# FOREST FIRE DETECTION AND ALERT SYSTEM USING A SOLAR POWERED WIRELESS SENSOR

PROJECTWORK&REPORTSUBMITTEDIN

PARTIALFULFILLMENTOFTHEREQUIREMENTSFORAWARDOF THE DEGREE OF BACHELOR OF TECHNOLOGY

IN

***ELECTRICAL ENGINEERING***

FROM

MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY


SUBMITTEDBY

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***2020-2024***

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# CERTIFICATE

This is to certify that the project work & report entitled

**"FOREST FIRE DETECTION AND ALERT SYSTEM USING A SOLAR POWERED WIRE-LESS SENSOR"**

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Has been approved as the project for the students, -

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# ABSTRACT

This project proposes an effective viable solution for detecting forest fires, in this paper the system incorporates. GSM network, so that the signal could be sent any far distance, where the centralized control center is located. The proposed system consists of smart sensor which uses solar power for its operation and a GSM module which is connected to the GSM network for transmitting the detected fire alarm signal. When fire is detected, the sensor produces a signal of approximate level which triggers GSM module to transmit the alarm signal to far end control center. The center in turn processes the signal and takes necessary action to counteract the situation. Since the sensors in the system powered by the GSM module is powered by solar energy there is no need for conventional electrical energy. It is expected that the system could be a cost effective one and a viable one for detecting fires. The aim of our project is to continuously monitoring forest condition, detect ion of forest fire and its position and to inform the forest authority. So that necessary action can be taken immediately in case of fire. The two main modules present in the project are the GSM Module and the GPS Module. This paper gives an importance of wireless sensor technology. The sensors collect the data and transmit to the central unit as well as alert is sent via Call or message using GSM.

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# LIST OF ABBREVIATION

| | |
|---|---|
| **RL** | Resistance-Inductance |
| **LCL** | Inductance-Capacitance-Inductance |
| **GSM** | Global System for Mobile Communications |
| **GPRS** | General Packet Radio Service |
| **UV** | Ultra Violet |
| **LI-ION** | lithium-ion |
| **MIC** | Microphone |
| **IDE** | integrated development environment |
| **LCD** | Liquid-crystal display |
| **IR** | infrared |
| **MCU** | microcontroller |
| **DCS** | distributed control system |
| **IOT** | Internet of Things |
| **PDA** | Personal Digital Assistant |
| **LED** | Light Emitting Diode |
| **GND** | Ground |
| **KB** | Kilo-bytes |
| **RX** | Receiver |
| **TX** | Transmitter |
| **USB** | Universal Serial Bus |
| **SMS** | Short Message Service |
| **TTL** | Transistor to Transistor Logic |
| **DC** | Direct Current |

# CHAPTER1: INTRODUCTION

## 1.1 GENERAL

Forests are part of the important and indispensable resources for human survival and social development that protect the balance of the earth ecology. However, because of some uncontrolled anthropogenic activities and abnormal natural conditions, Forest Fires occur frequently. Frequency of forest fires has increased considerably due to climate changes, human activities, and other factors. The prevention and monitoring of Forest Fires has become a global concern in Forest Fire prevention organizations.

To simplify and reduce the costs of fire monitoring, the concept of Wireless sensor. Networks (WSNs), has been recently proposed. Cheap and compact wireless sensor devices deployed over a large territory and operating both jointly and autonomously may be effectively used to detect hazardous gases and monitor wild-fires. Forests Fires is the most universal and most immediate destructive agency. This is usually caused due to carelessness and negligence but exceptionally because of matchsticks, friction of rocks etc.

In this project, an automatic early warning system integrating multiple sensors to remotely monitor areas of forest for the risk of fire and extreme weather conditions is developed. The system integrates various sensors including temperature sensor, smoke sensor, carbon monoxide sensor, flame sensor. The signals and measurements collected from these sensors are transmitted to the control center using GSM module to automatically analyze and combine sensor information and detect the presence of fire or smoke.

## 1.2 LITERATURE SURVEY

This paper reviews on the various aspects of security, range of application, characteristics of the wireless sensor network. At present, with the advancement of internet of things, there is rapid development of wireless sensor network in communication technology and sensor technology. Therefore, the range of application in wireless sensors will also increases deeply. As a result of basic service of security, the security management will seek more importance. The idea is to develop a model that includes combination of multiple sensors for the detection of fire and also communicate with the nearest authorized center regarding the crisis. This system also includes the connection to nearest pond and water pipelines around the forest to extract water to minimize the further destruction. Another part of approach is

to carry water to the area where fire is initiated using unmanned aerial vehicles. The aim of the ideology is the early determination of forest fire in order to avoid property loss and protect the rare species, also to determine the fire locations with the help of particular sensor data.

To prevent fault data injection attacks in wireless sensor networks, this paper proposed an idea based on correlation theory to identify the malicious nodes present. Firstly, based on time correlation the similar sensor data type is used. Secondly, using spatial correlation infected nodes are identified. Lastly, based on event correlation, the verification of recognized malicious node is done. The paper focuses false data injection attacks, where attackers change node detection and system by injecting inappropriate information. Hence it can be said that it is very important to detect such type of attacks in wireless sensor network.

The paper is based on wireless sensor network framework in order to continuously monitor and for the fire detection in real time by using various types of sensors. Various sensors include temperature, humidity sensors integrated with the infrared camera sensor for surveillance. This proposed system aims to notify fire detection faster than any other conventional approaches by using specification like temperature, gaseous contents in the atmosphere

A system to detect forest fires, by use of a network of wireless sensors and info fusion methods. The older detection system contained satellite based systems. But these systems not efficient due to different reasons, such as high infrastructure and high expenses, real-time monitoring systems are required, when the fire is detected, the speed it spreads is uncontrollable and levels of loss is high. a fire detection system for forest fires is proposed in the paper where in its base stage, using a sensor network. The main part of this work is the implement a low-computational and low complexity algorithm, which has the capability to detect fire using only the data from two sensors like temperature and humidity.

A method for managing and detecting fire with combined technology. Forest fires are very common that could be a very big disaster to the surroundings and life. So as to guard these and measures have to be taken early to regulate the spreading fire. Typically it needs huge dependency of man power, transportation facility and insulating material to trace true space can results in delay. Through this search gave answer for this by implementation the IOT sensor technology. Fluctuation is detected by sensors were it observed within the temperature and wetness by using Node MCU small controller that is additionally a Wi-Fi module sending these values to the information to cloud.

A style to develop a Arduino based IOT enabled fire detecting and observation system for solution to the forest fire. In this project, fire detector by Arduino that is interfaced with few sensors. GSM is employed to produce the send message to the user through a particular range. The sensing element values area unit showed within the display.

A system that is depending on different sensors together to that and therefore the information from these wireless transmission, to fulfill the of fire detection. The paper tells the important features of wireless sensing element networks as a probable answer to the early detection of forest fires challenge. The system mentioned uses varied sensors hooked up and information transmission through wireless means, to satisfy the activity. These information that are gathered are unit sent to the tiny satellite that keeps on transmitting them to the ground station and that they are unit analyze.

An article about working of a system based on far infrared sensor having narrow beam. This infrared sensor can identify fire and its location. Therefore it can detect forest fires. This system can be externally connected to sprinklers to extinguish forest fire. The main motive of this project was to design a system.

An IOT based system which detects forest fires and sends the exact place of forest fire to the officials using GSM. Thus knowing the exact location of fire helps in early extinguishing of forest fire and saving the rest of the forest part from forest fire. By these large destruction in forests can be reduced and ecosystem can be maintained.

## 1.3INSPIRATION OF THE WORK

1. **Interdisciplinary Collaboration**:

- The field of forest fire detection inspires collaboration between various disciplines, including environmental science, engineering, computer science, and emergency management. This interdisciplinary approach leads to innovative solutions that leverage the strengths of different fields.

2. **Technological Innovation**:

- The challenges posed by forest fires drive technological innovation. The need for more accurate and rapid detection methods has led to advancements in sensor technology, data analytics, and aerial surveillance. These innovations often find applications in other areas, such as urban planning, disaster management, and agricultural monitoring.

3. **Global Cooperation**:

- Forest fires are a global issue, and their detection and management often require international cooperation. Sharing technology, data, and best practices among countries fosters a sense of global community and collective responsibility toward environmental stewardship.

4. **Public Awareness and Education**:

- The development and implementation of forest fire detection systems also serve as a catalyst for raising public awareness about the importance of fire prevention and environmental conservation. Educational campaigns and community engagement activities help inform the public about fire risks and the role they can play in mitigating these risks.

In conclusion, forest fire detection contributes significantly to environmental protection, technological advancement, and community safety while inspiring interdisciplinary collaboration, technological innovation, global cooperation, and public awareness. These efforts are essential in building a sustainable and resilient future in the face of increasing wildfire threats.

## 1.4CONTRIBUTION OF THE WORK

1. **Environmental Protection**:
   - **Early Warning Systems**: Advanced forest fire detection systems provide early warnings, which are crucial in minimizing the damage to ecosystems. By detecting fires in their initial stages, authorities can respond quickly to prevent the fire from spreading, thereby protecting flora and fauna.
   - **Carbon Emission Reduction**: Forest fires release a large amount of carbon dioxide and other greenhouse gases into the atmosphere. Effective detection and suppression reduce these emissions, helping mitigate climate change.
2. **Technological Advancements**:

- **Remote Sensing Technologies**: The development of satellite-based and UAV (Unmanned Aerial Vehicle) systems has revolutionized fire detection. These technologies enable real-time monitoring and data collection over large areas, providing detailed information about fire location, size, and movement.
- **Artificial Intelligence (AI) and Machine Learning**: AI and machine learning algorithms are increasingly used to analyze data from various sensors and predict fire risks. These technologies can identify patterns and anomalies that may indicate the presence of a fire, enhancing the accuracy and speed of detection.

- **Sensor Networks**: Deploying ground-based sensors that monitor environmental conditions such as temperature, humidity, and smoke levels can provide continuous and localized data. This networked approach allows for more precise and timely detection of potential fires.

3. **Community Safety and Economic Impact**:

- **Public Health and Safety**: Early fire detection helps in evacuating people from endangered areas promptly, thus saving lives and reducing injuries. Effective fire management also ensures that air quality is maintained, protecting communities from the harmful effects of smoke and particulate matter.
- **Economic Savings**: Forest fires can cause substantial economic losses due to the destruction of timber, property, and infrastructure. Efficient detection and management reduce these losses by enabling faster response times and minimizing the area affected by fires

# CHAPTER 2: MODEL CONFIGURATION

Nowadays their area unit numerous occurrences regarding the pirating of trees like sandal, Sag wan and then forth. These trees area unit high-ticket and pitiful. They’re utilized within the medicinal sciences, beautifying agents. To limittheirsneakingandtosparewoodlandsaroundtheworldsomepreventiveestimates ought to be sent. The wave got designed up a framework that may be utilized to limit sneaking.

The structure framework utilizes 3 sensors tilt sensor to acknowledge the tendency of the tree once it's being cut, temperature sensor to determine timberland fires, a sound sensor for the successful discovery of unlawful work for instance so, even the sounds created whereas chopping out the tree area unit in addition detected.

Information created from these sensors is consistently observed with the page. As for the sensors, their yield gadgets area unit initiated through a hand-off switch .For a tilt sensor and sound sensor, a ring e risen acted and for the temperature sensor, the water siphon is actuated. Created data is placed away within the cloud Server over the Wi-Fi module. Woods authorities square measure suggested once an occasion happens therefore correct moves created.

## 2.2 COMPONENTS OF THE WORK

### 2.2.1 FLAME SENSOR

### 2.2.2 SMOKE SENSOR

### 2.2.3 SIM900 GSM MODULE

### 2.2.4 LI-ION BATTERY

### 2.2.5 LCD DISPLAY

### 2.2.6 ARDUINO UNO

### 2.2.7 SOLAR PANEL

### 2.2.8 BUZZER

### 2.2.9 XL6009

### 2.2.10 TP4056

### 2.2.11 BREADBOARD

### 2.2.12 LED

### 2.2.13 REGISTER

### 2.2.14 JUMP WIRES

## Item Description :

2.2.1 FLAME SENSOR:

A flame-sensor is one kind of detectors which is mainly designed for detecting as well as responding to the occurrence of a fire or flame (refer Fig. 2.2.1). The response of these sensors is faster as well as more accurate compare with a heat/smoke detector because of its mechanism while detecting the flame.

Flame sensors are classified into four types-

a. IR single frequency

b. IR multi-spectrum

c. UV flame detectors

d. UV/IR flame detectors

*Features of flame sensors are:*

Some of the features of the flame sensors are categorized as follows:

I. Photosensitivity is high
II. Response time is fast
III. Simple to use
IV. Sensitivity is adjustable
V. It is responsive to the flame range.
VI. Accuracy can be adjustable.


Fig.2.2.1Flame sensor

2.2.2 SMOKE SENSOR**:**

A smoke detector is a device that senses smoke, typically as an indicator of fire(refer Fig. 2.2.2).Commercial smoke detectors issue a signal to a fire alarm control panel as part of a fire alarm system, while household smoke detectors, also known as smoke alarms, general-

ly issue an audible or visual alarm from the detector itself or several detectors if there are multiple smoke detectors interlinked. There are two basic types of passive smoke detectors photoelectric and ionization.

The ionization smoke detector consists of an alpha particle producing a radioactive source, a smoke chamber, and charged detector plates. Ionization smoke alarms work by detecting the presence of large quantities of very small particles entering the ionization chamber, which when in sufficient quantity will cause an alarm to sound.

Photoelectric technology is generally more sensitive to the large smoke particles that at tend to be produced by smoldering fires. "Smoke produced by a fire affects the intensity of a light beam passing through air. The smoke can block or obscure the beam. It can also cause the light to scatter due to reflection off the smoke particles. Photoelectric smoke detectors are designed to sense smoke by utilizing these effects of smoke on light.

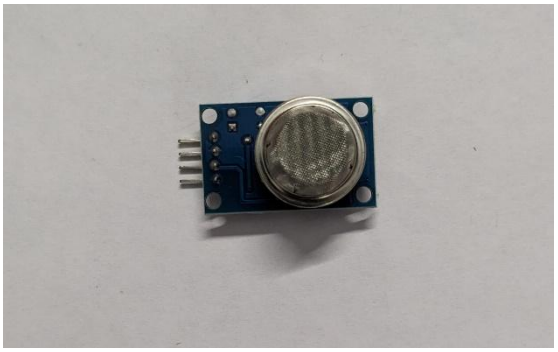


FIG.2.2.2 SMOKE SENSOR

2.2.3 SIM900 GSM MODULE:

The SIM900 is a readily available GSM/GPRS module, used in many mobile phones and PDA(refer Fig. 2.2.3). The module can also be used for developing IOT (Internet of Things) and Embedded Applications. The G.S.M refers to global system for mobile. It acts as the transmitting device which can transmit the reference signal over a global area through its wide spread network.

FIG2.2.3 SIM900 GSM MODULE

*SIM900 GSM MODULE Features*

Here's some of the most important features of the shield:

a. Compatible with Arduino and clones

b. Based on SIM900 module from SIMCOM

c. Allows you to send SMS, MMS, GPRS and Audio via UART using AT commands.

d. It has 12 GPIOs, 2 PWMs and built-in ADC of the SIM900 module

e. Quad Band: 850; 900; 1800 and 1900 MHZ, so it should work in all countries with GSM(2G) network

f. Control via AT commands

g. Supports RTC (real time clock) – it has a holder for a 3V CR1220 battery at the back

Arduino GSM shield The Arduino GSM Shield connects an Arduino to the internet using the GPRS wireless network. A GSM library contained in the Arduino IDE enables an Arduino board to do most of the operations you can do with a GSM phone: place and receive voice calls, send and receive SMS, and connect to the internet over a GPRS network (Arduino, 2014).

2.2.4 LI-ION BATTERY:

A lithium-ion battery or Li-ion battery is a type of rechargeable battery (refer Fig. 2.2.4). Lithium-ion batteries are commonly used for portable electronics and electric vehicles and are growing in popularity for military and aerospace applications. In the batteries, lithium ions move from the negative electrode through an electrolyte to the positive electrode during discharge, and back when charging. Li-ion batteries use an intercalated lithium compound as the material at the positive electrode and typically graphite at the negative electrode. The batteries have a high energy density, no memory effect and low self-discharge.

Fig.2.2.4 Li-ion Battery

2.2.5 THE LCD DISPLAY:

This is used for displaying the current status of the circuit and the actions taken by the circuit (refer Fig. 2.2.5).. It displays if fire is occurred or not.


Fig.2.2.5 LCD Display

2.2.6 ARDUINO UNO:

It is an open-source microcontroller- based kit for building digital devices and interactive objects that can sense and control objects in the physical world (refer Fig. 2.2.6). It is based on microcontroller beard designs, manufactured by several vendors, using various microcontrollers. These systems provide sets of digital and analog 1/0 pins that can be interfaced to various expansion boards ("shields") and other circuits. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers, For programming the microcontrollers, the Arduino has a specific software associated with it which provides an integrated development environment (IDE) based on the Processing project, which includes support for the C and C++ programming languages. In this project this is the main workhorse. This controls the entire circuit and makes all the decisions. The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically.

**Vin:** This is the input voltage pin of the Arduino board used to provide input supply from an external power source.

**5V:** This pin of the Arduino board is used as a regulated power supply voltage and it is used to give supply to the board as well as onboard components.

**3.3V:** This pin of the board is used to provide a supply of 3.3V which is generated from a voltage regulator on the board

**GND:** This pin of the board is used to ground the Arduino board.

**Reset:** This pin of the board is used to reset the microcontroller. It is used to Resets the microcontroller.

**Analog Pins:** The pins A0 to A5 are used as an Analog input and it is in the range of 0-5V.

**Digital Pins:** The pins 0 to 13 are used as a digital input or output for the Arduino board.

**Serial Pins:** These pins are also known as a UART pin. It is used for communication between the Arduino board and a computer or other devices. The transmitter pin number 1 and receiver pin number 0 is used to transmit and receive the data resp.

**External Interrupt Pins:** This pin of the Arduino board is used to produce the External interrupt and it is done by pin numbers 2 and 3.

**PWM Pins:** This pins of the board is used to convert the digital signal into an Analog by varying the width of the Pulse. The pin numbers 3,5,6,9,10 and 11 are used as a PWM pin.

**SPI Pins:** This is the Serial Peripheral Interface Pin, it is used to maintain SPI communication with the help of the SPI library. SPI pins include:

1. SS: Pin number 10 is used as a Slave Select
2. MOSI: Pin number 11 is used as a Master Out Slave In
3. MISO: Pin number 12 is used as a Master In Slave Out
4. SCK: Pin number 13 is used as a Serial Clock

**LED Pin:** The board has an inbuilt LED using digital pin-13. The LED glows only when the digital pin becomes high.

**AREF Pin:** This is an Analog reference pin of the Arduino board. It is used to provide a reference voltage from an external power supply.

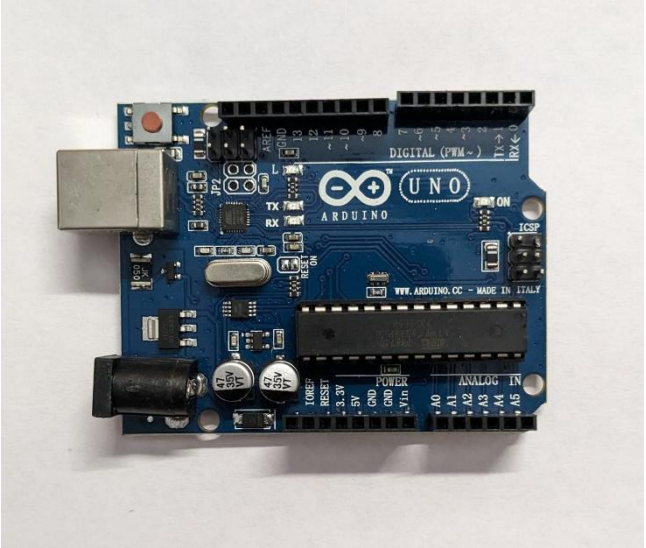



Fig.2.2.6Arduino Uno

- PIN DIAGRAM OF ARDUINO UNO :


2.2.7 SOLAR PANEL:

In our project we are using solar panel to provide supply to the controlling unit at the forest side(refer Fig. 2.2.7). Since in a forest the electrical energy may be critical and sun is a big source of energy during the day time. In a day time battery is charged as well as it is used as a supply for controlling unit. Solar power is the conversion of energy from sunlight into electricity, either directly using photovoltaics (PV), indirectly using concentrated solar power, or a combination. Concentrated solar power systems use mall beam. Photovoltaic cells convert light into an electric current using the photovoltaic effect. lenses or mirrors and solar tracking systems to focus a large area of sunlight into a small beam. Photovoltaic cells convert light into an electric current using the photovoltaic effect.

Fig.2.2.7Solar panel

2.2.8 BUZZER :

Audio signaling device like a beeper or buzzer may be electromechanical or **piezoelectric** or mechanical type (refer Fig. 2.2.8). The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren.

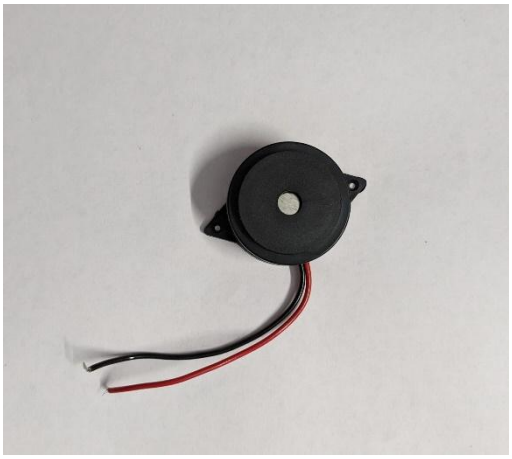


Fig 2.2.8 Buzzer

2.2.9XL6009:

XL6009 Module is A non-isolated step-up (boost) voltage converter featuring adjustable output voltage and high efficiency (refer Fig. 2.2.9). Specification. Modules Type: Non-isolated step-up (Boost) Rectification: Non-synchronous rectification.

Applications

I. Low voltage to high voltage Power Supply
II. Power supply for electronic equipment
III. Battery Powered Lab Power Supply
IV. Hand-held electronics that runs on high voltage but needs to run on low voltage batteries.

Fig.2.2.9XL6009

## 2.1.10 TP4056:

TP4506 Lithium Battery Charger Module MINI USB 5V 1A TP4056 Charging Board with Protection Dual Functions 1A TP4056(refer Fig. 2.2.10).

Uses of TP4056:

The TP4056 is a complete constant-current/constant-voltage linear charger for single cell lithium-ion batteries. Its SOP package and low external component count make the TP4056 ideally suited for portable applications. Furthermore, the TP4056 can work within USB and wall adapter.

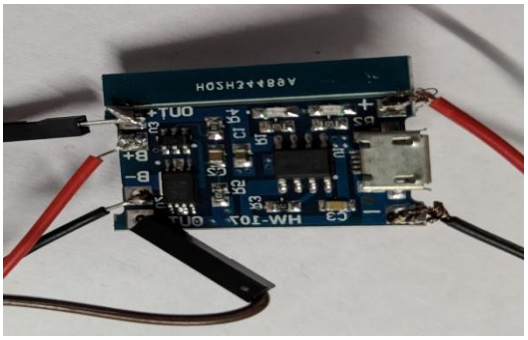


Fig.2.2.10TP4056

2.2.11BREAD BOARD**:**

In modern electronics and engineering, a breadboard refers to a (usually) solder-free, plug-and-play platform allowing for speedy insertion and removal of electrical components in circuit-building applications (refer Fig. 2.2.11).

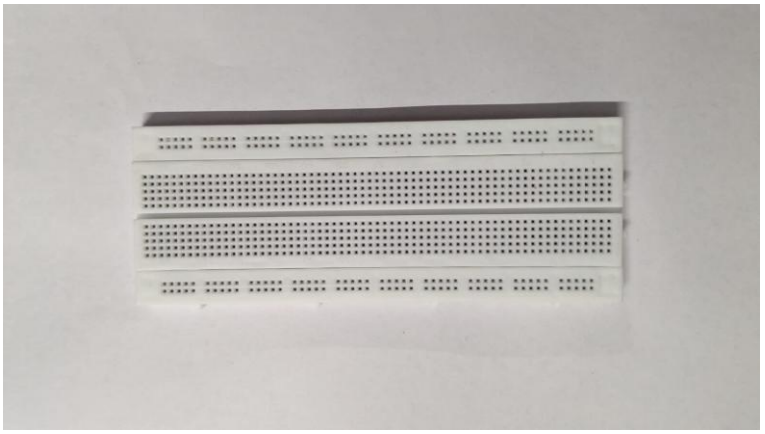


Fig.2.2.11Breadboard

2.2.12LED**:**

LED or Light Emitting Diode is a light source dvice(refer Fig. 2.2.12). It releases light when current passes through it. The LED concept is based on a semiconductor device where holes and electrons recombine to produce energy in the form of photons.

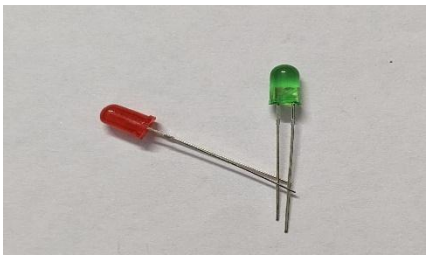


Fig.2.2.12 LED

2.2.13REGISTER**:**

A passive electrical component with two terminals that are used for either limiting or regulating the flow of electric current in electrical circuits (refer Fig. 2.2.13).

The main purpose of resistor is to reduce the current flow and to lower the voltage in any particular portion of the circuit. It is made of copper wires which are coiled around a ceramic rod and the outer part of the resistor is coated with an insulating paint.

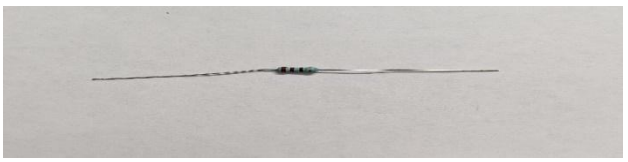


Fig.2.2.13Register

2.2.14JUMPER WIRES:

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering (refer Fig. 2.2.14). Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed. Fairly simple. In fact, it doesn't get much more basic than jumper wires.

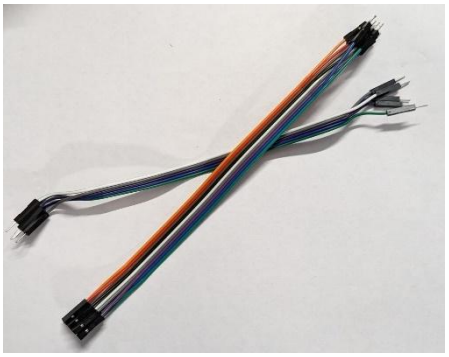


Fig2.2.14 Jump wires

2.3WORKING:

In this project we have used the smoke sensor and flame sensor which are connected to output of Arduino UNO. Arduino UNO is connected to GSM and GPS module which is powered by 12v solar panel. Since the sensors in the system powered by the GSM module is powered by solar energy there is no need for conventional electrical energy. Hence the system is cost effective.

When the fire occurs, the sensors sense the fire according to their functions. Smoke sensor detect the smoke. Smoke alarms provide a critical early warning of fire, allowing additional time to escape. flame sensor detects flame or fire. The signals and measurements collected from these sensors are transmitted to the control center using GSM module to automatically analyses and combine sensor information and detect the presence of fire or smoke.

The sensors collect the data and transmit to the central unit as well as alert is sent via message using GSM which shows "FIRE ALERT". The GSM Module sends a text message to the user's phone number from the SIM Card that is inserted into the module. The code run on the Arduino determines which number to send the message to, how many times the message needs to be sent, and some other details. Now that the user has been alerted, the job of the system is over. It is now up to the user to take preventive measures.

This module is responsible for the communication part of the circuit. It takes information from the Arduino where to send information and what information is to be sent. It uses aGSMSIMcardforcommunicationpurposes.ItisbasicallyjustaMODEMwhichusesserialcommunica

tionto interface with and need Hayes compatible AT commands for communication with the Arduino. The alert message and the phone number of the recipient is given by the user through the Arduino code. As soon as fire is detected an SMS will be sent to the recipient's phone number from the SIM card inserted into the module.

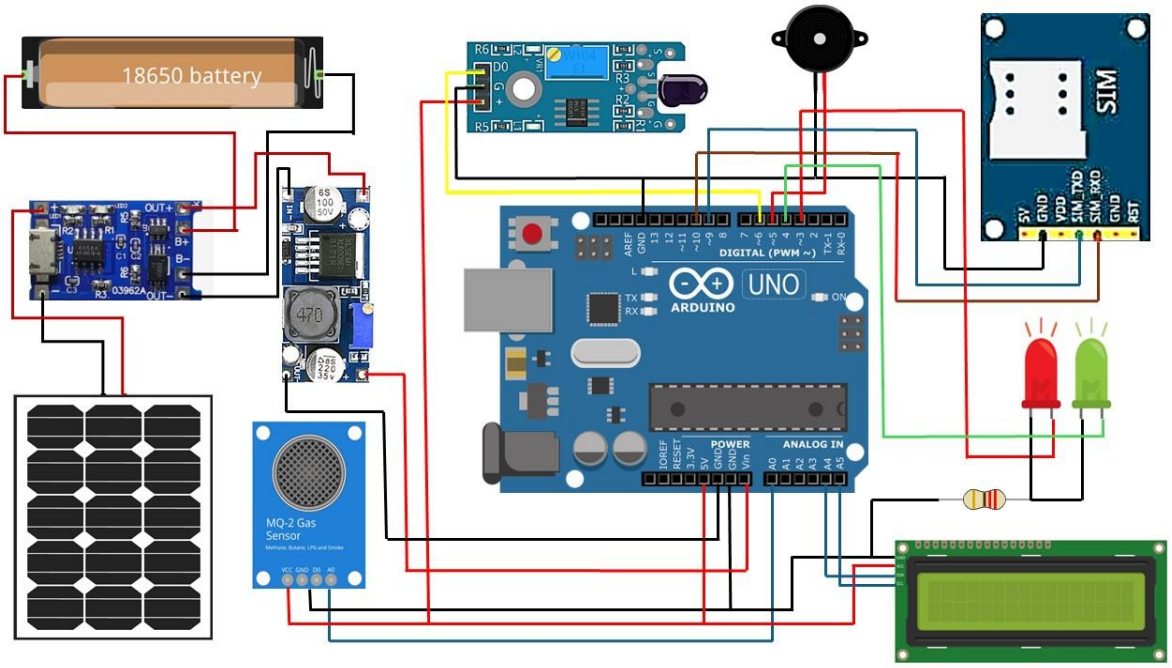



Fig2.3.1 Circuit diagram

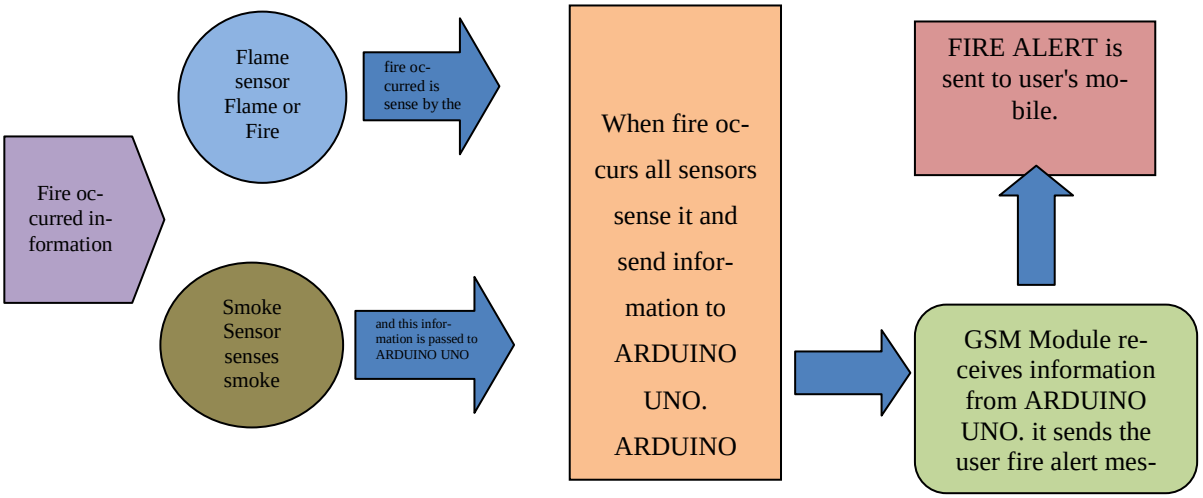
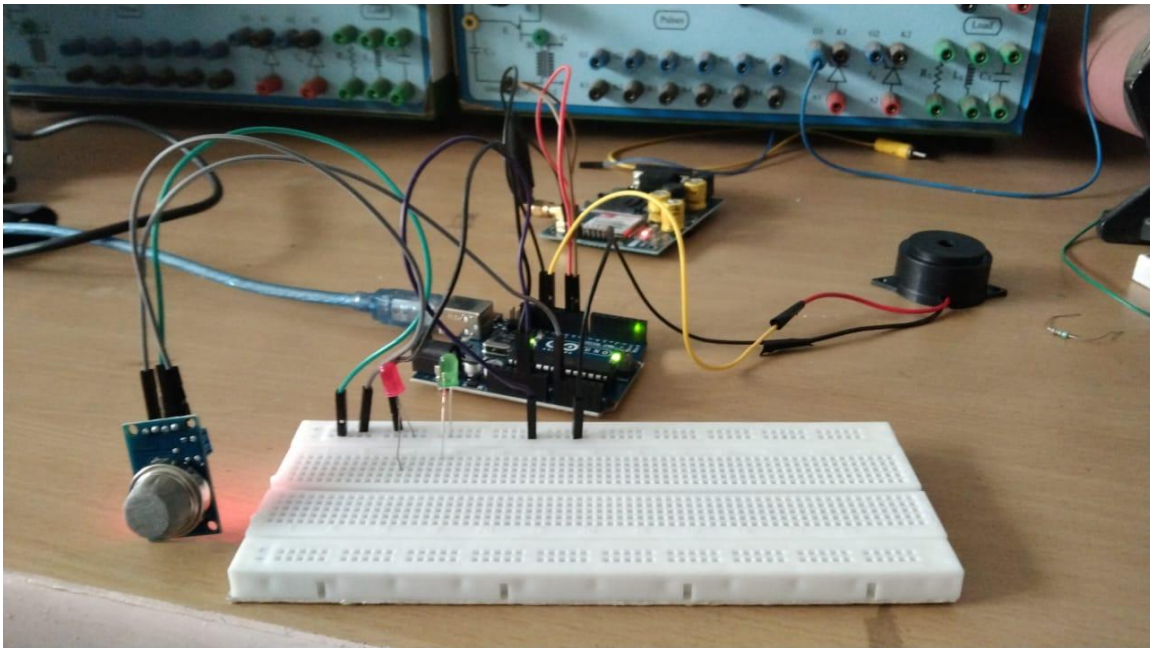


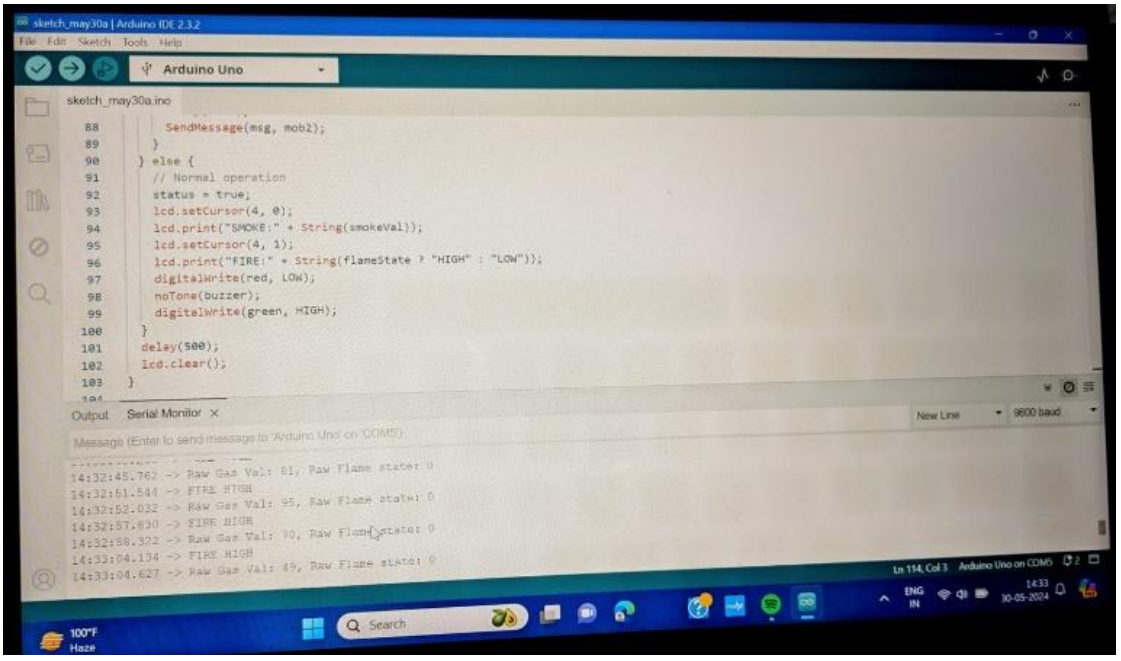

Fig 2.3.2 Block diagram

# CHAPTER 3: OBSEVATION AND REASULT

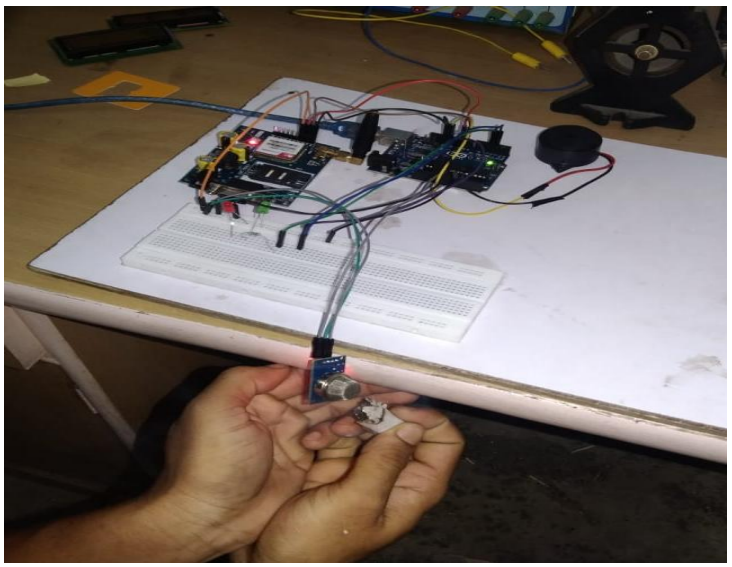
Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button.

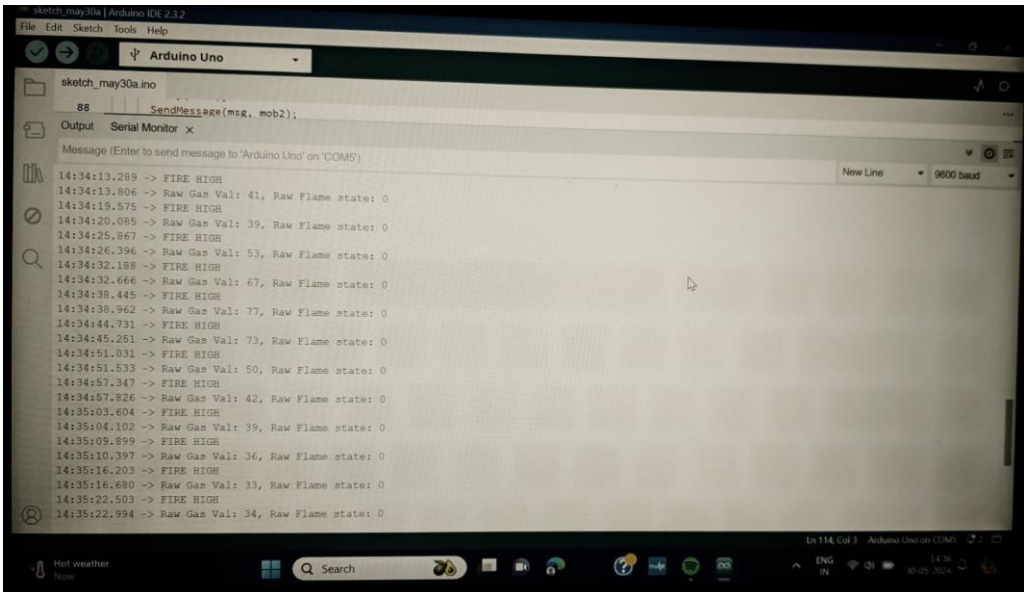
CASE 1



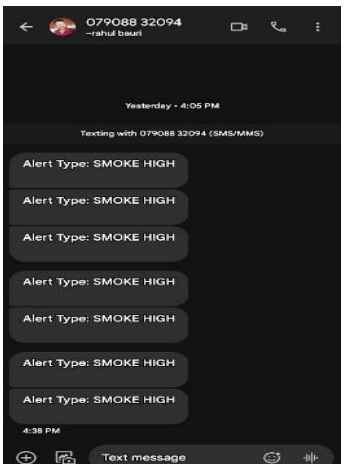


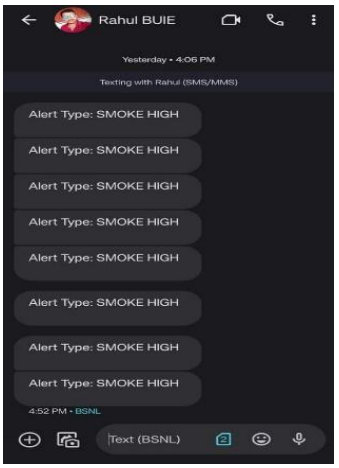
CASE 2






REASULT:



# CHAPTER 5

## 5.1 CONCLUTION **:-**

Using this GSM based forest fire detection and prevention system, temperature and smoke concentration of the forest area can be easily obtained. The system is low cost, simple and efficient since it involves less components. Algorithm used can be easily implemented and the sensors regularly keep providing the readings for monitoring purpose. One of the fundamental points of interest of this framework is its adaptability. There is scope of connecting a few more sensors for accurate fire detection. The invented system achieves 90% fire detection rate and 10% false detection rate.

The invented method was compared with other methods in the literature and had good performance in terms of higher fire detection rate and less false alarm rate. Since the proposed project is easy for the installation due to the simple arrangements, the time frame for developing and integrating the subsystems and installation process is less. Even for the demonstration purpose we can put up the fire manually in any plain land and we can test for the working of these components.

## 5.2 FUTURE WORK :-

The project gives emphasis on using modern technology of remote sensing and other techniques to equip the forest authority and organizations in their work for forest conservation. Due to the lack of efficient staff and emergency plan there is a greater need to use much efficient systems. It is difficult for authorities to manage huge forest areas and to be present at a time of accidents. This system uses advance technology which will help in tracing out the forest fire in its initial stage. This system also has future scope, as we can use wind sensor to detect direction of smoke and hence further damage can be avoided by using automatic fire extinguisher. In upcoming time, we can also add the fire extinguisher system to stop the spread of fire. As Solar panel is used in this system to generate electricity, system is suitable to install at low cost. It is a affordable and easy to operate system hence can be install at many places in further years.

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Chetan Singh Solanki

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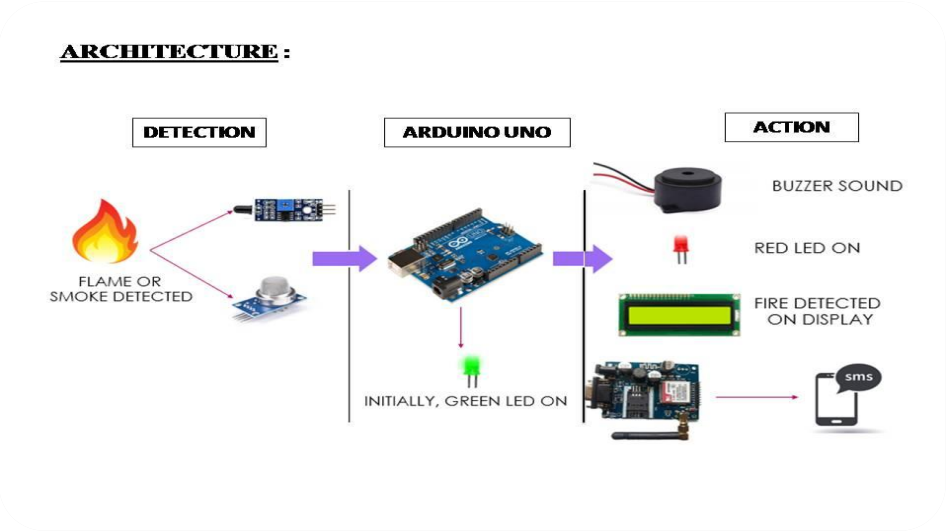
# APPENDIX

## A.1 Architecture of Arduino Uno:




## A.2 Coding:

```
#include <SoftwareSerial.h>

#include <Wire.h>

#include <LiquidCrystal_I2C.h>


LiquidCrystal_I2C lcd(0x27, 16, 2);  // set the LCD address to 0x27 for a 16 chars and 2 line display

SoftwareSerial mySerial(9, 10);

const int red = 3;

const int green = 4;

const int buzzer = 13;

const int smoke = A0;

int thresh = 200;

bool status = true;

bool alertActive = false;

String alertMsg;

String mob1 = "+919851279230";  // Enter first mobile number with country code
```

```
String mob2 = "+919339035029";  // Enter second mobile number with country code

void setup() {
  pinMode(red, OUTPUT);
  pinMode(green, OUTPUT);
  pinMode(smoke, INPUT);
  pinMode(buzzer, OUTPUT);

  lcd.init();  // initialize the lcd
  lcd.clear();
  lcd.backlight();

  mySerial.begin(9600);  // Setting the baud rate of GSM Module
  Serial.begin(9600);  // Setting the baud rate of Serial Monitor (Arduino)
  delay(100);

  Serial.println("Setup complete");
}

void siren(int buzzer) {
  for (int hz = 440; hz < 1000; hz++) {
    tone(buzzer, hz, 50);
    delay(5);
  }
  for (int hz = 1000; hz > 440; hz--) {
    tone(buzzer, hz, 50);
    delay(5);
  }    }

void loop() {
  int smokeValue = analogRead(smoke);
```

```
Serial.println("Gas Val: " + String(smokeValue));
digitalWrite(green, HIGH);
bool smokeDetected = (smokeValue > thresh);

if (smokeDetected) {
  digitalWrite(red, HIGH);
  digitalWrite(green, LOW);
     // Activate the siren
  Serial.println("Activating siren");
  siren(buzzer);  // Keep the siren running during the alert

  if (!alertActive) {
    alertActive = true;
    status = false;
    alertMsg = "SMOKE HIGH";
    String msg = "Alert Type: " + alertMsg;
    SendMessage(msg, mob1);
    delay(8000);
    SendMessage(msg, mob2);
  }

  lcd.setCursor(2, 0);
  lcd.write(1);
  lcd.setCursor(4, 0);
  lcd.print("SMOKE HIGH");
  lcd.setCursor(4, 1);
  lcd.print("SMOKE: " + String(smokeValue));

  Serial.println(alertMsg);  // Print on LCD
} else {
  if (alertActive) {
```

```
      alertActive = false;
      noTone(buzzer);  // Deactivate the siren
      Serial.println("Deactivating siren");
    }

    status = true;
    lcd.setCursor(4, 0);
    lcd.print("SMOKE: " + String(smokeValue));
    lcd.setCursor(4, 1);
    lcd.print("NORMAL");
    digitalWrite(red, LOW);
    digitalWrite(green, HIGH);
  }
  delay(500);
  lcd.clear();
}
void SendMessage(String msg, String mob) {
  Serial.println(msg);  // Message sent to Mobile
  mySerial.println("AT+CMGF=1");  // Sets the GSM Module in Text Mode
  delay(1000);  // Delay of 1000 milliseconds or 1 second
  mySerial.println("AT+CMGS=\"" + mob + "\"\r");  // Replace x with mobile number
  delay(1000);
  mySerial.println(msg);  // The SMS text you want to send
  delay(100);
  mySerial.println((char)26);  // ASCII code of CTRL+Z
  delay(1000);
}
```