig

.3 Pin Diagram[6]

NodeMCU Development Board/kit v1.0 (Version2)

NodeMCU Dev kit/board has Arduino like Analog (i.e. A0) and Digital (D0-D8) pins, has wifi capability and it supports serial communication protocols i.e. UART, SPI, I2C etc., through which we can connect it with serial devices like I2C enabled LCD display, Magnetometer HMC5883, MPU-6050 Gyro meter + Accelerometer, RTC chips, GPS modules, touch screen displays, SD cards etc.

We can use two different types of IDE (Integrated Development Environment) for the development of NodeMCU namely ESPlorer IDE and Arduino IDE. The former one uses Lua scripts for writing and uploading codes on the NodeMCU. Lua is an open source, lightweight, embedded scripting language. The latter one uses the well-known IDE and uses C/C++ language for developing applications on NodeMCU.

Since, NodeMCU is Lua Interpreter, so when we write Lua scripts for NodeMCU and send/upload it to NodeMCU, then they will get executed sequentially. Whereas, when we will use C/C++ for NodeMCU, it will build binary firmware file of the code we wrote and it writes the complete firmware. Here, I have used Arduino IDE. I found it better as it makes it easy for the Arduino developers than learning a new language and IDE for NodeMCU. Since, I have used Arduino IDE, we need to take care of the fact that NodeMCU Dev kit pins are numbered differently than internal GPIO (General-purpose input/output) notations of ESP8266 [7]

### 2 SERVO MOTOR

A servo motor is a light-weight motor which works just like any standard motor but it is smaller in size and can rotate approximately 180 degrees (90 degrees in each direction). Some important specifications of servo motor are: operating voltage: 4.8 V (~5V), operating speed: 0.1 s/60 degree

### 3 DC MOTOR

A 3V DC Motor is a small motor which is ideal for hobby projects and demonstrations. It runs on 1.5-3VDC. It uses permanent magnets which makes it function as a motor as well as a generator

Some important specifications of DC motor are: RPM: 14200 RPM. Current: 300mA. Maximum Efficiency: 60%. Stall torque: 115 gram-cm.

### 4 LED

A light-emitting diode (LED) is a p-n junction diode that emits light when a suitable current is applied to the leads. LEDs are typically small (less than 1 mm<sup>2</sup>).

### 5 RELAY BOARD

2-channel relay module is used to control larger loads like AC or DC Motors, solenoids, light bulbs, electromagnets, etc.

Features of a relay board are Number of Relays: 2 Control signal: TTL level Rated load: 7A/240VAC 10A/125VAC 10A/28VDC

### 6 SMARTPHONE

A smart phone with the Google assistant application is needed so that we can use voice commands to control the room's appliances.

### 7 JUMPER CABLES

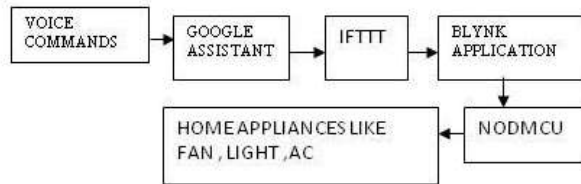
Jumper cables are necessary in order to make the connections between the devices.

## III. METHODOLOGY

The idea is basically of a room which can be controlled using our voice commands over the internet from anywhere in the world. We will use Google assistant for giving the voice commands. The voice commands will be interpreted by IFTTT and then the appropriate requests will be sent to the BLYNK application, which will send the request to the NodeMCU and turn the room's appliances ON and OFF.[8]

In this work, all the sensors will be connected to the internet through NodeMCU. At first the NodeMCU is programmed and connected to various appliances. Once the NodeMCU is powered, it will automatically connect to the WIFI network specified in the program uploaded on the NodeMCU. BLYNK will send an ON/OFF commands to the NodeMCU which will turn the home appliances on and off. IFTTT will bridge the gap between Google assistant and the BLYNK app. Once the commands are said to the Google assistant, it will send the command to IFTTT. IFTTT will then interpret that command and send

appropriate request to the BLYNK app which will send the request to the NodeMCU and then to the electrical appliances. In, IFTTT 'this' is Google assistant where we will have to add voice commands and 'that' is web-hooks, which allows us to send web request to the BLYNK app [9].



**Fig. 4** Proposed system modelIV. **SYSTEM**

#### IV. Analysis And Discussion

The main idea is using a NodeMCU board with Internet to develop home automation system which can be remotely controlled by any smart phone. With the advancement in technology, our houses are getting smarter. They are gradually shifting from conventional switches to centralized control system. Remote controlled home automation system providing a modern solution with smart phones. The proposed system could be more convenient and implementing with such a real time system will make our lives much better. The discussed approach could be used to control the room appliances remotely using the Wi-Fi technology. We can conclude that this idea once implemented will have lower cost, low maintenance and high efficiency. Greater control and better energy efficiency can also be achieved. Home automations can thus bring greater savings [10]. It is reassuring and definitely worth the investment. The system once developed will be highly convenient and will surely draw great comforts to our lives

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