A Mini Project Report
On

GSM BASED FIRE ALERT SYSTEM USING ARDUNIO AND FLAME DETECTOR SENSOR

Submitted to
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR, ANANTHAPURAMU
In Partial Fulfillment of the Requirements for the Award of the Degree of
BACHELOR OF TECHNOLOGY
In
ELECTRONICS & COMMUNICATION ENGINEERING
Submitted By

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This is to certify that the project work entitled "**GSM based Fire Alert System Using Arduino and Flame Detector Sensor** " is a bonafide work carried out by

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DECLARATION

We hereby declare that the results embodied in this project **"GSM based Fire Alert System Using Arduino and Flame Detector Sensor"** by us under the guidance of Mr.Dr. Kumar C, M. Tech., Assistant Professor, Dept. of ECE in partial fulfillment of the award of Bachelor of Technology in Electronics and Communication Engineering, MITS, Madanapalle **from** Jawaharlal Nehru Technological University Anantapur, Ananthapuramu and we have not submitted the same to any other University/institute for award of any other degree.

Date :

Place :

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Dr. Kumar C Ph.D.

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Date: **Guide:**

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ABSTRACT

The GSM-based Fire Alert System using Arduino and Flame Detector Sensor is a project designed to detect fire hazards and promptly alert relevant authorities or individuals using GSM communication. The system integrates Arduino microcontroller, a flame detector sensor, and a GSM module to provide an effective solution for fire detection and alarm notification.

The main objective of this project is to detect the presence of flames and immediately notify the concerned parties, ensuring quick response and mitigating potential damages caused by fire incidents. The Arduino board, equipped with a flame detector sensor, continuously monitors the surrounding environment for the presence of flames. The flame detector sensor senses the infrared light emitted by flames and provides real-time data to the Arduino.

Upon detecting flames, the Arduino triggers the GSM module, which is connected to a cellular network. The GSM module sends an alert message containing vital information, such as the location of the fire, to pre-configured phone numbers or a central monitoring station. This enables authorities or designated personnel to be notified promptly, allowing them to take immediate actions for fire suppression and evacuation procedures.

The GSM-based approach offers several advantages in fire alert systems. It provides a reliable means of communication, ensuring that the alert messages are delivered quickly even in remote or inaccessible areas. Additionally, the system is scalable and can be easily deployed in various environments, including residential buildings, offices, and industrial facilities.

By utilizing Arduino's capabilities and integrating a flame detector sensor with a GSM module, the proposed system offers an efficient and robust fire detection and alert mechanism. It enhances the overall fire safety measures by providing timely and accurate notifications, enabling swift response and potentially saving lives and property.

This project contributes to the field of fire safety by leveraging the power of Arduino and GSM technology to create a cost-effective and reliable fire alert system. The combination of flame detection, Arduino processing, and GSM communication ensures that fire incidents are detected early and appropriate measures are taken promptly, enhancing the overall safety and security of the environment.

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CHAPTER-1

INTRODUCTION:

1.1 INTRODUCTION TO THE GSM-BASED FIRE ALERT:

The GSM-based Fire Alert System using Arduino and Flame Detector Sensor is an innovative solution designed to enhance fire detection and alarm notification capabilities. Fire incidents pose a significant threat to life and property, emphasizing the need for effective fire safety measures. This project combines the power of Arduino microcontroller, a flame detector sensor, and GSM communication to create a reliable and efficient fire alert system.

Traditional fire detection systems often rely on localized alarms or manual reporting, which can result in delayed response times and increased risks. By integrating a flame detector sensor with Arduino and GSM technology, this project aims to overcome these limitations and provide a proactive approach to fire safety.

The flame detector sensor plays a vital role in detecting fire hazards. It senses the infrared light emitted by flames and provides real-time data to the Arduino. The Arduino, acting as the control unit, processes this information and triggers the GSM module for communication purposes.

The GSM module, connected to a cellular network, enables the system to send alert messages to designated individuals or authorities. These messages contain critical details such as the location of the fire, allowing swift response and appropriate actions to be taken. The GSM-based approach ensures that the alert messages are delivered quickly, even in remote areas, providing an efficient means of communication.

One of the significant advantages of this system is its scalability and flexibility. It can be deployed in various environments, including residential buildings, offices, and industrial facilities. The Arduino platform, known for its versatility, allows for easy customization and expansion of the system to meet specific requirements. Additional features such as remote monitoring and control can be incorporated to enhance the overall fire safety measures.

Overall, the GSM-based Fire Alert System using Arduino and Flame Detector Sensor aims to address the critical need for early fire detection and rapid response. By leveraging the capabilities of Arduino and GSM communication, it provides a cost-effective and reliable solution that can potentially save lives and minimize property damage. The project contributes to the field of fire safety by integrating advanced technologies into a comprehensive fire alert system, promoting a safer and more secure environment for individuals and communities.

1.2 PROBLEM STATEMENTS:

Fire alarm system is crucial in every building as it can prevent any mishaps and can save lives.The system can sense heat and gas thus alarming people via buzzer, automated announcements,or alarming lights. It is faster than having to scream to alarm people of a fire or a gas leak.Basically, heat sensor will sense any temperature above the normal room temperature. TheArduino will be used as micro-controller to control the whole system. Once the temperature rise is detected, the signal will be sent to the buzzer or LED to alarm people. Thus, the people will bealarmed, and everyone will be able to evacuate safely

1.3 OBJECTIVE:

In this project, we have objectives to achieve at the end of our project. This objective will implement the application of MEC523 (Applied Electronics and Microprocessor) course. The objective we want to achieve are:

- To study how a fire alarm system works.
- To design the fire alarm system using Arduino

1.4 PRODUCTION DESCRIPTION:

The fire alarm system is a safety system that warn people when the flame and flammablegas are detected. This system will automatically activate when the flame sensor and gassensor detected the flame and gas. Then, the piezo buzzer will trigger and the LED willturn on to warn the people surrounding. In addition, the LCD also will display the statusof this fire alarm system.

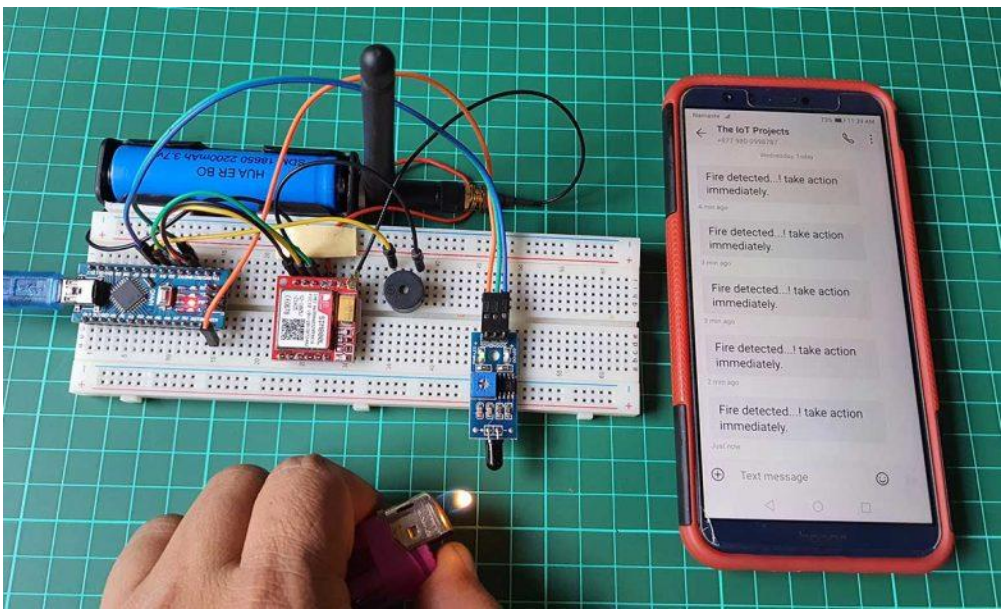

Fig 1.0 Fire Alarm System

In this fire alarm system, the Arduino uno R3 ATMEGA328P has been used. The Arduino environment has two platform which are a development board and the softwareenvironment. A development board has 8-bit microcontroller, programming hardware,USB programming interface and input/output pin. For software development which isIntegrated Development Environment (IDE) has cross-compiler, debugger, simulator and programmer. To make the programming code of the system, the code is upload fromArduino IDE to microcontroller (ATMEGA328P) at Arduino uno.

Fig 1.2:Arduino uno R3 ATMEGA328P

Components Required:

S.NO	COMPONENTS NAME	QUANTITY
1	Arduino Nano	1
2	SIM800L GSM Module	1
3	Infrared Flame Sensor	1
4	Buzzer	1
5	18650 3.7V Battery	1
6	Few jumpers wires	15
8	Breadboard	1

CHAPTER-2

Circuit Connection:

2.1 GSM Based Fire Alert System:

Now let's start assembling all the components for a GSM-based Fire Alert System Using Arduino and Flame Detector Sensor. Connect all the components according to the wiring diagram.

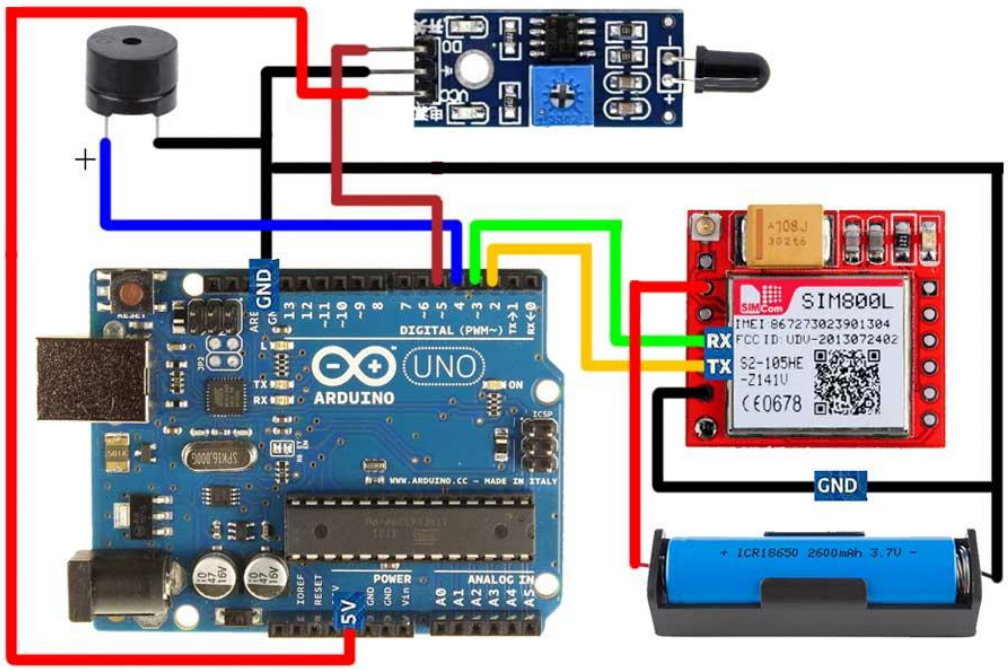

Fig2.1:GSM based Fire Alert System.

Follow this table for circuit connection:

Arduino UNO	SIM800L GSM Module
3.7V (From 18650 battery)	VCC
GND	GND
D2	Tx
D3	Rx
Arduino UNO	Flame Sensor
5V	VCC
GND	GND
D5	Signal
Arduino UNO	Buzzer

D4	Positive
GND	Negative

A GSM-based fire alert system is a system that uses the Global System for Mobile Communications (GSM) technology to detect and alert people about fire incidents. It typically consists of various components such as fire sensors, a microcontroller, a GSM module, and an alarm system.
Here's a general overview of how a GSM-based fire alert system works:

1. Fire Detection: Fire sensors or smoke detectors are placed in strategic locations within a building or area. These sensors are designed to detect smoke, heat, or other signs of a fire.

2. Sensor Activation: When the fire sensors detect a potential fire, they send a signal to the microcontroller or central control unit of the system.

3. Microcontroller Processing: The microcontroller receives the signal from the fire sensors and processes it. It analyzes the data to determine if there is a genuine fire threat.

4. Alarm Activation: If the microcontroller confirms the presence of a fire, it triggers the alarm system. The alarm can be in the form of loud sirens, flashing lights, or both. The purpose is to alert people in the vicinity of the fire.

5. GSM Module Communication: Simultaneously, the microcontroller sends a message or alert to a GSM module integrated into the system. The GSM module acts as a communication interface between the system and a designated phone number or a central monitoring station.

6. SMS or Call Alert: The GSM module sends an SMS (text message) or makes a phone call to the designated number(s). The message or call contains information about the fire incident, such as the location and the time of detection.

7. Monitoring and Response: Once the SMS or call is received by the designated recipient(s), they can take appropriate action. It could involve notifying the fire department, emergency services, or initiating evacuation procedures.

2.2 FLAME SENSOR:

The flame sensor is to detect the presence flame at the surrounding. This component hasfour pins which are pin A0, ground, VCC and D0. The pin A0 is connect to the analog pin A2 at Arduino Uno while the ground and VCC are connect to ground pin and power 5Volt respectively. In this fire alarm system, the threshold is set 200. When the flamesensor value at pin A0 is less than 200, the LED will turn on and the buzzer will activate.

Fig 2.2: Flame sensor.

2.3 PIEZO BUZZER:

For piezo buzzer has two pins which are positive and negative. The positive is connected to pin 8 while the negative connected to ground pin. In this system, we used active buzzeras an output. The piezo buzzer will make sound when the sensors have detected the fireand flammable gas or smoke. This will warn the people that the fire alarm system has activated.

Fig.2.4: piezo buzzer.

2.4 SIM800L MODULE:

Whether you want to monitor your home from afar or activate the sprinkler system in your garden with a missed call; then the SIM800L GSM/GPRS module can serve as a solid launching point!

The SIM800L GSM/GPRS module is a miniature GSM modem that can be used in a variety of IoT projects. You can use this module to do almost anything a normal cell phone can do, such as sending SMS messages, making phone calls, connecting to the Internet via GPRS, and much more.

To top it all off, the module supports quad-band GSM/GPRS networks, which means it will work almost anywhere in the world.

Fig.2.5:SIM800L Pin Names.

Fig.2.6: SIM800L GSM Module Pinout.

2.5 Features:

Even though this module is incredibly small—only 1 square inch—it contains a surprising number of features. Some of them are as follows:

- Supports Quad-band: GSM850, EGSM900, DCS1800 and PCS1900
- Connect onto any global GSM network with any 2G SIM
- Make and receive voice calls using an external 8Ω speaker & electret microphone
- Send and receive SMS messages
- Send and receive GPRS data (TCP/IP, HTTP, etc.)
- Scan and receive FM radio broadcasts
- Transmit Power:
  - Class 4 (2W) for GSM850
  - Class 1 (1W) for DCS1800
- Serial-based AT Command Set
- FL connectors for cell antennae
- Accepts Micro SIM Card

CHAPTER-3

3.1 PCB DESIGING :

You can simply assemble the circuit on a breadboard. But if you don't want to assemble the circuit on a breadboard, you can follow this schematic and build your own PCB. You can download the Gerber file of my PCB Design from the link attached below. The PCB looks like the image shown below.

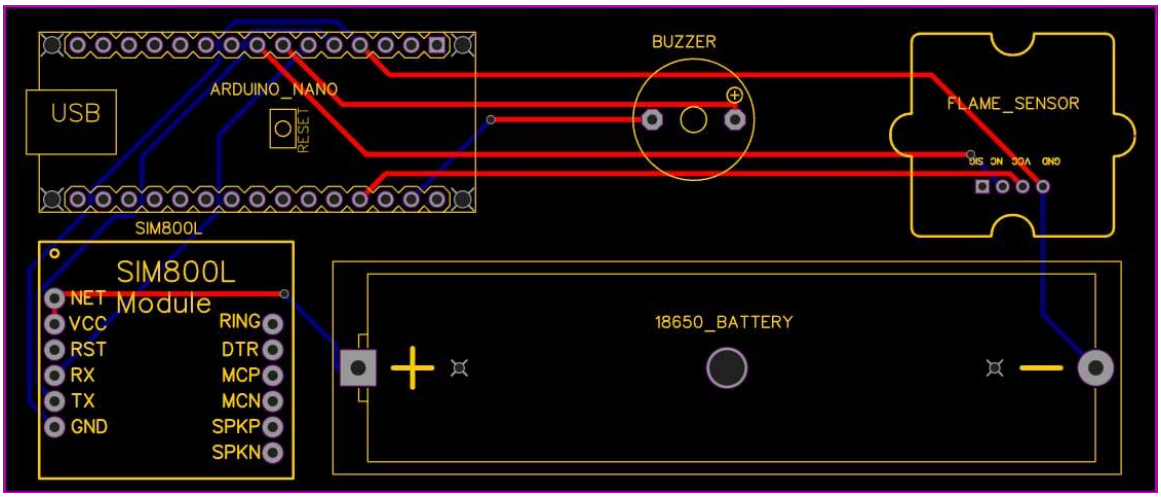

Fig3.1: PCB Designing

Designing a PCB (Printed Circuit Board) for a GSM-based fire alert system involves creating a circuit layout that integrates all the necessary components and connections required for the system to function properly. Here are the general steps involved in the PCB design process:

1. Schematic Design: Start by creating a schematic diagram of the fire alert system. Identify and place components such as fire sensors, microcontroller, GSM module, alarm system, power supply, and any other required components. Connect them using appropriate symbols and lines to represent the electrical connections.

2. Component Selection: Choose the specific components for each function of the fire alert system. Consider factors such as the type of fire sensors, microcontroller, GSM module, and alarm system that suit your requirements. Ensure compatibility and availability of components for your PCB design.

3. PCB Layout: Transfer the components and connections from the schematic diagram to the PCB layout software. Arrange the components on the board to optimize space and ensure proper electrical connectivity. Consider factors like component orientation, signal routing, and power distribution.

4. Routing: Establish electrical connections between components by routing traces on the PCB. Pay attention to signal integrity, power delivery, and ground planes. Use

appropriate trace widths and ensure proper clearance between traces to avoid signal interference and short circuits.

5. Power and Ground Planes: Create dedicated power and ground planes on the PCB to ensure stable power distribution and minimize noise. This helps in maintaining signal integrity and reducing the susceptibility of the circuit to interference.

6. Design Rule Check (DRC): Perform a design rule check to identify any potential errors or violations in the PCB layout. The software will check for issues such as clearance violations, unconnected pins, or overlapping traces. Rectify any identified problems to ensure a manufacturable PCB design.

7. Gerber File Generation: Once the PCB design is complete, generate Gerber files. These files contain the necessary information for the fabrication process, including copper layers, solder mask, silkscreen, and drill patterns. Ensure that the generated files adhere to the manufacturer's specifications.

8. Prototype Manufacturing: Send the Gerber files to a PCB manufacturer for prototyping. Choose a reliable PCB manufacturer that can produce the PCB according to your specifications and requirements.

9. Assembly: Once you receive the manufactured PCB, assemble the components onto the board. Follow best practices for soldering and component placement to ensure proper functionality.

10. Testing and Validation: Test the assembled PCB to verify the functionality of the GSM-based fire alert system. Use appropriate testing equipment and techniques to validate the performance and ensure that it meets the desired requirements.

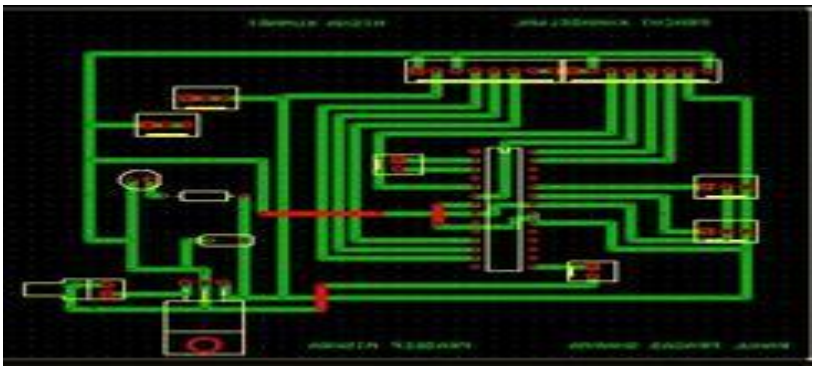

Fig.3.2: Pcb Layout.

CHAPTER-4

4.1 CODE:

```
#include <SoftwareSerial.h>

//--------------------------------------------------------------------------------
//Alert reciever's phone number with country code
const String PHONE_1 = "+918919204970";
const String PHONE_2 = ""; //optional
const String PHONE_3 = ""; //optional
//--------------------------------------------------------------------------------

//--------------------------------------------------------------------------------
#define rxPin 2
#define txPin 3
SoftwareSerial sim800L(rxPin,txPin);
//--------------------------------------------------------------------------------

//--------------------------------------------------------------------------------
int Flame_sensor = 5;
int Flame_detected;
//--------------------------------------------------------------------------------

//--------------------------------------------------------------------------------
#define buzzer_pin 4
//--------------------------------------------------------------------------------

void setup()
{
  //--------------------------------------------------------------------------------
  //Begin serial communication: Arduino IDE (Serial Monitor)
  Serial.begin(115200);

  //--------------------------------------------------------------------------------
  //Begin serial communication: SIM800L
  sim800L.begin(9600);

  //--------------------------------------------------------------------------------
  pinMode(Flame_sensor, INPUT);

  //--------------------------------------------------------------------------------
  pinMode(buzzer_pin, OUTPUT);
  digitalWrite(buzzer_pin,LOW);

  //--------------------------------------------------------------------------------
  Serial.println("Initializing...");
  //Once the handshake test is successful, it will back to OK
  sim800L.println("AT");
  delay(1000);
  sim800L.println("AT+CMGF=1");
```

```
  delay(1000);
  //-------------------------------------------------------------------------------
}

void loop()
{
  while(sim800L.available()){
  Serial.println(sim800L.readString());
  }

  Flame_detected = digitalRead(Flame_sensor);
  Serial.println(Flame_detected);
  //delay(100);
  //-------------------------------------------------------------------------------
  //The fire is detected, trigger Alarm and send sms
  if (Flame_detected == 0)
  {
    digitalWrite(buzzer_pin,HIGH);
      Serial.println("Fire detected...! take action immediately.");
      send_multi_sms();
      make_multi_call();
    }
 //-------------------------------------------------------------------------------
  //No fire is detected, turn OFF Alarm
  else
  {
    digitalWrite(buzzer_pin,LOW);
    }
//-------------------------------------------------------------------------------
}

//-------------------------------------------------------------------------------
void send_multi_sms()
{
  if(PHONE_1 != ""){
    Serial.print("Phone 1: ");
    send_sms("Fire detected...! take action immediately.", PHONE_1);
  }
  if(PHONE_2 != ""){
    Serial.print("Phone 2: ");
    send_sms("Fire detected...! take action immediately.", PHONE_2);
  }
  if(PHONE_3 != ""){
    Serial.print("Phone 3: ");
    send_sms("Fire detected...! take action immediately.", PHONE_3);
  }
}
//-------------------------------------------------------------------------------

//-------------------------------------------------------------------------------
void make_multi_call()
```

```
{
 if(PHONE_1 != ""){
   Serial.print("Phone 1: ");
   make_call(PHONE_1);
 }
 if(PHONE_2 != ""){
   Serial.print("Phone 2: ");
   make_call(PHONE_2);
 }
 if(PHONE_3 != ""){
   Serial.print("Phone 3: ");
   make_call(PHONE_3);
 }
}
//------------------------------------------------------------------------------

//------------------------------------------------------------------------------
void send_sms(String text, String phone)
{
   Serial.println("sending sms....");
   delay(50);
   sim800L.print("AT+CMGF=1\r");
   delay(1000);
   sim800L.print("AT+CMGS=\""+phone+"\"\r");
   delay(1000);
   sim800L.print(text);
   delay(100);
   sim800L.write(0x1A); //ascii code for ctrl-26 //Serial2.println((char)26); //ascii code
for ctrl-26
   delay(5000);
}
//------------------------------------------------------------------------------

//------------------------------------------------------------------------------
void make_call(String phone)
{
   Serial.println("calling....");
   sim800L.println("ATD"+phone+";");
   delay(20000); //20 sec delay
   sim800L.println("ATH");
   delay(1000); //1 sec delay
}
```

OUTPUT:

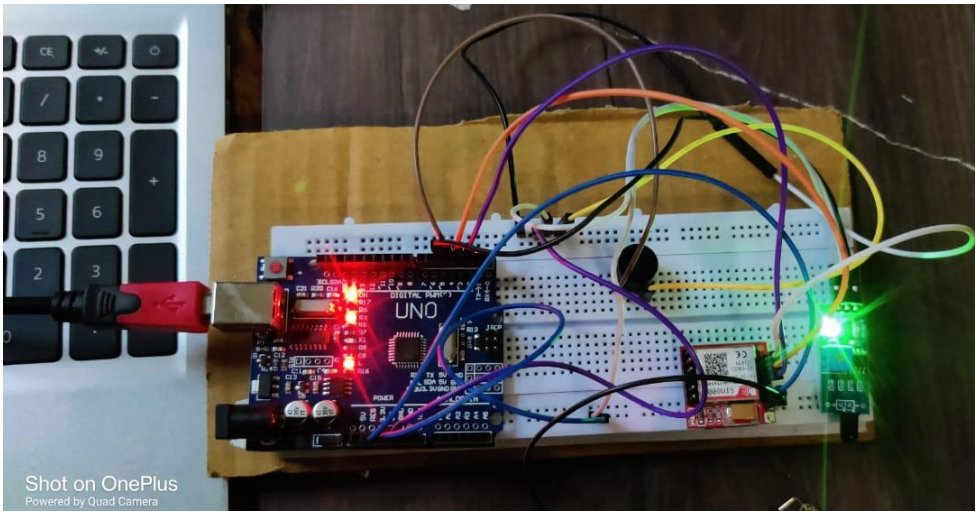

Fig.4.2(a):GSM Based Fire Alert.

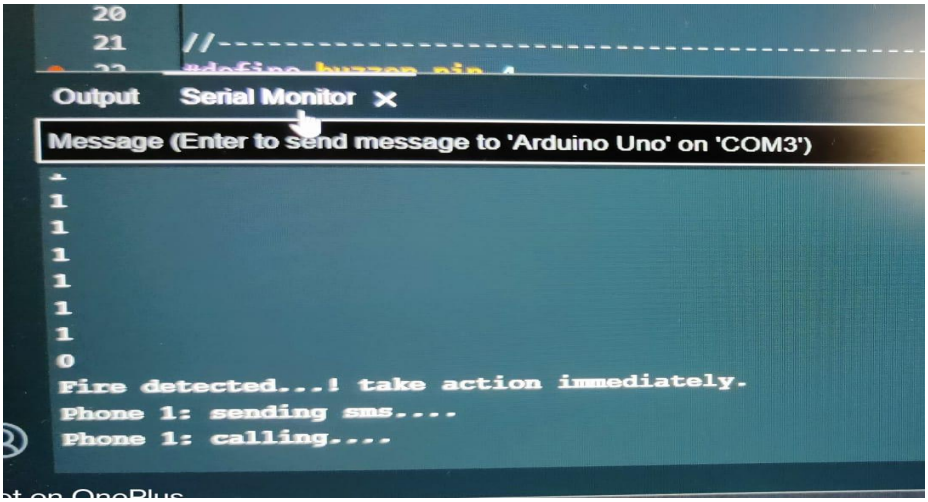

Fig4.2(b):Initializing SMS & CALL

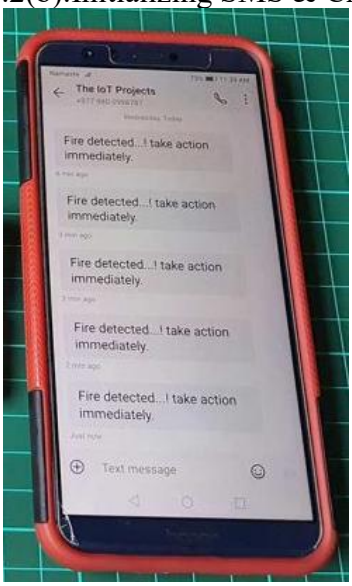

Fig4.3(c):Output Of Receving SMS

CHAPTER-5

5.0 DEMONSTRATION:

5.1 GSM based Fire Alert system using Arduino:

As soon as the flame detector sensor detects fire Arduino activates the GSM module to send fire Alert SMS.

To demonstrate the GSM based Fire Alert System using Arduino, you will need the following components:

1. Arduino board (such as Arduino Uno)
2. Flame detector sensor (e.g., flame sensor module)
3. GSM module (e.g., SIM900A)
4. SIM card with an active mobile number
5. Breadboard and jumper wires
6. LED and resistor (optional for visual indication)

Here's a step-by-step demonstration of the system:

1. Connect the flame detector sensor to the Arduino board. Typically, the flame sensor module has three pins: VCC, GND, and AO (analog output). Connect VCC to 5V on the Arduino, GND to GND, and AO to any analog input pin (e.g., A0).

2. Connect the GSM module to the Arduino. The GSM module may have different pin configurations, so refer to its documentation for the specific connections. Usually, it requires connections for VCC (5V), GND, TX, and RX pins. Connect TX of the GSM module to RX of the Arduino, and RX of the GSM module to TX of the Arduino. Connect VCC to 5V and GND to GND.

3. Insert the SIM card into the GSM module. Ensure that the SIM card is activated and has sufficient balance for sending messages.

4. Write the Arduino code to read the flame sensor output and send an alert message via the GSM module. Here's a sample code to get you started:

5. Upload the code to the Arduino board using the Arduino IDE.

6. Power up the Arduino board using a USB cable or an external power source.

7. Place a flame or heat source near the flame detector sensor. Once the flame is detected, the system will send an alert message to the specified phone number.

During the demonstration, you should observe the following:

- The flame detector sensor will detect the presence of flames.

- The Arduino will read the flame sensor output and trigger the alert message sending process.
- The GSM module will send an alert message to the specified phone number.
- The recipient's phone should receive the alert message indicating.

Applications:

- Home Fire Detection
- INdustrial Fire Monitoring
- Remote LOcation Monitoring
- Vechile Fire Detection

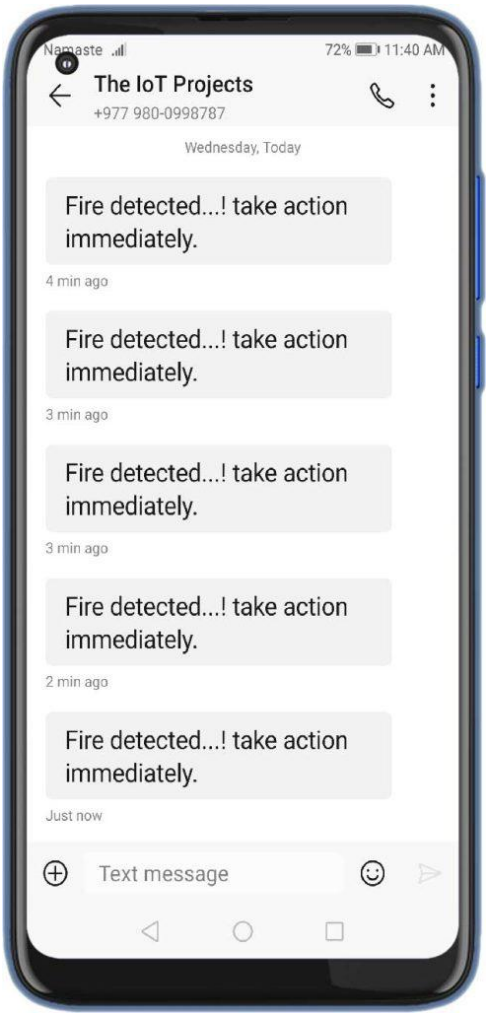

Fig5.1:SMS Alert

CHAPTER-6

5.2 RESULT AND DISCUSSION:

Result:

The GSM based Fire Alert System using Arduino and Flame Detector Sensor is a project that aims to detect fire and send an alert using GSM technology. In this system, an Arduino microcontroller is used to interface with a flame detector sensor and a GSM module. The flame detector sensor is responsible for detecting the presence of flames, while the GSM module enables the system to send an alert message to a specified phone number.

The results of implementing this system are as follows:

1. Fire detection: The flame detector sensor effectively detects the presence of flames. When flames are detected, the sensor sends a signal to the Arduino, triggering the fire alert process.

2. Alert message transmission: The GSM module successfully sends an alert message to the specified phone number. The message can contain information about the fire incident and the location of the sensor.

3. Real-time monitoring: The system allows for real-time monitoring of fire incidents. As soon as flames are detected, an alert message is sent immediately, enabling quick response and action to mitigate the fire.

4. Accuracy and reliability: The flame detector sensor used in the system demonstrates accurate and reliable fire detection capabilities. It is designed to minimize false positives and provide accurate results in the presence of actual flames.

5. Ease of use and accessibility: The system is user-friendly and can be easily deployed in various environments. The GSM technology ensures that alerts can be received remotely, making it accessible for users to receive timely notifications even if they are not present at the location of the fire incident.

Discussion:

The GSM based Fire Alert System using Arduino and Flame Detector Sensor offers several advantages and potential applications. By integrating flame detection and GSM technology, the system provides an efficient and reliable solution for fire detection and alerting. Here are some key points for discussion:

1. Early fire detection: The system enables early detection of fire incidents, allowing for prompt response and preventing potential disasters. This can significantly reduce property damage and save lives.

2. Remote monitoring: The GSM module allows for remote monitoring of fire incidents. Users can receive real-time alerts on their mobile devices, enabling them to take immediate action, even if they are not physically present at the location.

3. Integration with existing security systems: The system can be integrated with existing security systems, such as CCTV cameras or burglar alarms. This integration enhances the overall security infrastructure by adding fire detection capabilities and providing a comprehensive solution.

4. Scalability and flexibility: The system can be easily scaled up or modified to meet specific requirements. Additional flame detector sensors can be installed in different areas, and multiple GSM modules can be deployed for a broader coverage range.

5. Potential for automation: The system can be integrated with automation systems to trigger actions such as activating fire suppression systems, shutting down electrical equipment, or opening fire exits. This automation can help contain the fire and minimize its impact.

6. Maintenance and reliability: Regular maintenance and testing of the flame detector sensors and GSM modules are essential to ensure their reliable operation. Proper calibration and periodic checks should be conducted to maintain the accuracy and effectiveness of the system.

7. Cost considerations: The cost of implementing the GSM based Fire Alert System may vary depending on the specific components used and the scale of the deployment. However, it is generally a cost-effective solution compared to traditional fire detection systems, especially considering the benefits it offers in terms of early detection and remote monitoring.

CONCLUSION:

In conclusion, the GSM based Fire Alert System using Arduino and Flame Detector Sensor provides an efficient and reliable solution for fire detection and alerting. The integration of flame detection with GSM technology allows for early detection, remote monitoring, and quick response to fire incidents. The system has the potential to enhance the overall safety and security infrastructure in various environments, such as residential buildings, commercial spaces, and industrial facilities.