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# Internet of Things in Smart Technologies for Sustainable Urban Development

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# Edge Computing-Based Intrusion Detection System for Smart Cities Development Using IoT in Urban Areas



S. Vimal, A. Suresh, P. Subbulakshmi, S. Pradeepa, and M. Kaliappan

## 1 Introduction

Internet of Things (IoT)-based industry has had enormous growth in urban planning with its foundations in the development of the industries for chips, microcontroller kits, electronic gadgets, and telecommunication systems, forming industrial segments. Attacks and vulnerability issues are the main concerns in the IoT, such as network breaches. Vulnerability can be suspected using an intrusion detection system, which can encounter anomalies with the reliable services of IoT applications. Various deep learning models have been proposed, with the modeling scheme of learning and data from sensors forming the structure of the setup. The

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# Chapter 3

## Machine Learning Techniques to Mitigate Security Attacks in IoT

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### ABSTRACT

*Evolving technologies involve numerous IoT-enabled smart devices that are connected 24-7 to the internet. Existing surveys propose there are 6 billion devices on the internet and it will increase to 20 billion devices within a few years. Energy conservation, capacity, and computational speed plays an essential part in these smart devices, and they are vulnerable to a wide range of security attack challenges. Major concerns still lurk around the IoT ecosystem due to security threats. Major IoT security concerns are Denial of service(DoS), Sensitive Data Exposure, Unauthorized Device Access, etc. The main motivation of this chapter is to brief all the security issues existing in the internet of things (IoT) along with an analysis of the privacy issues. The chapter mainly focuses on the security loopholes arising from the information exchange technologies used in internet of things and discusses IoT security solutions based on machine learning techniques including supervised learning, unsupervised learning, and reinforcement learning.*

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
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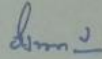


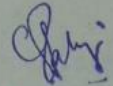
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## IoT BASED SMART IRRIGATION SYSTEM

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### ABSTRACT

Agriculture is our backbone to our country. Now a days the world markets are marching towards new technologies and it is essential to improve on agriculture also. IoT plays a very Smart role in agriculture. IoT sensors are sending information about agri- fields. Here we are demonstrating smart agriculture system using automation through IoT. This IoT based monitoring system works with help of sensor networks that collects data from different sensors connected at various nodes and send the data through the wireless protocol. This smart agriculture using IoT system is powered by Arduino, it consists of Temperature sensor, Moisture sensor, water level sensor, PIR sensor, SMD led, DC motor and GSM module. IoT based smart agriculture monitoring system monitors the water level, humidity and moisture level with intrusion detecting. It sends SMS alert and update the data in the cloud to the mobile about the various levels. Sensors sense the water level, humidity and moisture level and Person intrusion, if the level of water goes down or above the limit, it automatically switch on or off the water pump depends on the sensed data's and intrusion detected means SMD gets turn on. These are displayed on the LCD display module.

**Keywords:** Temperature, Moisture, Ph and intrusion detection System, Stability, Delay,.

### INTRODUCTION

In the modern world the internet like Internet of Things (IoT) is the next big thing for the industry. On the other side, it is predicted that in future the population of the world will exceeds and the food needed to people is about 70%. Incorporating IoT based smart agriculture systems is essential to meet up our needs.

According to the survey it is observed that agriculture promotes 27% to GDP, and provides employment to 75% of Indian population. IoT is changing the agriculture sector and supporting farmers to fight with the huge problems they face. The agriculture must face water drought,

availability of lands. The ph level of the soil varies from area to area leads to uncertainty in the soil. New emerging IoT applications are addressing these issues and increasing the quality, quantity, sustainability and cost effectiveness of agricultural production in soil and the case studies shows the fertilizers impact on soil over 15 years.. In today's world population to meet out the food to all people through agriculture. Agriculture becomes more important to meet the needs of the human race. However, agriculture requires irrigation and in every year we have more water consumption but there is a lack of rainfall, it becomes critical for growers to find ways to conserve water while still achieving the highest yield.. In current era the farmers should provide daily irrigation properly. Based on statistics, agriculture consumes 85% of available freshwater resources, and this percentage will continue in water consumption due to population growth and increased food demand. Hence it can greatly improve the utilization of water and decrease water quantities. The Internet of Things (IoT) is a technology where in a cloud where we can store data on time from sensors to monitor the field. The Internet of Things (IoT) is going to deal with interconnected communicating objects that are installed at various locations and distant from each other. Internet of Things (IoT) is a type of network technology, which senses the information from different sensors and makes anything to join the Internet to exchange information. It can also be used to modify the status of the device. The central processing unit will also include communication device to receive data from the sensors and to be relayed to the user's device. This will be done using a Wi-Fi module. The data is transferred to the user through cloud /gsm. water scarcity is a big problem in farming. This idea helps the farmers to irrigate the farmland based on sensed data's.

### RELATED WORK

1.Chavan, C. H., & Karande, P. V. (2014). Wireless monitoring of soil moisture, temperature & humidity using zigbee in agriculture. *International Journal of Engineering Trends and Technology (IJETT)*, 11(10), 493-497

### INFERENCE:

- Monitoring the data's from sensors in farm land

- Reduce Manual Intervention, less power consumption
- Cost and Protocol Of zigbee module is high

2. Satyanarayana, G. V., & Mazaruddin, S. D. (2013, April). Wireless sensor based remote monitoring system for agriculture using ZigBee and GPS. In *Proceedings of the Conference on Advances in Communication and Control Systems-2013*. Atlantis Press.

**INFERENCE:**

- Monitor the Farm land in remote location with knowledge of sensors
- Monitor and calculate the data's in flood area and drought area's
- Cost and Protocol Of zigbee module is high, distance between the communicating nodes is about 15m

3. Kodali, R. K., & Mahesh, K. S. (2017, September). Low cost implementation of smart home automation. In *2017 International Conference on Advances in Computing, Communications and Informatics (ICACCI)* (pp. 461-466). IEEE.

**INFERENCE:**

- Controlling the home applications using Internet of Things
- Android application based home automation
- Made it in a huge scale, complex of control

4. Gupta, P., Agrawal, D., Chhabra, J., & Dhir, P. K. (2016, March). IoT based smart healthcare kit. In *2016 International Conference on Computational Techniques in Information and Communication Technologies (ICCTICT)* (pp. 237-242). IEEE.

**INFERENCE:**

- Collect all the medical data of a patient
- Monitoring the real time parameters
- The real time values does not specify the exact disease that could occur

5. Chieochan, O., Saokaew, A., & Boonchieng, E. (2017, October). Internet of things (IOT) for smart solar energy: A case study of the smart farm at Maejo University. In *2017 International Conference on Control, Automation and Information Sciences (ICCAIS)* (pp. 262-267). IEEE.

**INFERENCE:**

- Interactive energy-saving behaviors where devices control their

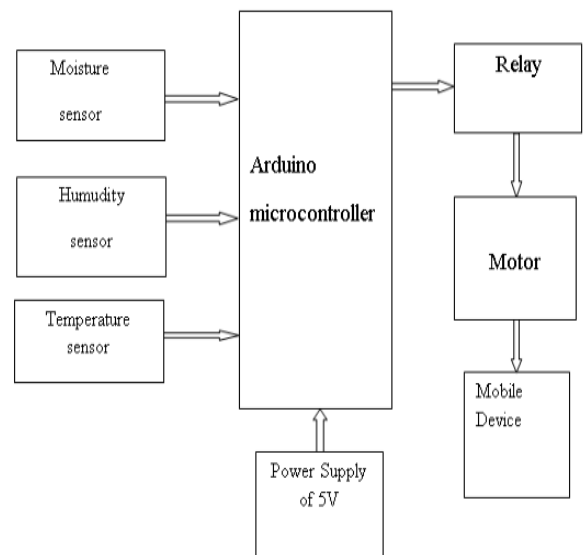
power state to meet user needs while minimizing energy use.

- When applicable to industries, the controlling of systems will be affected that could affects the final product

**EXISTING METHODOLOGY**

The proposed system used to avoid the unnecessary water flow into the fields. Moisture, temperature and humidity readings are continuously monitored by using temperature, moisture and humidity sensor and send these data's to the assigned Protocol. Android application continuously gets the sensed data's from the assigned IP address. Once the soil moisture values are exceeded the limit it turns the motor on, which is connected to the Arduino . This android application has 4 options. This includes motor, temperature , humidity values and moisture values.

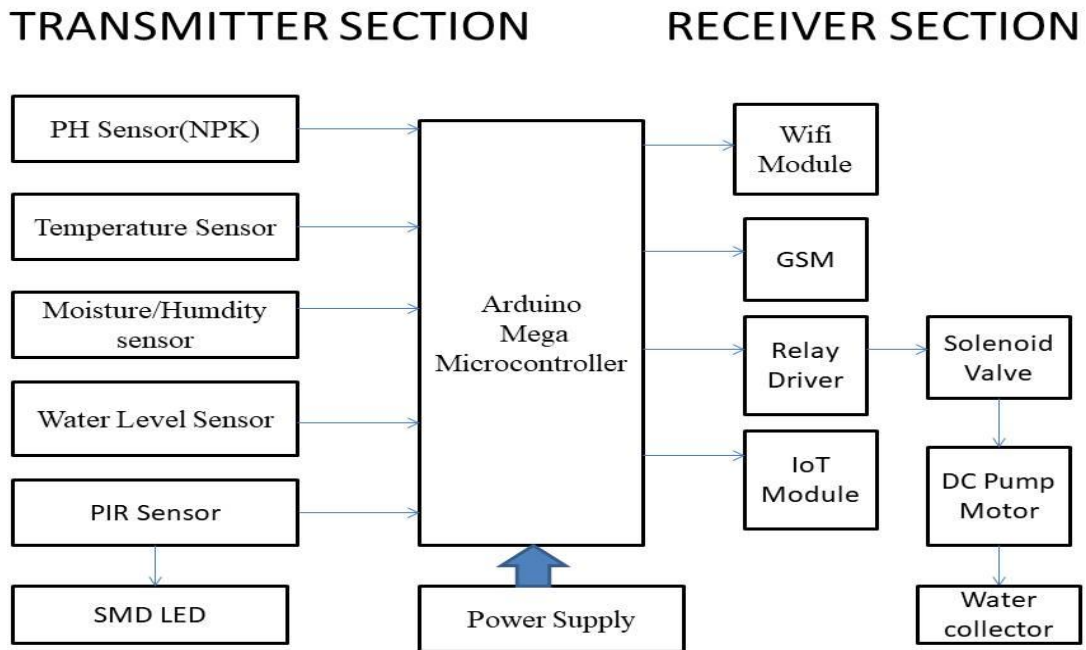
**EXISTING BLOCK DIGARAM:**



**PROPOSED METHADODOLOGY**

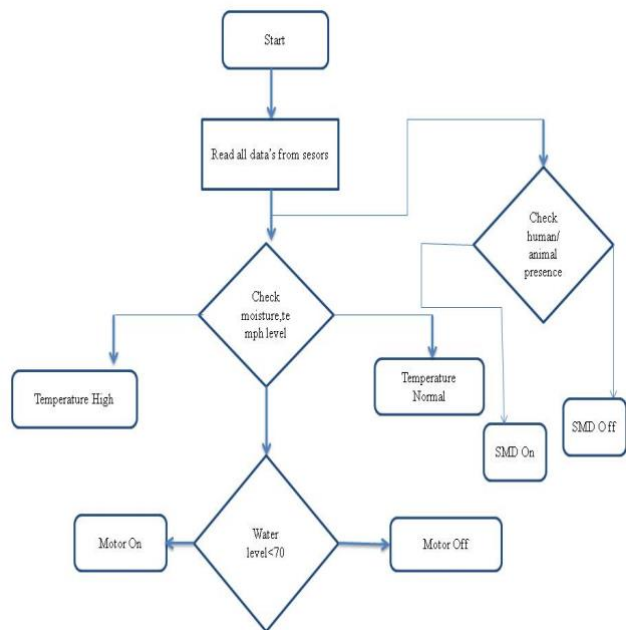
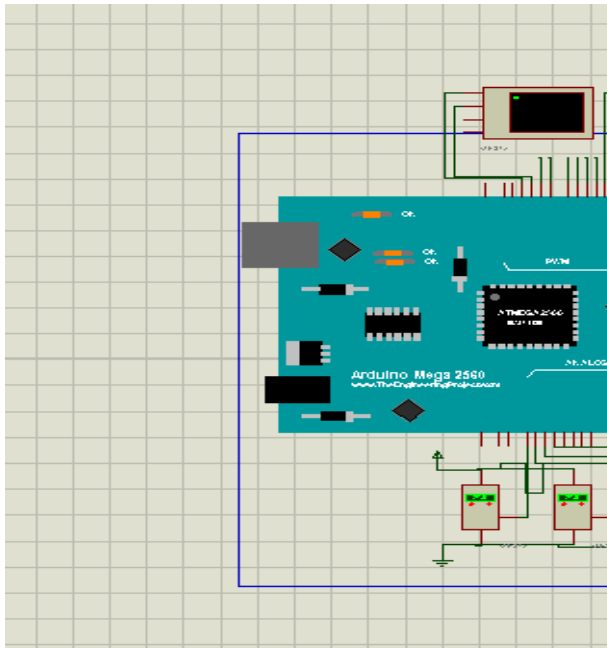
The modified block diagram has 2 sections listed follows ,Transmitter section and receiver section .Transmitter section having Temperature, moisture ,water level, ph sensor and Pir sensor. This transmitter section shows the reading which is viewed through Lcd module, serial monitor , IoT module ,GSM module. If the temperature value goes above 40 which shows temperature high message. If Moisture level >70 & water level < 70 the motor gets turn on, then if any human/animal movement detected means the pir sensor shows the output value incremented as one which is followed by smd led gets turned on .These are displayed through IoT & GSM module

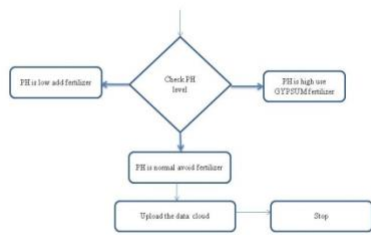
**PROPOSED BLOCK DIAGRAM:**



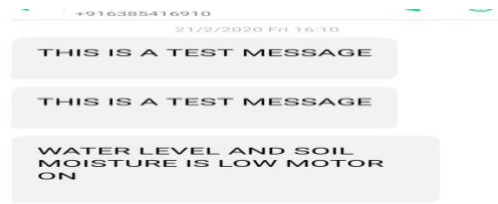
**FLOW CHART**

**SIMULATED DIAGRAM:**



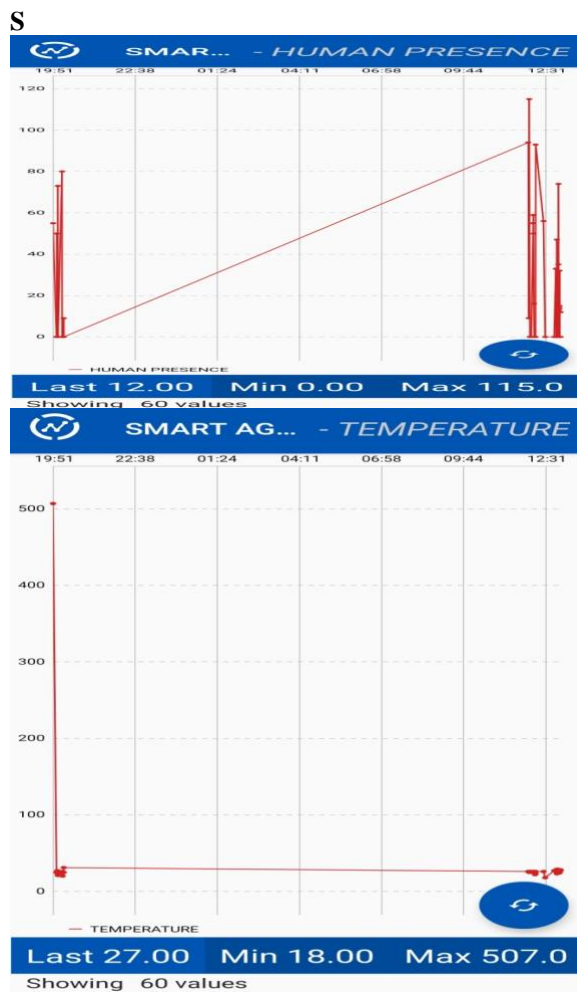


## GSM OUTPUT

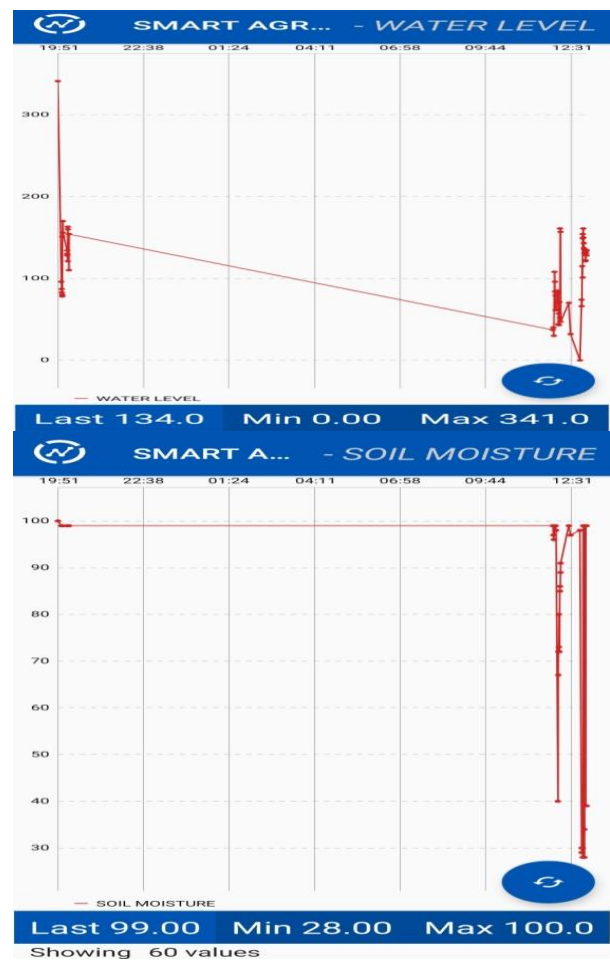


## SIMULATED OUTPUT:

### HUMAN PRESENCE SENSOR TEMPERATURE SENSOR



### WATER SENSOR SOIL MOISTURE SENSOR



## CONCLUSIONS

The IoT module shows the output in the cloud of various sensed data's which is very useful to manage the field during spraying the fertilizer and irrigation time. The normal ph of soil is obtained using Gypsum salt, where the soil is protected from inorganic fertilizers

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- Gupta, P., Agrawal, D., Chhabra, J., & Dhir, P. K. (2016, March). IoT based smart healthcare kit. In *2016 International Conference on Computational Techniques in Information and Communication Technologies (ICCTICT)* (pp. 237-242). IEEE.
- Chieochan, O., Saokaew, A., & Boonchieng, E. (2017, October). Internet of things (IOT) for smart solar energy: A case study of the smart farm at Maejo University. In *2017 International Conference on Control, Automation and Information Sciences (ICCAIS)* (pp. 262-267). IEEE.
- Lanzisera, S., Weber, A. R., Liao, A., Pajak, D., & Meier, A. K. (2014). Communicating power supplies: Bringing the internet to the ubiquitous energy gateways of electronic devices. *IEEE Internet of things journal*, 1(2), 153-160.



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# ***SOLAR PANEL COOLING SYSTEM***

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## **Abstract:**

This project highlights two different cooling techniques to diminish the operating temperature of the PV cells. This review project focuses on the enhancement of the performance of the small domestic use PV systems by maintaining the temperature of the cells as low as possible. Distinctive cooling practices have been look over experimentally and numerically the bearing of the operating temperature of the cells on the electrical and thermal performance of the PV systems. It was notorious that the water spray cooling system has a proper crash on the PV panel performance. So the water cooling is one way to augment the electrical efficiency of the PV panel. The performance was evaluated under three different cases:

(a) without panel cooling, (b) with water cooling on beneath the surface of the panel with copper tube, (c) with water cooling beneath the surface of the panel with jute. The outcome of different cooling cases on the various performance parameters such as voltage, current, power output, pump efficiency and system efficiency has been analyzed and discussed. The results showed that the water cooling on the bottom of the panel and beneath the surface of the panel with jute has considerable influence on performance enhancement when compared to other cases.

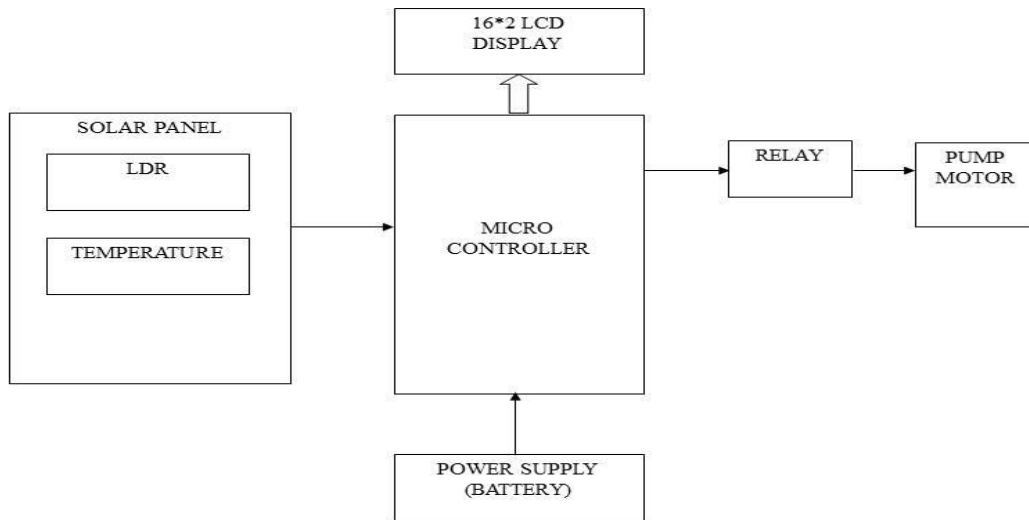
## **Introduction:**

The renewable energy use becomes more popular during the increase of human population and the environmental issues. The solar energy is one of the main type of the renewable energy sources that has attracted many researchers in the region of the world to work on. There are two types of energy that can be produced from the solar energy, electrical energy and thermal energy. The electrical energy can be produced by using photovoltaic (PV) cells.

The PV cell openly converts the incident solar irradiance to electricity. The most efficient, sustainable, and eco-friendly systems are the PV modules which convert small part of the solar irradiance to electricity. The residual part of the solar irradiation then converts into heat, which increases the temperature of the cells and reduces the performance of the PV module. The maximum accepted PV cells temperature with solar irradiance of 1000 W/m<sup>2</sup>, 70% of absorption rate and no-winds is 60°C while for the winds speed of higher than 4 m/s the PV cells temperature is lower than 40°C. The maximum output power, short circuit current and open circuit voltage are the main parameters which are influenced by the temperature discrepancy of the cells temperature. As the temperature increases, the open circuit voltage and the maximum output power reduces and the short circuit current rises. The impact of the temperature of the cell on the performance of mono-crystalline silicon photovoltaic cell was investigated experimentally. The impact of the cell temperature on the performance of the photovoltaic panel with continuous irradiance value were investigated experimentally and numerically. Finally, Results indicated that the efficiency and output power were reduced with the raised temperature of the cell. The decrease in efficiency is caused by the temperature difference and therefore the location of the PV panel is a key factor to be considered.

## **Methodology:**

This project is alienated into two divisions, hardware development and programming. Figure 1 demonstrates block diagram of the project.



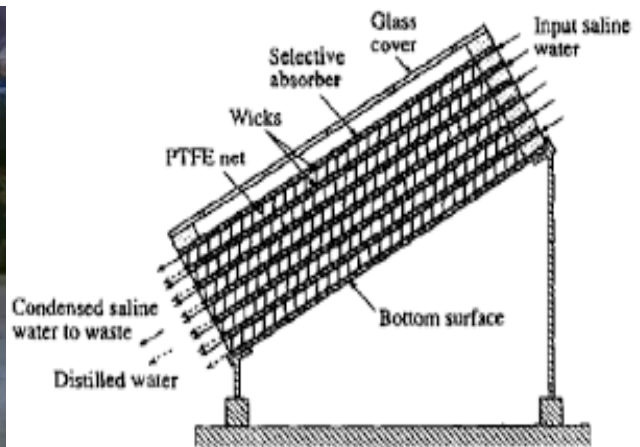
**Figure 1: Block diagram of the project**

The objective of the project is to develop the comparative study of three cooling system such as atmospheric air, cooper pipe and jute. It is used to eliminate the waste heat and reduce the cost of the panel with efficient cooling system. It helps to improve the efficiency of the solar panel. The LDR senses the light intensity of the panel and the temperature sensor senses the temperature of the panel. When the excessive heat occurs in the panel, the

microcontroller sends the signal to the relay. The relay operates the pump motor and the water pump limits the excessive heats due to the sunlight through the copper pipe. Jute is fitted under the solar panel. The two ends are immersed in water to reduce the heat. Figure 2 and Figure 3 shows the cooling system using copper pipe and jute.



**Figure 2: Cooling system using copper pipe**



**Figure 3: Cooling system using jute**

## System operation:

### 1) Sensors:

A sensor is a contrivance that detects and responds to some type of input from the physical environment. The specific input could be light, heat, motion, moisture, pressure, or any one of a great number of other phenomena. The output is generally a signal that is converted to human related and usable form.

#### A. Light Dependent Resistor (LDR):

An LDR is a component that has a (variable) resistance that revise with the light intensity that cataract upon it. This agrees to them to be used in light sensing circuits. LDR's are light dependent devices whose resistance is decreased when light falls on them and that is increased in dark. It can perceive the quantity of light falling on it and thus can prophesy days and nights. These resistors are frequently used in a lot of circuits where it is requisite to sense the incidence of light. LDRs are cheap and are readily available in many size and shapes. They requisite very small power and voltage for its manoeuvre. Figure 4 shows the LDR sensor circuit.

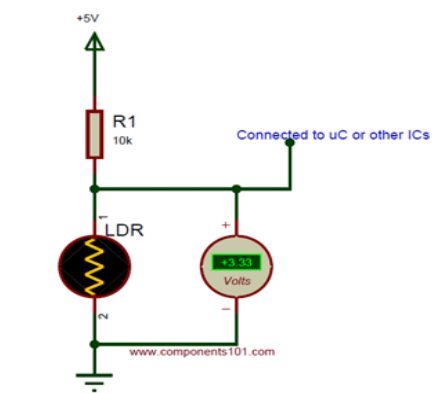


Figure 4: LDR sensor circuit

Light Sensor (LDR) circuit is shown in fig. 5. The relationship between the resistance  $R_L$  (LDR) and light intensity Lux for a typical LDR is shown in (1).

$$RLDR = 500/Lux \quad (1)$$

If the LDR connected to 5V through a 3.3k  $\Omega$  resistor, using the voltage divider rule, the output voltage of LDR is shown in (2).

$$V_o = 5 \times (RLDR / (RLDR + 3.3)) \quad (2)$$

Light intensity measurement formula is shown in (3).

$$Lux = ((2500/V_o) - 500) / 3.3 \quad (3)$$

#### B. Temperature Sensor:

Here LM35 is used as a temperature sensor. LM35 is a temperature sensor that outputs an analog signal which is proportional to the direct temperature. The output voltage can easily be read to obtain a temperature reading in Celsius. With LM35, the temperature can be measured more exactly than with a thermistor. It also mobs low self heating and does not cause more than 0.1°C temperature rise in still air.

The working principle of LM35 temperature sensor we have to know the linear scale factor. In the features of LM35 it is given to be +10 mills volt per degree centigrade. It means that with augment in output of 10 mills volt by the sensor vout pin the temperature value increases by one. For example, if the sensor is yield 100 mills volt at vout pin the temperature in centigrade will be 10-degree centigrade. The same goes for the negative temperature reading. If the sensor is yield -100 mills volt the temperature will be -10 degrees Celsius.

### 2) Liquid Crystal Display (LCD):

LCD (Liquid Crystal Display) is a variety of flat panel display which utilizes liquid crystals in its primary kind of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smart phones, televisions, computer monitors and instrument panels.

Numerous types of LCDs are available in market such as 16x2, 16x4, 20x2, 20x4, graphical LCDs (128x64) etc.. In this paper, 20x4 LCD display is used to display the values of the measured parameters.

### 3) I2C Module:

I2C is a serial protocol for two-wire interface to link up low-speed devices like microcontrollers, EEPROMs, A/D and D/A converters, I/O interfaces and other related peripherals in embedded systems. The preliminary I2C provisions definite maximum clock frequency of 100 kHz.

I2C merges the best features of SPI and UARTs. With I2C, you can link up multiple slaves to a single master (like SPI) and you can have multiple masters scheming single, or multiple slaves.

#### 4) Arduino Uno:

Arduino is an open source electronics platform or board which can be easily programmed, erased and reprogrammed at any instant of time. It is a microcontroller board pedestal on the ATmega 328. It has 6 MHz ceramic resonator, a USB connector, reset button and a power jack. It has 14 digital I/O pins and ICSP header.

#### 5) Two channel Relay:

A relay is defined as an electrically operated switch, their main task is controlling circuits by a low-power signal or when some circuits must be inhibited by one signal. The Arduino relay module is considered for a wide range for micro controllers such as the Arduino board, AVR, PIC, ARM, with digital outputs.

Two channel relays that are electrically isolated from the controlling input. The relays can be worn to switch higher voltage and current loads than a microcontroller can conventionally achieve.

#### 6) Pump motor:

A DC motor is whichever of a class of rotary electrical machines that renovates direct current electrical energy into mechanical energy. It works on the fact that a current carrying conductor placed in a magnetic field experiences a force which causes it to rotate with respect to its original position.

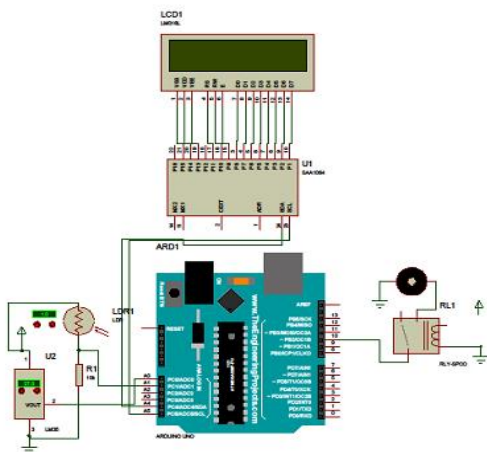


Figure 5: Connection diagram of the project

#### Observation:

The efficiency of the solar panel is calculated by using the below formula (5).

$$\text{Maximum Efficiency} = \frac{P_{max}}{E \cdot A \cdot C} * 100 \% \quad (5)$$

#### Conclusion:

The present article has tinted different techniques of cooling for small domestic use photovoltaic panel. It is concluded that: The temperature of the PV cell decreases about 12° C by means of heat sink with air cooling. In case of air cooling the electrical efficiency of the system does not always increase with increasing the bunch flow rate of the air but there is a best possible value of heap flow rate. This work effectively demonstrated the choice of a heat pipe cooling solution for concentrating photovoltaic cells. Heat pipes can be used to submissively remove the heat, accepting a high heat flux at the CPV cell, and rejecting the heat to fins by natural convection, at a much lower heat flux. Copper and aluminium heat pipes with various working fluids were examined, and a copper heat pipe was chosen, with water as the working fluid. By using jute material as a cooling pad beneath the panel surface the efficiency increase at particular rate. And also this method is cheapest cooling technique than other methods.

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a paper titled . . . . . IOT . . . . . BASED . . . . . SMART . . . . . GARBAGE . . . . . DETECTION . . . . . SYSTEM . . . . .  
. . . . . in the national conference on*

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Convener

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Principal

# IoT BASED SMART GARBAGE DETECTION SYSTEM

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**Abstract** - As citizens it is our duty to keep city clean. One of the main concern of our environment has been solid waste management which impacts both health and environment of our society. This system monitors the garbage bins and informs about the level of garbage collected in the bins via a web page. Internet of Things (IOT) is playing an important role in many application fields such as home, industry, environment and health. Smart bins are placed in the urban which are interfaced with microcontroller based system with IR sensors, gas sensor and Wi-Fi modules, where the IR sensor that detects the level of garbage. The data collected by sensors is sent over the Internet to a server where it is stored and processed. Once it is detected immediately this system altered to concern authorized through GSM. This solution helps us to keep our city clean as well as to reduce traffic that occurs due to unnecessary travelling of municipal vehicles in the city/town.

**Index Terms** – IR sensors, Arduino Uno, GSM, Smart City, communication technologies

## I. INTRODUCTION

Recent days, many people are living in the urban areas for their well being. Due to this there is a drastic increase of population in the cities which causes the production of enormous amount of waste leading to overflow of bins. This causes a problem for disposal of wastes by municipal corporation. In addition, various diseases due to breed of insects and foul smell will be created. Smart dustbin was introduced to minimize this issue. "Swachh Bharat Abhiyan" was introduced by our Prime Minister of India Narendra Modi to ensure a clean environment. Till date we are using traditional old bins in our home and street. IoT has brought a major change in the technology. IoT is used in all field such as home, environment and industry. It can be applied in the field of waste management for the implementation of smart city which leads to clean environment and pollution free society. This is a technique in which the garbage level can be checked at regular intervals and prevents the overflow of bins. The system makes use of IR sensors, gas sensors, microcontroller, Wi-Fi module, GSM module, relay driver and DC motor. This system detects the level of garbage in the bins and sends message to the truck driver when the dust reaches the medium (50%) and high (100%). This helps the driver to give priority to the dustbin which has to be collected first by the municipal corporation. For this the system uses Infrared sensors and gas sensors which indicate the level of waste and toxic content present in the bin. Infrared sensor is a multipurpose sensor that detects the waste level in the bin. Gas sensors can be used to detect

combustible, flammable and toxic gases, and oxygen depletion. The LCD (16\*2) is used to display the message by the input given through the controller. This type of device is used widely in industry and can be found in locations, such as on oil rigs, to monitor manufacture processes and emerging technologies such as photovoltaic. If the bin is filled up to a level (threshold value) the notifications will be send to the concerned authority by the GSM module. The Wi-Fi module is used to update the data to the cloud continuously. In this method, it is an IoT Based Smart Garbage Detection System that will help us to keep the city clean, healthy environment and to reduce the traffic.

## II. DETAILS ABOUT THE PROJECT

The population in the world is increasing tremendously in the same way the waste produced by us is also increasing, therefore it is necessary to have the smart bins in city. In this method the Infrared sensors is used to detect the motion of the object (waste). It emits the light which is detected by electronic components, consists of IR transmitter and IR receiver. LED in IR sensor is used to detect the objects and a potentiometer is present which is used to calibrate the sensor. Here the Arduino UNO which is an open source microcontroller board with microchip ATmega328P. Firstly the embedded c and c++ programming can be uploaded in the controller. The sensors are fixed in the bin. When it reaches the threshold limit the call and the message will be generated by GSM module. The notification will be sent to the concerned authority/workers in municipality. If the toxic content is present in the bin the priority will be given to that bin. The relay driver is connected to the DC motor which will act as an open and close switch, when the bin reaches the threshold value. DC motor is used for quick starting and stopping. In this method it shows a vehicle indication. Wi-Fi module is a wireless technology and it is used to send the data/information to the cloud and it is stored in IoT. ThingView is an open source app and by giving specific ID of an user and password. We have to create a channel (graphical representation) related to our data and information. The graph indicates the level of the bin along with time. It can be seen only when there is the internet connectivity and supply.

### III. PROPOSED SYSTEM

#### A. BLOCK DIAGRAM

##### A.1 Transmitter Section

The block diagram of an transmitter section is shown in fig 1. The InfraRed sensor and gas sensor is interfaced with controller which is Arduino UNO. The IR sensor 1,2 and gas sensor is fixed over the bin 1. Another two IR sensor 3,4 is fixed over the bin 2.

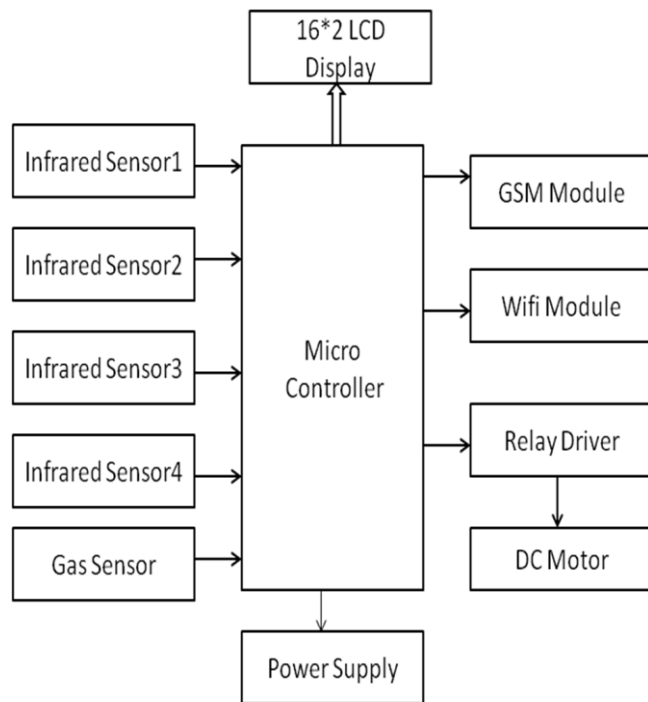


Fig 1 Transmitter section

The IR sensor detect the waste level in the bin and it will send the message. The gas sensor sense the toxic content in the waste. The output side is interfaced with LCD display, GSM module, Wi-Fi module, relay driver and DC motor. The LCD will display as smart bin monitoring at first. The DC motor will rotate which will indicate the working of the system condition. The GSM stands for Global System for mobile communication. GSM uses narrowband TDMA. In this system sim-800 is used. A GSM module is an IC or chip that connects to the GSM Network using a SIM (Subscriber Identity Module) and Radio Waves. Wi-Fi stands for Wireless Fidelity which is connected to a network using radio waves, without the use of wires. The DC motor converts electrical energy to mechanical energy. The inductors are placed inside that produce the magnetic field. It is used for quick starting and stopping. It is cheaper to control than AC motor.

##### A.2 Receiver section

The block diagram of receiver section is shown in fig 2. The message is sent to the end user. The data will be continuously updated in the cloud. ThingView app gives us the information about the level of garbage filled in the bin with the date, month, year. The received data can be accessed at any time from anywhere. This section receives the information about the overflow of the dustbin when it reaches the threshold level. Using IoT the data can be received correctly.

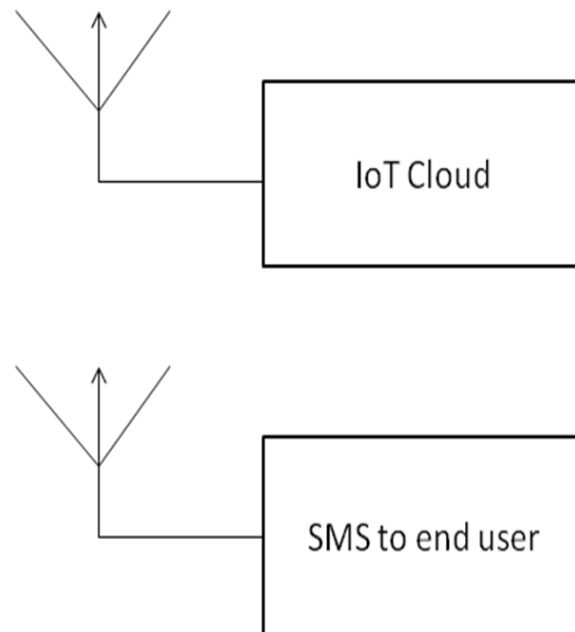


Fig 2 Receiver Section

#### B. COMPONENTS

Smart garbage detection system built on Arduino UNO board platform. Arduino is interfaced with GSM (sim 800A) module, IR sensor, Wi-Fi module, gas sensor, LCD, DC motor, Relay driver.

##### B.1 Arduino UNO board

It is an open source microcontroller board with Atmega328P developed by arduino.cc. It comprises of 14 digital input/output pins, six analog pins and is programmable with Arduino IDE via a type B USB cable. It is powered by USB cable or by an external 9-volt battery.

##### B.2 Infrared sensors

It is an electronic component that is used to sense certain characteristics of its surroundings. It works by either emitting or detecting infrared radiation. They are also capable of measuring heat being emitted by an object and detecting

motion. The active IR sensor is used here which consists of both transmitter and receiver. It works by radiating energy, received and detected by detector and further processed by signal processor in order to fetch information required.

### B.3 Gas sensor

It is a device which detects the presence or concentration of gases in the atmosphere. Based on the concentration of the gas the sensor produces a corresponding potential difference by changing the resistance of the material inside the sensor which is measured as output voltage.

### B.4 GSM module

GSM modem is a unique type of wireless modem that operates similar to mobile phone with its own specific mobile number. It mainly consists of antenna for wireless communication, SIM holder. This is used in variety of applications like home automation home security system, online banking etc.

### B.5 Wi-Fi module

The ESP8266 wifi module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to WiFi network. It is an extremely cost effective board with a huge and ever growing community.

### B.6 Relay driver

A relay driver circuit is a circuit which can drive or operate a relay so that it can function appropriately in a circuit. The driven relay can be operated as a switch in the circuit which opens or closes, according to the needs of the circuit and its operation.

### B.7 DC motor

A DC motor converts electrical energy into mechanical energy. Nearly all types of DC motors have some internal mechanism either electromechanical or electronic to periodically change the direction of current in part of the motor.

## IV. FLOWCHART

This diagram represents the flow of the system. The IoT Based Smart Garbage Detection System is a pioneering way of keeping the cities and surroundings clean. This system monitors the level of garbage in the bins and informs the concerned authority when it reaches the threshold level.

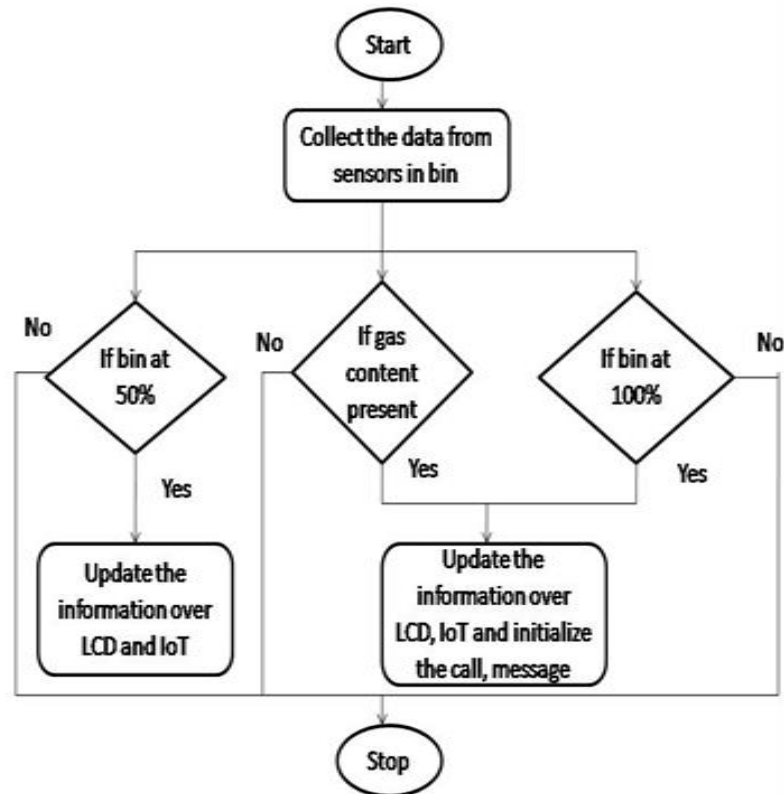


Fig 3 Flow chart Diagram

## V. IMPLEMENTATION

This system is implemented for two locations in an area. Initially when the power supply is ON the “smart bin monitoring” is displayed in the LCD (fig 3) and the motor also rotates (fig 4) which indicates the proper working of all components.



Fig 4 LCD

Fig 5 DC Motor

We have chosen two dustbins bin1 and bin 2. In bin 1 we have placed two Infrared sensors (high-100%), medium-50%) and Gas sensor in bin 1. In second bin we have placed two Infrared sensors (high-100%, medium-50%). The IR sensor indicates the presence of obstacle by emitting the infrared radiation. The gas

sensor indicates the presence of toxic content present in the bin 1. If the toxic gas present in the bin it is indicated in the LCD. In LCD it will be displayed as “Toxic content in bin” in fig 5. The message is sent to the mobile using GSM module. The priority will be given first by the truck driver in presence of toxic content.



Fig 6 Indicating the presence of gas content in bin

When the bin1 reaches the level of high(100%) then the motor will start to rotate which is the vehicle indication here. The LCD is displayed as “BIN AT 100%” in below fig 6.



Fig 7 Indicating the level of dust in bin



Fig 8 Indicating the level of dust in bin

When the waste in the bin is medium (50%) the message will be displayed in the LCD. Similarly in second bin follows the same. The notifications will be sent to the truck driver/authority and the call will be generated first then the message will be displayed in the LCD.

The data obtained by the Wi-Fi module is sent to the cloud by using IoT. The data obtained in the cloud is shown in the figure below (fig 8, fig 9, fig 10, fig 11, fig 12). The field 1, field 2, field 3, field 4 and field 5 indicates the graph of the IR sensor 1, 2, 3, 4 and gas sensor respectively. The date and time of the

level indication is shown in the presence of internet connectivity.

## VI. RESULTS AND OUTPUT

The output is shown below in the following images  
A. THINGSPEAK

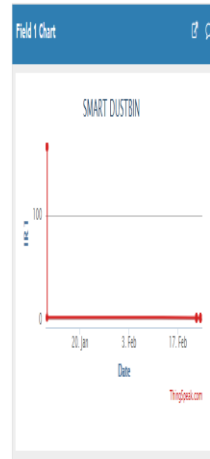


Fig 9 IR Sensor 1

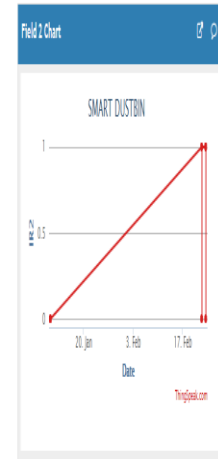


Fig 10 IR Sensor 2

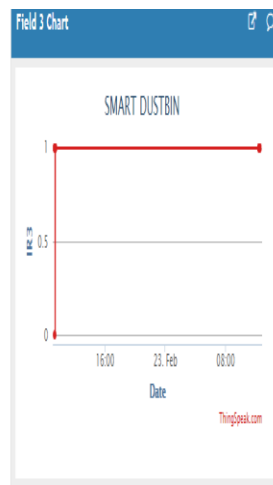


Fig 11 IR Sensor 3

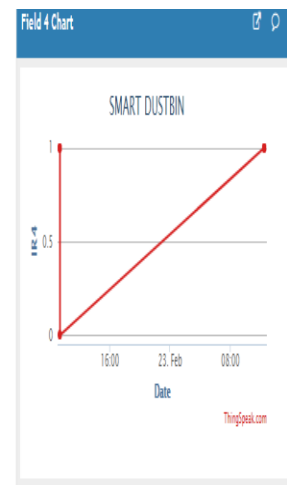


Fig 12 IR Sensor 4

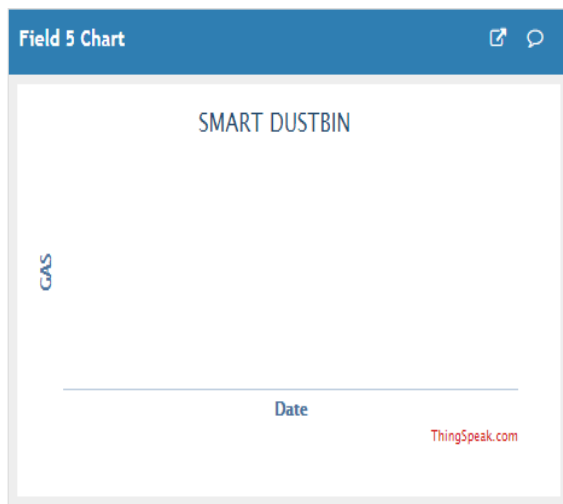


Fig 13 Gas Sensor

The above figure is the output obtained from THINGSPEAK. This indicates the level of bins at various levels and gas content present in the bin.

## VII. CONCLUSION

The implementation of Smart Garbage Detection system is useful for cleaning the dustbins as soon as possible when the waste is filled. The number of times the vehicle comes for garbage collection reduces it leads to the reduction in the expenditure of garbage collection. It helps in ensuring the cleanliness of the country. This system aims mainly at the cleanliness of the nation. We make use of advanced technologies like IoT for the better development of the system. The benefits of this system is less labor work, smart work, fuel consumption etc. It contributes a lot towards a clean and hygienic environment in a city. The cost of this system is affordable for people to implement it. Proper awareness should be created to the public before implementing in large scale. Otherwise the sensors would be damaged due to rough action of users.

## VIII. FUTURE SCOPE

We have implemented "IoT based smart garbage monitoring system" but there will be still a change.

- The system would be installed in all cities and the awareness would be created among the public.
- The automated system can be developed which is able to pick up waste in and around the bin segregate them and put them in respective bins.

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# SMART MEDICINE BOX

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## ABSTRACT:

Many elderly people are living alone, some are unable to take care of themselves. Any deferral in taking medicine or intake of medicine at wrong time may lead to raising in health issues. In this project, the model of Smart Medicine Box with a line follower robot has been introduced. The proposed system Smart Medicine Box with a line follower robot takes care of patients by giving them medicines at the right time instead of depending on nurses or caregivers. Smart Medicine Box provides buzzer sound and alert the patients to take medicine. Then, GSM is used to send messages to the patients and care givers.

## INTRODUCTION:

With the advancement in medical field, there is a remedy for many direful diseases by taking several new medicines. The number of pills taken by each individual has been increased. Most the people, from young age to the old age forget to take medicines on time. The elder people also forget which medicine to take at particular time. It has become hard for us to remind ourselves to take the medicines at particular time. So, the patients will skip the medicine by throwing them in the dustbin. Hence, this Smart Medicine Box will provide statistics to the affected person to take proper dosage of proper medication on the proper time. In order to lessen the work of the nurses in hospitals, smart medicine box has been introduced. The Smart Medicine Box remind the patients to take medicines at the right time. The timer has been set to alert the patients to take medicines at a proper time by using a buzzer sound. After the buzzer sound, through GSM the message is send to the patients and care givers in order to remind them for

Taking the medicine. The line follower robot is used for supplying the medicines to the patients. Smart Medicine Box with line follower robot can be used in government hospitals to avoid the carelessness of the nurses and to avoid the missed doses of the patients.

## RELATED WORK:

1. Minaam, D. S. A., & Abd-Elfattah, M. (2018). Smart drugs: "Improving healthcare using smart pill box for medicine reminder and monitoring system" *Future Computing and Informatics Journal*, 3(2), 443-456.

## Inference:

- To avoid wrong pills ingested by patients.
- To avoid missed dose.
- To avoid memory misfortune in taking medicines

2. Kong, L., & Woods, O. (2018). Smart eldercare in Singapore: Negotiating agency and apathy at the margins. *Journal of aging studies*, 47, 1-9.

## Inference:

- Smart eldercare within the home.
- Caregivers are needed for giving medicines to the aged persons.

3. M. Shailaja, K. Lokeshwaran, S. Sheik Faritha Begum "Smart Medication Pill Box For Blind People With Pulse Sensor" *International Journal of Recent Technology and Engineering (IJRTE)*, Volume : 8 | May 2019.

**Inference:**

- Useful for both normal people as well as blind people.
- Measure the heartbeat of the patients.
- The tablet count is transferred to the Pharmacist's site to refill when tablet gets unfilled.

4. Kang, M., Park, E., Cho, B. H., & Lee, K. S. (2018). Recent patient health monitoring platforms incorporating internet of things-enabled smart devices. *International neurology journal*, 22(Suppl 2), S76.

**Inference:**

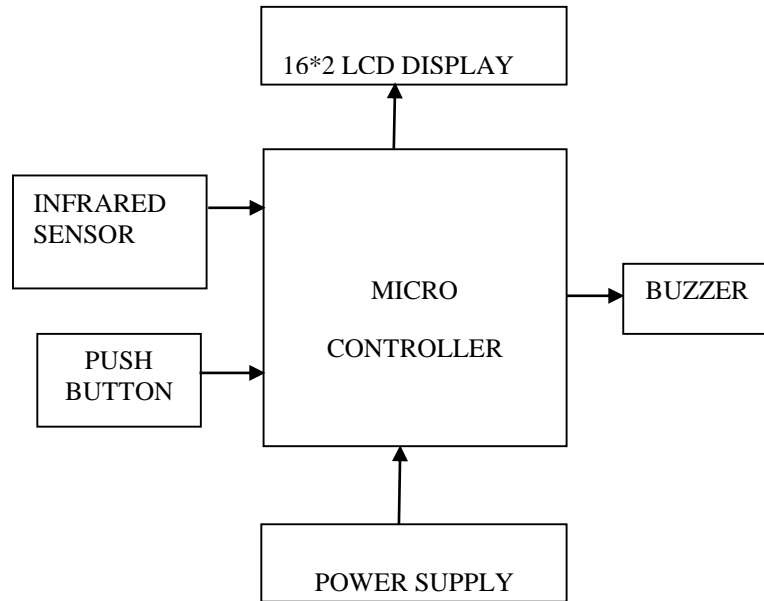
- IoT – enabled smart devices that can collect real-time patient data and transfer information for assessment by healthcare providers.
- The use of IoT technology helps automate the entire patient care workflow.
- Patients can use these devices anywhere and immediately transmit their health conditions using IoT.

5. Lester, R., Jay, J. H., Bolten, L. M., Enjetti, A., Johnston, J. C., Schwartzman, K., ... & von Delft, A. (2019). Mobile phone short message service for adherence support and care of patients with tuberculosis infection: evidence and opportunity. *Journal of clinical tuberculosis and other mycobacterial diseases*, 100108.

**Inference:**

- SMS is used to support treatment adherence.
- Interactive SMS – based mobile phone support of treatment adherence

**EXISTING DIAGRAM**



**EXISTING SYSTEM:**

Pill box is based on the medicine bag concept and matrix bar code printed on the medicine bag simplifies the operational procedures.

A shrewd pill confine is proposed. It educates the older folks to take prescription. It effectively controls the season of older folks to take prescription. It similarly lessens the part that understanding misses and defers captivating instruction the remote enlightening outline joins with the Skype encoding so the parental statistics can sustain the long-suffering. The arrangement plan is also evenhanded for the prescription bundles. Soon after on, we faith that the vivacity thrifty and resourceful can be measured. Next to these appearance, absent and deferring charming medication can be entirely killed. Taiwan is venturing into the growing civilization. The superior division of the elder persons has abundant interminable sicknesses, and they utilize medications to steadiness out their safety position. Drug specialists organization asked the folks should be gradually troubled intriguing drugs comfort of the grown-up individuals. In this conduct, this paper structures a clever capsule box and its back-end inspection agenda. The executed tablet container can

tell again the adult persons to get instruction in instance and can teach the families tenuously when the seniors capture the medication. The welfare formation of this capsule box can anticipate the medications mistreatment the parental statistics can without much of a broaden datebook the model occasion for the elder persons to take medicine.

However, the users unmoving have to put dissimilar kinds of medicine in the similar box, and restock the boxes each week. Furthermore, it might only repeat the user to receive tablets on one occasion a daytime. The standard expenses of this category of capsule box were about 1000 INR. Consequently, we imagine it was compulsory to construct a inexpensive and purposeful smart Medicine Box that can bring more expediency for the user. Numerous special capsule box were vacant in the bazaar. The cheapest one was the conventional pillbox, which enclosed seven boxes for seven dissimilar days of a week, estimate approximately 200 rupees. However, user had to load the tablets to the boxes every week.

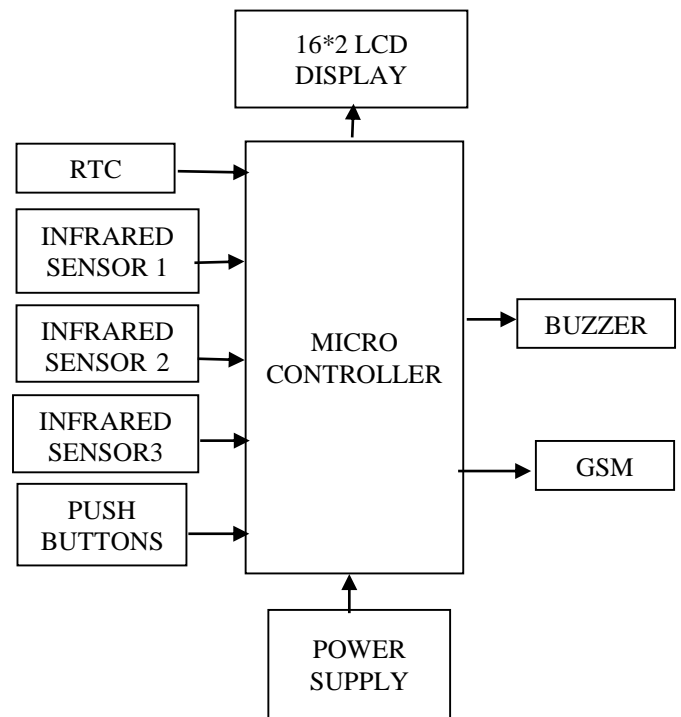
The capsule bottles are very small where it can only have enough money only one drug at a time. So patients with more than one tablets on the whole necessitate to own more than one bottle which is evidently an unprofitable assignment.

We then defined the specifications of our device based on the user needs. With the assist of easy microcontroller, we have attempted to generate a copy of a capsule box - and programmed tablet memento.

In this scheme we current a functioning copy of an automatic capsule reminder setup that can assuage irregularities in attractive prearranged dosage of medicines dictated by the medical practitioner and control from approaches principally reliant on human recollection to computerization with insignificant administration, thus relieving persons from error-prone household tasks of generous wrong tablets in the wrong amount.

The system does not have a tracking system of the patient's medication. That is it does not keep track when the medicines get over and when the patient have next check-up or medicine refill. The system does not authenticate the medicine intake and thus can use steeling of medicines.

## PROPOSED DIAGRAM



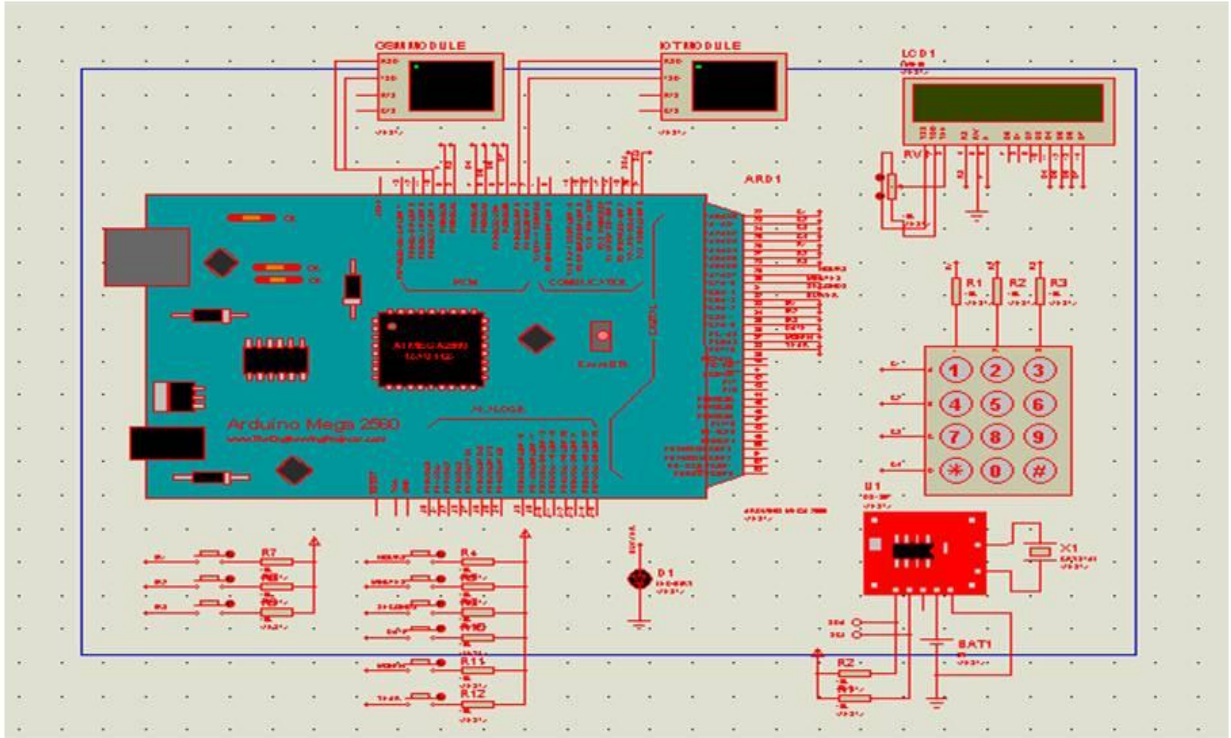
## PROPOSED SYSTEM

The risks of this existing system are to take the right dose of medication but the alarm system indicates an error in the number of taken pills or the system would not detect an error or a missing medication intake and will not turn on the alarm system. The safe state can be expressed by sending a message to the patient and his parents via the phone application mentioning that the whole system is no more functional and the patient must check manually for the medication and bring the system into de-energized state. Added to that, the box will remain unlocked. The proposed project is, in its general purpose, aiming to control medication adherence. In this way, this smart pill box will help to increase life expectancy for those of older as

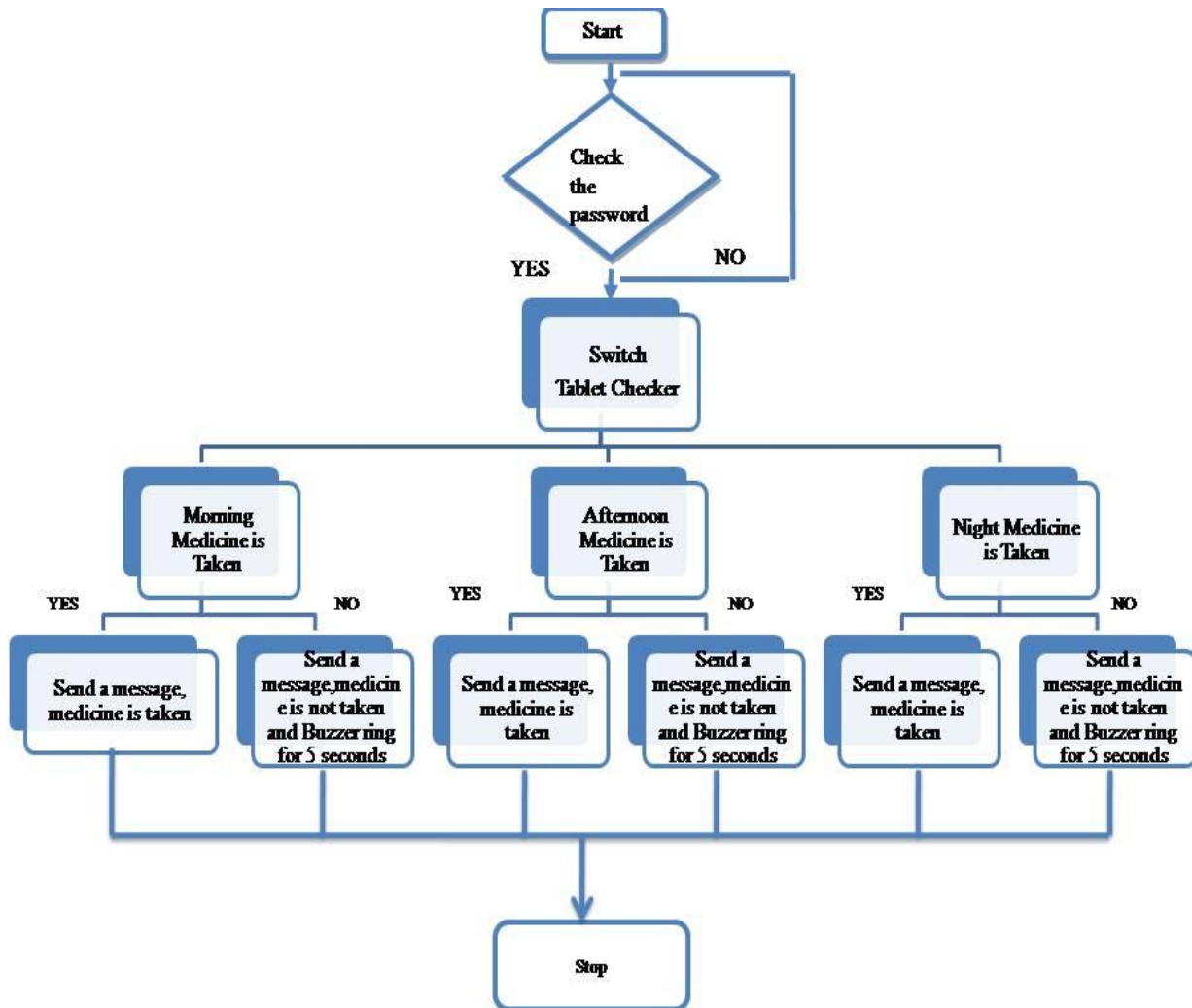
well as younger aged adults. Additionally, the proposed device is low cost, user friendly, and above all, a safe system. Compare to other devices accessible in market are accomplished to create sound at one time and afterwards it stops. Thus, final outcome of our scheme provides quick remedial of patient health by using our beneficial system. The proposed capsule box can reduce family member's accountability towards ensuring the correct and timely utilization of medicines.

We require to be in suggestion of Doctor who tells us to take preferred tablets in desired way so that patients countenance troubles similar to forgetting tablets to take at right time and also when Doctor changes the instruction of medicine patients have to remember the new schedule of medicine. This problem of forgetting to take pills at right time, **BLOCK DIAGRAM:**

taking wrong medicines and accidentally taking of expired medicine causes health issues of patient and this leads to suffer from unhealthy life. Our development is to make Arduino based Smart medication box which uses actual time clock. The new awaited feature in our scheme is our scheme is reasonable that patient has in use tablets or not and thus the patient can't reschedule the occasion on which he requirements to take tablets. It is essential for the patient to take medicine from the box at the right time or else our systems continues to make large sound awaiting the medicine is taken out from the box. This notification feature adds life years to the patient and thus this thing is not available in any device which is the necessity for present days.



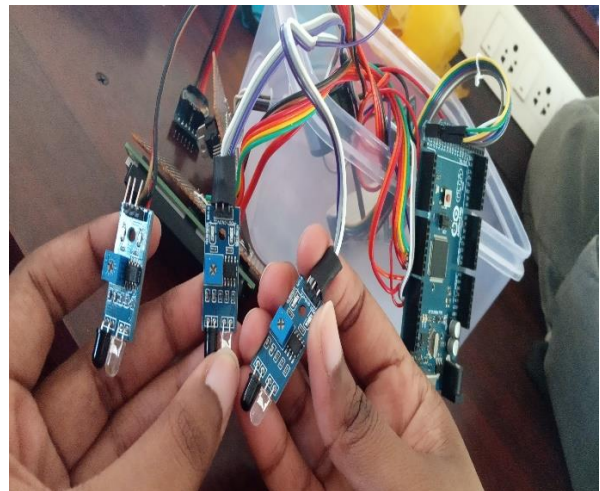
**SOFTWARE MODULE:**

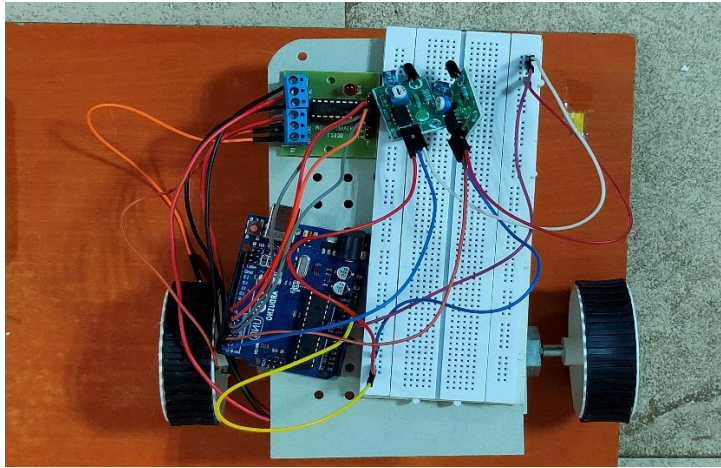
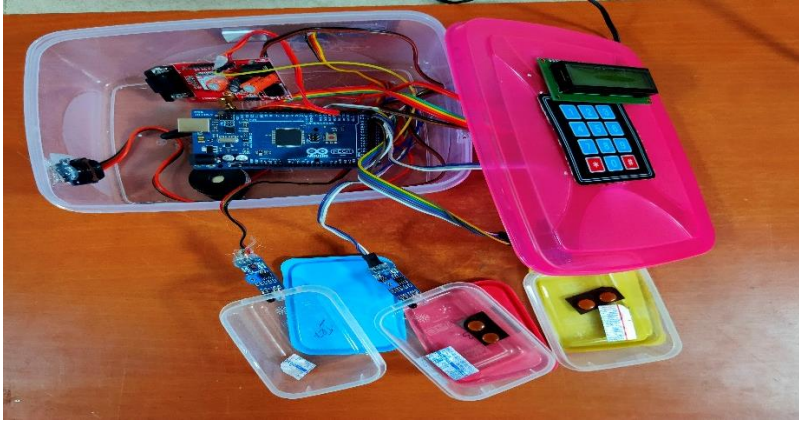


**ALGORITHM:**

1. Start the process.
2. Check for the current time
3. Set the alarm time
4. Initiate the user with test message
5. Check for the password
6. After check, check for the tablet indicators
7. If the medicine\_1 is taken, send message to the user
8. Else remain same

9. If the medicine\_2 is taken, send message to the user
10. Else remain same
11. If the medicine\_3 is taken, send message to the user
12. Else remain same
13. Switch
14. Tablet Checker
  - a. Morning Medicine is Taken
    - i. Send a message ,medicine is taken
    - ii. Send a message, medicine is not taken and Buzzer ring for 5 seconds
  - b. Afternoon Medicine is Taken
    - i. Send a message ,medicine is taken
    - ii. Send a message, medicine is not taken and Buzzer ring for 5 seconds
  - c. Night Medicine is Taken
    - i. Send a message ,medicine is taken
    - ii. Send a message, medicine is not taken and Buzzer ring for 5 seconds





## CONCLUSION

There is a great use for timely consumption of pills which is often missed by many people. This smart medicine box helps to remind us to take medicines recurrently and also on time. Thus this medicine box though small and simple will be a very great and useful step in the field of medicine. This paper has focused on the problems faced by the elderly persons concerning towards their prescribed medication. It not only aids the aged people who live independently but also the caretakers of the elderly by reminding correct amount of medicine at correct time. The benefit of this box is that it is very easy to use and the difficulty is less. This ensures that the elderly patient consumes the correct dosage of capsule at the right time provided he/she agrees this new uncommon method of medication. The goal of our paper is to provide healthy and tension free life to those users who are taking tablets regularly and to provide this product at reasonable cost also. These simple

effective techniques are supported by developments like GSM technology to bridge the gap in communication between the care taker and the patients.

In conclusion, this device can help and give benefit to the nurses. The main aim for this innovation is to observe the intake of medicine for intrinsic patients. It is practical in the morning, afternoon and night. This pill box is controlled by using GSM so the nurse does not need to go to the personal ward. This system is very efficient to apply in the hospital because it can make the nurses stress-free besides making the patients more relaxed to stay in the hospital.

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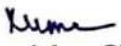
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FOR BREAST CANCER DETECTION  
in the 7th National Conference on Advanced Computing Technologies  
Organized by Department of Computer Science and Engineering, Velammal  
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# CONDUCTOR BACKED CPW FED BOWTIE SLOT ANTENNA FOR BREAST CANCER DETECTION

POONKODI S<sup>1</sup>, PRAMILA R<sup>2</sup>, PRAVEENA S<sup>3</sup>

1, 2, 3 - students

Mrs.R.Ramalakshmi B.E,M.E,

Assistant Professor,

Department of Electronics and Communication Engineering  
Ramco Institute of Technology, Rajapalayam

## ABSTRACT

Microwave imaging is an efficient technique that can be used for the early detection of breast cancer. Breast imaging uses low power and longer wavelength signals to obtain information about breast. A flexible antenna with a simple structure and small size (30mm\*20mm\*1.6mm) designed for detecting breast cancer. The main objective of the proposed model is to design a flexible antenna to improve gain, efficiency, and directivity and reduces losses, backward radiation.

The antenna consists of bowtie slot radiation elements fed by a coplanar waveguide structure and a floating ground and it operates at a frequency of ultra-band frequency. The antenna incorporates EBG-FSS in patch, which reduces the backward radiation, with reduced Specific Absorption Rate SAR. The antenna resonates at 8.40 GHz and has a peak gain of 6.91 dBi. The antenna is simulated by using CST Microwave Studio software. The analysis of the antenna is done by measuring the antenna parameters such as gain, bandwidth, efficiency, near and far-field radiation pattern.

## INDEX TERMS:

CPW fed bowtie antenna, Floating ground structure, Coplanar Waveguide, Specific Absorption Rate, Electromagnetic Band gap (EBG)

## I. INTRODUCTION

Cancer is defined as an abnormal growth of cells, which is also called as malignancy. There are several types of cancers, including breast cancer, prostate cancer, colon cancer, lung cancer, skin cancer, colon cancer etc... Breast cancer is a malignant tumor that forms in the cells of breast. After skin cancer, breast cancer is the most common cancer diagnosed in women. Breast cancer can also affects men.

Today the breast cancer survival rates and the number of death due to breast cancer is also

increased [2]. Breast cancer needs to be treated by radiotherapy, chemotherapy, hormonal therapy, and in worse cases, breast surgery or mastectomy. All the above treatment techniques are very costly, bear's pain, and discomfort towards the patient to survive normally. Thus the preventive method to diagnosis the breast cancer remains important to survive the patients normally.

There are different enhancement techniques are used to provide high look of mammogram to detect breast cancer. For improving the accuracy is to combine different imaging methods such as x-ray, ultrasound and magnetic resonance imaging (MRI). Mammogram is the one of the computer-aided diagnosis system for breast cancer detection [2]. For analyzing the medical images Convolutional Neural Networks (CNNs) method is used in the field of deep learning.

The system architecture for breast cancer detection consists of four parts:

1. Image preprocessing
2. Region of Interest (ROI) area segmentation
3. Feature extraction
4. Classification

Image processing is to remove the variability and artifacts for better detection performance. We need to extract the most relevant parts of the image before running detection Region of Interest (ROI) area segmentation is used. Feature extraction could map raw image data into a feature space with much lower dimensions. In classification part extracted features are fed into one or more classifier to classify the feature [2].

CPW fed slot antennas are used in the field of medical applications and it has good synchronization for the ISM Band and WIMAX frequency standard. For achieving the good forward radiation and low SAR value the cpw fed slot antenna is used with floating ground structure [1].

The antenna consists of bowtie slot radiation elements fed by a coplanar waveguide structure and a floating ground. Normally CPW provides low dispersion, avoids noise and good frequency response.



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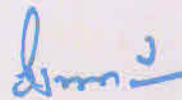
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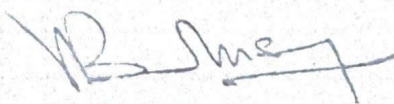
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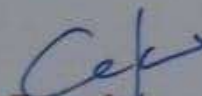
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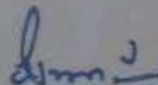


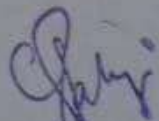
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# CONDITION MONITORING ON PIEZO ENABLED COMPOSITE BEAM STRUCTURE UNDER FINITE ELEMENT SIMULATION USING COMSOL®

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## **Abstract:**

In this research paper, a piezoelectric material is embedded into composite material in the form of beam structure. Structural Health Monitoring system is created to find the mechanical parameters under dynamic loading condition. The Finite Element Simulation Software tool is used to predict the failure, deformation and induced stress during the loading condition. A Multiphysics COMSOL® tool is used for Finite Element Simulation under dynamic loading condition. A mathematical calculation is made using coupled constitutive equations for correlation purpose. A Piezoceramic (NEPEC 6) material is embedded with different material and tested under dynamic loading condition built with variable frequency range. The output intensity of spectrum depends on the damage size of the given component. Based on the test results of mechanical properties, the final material is selected. The Finite Element result gives the ample guidance for selecting composite material is the best one amongst other materials.

**Keywords:** *SHM, Composite, COMSOL, Finite Element Method, PIEZO.*

**SSAD-315****NUMERICAL SIMULATION OF SOOT BUILD UP IN A DIESEL  
FILTER SYSTEM USING COMSOL MULTIPHYSICS®****J. Jerold John Britto<sup>1</sup> A. Vasanthanathan<sup>2</sup> Dr. P. Nagaraj<sup>3</sup>**

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**Abstract:**

In the present, the finite element model of a filter system for a diesel engine has been made for getting better efficiency of the engine using COMSOL® Multiphysics tool. A filter system's efficiency and durability are closely related to the manner in which it removes soot deposits from the porous filter walls. The cerium additives were added into the fuel. Cerium oxide species are subsequently present in the soot layer, acting as a catalyst in carbon-oxidation reactions. The soot layer in the diesel filter was removed continuously or at intervals to keep the filter in working condition. The free and porous media flow, transport of diluted species, heat transfer in fluids and moving mesh concepts has been applied for simulation. The composition of the reacting species along the channel length at 653 K, below "catalyzer ignition" temperature, and on at 705 K where the catalyst is ignited. At 703 K oxygen becomes depleted at approximately 0.12 m into the reactor. As the temperature increases, the range of oxidation increases until the depletion of oxygen in the reactor. The decreased rate of CeO<sub>2</sub> regeneration substantially and Ce<sub>2</sub>O<sub>3</sub> becomes the dominating cerium-containing species. The exothermic reaction has been studied on carbon. The temperature distribution curves were explained in the system after 300 s for an inlet temperature of 550 K. The exhaust gases leave the filter at somewhat elevated temperatures due to the net exothermicity of the reactions. The efficiency has been improved and finite element simulation gives the ample guidance for eliminating the carbon content.

**Keywords:** Diesel filter, Cerium oxide, finite element method, COMSOL, Multiphysics



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## **Analysis of Surface Properties of Tungsten Carbide (WC) Coating over Austenitic Stainless Steel (SS316) using Plasma Spray Process**

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### **Abstract**

Surface modification is a broad term which is associated with various technologies that can be exploited to achieve high reliability and performance capability of industrial components. The increasing usefulness and benefits of surface engineering has resulted in significant recent advances in the field. Among the various coating techniques, Thermal coating technique of Plasma spray process has been embraced in this work. Surface properties are enhanced with Tungsten Carbide (WC) coating over Austenitic Stainless Steel (SS316). The Plasma Spray Coating is the deposition coating technology in which solid feed stock in form of Tungsten Carbide powder of 50 micron size is introduced in hot plasma jet to form liquid droplets which are accelerated toward a substrate (SS316). The surface morphology of Tungsten Carbide (WC) coating over Austenitic Stainless steel (SS316) using Scanning Electron Microscope is discussed in this paper. Erosion wear tests and corrosion tests for Tungsten Carbide (WC) coated Austenitic Stainless Steel and uncoated Austenitic Stainless Steel has been conducted. The comparison studies are carried out and it is found that the coated Tungsten carbide (WC) over Austenitic Stainless Steel (SS316) gives longer life in corrosion environment and better resistance in erosion of surface materials in the exposure of high velocity air mixed with Al<sub>2</sub>O<sub>3</sub> abrasive particles. Scanning Electron Microscope images analysis gives better improvement in surface behaviour of coated material when compared to uncoated material.

**Key words:** *Erosion Wear, Plasma Spray, Corrosion, SEM, Surface*

### **1. Introduction**

The powder form feed stock material is deposited over the substrate with accelerating plasma jet. The temperature is generated around 10,000K. The coating is formed by rapid solidification of flattened molten droplets of feed stock material. Plasma gas composition, flow rate, energy input, feed stock type, torch off set distance are the parameters of plasma spray process. The bond-coat is provided to resist the oxidation over the coating and increases the adhesion between ceramic top-coat and the metallic substrate. YSZ + Al<sub>2</sub>O<sub>3</sub> coating provides more resistant to corrosion in the molten salt environment than YSZ coating (1). The weak splat bonding of Plasma Sprayed coating leads to erosive surface damage (2). Better cohesive strength, higher dense coating can be achieved by heat treating the coated material (3). Superior erosion resistance, high surface hardness and less porosity coating can be achieved by Al<sub>2</sub>O<sub>3</sub> – 40% TiO<sub>2</sub> coated material over the substrate (4). The increase in grain boundaries and increase in number of micro galvanic cells leads to localised corrosion due to increase in W<sub>2</sub>C nano particles in Ni – WC nano composite coating (5). Wear resistance is improved with hard ceramic phases that are surrounded by matrix binder. Microstructure, coating composition, adhesion, defect level and cohesion substrate properties are very important design variables for corrosion resistance (6). It is observed that by increasing the impingement angle from 20° to 90°, the erosion rates over the range of gas temperature and velocities also increases (7). By increasing the spray time, the porosity decreases which results in the formation of uniform microstructure which in turn increases the micro hardness (8). Al<sub>2</sub>O<sub>3</sub> + Cr<sub>2</sub>O<sub>3</sub> composite coating has more advantage in Cohesion strength inside the splats and splats to splat interface strength than single Al<sub>2</sub>O<sub>3</sub> coating. (9). Supersonic Atmospheric Plasma Spraying - W/TiC coating provides lower porosity, dense structure, high thermal conductivity, reduced oxygen content, Young's modulus, high hardness and higher ability to resist to elastic fracture(10). A TiO<sub>2</sub> coating is the most potential hard ceramic coatings because of its hardness, ductility and wears resistances (11). Plastic deformation leads to the formation

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## **Enhance shear strain distribution and properties of AA6063 by pneumatic operated ECAP with back pressure: Experiment**

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### **Abstract**

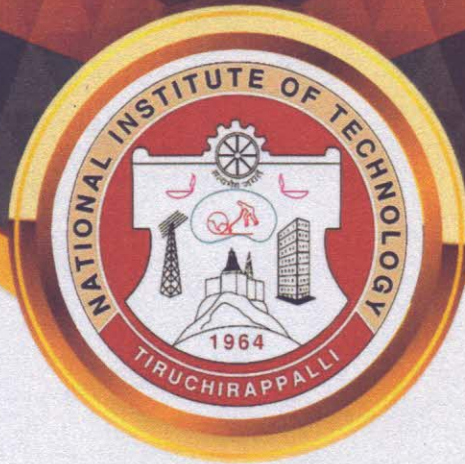
Equal channel angular pressing (ECAP) is a novel metal forming technique to fabricate ultra-fine grained material even at nanolevel without changing the billet cross-section. In ECAP, the material deformation is affected by die geometry, material behaviour, friction and back pressure. In this paper, the influence of Back Pressure (BP) on microstructural change and mechanical properties of Equal Channel Angular Pressed (ECAP) AA6063 is investigated. The elemental and microstructural analysis is investigated by Energy Dispersive Spectroscopy (EDAX) and Scanning Electron Microscope (SEM). ECAP is carried out with different back pressures using die with channel intersecting angle of 120°. Macro hardness and Strength of the BP applied ECAP is compared with conventional pressing. The result indicates that the strength and macro hardness of AA6063 alloy are significantly enhanced by BP. This is because, the back pressure induces the homogeneity of billet and leads to an increased rate of continuous recrystallization. The positive effect of BP causes more deformation that leads to an more dislocation, thereby increasing subgrain formation. The corner gap between billet and die is reduced by more uniform and large deformation during ECAP with back pressure. The room temperature strength and hardness of initially coarse grain alloy are subjected to ECAP pass with BP higher than the conventional pressing by grain refinement technique.

**Keywords:** *ECAP, Grain refinement technique, Back pressure, macro hardness, tensile strength*

### **Introduction**

AA6063 alloys are very attractive materials as a fundamental development of high strength structural materials for automotive, aircraft and marine application. There are different technologies are used to increase the strength of AA6063 such as alloying addition, bulk-forming and altering internal grain arrangement. Among these techniques, recently to improve the mechanical and processing properties of materials by altering grain size. As per the Hall Petch relationship, the yield strength of the material has been increased by reducing grain size with appropriate technology. Very small grain size can be produced by different non-conventional methods such as rapid solidification, powder metallurgy, physical and chemical vapour techniques and vapour condensation. These methods are only used for the production of very small quantities of materials. For large production, the material can be transferred from a big scale of grain to smaller grain is based on large strain deformation of bulk metal. In order to attain large plastic deformation of materials, the metal forming technique is used, but there is a disadvantage to use metal forming technique such as strain localization and ductile fracture on material. The

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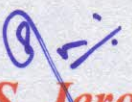


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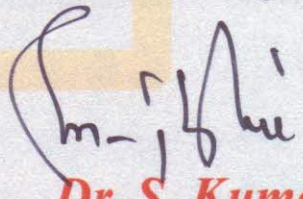
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Austenitic stainless steel (SS 316) using Plasma Spray process in the  
"International conference on Materials and Manufacturing Method" ( MMM'19 )  
held during 5-7<sup>th</sup> July 2019, Department of Metallurgical and Materials Engineering,  
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# **Book of Abstracts**

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**SRM Institute of Science and Technology, INDIA**

**381: Experimental and CFD Studies on Energy and Exergy Efficiencies of Solar Dish Cavity Receivers with Different coil configurations**

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**Abstract:**

A scalable solar thermal dish collector system is proposed in response to the growing demands in small scale concentrated solar thermal energy conversion to enhance the performance of solar cavity receivers. In this work, receivers of cylindrical and hemi spherical shapes and uniform absorber cavity area with geometries having length to diameter ratios of 1.5, 1 and 0.75 are made with two different materials of aluminium and copper. The coil tube configurations for the flow path of heat transfer fluid have been modelled for same dimensions with respect to the geometrical shape of the receivers. The experimental and CFD studies have been compared through average solar direct normal irradiances of 860 W/m<sup>2</sup> for the reflector area of 12 m<sup>2</sup> to maintain uniform heat flux of 7 kW/ m<sup>2</sup> at the absorbing area of the cavity receivers. The energy and exergy efficiencies from the experimental and CFD analyses on the receiver models were studied based on the temperature distribution, heat gain by the heat transfer fluid water, for different mass flow rates. The receiver with copper material and L/D ratio of 0.75 has been found as the optimized one among all other models, when water is used. The thermal performance of the optimized receiver model with L/D ratio of 0.75 was validated with the results of CFD analysis for the different heat transfer fluids such as water, Silicon Carbide/Water nano fluid and Thermal VP1. When water is used as fluid, the maximum energy and exergy efficiencies of 73.64 and 7.31 % are obtained.

**Keywords:** concentrated solar power, heat transfer fluids, receiver geometries, coil configurations, cavity receiver. Nano fluid.

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**382: DSMC Simulation of Rocket Plume Interactions with Extra-Terrestrial Regolith**

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**Abstract:**

Soft landings on extra-terrestrial surfaces are vital for any sample return missions. Moreover, during landing on such bodies, dust impingement on the lander module and Extra- Vehicular Activity (EVA) systems can cause serious complications. In order to prevent system failures due to scoured regolith, and also minimise contamination of surface regolith for sample collection, rocket can be used to decelerate the spacecraft to a vertical descent velocity from which it can freefall. A Direct Simulation Monte Carlo (DSMC) technique is developed to investigate the interaction of rocket plume with surface regolith of an airless extra-terrestrial body. Continuum breaks down as the exhaust exits the engine nozzle, and the gases expand rapidly into vacuum. Near the nozzle exit, the process enters a rarefied flow regime and an opensource DSMC code is developed to model the movement and collision stages of rarefied plume gas and dust particles. In this simulation, collision occurs between gas particles of the rocket plume as it impinges on such an extra-terrestrial surface. The solver used for carried out this simulation is dsmcFOAM solver, a part of OpenFOAM. The surface properties such as pressure coefficient and heat flux are computed and analysed to observe the impact of plume impingement on extra-terrestrial regolith.

**Keywords:** DSMC, Plume Impingement, dsmcFOAM, Extra-Terrestrial Regolith

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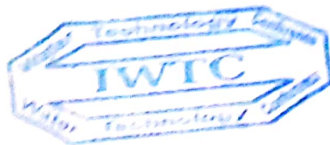
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74.	<b>Authors:</b>	<b>M.Kartick, S.Kamatchi, .Mujibur Rahuman, K.Manoj Kumar</b>
	<b>Paper Title:</b>	<b>Experimental Investigation of Thermal and Mechanical properties of Polypropylene Matrix with Polytetrafluoroethylene Particle Reinforced Composites</b>
	<p><b>Abstract:</b> Wide varieties of thermoplastic polymers find more application in manufacturing domestic and industrial allied products. Thus the need for a study of thermal and mechanical properties of thermoplastics and their composites is on the growth. A brief report of the thermal and mechanical properties of Polypropylene polymer with Polytetrafluoroethylene synthetic particle reinforced composite material is updated in this project work. Factors such as particle reinforcement, interfacial adhesion developed by melt and fusion – injection moulding technique, thermal and mechanical properties have been studied. The results shown the PTFE particles at 10 wt.% 20 wt.% and 30 wt.% finding better option for reinforcement utilized for making PP polymer composites. In addition to that, there was high potential report for polymer composites than individual PP.</p> <p><b>Keywords:</b> Polypropylene, Polytetrafluoroethylene, Thermal and Mechanical Properties, Injection moulding technique.</p>	
75.	<b>Authors:</b>	<b>J.Jerold John Britto, A. Vasanthanathan, S.Rajakarunakaran, R.Venkatesh, R. Prabhakaran</b>
	<b>Paper Title:</b>	<b>Numerical Study on Interfacial Failure of Mixed Mode Debonding Laminated Composite Using Cohesive Zone Model</b>
	<p><b>Abstract:</b> In this research work, the cohesive zone model is prepared to predict crack propagation at the interface of a laminated composite beam under mixed-mode loading. This model is a traction separation law that describes the softening in the cohesive zone near the delamination tip. The mixed mode bending model is tested experimentally to demonstrate the capabilities of the CZM. Initially a beam cracked along a ply interface halfway through its thickness. The initial crack has been developed. The force is applied on the top edge at the cracked at the centre of the beam. AS4/PEEK unidirectional laminates were seleted for this simulation. The model is analysed for a mixed mode ratio of 50%.The Von-mises stress distribution of the last computed parameter step for the Layered Shell Model (LSM) is simulated. The output results were compared with solid mechanics model, the distribution of stressed from the Layered Shell Model matches closely. The interface health predicted by the Layered Shell Model flow excellent agreement with the solid mechanics model.</p> <p><b>Keywords:</b> MMB, CZM, AS4/PEEK, COMPOSITE, LSM.</p>	
76.	<b>Authors:</b>	<b>K.Solai Senthil Kumar</b>
	<b>Paper Title:</b>	<b>Mechanical Property and Orientation Study on Acacia a Natural Fiber Composites</b>
	<p><b>Abstract:</b> In recent years, natural fibers reinforced composites have received much attention because of their lightweight, non-abrasive, combustible, nontoxic, low cost and bio-degradable properties and the usage of composites increasing drastically because of their salient features. The project is based on Polymer reinforced composites, attempting to compare two different type of manufacturing process Plates in polymer reinforced composite. One set of plate are manufactured Random Orientation process and the orientation for the fiber (Vagai)and Acacia fiber which is treated with NaOH and the other set of plates are manufactured with unidirectional orientation of Albizia fiber and Acacia fiber(Udai) in unidirectional which is treated with NaOH. The tensile and impact test are tested for the following plates and compared the results of both the process. From the result am going to conclude that Random Orientation plates and unidirectional orientation plates which has the maximum strength. The required specimen is prepared with different orientated.</p> <p><b>Keywords:</b> Fiber (Vagai), Acacia Fiber, Albizia Fiber And Acacia Fiber (Udai), Unidirectional, NaOH.</p>	
77.	<b>Authors:</b>	<b>Ananth.A, Merlin.Y, Nagaveena.S</b>
	<b>Paper Title:</b>	<b>Synthesis And Structural Properties of Pure And Ni<sup>2+</sup> Doped Barium Oxide Nanoparticles</b>
	<p><b>Abstract:</b> Nanosized oxides are of great interest because of their unusual physical and chemical properties. Metal oxide nanoparticles have wide application in the field of fuel cells, batteries, agriculture, etc. Barium oxide is a white hygroscopic, non-flammable compound. Barium Oxide nanoparticles have a wide range of application in cathode ray tube, crown glass and catalyst. The present study report the synthesis and properties of pure and Ni<sup>2+</sup> doped Barium Oxide nano particles synthesized by domestic microwave assisted solvothermal method. Barium chloride,and Urea were the reactants and Ethylene glycol was used as the solvent. Prepared sample was annealed at 500°C for one hour and collected as yield. Nickel chloride hexahydrate was used as dopant precursors. The synthesized nanoparticles were characterized by Powder X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray spectroscopy (EDAX) studies. The method adopted for preparing pure Barium oxide nanoparticles is found to be economical and result with good yield percentage. It is also believed these pure Barium Oxide nanoparticles prepared could represent as an effective material for the application of cathode ray tube.</p> <p><b>Keywords:</b> Barium oxide, XRD, SEM, Nanoparticles.</p>	



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### **Organic Manure by Rapid Composting Method**

Geethamani R<sup>a</sup>, Soundara B<sup>a</sup>, Kanmani S<sup>b</sup>, Jayanthi V<sup>a</sup>, Subaharini TR<sup>a</sup>, Sowbyalakshmi V<sup>a</sup> and Sowmini C<sup>a</sup>

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Corresponding Author E-mail: geethamanir@bitsathy.ac.in

#### *Abstract*

This project is an initiative to convert the solid waste (easily available inside Bannari Amman Institute of Technology campus, Sathyamangalam, Erode District.) to compost within a short duration of 14 to 18 days by rapid composting. The wastes included in the composting comprises materials such as vegetable cuttings, dry and wet leaf twigs, grass clippings, tree trimmings etc., That's where composting steps in; organic waste can be recycled through composting and the resulting product can be used to improve soil quality and help plants grow. The size of the composting bin was 3 feet x 3 feet x 3 feet. Alternate layers of wet waste and dry waste were added to the composting bin. Saw dust and cow dung were used as the accelerators. Quantity of waste added was: Wet waste - 169kg, Dry waste- 66kg, saw dust - 24 kg which was in the ratio 7:2.75:1. Wastes were chopped to 0.5 to 1.5 inches for better composting. The dry leaves are used only for burning (which causes air pollution and causes health hazards), as an alternative we made compost with dry leaves combining with wet waste. This can be readily adopted in colonies, schools and colleges where dry and wet wastes are easily available. The resultant product of compost obtained is used as manure for plants inside our campus.

### **Activation of Plastic Deformation Severely on Al/Mg/Si Alloy by RCS Method**

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<sup>a</sup>Mechanical Engineering Ramco Institute of Technology Rajapalayam, India

<sup>b</sup>Bannari Amman Institute of Technology, Sathyamanagalam, India

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#### *Abstract*

Nowadays, Severe Plastic Deformation (SPD) technique are widely used to produce bulk ultrafine grained (UFG) metallic materials even at nanometer size level. In present study, Repetitive Corrugation and Straightening (RCS) method has been concentrated for improving material property by reducing the grain size. The grain refinement technique mechanism were influenced more on RCS method. In this work, AA6063 alloy were processed by RCS method upto 10 passes at different thickness of specimen. The grain size were analyzed through Scanning Electron Microscope. The true strain of specimen were calculated theoretically and confirmed through experimental results. The hardness of each specimen before and after RCS were taken by Micro Hardness Machine. The result demonstrate that processing by RCS gives a very significant increase in hardness from 87 at single pass to 124 after 10 passes for 1.2 mm thick sheet. This increase of hardness due to reduction of grain size and confirmed through SEM structure. The grain size were reduced from 256  $\mu\text{m}$  to 124  $\mu\text{m}$  after 10 passes of RCS.

**Influence of Titanium and Mild Steel Backing Plate on Tensile Behaviour and Microstructural Features of Friction Stir Welded AA2014-T6 Aluminium Alloy Joints**

Raja S<sup>a</sup>, Manikumar R<sup>a</sup>, Benruben R<sup>a</sup>, Ragunathan S<sup>b</sup>

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*Abstract*

AA2014-T6 sheets were friction stir welded by means of two dissimilar backing plate, namely mild steel (MS) and titanium (Ti) alloy. The results indicate that the MS backing plate with great conductivity efficiently declines the temperature contribution to the specimen in the course of welding. By reducing the backing plate conductivity, the sizes of equi-axed grains due to recrystallization in the weld zone raises. However, the peak hardness of the weld zone raises considerably. The joint, welded using a Ti backing plate yielded inferior hardness in the weld compared with weld made with MS backing plate. This could be due to the low conductivity of heat in the weld through friction stir welding.

**Effect of Artificial Aging on Microstructural Behaviour of Friction Stir Welded AA2014 Aluminium Alloy Joints**

Nova Ajay Joseph R, Jishadh Ahmed KA, Mohamed Rizwaan M and Rajendran C

Department of Mechanical Engineering, Sri Krishna College of Engineering and Technology,  
Coimbatore, India-641008,

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*Abstract*

Friction stir welding (FSW) of the heat treatable Al alloy causes degradation of strength properties in the as-weld condition due to thermal cycle. Hence, the post weld heat treatment is used to recover the lost joints properties. In this research, the effect of artificial aging on microstructure characteristics was scientifically studied. The microstructural features were carried out using a microscope. The strength and hardness properties were correlated with the grain size. It was found that the aged joint exhibited higher lap shear strength than the as weld joint due to the formation of equi-axed grains and fine precipitates.

**Study of Underwater Welding**

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*Abstract*

The concept of welding in underwater yields the attraction of many naval construction because it is useful in repairing of collided ships and damaged ones. In this work a study on underwater welding was carried out to list its evolution salient features, systematic procedures for performing this welding, its advantages and dis-advantages, and identifying the extension works in this area.

**Enhancement of Mechanical Properties of Aluminium Metal Matrix Composite by Reinforcing Waste Alumina Catalyst and nano Al<sub>2</sub>O<sub>3</sub>**

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*Abstract*

The manufacturing industries are ready to experiment with the metal matrix composites by miscellaneous materials out of ordinary combination. From the rundown, it is obvious that research is concentrated in recycling or reusing any waste material so as to reduce the usage of conventional materials. The present investigation aims to reuse waste spent catalysts from the petroleum industries (goes as waste in landfills) to synthesize aluminium metal matrix composite. The waste catalysts used in the investigation consists of beneficial elements like alumina, molybdenum, silica, nickel etc. The waste spent catalyst previously proved to increase the strength of cement, bricks etc. in construction field. The inclusion of nano materials enhances the mechanical properties of the metal matrix composites. In this research, aluminium metal matrix composite was synthesized with dual reinforcement of waste alumina catalyst and nano Al<sub>2</sub>O<sub>3</sub> by Stir casting. The ratio of nano Al<sub>2</sub>O<sub>3</sub> was varied such as 0.5%, 0.75% and 1% along with 10% waste alumina catalyst in the aluminium matrix. The nano composites were tested for hardness and tensile strength with a detailed microstructural study using Scanning Electron Microscope. The nano composites resulted with improved mechanical properties than pure aluminium. The nano composite Al+10%WAC+1% nano Al<sub>2</sub>O<sub>3</sub>, yielded the highest hardness of 94HRB and tensile strength of 115.21MPa.

**Simple Mechanical Devices for Hemorrhagic Stroke Patients**

Godwin Barnabas S, Sivakumar V, Valai Ganesh S, DhineshRaja A, Muthukumar P and Hariharan K

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*Abstract*

Physiotherapy is a technique for relaxing the stresses in muscles in different parts of the body. This technique needs the physiotherapist supervision and a regular visit to the hospitals to overcome this technique we came with a solution by using simple mechanisms like slider crank mechanism, wiper and rack and pinion mechanism. by the simple mechanism, the therapy is done automatically and can be done at home without any assistance. Moreover, Home traction devices have also meant that patients once advised by the therapist regarding the weights and duration of traction treatment are able to apply traction themselves.



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### **Re-use of abandoned Sanitary Ware Waste as Abrasive Particles for Abrasive Jet Machine**

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#### *Abstract*

In recent years, the growth in the machinery industries has emerged to produce the ceramic components which are non-bio degradable wastes. In this paper, the abrasive particles are produced through a rehash of ceramic sanitary ware wastes to machine the glass material in the abrasive jet machining process. Beforehand, computational fluid dynamics (CFD) analysis is performed on the nozzle to evaluate the flow velocity at the corresponding pressure distributions. It results that the velocity of 810 m/s is achieved at the outlet of the nozzle. The nozzle is designed based on the consequent results of flow analysis. Further, the sanitary ware wastes from washbasin urinals, sinks, bathtubs, toilets, etc are collected and renewed to the form of abrasive particles using sieving and segregation processes. The mixing chamber is fabricated and abrasive particles, dry air is made to mix in the mixing chamber. Then mixed particles are made to flow out to the working chamber through the outlet opening. Hence, the focused stream of abrasive particles is propelled through a convergent nozzle at a high-velocity stream to machine the glass materials in the abrasive jet machining process. Moreover, the performance characteristics of abrasive particles in the abrasive jet machining process are evaluated.

### **Experimental Investigation on Reliable and Accurate Prediction of Buckling Analysis of Thin Cylindrical Shells with Geometric Imperfections**

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#### *Abstract*

The cylindrical shell having a diameter to thickness ratio more than 10 is normally called as thin cylindrical shell. The primary threat to the thin cylindrical shell is axial compressive force. This force leads to buckling and it provokes the failure of shell. Owing to several consequences in terms of loss of injury, property, life & damage of failure incidents, pipeline planners are setting more accentuation both on protection measures against outside impedance and on giving sufficient obstruction against buckling.

The universally useful FE code ANSYS is utilized for the improvement of the material disappointment model. A numerical alignment technique is portrayed which empowers the utilization of standard pliable test information for steels and measure of weight as the contribution to the trial arrangement with and without internal pressure. The experimental results will be compared with numerical results to identify the deflection, and also confirmation of limit conditions used. The load at which the thin cylindrical shell starts to buckle, yield point and maximum failure load will be determined by the results.



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## Micromechanics study on FRP composite cylinder under finite element simulation COMSOL Multiphysics<sup>®</sup>

J. Jerold John Britto<sup>a</sup>, R. Venkatesh<sup>a</sup>, K. Amudhan<sup>a</sup>, A. Vasanthanathan<sup>b</sup>, N. Gokulakrishnan<sup>a</sup>, M. Manikandan<sup>a</sup>

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### ABSTRACT

Buckling is a major structural instability of composite material that can lead to failure of large component without initial failure. The Finite Element Simulation is performed on CFRP, GFRP and KFRP composite material using COMSOL Multiphysics<sup>®</sup> and the buckling factor is compared with these composite materials. It is performed with a linear analysis of a composite cylinder under compressive loading and fixed end conditions. The composite materials are made up of eight layer (plies) of a composite. An Equivalent Single Layer (ESL) based approach is used for this analysis. The stacking sequence of composite materials are Layered 1 [0/0/45/-45], Layered 2 [90/90/45/-45], Layered 3 [90/0/90/0] and Layered 4 [45/45/45/45]. The critical buckling load factor is compared among the three materials with 4 layered sequence. Based on the Finite Element Simulation Result. The Kevlar Fiber Reinforced Polymer has considerable buckling load stability factor compared with other material. It is proposed that the KFRP material is best suitable for larger applications.

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## 1. Introduction

Composites are mixture of two materials such as one in the form of fibers, panes and particles and other implanted material is called as matrix phase. In case of Fiber Reinforced Plastics, It has shown the thermosets of polyester fibers. FRP can be classified by the terms of matrix used: carbon matrix, polymer matrix, and metal ceramic composites.

Glass Polyesters are one of the structural materials in the larger family of composite materials. Recently, modern composites oblige their source of glass-fiber reinforced polyester has been developed in the years of 1940–50 [1]. The GFRP basically consists of polyester resin and E-glass fibers that have thickest mould ability with several required qualities such as high yield strength, less weight, aesthetic appearance, more stiffness, extreme toughness and chemical unreactive, etc.

Carbon-fiber reinforced composites have extra-desired mechanical properties such as less weight, high stiffness strength, and high strength. So, CFRP is the best choice for lightweight &

superior performance applications i.e., aircraft, railway and automotive, etc.

Kevlar epoxy has a high tensile comparing to carbon fiber, a moduli between glass and carbon fibers and both having lower densities [2]. Kevlar-49 reinforced composites are highly demandable in commercial applications but Kevlar is completely new to the field when compared to traditional fibers.

The properties of shape memory epoxy composites are at least an order of magnitude higher than those in existing typical Shape Memory Polymer systems [3]. The CF reinforced SMEPCs has excellent mechanical properties of the fibers and their ability to retard crack propagation in the matrix are studied.

In finite element modelling there is an existing gap in the literature on modelling the dynamic response of piezoelectric vibration energy harvesting in relation to real-world vibration data [4]. It is studied that Piezoelectric device physics involving solid mechanics and electrostatics were combined with electrical circuit defined as FE model and simulation results were validated by experiments with <10% deviation, providing confidence for the

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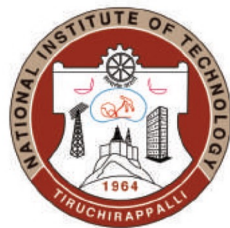
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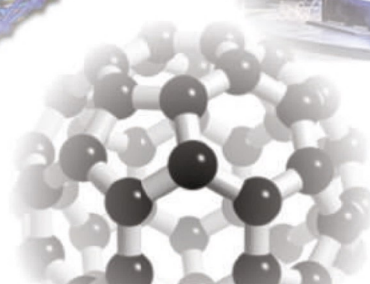
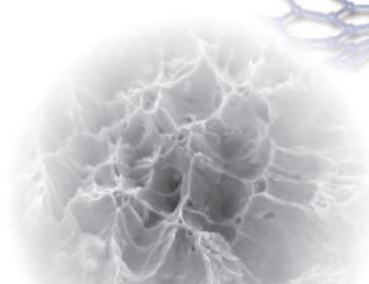
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### 131. DESIGN OPTIMIZATION OF BIOMEDICAL STENT UNDER THE INFLUENCE OF THE RADIAL PRESSURE USING FEM

J. Jerold John Britto<sup>1</sup>, R. Venkatesh<sup>2</sup>, R.Prabhakaran<sup>2</sup>, K.Amudhan<sup>2</sup>

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#### Abstract

Atherosclerosis problem is treated by means of stenting a percutaneous transluminal angioplasty method. During the process a stent is deployed into the artery by using a balloon as an expand-er. Balloon is removed after deflation but the stent remains expanded to act as a scaffold and keeping the blood vessel open. In this paper, the non-uniform deformation of the stent and for shortening effect is simulated by means of Finite Element Simulation using COMSOL. The dog boning and foreshorten-ing effects are simulated to change the geometry parameters for optimum performance of the study. The Palmaz Schatz stent model is used for this simulation. The stress evaluation is calculated using the FEM. The stent is expanded from an original diameter of 0.74 mm to a diameter of 2 mm in the mid-dle section. The average displacement of the stent's inner radius is determined and a global equation is used to computer the corresponding applied pressure load. The longitudinal recoils is about -0.9 %, the distal radial recoil is about 0.4 % and the central radial recoil is about 0.7 %.

**Keywords:** STENT, DOGBONING, PULMAZ-SCHATZ, COMSOL, FEM

### 132. INFLUENCE OF NEAR DRY WIRECUT ELECTRICAL DISCHARGE MACHINING PARAMETERS ON KERF WIDTH IN MONEL 400

N.E.Arun Kumar<sup>1, a \*</sup>, N.Sathishkumar<sup>2, b</sup>, E.Raviraj<sup>3, c</sup>,  
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#### Abstract

This work explains the more refined and subtle analysis on one of the significant response parameters in kerf width upon machining Monel 400. Machining was done under near-dry ambiance with the support of the mathematical modeling technique of Response Surface Methodology (RSM) and the more sophisticated predictive computational modeling in an artificial neural network (ANN). Driving control elements considered for this WEDM process were pulse-on and off time (T ON and TOFF), Voltage (V), Wire Feed (WF), Air inlet pressure and Water flow rate. The impact on the intermittent zone that prevails between the surface of the material in the spark zone and the wire during the process has not only being influenced by the control parameters but also by the dielectric medium. The implications of di-electric medium maintained at near dry conditions were given utmost importance and considerations in this investigation. The execution of the RSM and created ANN models are contrasted and trial consequences of Kerf Width for their adequacy. The examination demonstrates that ANN shows more exact expectation contrasted with the RSM models.

## 229. MACHINING STUDIES OF AL7075 IN CNC TURNING USING GREY RELATIONAL ANALYSIS

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### Abstract

The demand for light materials is increasing continuously and Aluminium plays a vital role in fulfilling that demand due to their light weight and high strength properties. Al7075 is a work material because of its wide applicability as material for Automobile and aerospace components. In metal removal Turning is one of the main manufacturing processes. Therefore this paper represents the surface roughness and MRR of Al7075 with Tungsten carbide tool with coolant and without coolant conditions. The GRA is carried out to find the minimum value of surface roughness where the MRR is maximum. Suitable machining parameters for turning of Al7075 are recommended at end of the investigation based on GRA and confirmed by using ANOVA.

**Keywords:** Grey Relational Analysis; Turning; Optimization; surface roughness; MRR; ANOVA

## 30. INSTANT ASH MONITORING USING A LOAD CELL IN THE BOILER

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### Abstract

The aim of this paper is to design a novel system for measuring the amount of ash deposited at the base of the boiler. In this system piezoelectric load cell are used to measure the weight of the amount of ash deposited due to burning of pulverized coal. In the existing system level switches are used to indicate the level of ash deposited. These switches provide inaccurate output. To overcome this problem piezoelectric load cell is introduced. This provides an accurate level of ash fouling inside the boiler.

**Keywords:** Load cell; Level switches; Ash fouling; Pulverized coal; Furnace



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## FINITE ELEMENT MODELING AND SIMULATION OF CFRP / GLARE COMPOSITE FOR WARSHIP HULL UNDER STATIC AND DYNAMIC CONDITION

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<sup>1</sup>Assistant Professor, <sup>2,3,4</sup>UG Scholars,  
Department of Mechanical Engineering,  
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Rajapalayam, India

### ABSTRACT:

The static and dynamic analysis deals with detailed investigation on vibration behavior of laminated composite. The composite laminate of CFRP and GLARE has been compared with STEEL for better utilization of composites in the marine structure. The material is analysed under explicit dynamics mode in ANSYS Workbench®, for static loading conditions under tensile loading for getting deformation. In vibration simulation, composite laminate is made up of three-layer bidirectional woven Fibre [0/0/0]. The delamination occurs in between second and third layers of the laminate plate modeled using the layerwise theory in COMSOL Multiphysics®. The frequency response analysis in the composite plate is performed under bending and twisting loads, the response of the plate in terms of transverse velocity and impedance is measured at different points on the plate. Based on the simulation results with the parameter of deformation in CFRP materials is minimum when compared to other materials. Under dynamic loading condition Sandwich structure of GLARE with Steel structure is best suitable for marine applications.

**Keywords-** Ansys workbench, CFRP, composite laminate, comsol, FEM, GLARE, steel, ship hull.

## DESIGN AND DEVELOPMENT OF PLANT SEEDLING PLANTING MACHINE

Mohmmad Ismail P<sup>1</sup>, Santhosh Padmanabhan S<sup>2</sup>, Subramani S<sup>3</sup>,  
ThangaveL.K<sup>4</sup>  
Department of Mechatronics,  
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### ABSTRACT:

Nowadays Automation occupies its immense importance in each and every field of the development. One such important field of development is Agriculture. Being the backbone of our country's economy, the technologies in agriculture are far limited and not so compatible. Our aim is to concentrate the nurseries where manpower usage is comparatively high and the focus of the engineering technologies are limited in recent past. Seedling planting process is manual and automating such process leads to efficient and precise planting. Transplanter is one such farm equipment which is manually used. The equipment is fabricated in such way it is placed on four wheeled robot and actuated using pneumatic system. The plantlets are placed in conveyor and dropped into the transplanter. It penetrates into the soil and then



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# Advances in Forming, Machining and Automation

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# Chapter 1

## Effect of Heat Treatment on Formability of AA6082 by Single Point Incremental Forming



S. Maharajan , D. Ravindran and S. Rajakarunakaran

**Abstract** This paper investigates the formability of annealed and un-annealed AA6082 sheets by using single point incremental forming (SPIF) process. Lightweight alloys represent key materials for the future of the manufacturing industry, and their use in the emerging fields, such as automobile and aerospace engineering, is a continual topic for researchers of all over the world. It is a reliable area where huge opportunities available for rapid prototyping. In this experimental work, the sheet metal is deformed into the required shape by a hemispherical tool in the vertical CNC milling machine. The straight groove tests are carried out by varying the forming process parameters like feed, speed and step depth. Four experiments are conducted with two sets of different forming process parameters for annealed and un-annealed sheet metals. The formability, forming time and maximum step depth are examined for each experiment. It is found that better formability is achieved in annealed AA6082 aluminium sheet than un-annealed AA6082 aluminium sheet and also observed that step depth plays a major role in forming time and formability.

**Keywords** Single point incremental forming · AA6082 aluminium alloy · Formability · Coordinate measuring machine

### 1.1 Introduction

Incremental forming is a forefront sheet metal forming technology enabling the formation of the desired shape by passing a sheet metal through a series of small incremental plastic deformation. A CNC vertical milling machine traces the movement of forming tool path. A special die is not required for this process. A fixture is enough to hold the sheet metal in all the four sides, and highly sophisticated machines are not required to carry out the forming operation. In this machining operation, forming

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# Numerical Simulation Study on Failure Prediction of FRP Laminate Composite Using COMSOL Multiphysics®



J. Jerold John Britto, A. Vasanthanathan, S. Rajakarunakaran, and R. Prabhakaran

## 1 Introduction

To obtain higher strength to weight ratio, carbon fiber-reinforced polymer (CFRP) is preferred for many applications. In this model, the structures reliability is assessed by means of applied load on the laminated ply. Each ply is assessed through the parameters called failure index and safety factor. In the fiber ply, each longitudinal and transverse orientation has different stiffnesses and strengths. Failure criterion is also called the first ply failure analysis and other ply termed as failure of the whole laminate. Carbon and Glass fiber is suitable for many applications when compared to Kevlar fibers even though Kevlar has a high tensile strength [1]. Compared to all other damages, more damages occurred in laminates carbon E-glass composites, ultrasonic C-scan are used to detected delamination zones and failure zone of the damaged area, SEM test is used to find the fractured areas [2]. Four layers with different orientations of carbon, glass epoxy composites has been considered for simulation using COMSOL Multiphysics. The performance characteristics are very essential to enhancing properties in various applications; KFRP has high higher longitudinal strength to compression strength [3]. Alternate failure of successive ply is determined by various loading conditions by layer-by layer failure analysis. The

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# Numerical Simulation of Self-Expanded NitinolBased Shape Memory Alloy Stent



J. Jerold John Britto, A. Vasanthanathan, S. Rajakarunakaran,  
and K. Vigneshwaran

## 1 Introduction

Due to unique superelasticity, shape memory effect, low elastic modulus, biocompatibility, non-ferromagnetic property, good corrosion resistance, SMA is gaining interest in biomedical fields like as endoscope spring, braces, palatal arches, stents and robotics [1, 2]. Because of the shape memory effect and superelasticity the deformed material will regain to its original shape by increase in temperature or by load removal; SMA gains the usage in smart and civil structures for actuating and to isolate and suppress the vibration [3]. Among different alloys, NiTi alloy has the best mechanical and functional properties like fatigue resistance, cycle stability at low stress level; hence, these are the most famous SMA [4]. By adding third elements like Zr, Pd and AL, Fe with NiTi alloys will increase and decrease the martensite transformation temperature, respectively [5]. However, these above NiTi alloy properties are limited to low temperature and not at high-temperature applications because NiTi alloy transformation temperature is below 100 °C [4]. Therefore, the choice of NiTi alloy is based on the working temperature as austenite temperature. It is important to control and enhance austenite temperature for NiTi alloys [2].

Nickel–titanium alloy can be ureteral stent for patients. The stent provides advantages over conventional double-J (Medical Engineering Corp., New York, New York)

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# Finite Element Simulation of Dynamic Behavior of FRP Laminate Composite Under Forced Vibration



J. Jerold John Britto, A. Vasanthanathan, S. Rajakarunakaran,  
and K. Amudhan

## 1 Introduction

Fiber-reinforced polymer (FRP) composites are replacing conventional metallic materials for their better strength and durability. They possess superior mechanical properties which provide enhanced performance for a wide range of applications. The complexity faced by researchers is to assess its behavior for different types of loads under different loading conditions for real-time deployment. The difficult part is to make a comprehensive conclusion due to the heterogeneity and responses of multiple distinct phases to varying loading conditions. Fiber-reinforced polymers (FRP) reinforcements also provide an option to explore quick repair techniques. This includes the possibility of easy reinforcement removal and replacement while maximizing the benefits resulting from the low self-weight and high strength of these fibers.

Delamination causes a notable reduction in the load-carrying capacity of fiber-reinforced polymer (FRP) composites, which is an important factor to be considered in automotive and other industries. High-performance FRPs are often subjected to dynamic loadings of different energy densities in their working environment when strain rate, stress developed, and impedance developed can have predominant effect on the interfacial strength of plies in a laminate. The impedance observed through

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# Validation and Verification of FRP Laminate Composite Material Characterization Under Numerical Simulation Using COMSOL Multiphysics<sup>®</sup>



J. Jerold John Britto, A. Vasanthanathan, S. Rajakarunakaran, and R. Venkatesh

## 1 Introduction

Laminated fiber-reinforced polymers (FRP) are widely used in variety of applications where outstanding mechanical properties are necessary for combination with weight savings [1]. In twentieth century, composites are one of the biggest material inventions around world. Composites have highest strength and stiffness with (Carbon, Aramid or Kevlar and Glass) fibers embedded in thermoset (polyester or epoxy) matrix. Fibers carry mechanical load and matrix transmits load to the fibers, and it covers toughness and ductility, thereby protecting the fibers from damage due to manipulation. Normally, matrix material determines the working temperature and manufacturing conditions [2]. In every industrial branch, the composite material systems are progressively used. In addition to that, it could be found in the aeronautical, automotive, sports sectors, and additionally, it is used in industrial operations like storage tanks, wind turbines, gas turbine engines, and high-speed and precision machinery and medical diagnostic equipment's [3]. In industrial functions, rivets are used to connect the components that are made of isotropic or anisotropic materials.

The isotropic material has mechanical, thermal, and physical properties of anisotropic materials. For example, in fibrous directional composites analyzing the

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# Numerical and Experimental Evaluation of Material Characterization on Glass Fiber/Epoxy Composite Material



J. Jerold John Britto, A. Vasanthanathan, S. Rajakarunakaran, M. Manikandan, and P. Ari Ramalingam

## 1 Introduction

Natural fiber and glass hybrid composites were fabricated by using epoxy resin combination of hand layup method and cold press method. Specimen was cut from fabricated laminate according to the ASTM standard for different experiments for tensile test, flexural test and impact test [1]. The glass/carbon thermoplastic (GCMT) composite material is selected for reducing the weight of the bumper beam. The design optimization and the mechanical properties of GCMT were predicted, and optimal design of bumper beam was performed with the impact simulation [2]. Bumper is one of the parts having slightly more weight. Polymers are having good strength to weight ratio compared with conventional material. So, the polymer material is selected to replace the conventional component. Composite material properties were used as an alternative to provide higher impact resistance than conventional materials used in automotive bumpers [3]. The influence of overbraiding on mechanical properties of pultruded rods, unidirectional rods, without braided fabric, was produced, as well [4].

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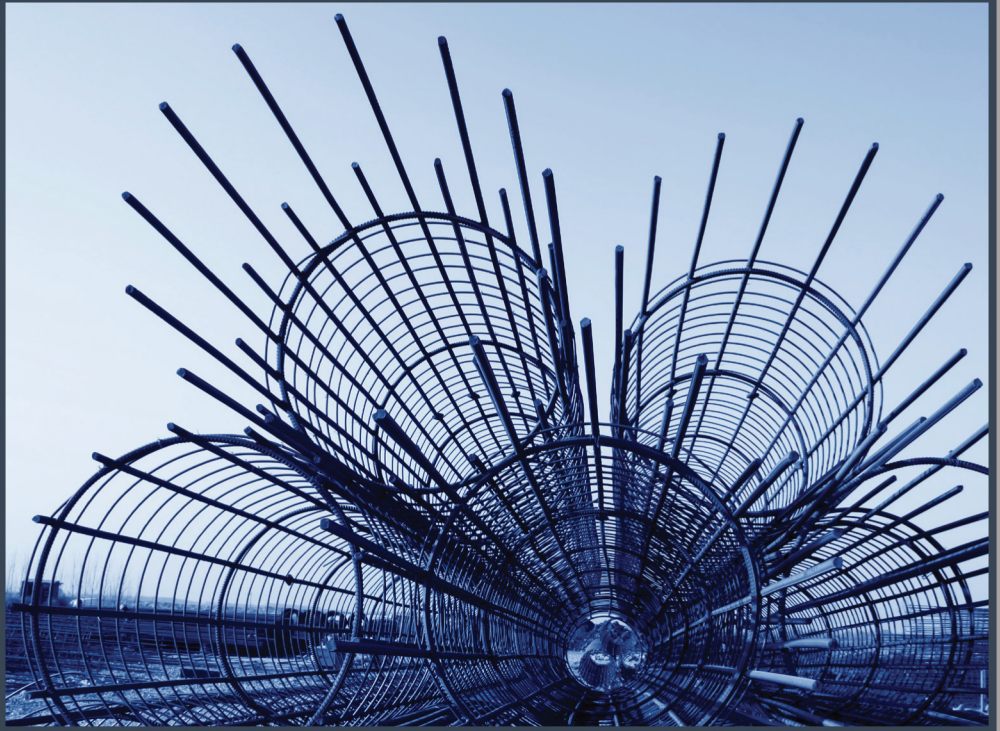
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# Role of characterization techniques in evaluating the material properties of nanoparticle-based polymer materials

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## 1 Introduction

In recent years, remarkable development has been made in synthesizing and characterizing the materials to the size of nanoscale for tailoring the properties of materials where they are used as filler. The nano-sized materials play a vital role in many fields such as (1) environmental engineering, (2) medicine, (3) industries, and (4) electronics [1]. In general, the nanomaterials will have a size between 1 and 100 nm. Furthermore, the longest and shortest dimensions in *x*- and *y*-axes do not differ significantly. Nanoparticles are also called “ultrafine particles,” and these materials are opposed to fine particles (size between 100 and 2,500 nm) and coarse particles (ranged between 2,500 and 10,000 nm). The properties of nano-sized materials can significantly vary by altering their sizes, and it differs noticeably from the fine particles or bulk materials [2]. For example, the transition temperature of ferromagnetic particles ( $\text{MgFe}_2\text{O}_4$ ,  $\text{MnFe}_2\text{O}_4$ ) can be varied by changing their particle size. Similarly, the bulk ZnO particles have different adsorption range, different rate of reaction, and redox than the nano-sized ZnO particles [3,4].

Incorporation of nanoparticle into the polymers has shown improvement in various properties. The enhancement in properties of the nanocomposites depends on (1)

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## Radiative life time of an exciton in a $\text{Cd}_{1-x}\text{Zn}_x\text{O}/\text{ZnO}$ semiconductor quantum dot

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### Abstract

Reducing the dimension in any semiconductor will lead to quantum confinement so that the exotic electronic and optical properties can be achieved. The charge carriers are confined in all the three directions in a quantum dot which shows the discrete energy levels and the transitions between electrons and holes are similar to the optical transitions between discrete levels of single atoms [1]. The band gap of ZnO can be tuned by adding Cd alloy content and it can be used as band gap engineered metal oxide nanostructures. It is well known that the ZnO material has a wide band gap semiconductor with the large exciton binding energy. The multi-photon absorption can be achieved with a high electron mobility in the present system. In the present work, the excitonic states, carrier overlaps, oscillator strength and radiative life time of a single exciton particle are analysed in a  $\text{Cd}_{1-x}\text{Zn}_x\text{O}/\text{ZnO}$  quantum dot. The efficient electronic and optical properties are achieved by changing its size and the composition. The built-in internal fields due to piezo and spontaneous polarizations are included in the Hamiltonian. The heavy hole exciton is taken in the system. The radiative life time as a function of dot radius is calculated. The computations are carried out employing variational formalism with the two variational parameters. The electronic excitation comprises a loosely bound electron-hole pair which is generally delocalized over a system [2]. Thus, the size dependent exciton radiative lifetime in a  $\text{Cd}_{1-x}\text{Zn}_x\text{O}/\text{ZnO}$  quantum dot is brought out. The results can be applied to improve the performance of opto-electronic devices such as chemical sensors, UV/violet/blue solid state emitters, laser diodes, Schottky diodes, antireflection coatings, window layers in solar cells, heat mirrors and piezoelectric devices and biological labels.

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### Biological Evaluation Of Pyrimidine Based Schiff Base And Its Metal (II) Complexes

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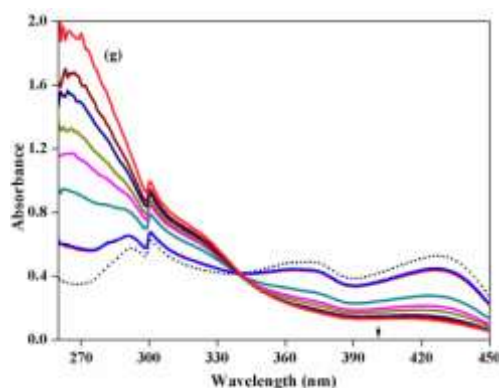
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#### ABSTRACT

A new novel pyrimidine derivative Schiff base 2-((4-amino-6-chloropyrimidin-2-ylimino)methyl)-4-nitrophenol has been synthesized using 2,6-diamino-4-chloropyrimidine and 5-nitrosalicylaldehyde. Transition metal complexes of Cu(II) and Zn(II) complexes are also

prepared with Schiff base / metal(II) acetate with molar ratio of M:L = 1:2. The Schiff base and the complexes are evaluated by UV-Visible, FTIR,  $^1\text{H}$  NMR, EI mass and ESR spectral techniques. Complexes have the composition of  $[\text{M}(\text{L}_3)_2]$  with the ratio of M:L = 1:2. Complexes are confirmed as square planar geometry. Electrochemical studies of the complexes are used to analyse the quasi reversible process. The complexes are good antimicrobial agents than Schiff base due to chelating ability against several bacterial and fungal strains. The interaction of the complexes with CT DNA is investigated by electronic absorption methods and viscosity measurements. The metal to CT DNA binding occurs in between the base pairs of DNA as major groove binding mode. The major groove binding mode is further confirmed by viscosity measurement. Complexes act as potent antioxidants than free Schiff base by DPPH radical scavenging assay.

Keywords: Schiff base, DNA binding, Viscosity, Antioxidant.





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# Recent Trends in Green Chemistry and Material Science (RTGCMS-2020)



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<p>PP-22</p>	<p><b>Keywords:</b> <i>Solid State Method, Chemical Route, Super paramagnetic, Ferro magnet.</i></p> <p><b>Facile Improvement In Proton Conductivity Of PA Doped Polybenzimidazole-SrZrO<sub>3</sub> Based Proton Conducting Polymer Electrolytes For Fuel Cell Applications</b>  <b>K. Selvakumar<sup>a</sup>, R.Chandramohan<sup>a</sup>, K.Kumar<sup>a</sup>, R.Swaminathan<sup>a</sup> and M. Ramesh Prabhu<sup>b*</sup></b></p> <p><sup>a</sup><i>PG-Department of Physics, Vidhyaagiri college of Arts and Science, Puduvayal-630108, India.</i></p> <p><sup>b</sup> <i>Department of Physics, Alagappa University, Karaikudi – 630 004, India.</i>  <i>*Email of the corresponding author: <a href="mailto:mkram83@gmail.com">mkram83@gmail.com</a></i></p> <p><b>Abstract:</b>  Polybenzimidazole (PBI) with SrZrO<sub>3</sub> based perovskite nano composite membranes were prepared by solvent casting technique. The polymer polybenzimidazole were prepared by polycondensation method. The prepared composite were characterized by using X-ray diffraction analysis, Fourier transform infra red spectroscopy, thermal analysis and physico chemical properties such as phosphoric acid uptake, IEC and leaching test. The prepared strontium titanate based nano composite membranes were also studied using electrochemical impedance spectroscopy, scanning electron microscope and atomic force microscope. The highest phosphoric acid uptake (120%) membrane shows highest proton conductivity <math>9.50 \times 10^{-2}</math> S/cm were observed for the PBI nano composite membranes containing 6 wt% strontium zirconite. Thus the composite membranes are found to be potential candidate for fuel cell application with improved conductivity.</p> <p><b>Keywords:</b> <i>Polybenzimidazole, proton conductivity, Phosphoric acid doping, PEM fuel cell.</i></p>
<p>PP-23</p>	<p><b>Biological Investigation And Antioxidant Study Of Cobalt (II) Complex Bearing Pyrimidine Moiety</b>  <b>N. Revathi<sup>a</sup>, M. Sankarganesh<sup>b</sup> and J. Dhaveethu Raja<sup>c*</sup></b></p> <p><sup>a</sup><i>Department of Chemistry, Ramco Institute of Technology, Rajapalayam, Virudhunagar District, Tamil Nadu- 626 117</i></p> <p><sup>b</sup><i>Department of Chemistry, K. Ramakrishnan College of Technology, Samyapuram, Trichy, Tamil Nadu-62112</i></p> <p><sup>c</sup><i>Department of Chemistry, The American College, Tallakkulam, Madurai, Tamil Nadu-62112,</i>  <i>*Email of the corresponding author: <a href="mailto:jdrapriya@gmail.com">jdrapriya@gmail.com</a></i></p> <p><b>Abstract:</b>  A new Schiff base ligand named 2-((4-amino-6-chloropyrimidin-2-ylimino) methyl) -4-nitrophenol (HL) was prepared through condensation reaction of 2,6-diamino- 4-chloropyrimidine and 5-nitrosalicylaldehyde in 1:1 molar ratio. The new ligand was characterized by elemental analysis and spectral techniques. The coordination behavior of Co(II) ion with the newly prepared Schiff base ligand (HL) is reported. The nature of bonding and the stereochemistry of the complex have been deduced from elemental analyses, IR, UV-Vis, <sup>1</sup>H NMR, mass and conductivity measurements. From the spectral study, Co(II) complex obtained as monomeric nature</p>

	<p>and the metal center moieties are four coordinated with square planar geometry. The redox behavior of the Co(II) complex was investigated by cyclic voltammetry. The preliminary in vitro antimicrobial screening activity revealed that Co(II) complex was found to possess high biological activity against different organisms. The binding interaction between Co(II) complex and DNA was investigated by means of electronic absorption and viscosity measurements. The DNA cleavage ability of Co(II) complex was also evaluated by agarose gel electrophoresis method. These studies revealed that the complex showed an intercalative mode of binding to CT DNA and also effectively cleaved the supercoiled DNA. In antioxidant study, the Co(II) complex is very active towards DPPH radicals.</p> <p><b>Keywords:</b> Schiff base, Antimicrobial activity, DNA binding, DNA cleavage, Antioxidant study.</p>
PP-24	<p><b>Studies The Effects On Physico-Chemical Properties Of Azolla Powder Added Ultra Graphite In Reclamation Of Red Soils</b>  <b>Dr.A.Mohamed Haroon Basha<sup>1*</sup>, Dr.R.Chandramohan<sup>2</sup></b>  <sup>1</sup>Department of Physics, AMET Deemed to be University, Chennai-603112, Tamilnadu, India.  <sup>2</sup>Department Of Physics, Vidhyaa Giri College of Arts And Science, Pudukkottai-630108, Sivaganga, TamilNadu, India.</p> <p><b>Abstract:</b>  In Green chemistry Azolla powder acts a vital role and it plays a wide act in the state of global environment as organic substances for increasing soil fertility, reclamation of red soils, as green manure etc. We assess the effect of ultra graphite on Azolla powder added red soil. Soil samples were collected from the top 15 cm depth from the experimental site using conventional soil tillage technology. We provide a detailed comparison of the morpho- and physico-chemical changes of Azolla powder added red soil samples with and without ultra graphite. FTIR, SEM, EDAX and soil analysis data support the fact that ultra graphite application significantly influences soil carbon, soil physico-chemical properties and exchange capacity of coarse-textured red soil.</p> <p><b>Keywords:</b> Morphological and physico-chemical properties, red soil, Azolla powder, soil quality, ultra graphite.</p>
PP-25	<p><b>Corrosion characteristics of CeO<sub>2</sub> dispersed of AZ31 alloy</b>  <b>Y.L.Rajamohan<sup>1&amp;2*</sup>, G.Senthamilselvan<sup>1&amp;2</sup> and A. Cyril<sup>2*</sup></b>  <sup>1</sup>Research Student, Alagappa University, Karaikudi-630003, Tamilnadu, India  <sup>2</sup>Post Graduate and Research Department of Chemistry, Raja Doraisingam Government Arts College, Sivaganga- 630561, Tamilnadu, India  *Email of the corresponding author: <a href="mailto:cyrilchemistry03@gmail.com">cyrilchemistry03@gmail.com</a></p> <p><b>Abstract:</b>  In this work, we have introduced CeO<sub>2</sub> nanoparticles in AZ31 alloy by vacuum melting and re-casting. Initial studies focused on the introduction of 5 wt% CeO<sub>2</sub> into the AZ31 alloy matrix and study the role of CeO<sub>2</sub> dispersion on the corrosion behavior of AZ31 alloy. The oxide dispersed AZ31 alloy allowed for characterization such as X-ray diffraction analysis (XRD), Field emission scanning electron microscope (FESEM), electrochemical linear polarization and impedance analysis. The XRD</p>