A

MINI PROJECT

On

# "Fire Detection Alarm using Arduino"

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In the academic year 2022-23

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# CERTIFICATE

**This is to certify that**

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**Had successfully completed their Mini-Project on**

# "Fire Detection Alarm using Arduino"

**Towards the partial fulfilment of**

**Bachelor's Degree In Computer Engineering**

**During the academic year 2022-23**

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**"Fire Detection Alarm using Arduino"** had been a wonderful subject to research upon, which leads one's mind to explore new heights in the field of Computer Engineering.

We dedicate this project based learning to our esteemed course professor, **Prof. N.G. Pardeshi** whose interest and guidance helped us to complete the work successfully and Head of the Department **Dr. D. B. Kshirsagar,** Director **Dr. A. G. Thakur** and My Institute **Sanjivani College of Engineering, Kopargoan.** This experience will always steer us to our work perfectly and professionally.

Last but not the least, We would like thank all others who in one way or another helped us in the successful completion of this Mini-Project.

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# ABSTRACT

This project describes Arduino based fire detection Alarm system that can monitor an industry, building, and home. It plays an important role in maintaining and monitoring the safety of all kind environments and everything that damaged by fire. How-ever many existing fire detecting (fire extinguisher) systems are not modernized or automatic and also comes with high cost. Subsequently, it is not affordable for the low-income users. The main objective of this project is to make a fire control system with low cost. It has two main system, the first is the detection system and the second is the monitoring system. The detection system operates as the fire detector. The detector will sense fire caused by fire accident and switch on the alert system to prevent major damage. This detection system has sensor called flame detector. This discussion is about the design and implementation of a fire detecting and controlling system. Any signal from detector at any level is monitored using the monitoring system. The signals from these sensor will activate the microcontroller which in- turn activates the message transfer system, alarm system The presented Project is designed by using GSM Module and Arduino.

### Keywords:

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# CHAPTER –1
# INTRODUCTION

- Nowadays, fire incidents have become a critical issue, which must be deal on time without any unnecessary delay to avoid the loss in lives and belongings. It is considered a fire situation when the monitored temperature exceeds $50^o$ C. In critical places such as hospitals, schools, and banks, personnel's arrival time to come for help in fire hazards is around 15 minutes. The statistics show that there are 475,500 structural fires annually in the United States, causing 2,950 civilian deaths, 12,775 civilian injuries, and \$7.9 billion in property damage. According to the National Fire Protection Association (NFPA), two-third of U.S. household fires occur in premises with no working fire alarms, alarms with no proper maintenance, or misplaced alarms. The appropriate allocation of fire alarms with a proactive warning could save lives and reduce property losses. Particularly, there are many types of fire alarms as heat detectors and smoke detectors; studying these types helps to decide which type is more suitable for home or store

- Delay in coping with fires can cause in loss of human life or materials. Most of the fire cases occurred in residential houses. A house is an object that is vulnerable to fire because of its kind of activities. Human safety is an essential factor that must be considered and prioritized in a house fire. Therefore, residents of houses affected by disasters must receive information in the form of early warnings when a fire happens so that the human can be evacuated independently. Information about the fire location is necessary to provide information to the fire department for easier access to the fire location and prevent more significant losses

- The concept of Internet of things (IoT) nowadays is applied in many applications ranging from the smart industry, smart agriculture to smart healthcare, and smart home application. Home automation is an area where IoT has several advantages. In the case of remote plant locations, for example, technology enabling remote operation and maintenance will benefit; autonomous inter-appliance such that devices are mutually aware of the information exchange, thereby minimizing engineering costs in handling all devices involved. Nowadays, fires can get out of control because people intend to save money rather than installing proper fire alarm systems. Some problems are still on, such as affordability, effectiveness, and responsiveness. Previous related works such as Network-Based Real-time Integrated Fire Detection and Alarm (FDA) System with Building Automation have been done to overcome these problems.

- Considering the a forementioned challenges, this study focuses on building an advanced fire alarm using heat alarms. The system reads the flame, data using IoT analyzes these data, and then quickly triggers the Alarm system and SMS alert System. Thus, this study's importance is to provide a low-cost fire alarm system considering the affordability, effectiveness, and responsiveness. Many studies have been conducted to address these issues like; however, fire detection issues are not addressed properly since these systems rely on machine vision, where the algorithms need more images to train, and the detection rate is not satisfactory. Other approaches like suffer from some limitations, mainly slow time responses and low accuracy. Thus, this aims to minimize false alarms, provide faster response, and a new IoT approach than previous studies that used mostly Node-Red. The contribution is as follows: (1) To determine which combinations and algorithms of sensors can accurately and quickly detect fires, (2) We have designed and then developed a system that detects fire and activates the fire alarm, (3) the proposed system evaluates the situation and initiates SMS Alert System which results in a faster response.

## 1.1 Objective:

1. To serve small scale industries and residential homes.

2. To design low cost fire alarm system.

3. To develop the monitoring system to safeguard the user and their belongings.

4. To develop the controlling system for fire incident area by using SMS Alert System.

5. It can be time efficient as compared to, waiting for the ambulance.

## 1.2 Scope :

1. Some places where the rescuers are unable to help in that situation it can be used to activate the SMS system and can give quick alert regarding the fire.

# CHAPTER: 2

# LITERATURE  SURVEY

- Several efforts have been put recently into designing systems that can detect and control fire outbreaks.

- Burchan  et al. (2019) in [577-582]  The paper examines the potential use of fire extinguishing balls as part of a proposed system, where drone and remote-sensing technologies are utilized cooperatively as a supplement to traditional firefighting methods. The system consists of court in gun manned aircraft system (UAS) to detect spot fires and monitor the risk of Wild fire approaching a building via remote sensing, communication UAS to establish and extend the communication channel between scouting UAS and fire-fighting UAS, and a fire-fighting UAS. One has to be very skillful in controlling drones and also the system is very complex which makes the system unreliable.

- Qin et al. (2018) in [245-254],  Designed an intelligent smoke alarm system with wireless sensor network using ZigBee. The system consists of a smoke detection module, a wireless communication module, and intelligent identification and data visualization module. The disadvantage of his system is that it is very expensive and complex to design.

- Izang  et al. (2018) in [577-582], Designed An SMS Based Fire Alarm and Detection System. The system works when fire or gas is detected by the sensors, the Arduino will trigger the GSM module to send SMS, sound the alarm system and trigger the servo motor. The disadvantage of this system is that the servo motor works at an angle of 170 degrees and hence cannot reduce fire outbreak as compared to using a pump motor.

- Jinan (2018) Designed and Implemented a Factory Security System that consist of a smoke sensor, a GSM (Global System for Mobile communication) module and a sound module. When the gas leakage is detected, an SMS will be sent to a number. The disadvantage of the system is that there is no device that can stop the gas leakage and hence, when there is fire outbreak the necessary device to extinguish the fire is not included in the system.

- Poonam et al. (2014).  Designed an Intelligent Fire Extinguisher System. The features are intelligent fire detection and suppression, locate the position of  fire origin, effective power control of electricity, reporting through an SMS or email and effective usage of water supply, among the sensors used is a gas sensor which detect any type of smoke, this can send a false alarm and hence not reliable.

| SR NO | Author Name | Year of Publication | Journal | Contents of the Research | Disadvantages |
|---|---|---|---|---|---|
| 01 | Dev V Savla, Amogh N Parab, Kaustubh Y Kekre, Jay P Gala, Meera Narvekar | 2020 | Third International Conference on Smart Systems and Inventive Technology (ICSSIT) | Monitoring the occurrence of fire in huge dumping grounds manually is a tough task and thus developing an automatic fire extinguishing system is highly required. The advanced technologies can be leveraged to ensure the protection and safety of people by eliminating hazardous risks. The air quality index (AQI) is an indicator of daily air quality report that shows how air quality affects a person's life in a very short time. | The system is very complex which makes the system unreliable |
| 02 | Zhigang Liu, Andrew K Kim. | 2020 | Journal of Fire Protection Engineering | It provides a review of progress in fire detection technologies over the last decade, including various emerging sensor technologies (e.g., computer vision system, distributed fiber optic temperature sensor, and intelligent multiple sensor), signal processing and monitoring technology (e.g., real-time control via Internet) and integrated fire detection systems. | The system is very expensive and complex to design. |
| 03 | Divya Sharma, Kajal Singh, Shipra Aggarwal | 2019 | Journal of Basic and Applied Engineering Research | The proposed system is an intelligent control system integrating the functions of intelligent fire detection and automatic fire control. The system is designed using smoke sensor, temperature sensor and flame sensor. These sensors continuously monitor the parameters like smoke, temperature and flame. Whenever the output values of all sensors exceed the predetermined threshold values stored in the database of microcontroller, then a buzzer will be alarmed and a warning message, with all the values, will be displayed at LCD. | Gas sensor which detect any type of smoke, can send a false alarm and hence not reliable. |

# CHAPTER: 3

# SYSTEM DESIGN AND ARCHITECTURE

In this system a prototype is designed for fire safety and alert system that sends alert to the User and fire-fighting facilities via SMS whenever the value of any sensor exceeds its threshold value. This architecture includes flame, Buzzer, GSM Module integrated and programmed in an Arduino microcontroller.

An architectural design of a fire safety and alert system using Arduino sensors with IoT integration.

The structure of this fire safety and alert system is composed of sensors that detect and sense the various factors that are changed during fire:

1) **Flame Sensor**- It is used to detect presence of fire or any other infrared source of light.

2) **Buzzer** – It Gives alert in the form of sound.

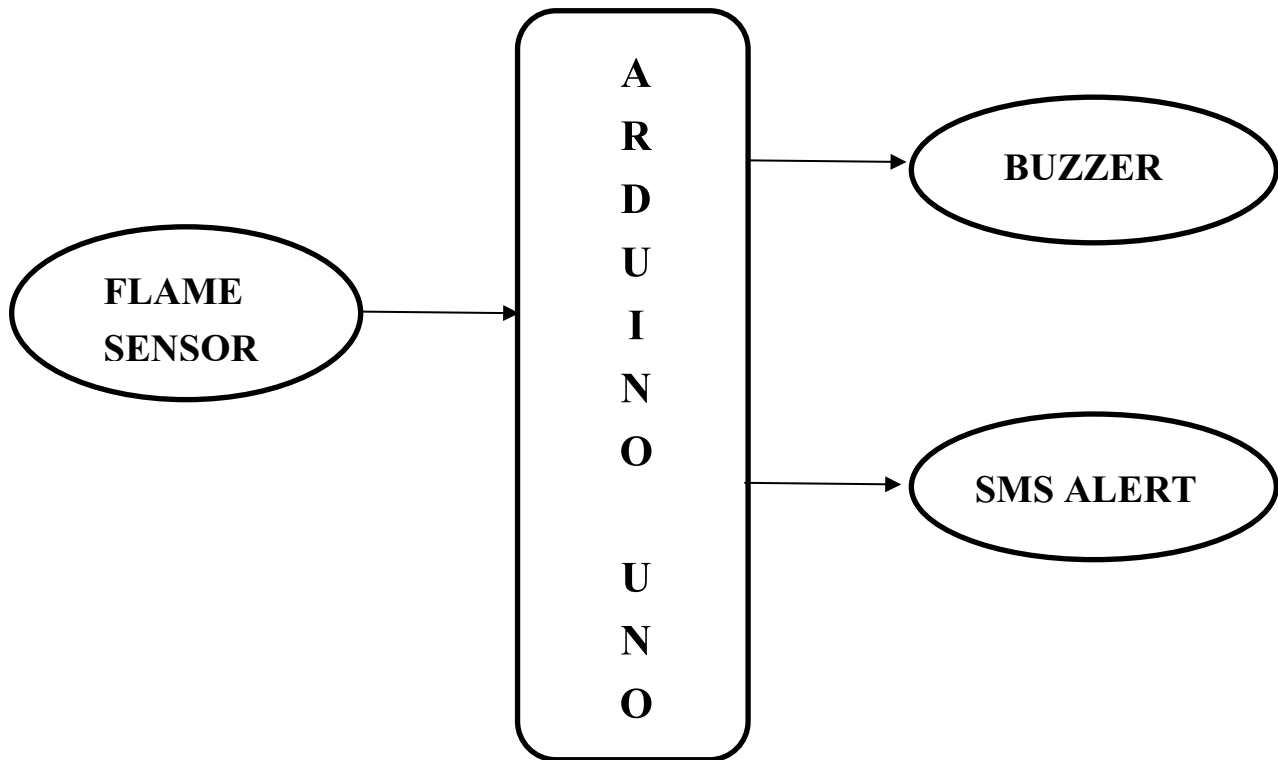3) **GSM Module** – Used to give SMS Alert System.

## 3.1 Block diagram:



Figure3.1: Block Diagram of the System

## 3.2 Flow Chart:

Central Security Controller

GSM Module

TX/RX

Flame Sensor

RF communication

Arduino

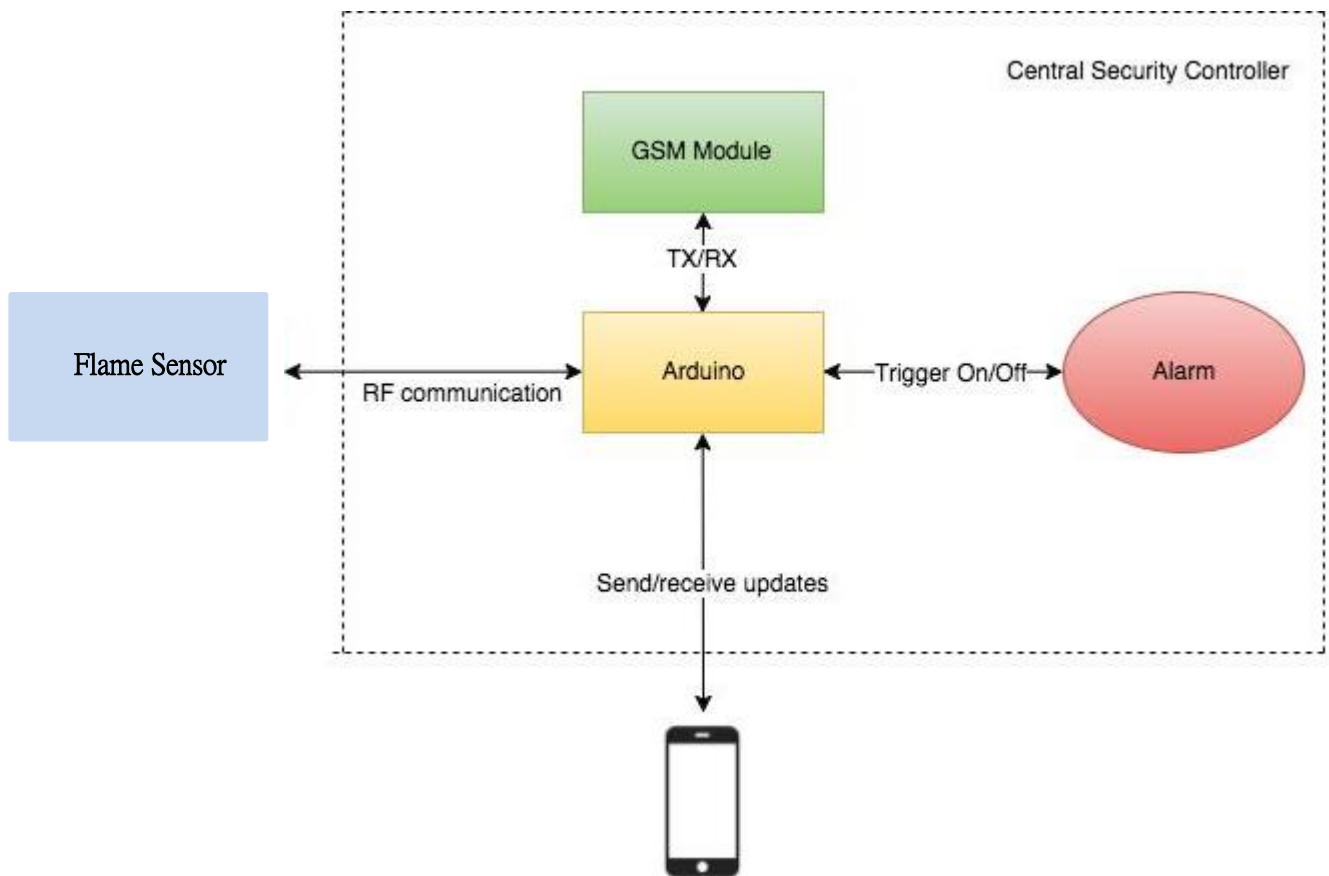Trigger On/Off

Alarm

Send/receive updates

Figure3.2: Flow Chart required for the system

**3.3   System Development:**

- **Implementation  Steps  :**



Figure3.3: Analytical Model for System implementation

### 3.3.1   In analysis phase:

Recent days fire detection system is based on infrared sensors, optical sensors, or ion sensors that detect the presence of smoke, heat or radiations using ionization or photometry. However, alarm is not issued unless the particles or heat reaches the sensors to activate them.

### 3.3.2   In designing phase:

The design and development of this system are divided into two main parts which are hardware architecture and software details. In the hardware architecture, the design of the circuit was constructed, and the prototype was built. While in the software development, the whole complete prototype was operated via programming codes.

### 3.3.3    In development and Testing:

The hardware components of the sensor-based fire detection unit is a device meant to be installed in some premises as a conventional fire detector. The sensor continuously sends input data to the Arduino board which stores the data. But if, the fire is detected, the Arduino triggers the relay which switch ON the Buzzer to notify and turns GSM Module.

### 3.3.4    In Finalize phase:

We designed a IOT based fire detecting and SMS System successfully.

### 3.3.5    System Workflow:

In case of fire, flame sensor send continuous readings to the Arduino. Updated readings are sent into a GSM module The data is analyzed in the Arduino and a response is extracted conditionally to launch a Alert . Batteries feed the system as a back-up source while the primary Alternating Current (AC) source function.
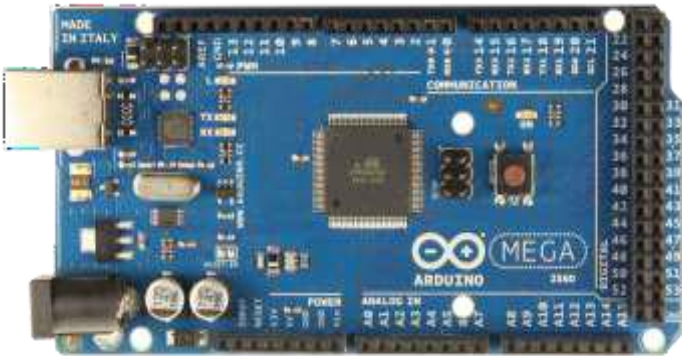
### 3.3 Hardware Requirements

## 1. GSM Module



A GSM modem or GSM module is **a device that uses GSM mobile telephone technology to provide a wireless data link to a network**. GSM modems are used in mobile telephones and other equipment that communicates with mobile telephone networks.

## 2. Arduino Mega:



The Arduino MEGA 2560 is designed for projects that require more Input and output lines, more sketch memory and more RAM. With 54 digital I/O pins, 16 analog inputs and a larger space for your sketch it is the recommended board for 3D printers and robotics projects.

### 3. Infrared Flame Sensor:

The IR flame sensor is used to detect the presence of fire or other infrared source (Flame or a light source of a wavelength in the range of 760 nm to 1100 nm can be detected). It can be used in firefighting robot or heat seeking robot.

### 4. Buzzer
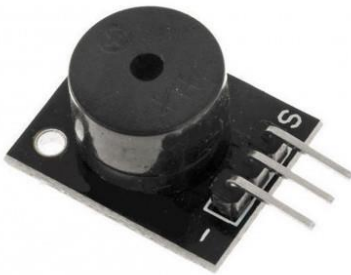
An Arduino buzzer is also called a piezo buzzer. It is basically **a tiny speaker that you can connect directly to an Arduino**. You can make it sound a tone at a frequency you set. The buzzer produces sound based on reverse of the piezoelectric effect.

### 5. Jumper Wires:

A jumper wire is an electric wire that **connects remote electric circuits used for printed circuit boards**. By attaching a jumper wire on the circuit, it can be short-circuited and short-cut (jump) to the electric circuit.

## 6. Breadboard

A breadboard (sometimes called a plugblock) is used for **building temporary circuits**. It is useful to designers because it allows components to be removed and replaced easily. It is useful to the person who wants to build a circuit to demonstrate its action, then to reuse the components in another circuit.

## 7. LED:

Light-emitting diode (LED) is a semiconductor device that emits light when an electric current is passed through it. Light is produced when the particles that carry the current

# CHAPTER - 4

# METHODOLOGY

Iot must be self-contained for search operation, decision making based on the real time data or current condition (object detection), intelligent decision (software program) for the immediate surrounding environment or condition is to perform the task or mission. Basically, the design and development of this project are divided into two main parts which are hardware architecture and software details. In the hardware architecture, the design of the circuit was constructed, and the prototype was built. While in the software development, the whole complete prototype was operated via programming codes.

## 3.1 Hardware architecture:

Since Arduino is the main board, microcontroller on it which is ATmega328 is used as the main controller to manage the circuit accordingly. It is a well-known open-source microcontroller-based kit for creating digital devices and interactive tool that can interact with LEDs, switches, buttons, motors, and many more. The Arduino system offers a set of analog and digital pins that can be integrated to many other boards and circuits which absolutely have different functions in a design. Arduino board provides a USB serial communication interface for loading the codes from computer. To do the codes, Arduino has prepared its own software called integrated development environment (IDE) which completely supports C and C++ programming languages.



Figure 4.1: The Arduino UNO board which uses microcontroller ATmega328 onboard.

## 3.2 Software development

The software of this project is based on the flow chart. When the system begins, Flame sensor will always sense the surrounding temperature. Whenever a fire is broken out, even a small little fire, a temperature rise is occurred. When that happens, Flame sensor can detect the flame value instantly. At the time when the temperature reaches 40 ºC or above, microcontroller on the Arduino UNO board will notify GSM module to send an alert message to the user. Value of temperature limit that can be triggered by Flame sensor can be changed in the code upon request by the user. The limit is not constrained to any value since the Flame sensor sensitively senses any surrounding heat with regards to the temperature range it can count (- 55o C to +150o C). During hot weather in Malaysia, the temperature can reach up to almost 38 ºC. Thus, the limit temperature to be detected; 40 ºC is definitely agreeable in accordance to the Malaysia's weather. Below figure will illustrate the flow chart of the home fire alert and the pseudo codes it represents for the system respectively. By referring to both figures, the complete program can be constructed later in Arduino IDE software.

**START**

   **IF** TEMPERATURE >= 40 DEG
   GSM ACTIVATED
   **SEND** SMS TO USER
   DISPLAY "FIRE ALERT!"
   **ELSE**
   CHECK TEMPERATURE AGAIN

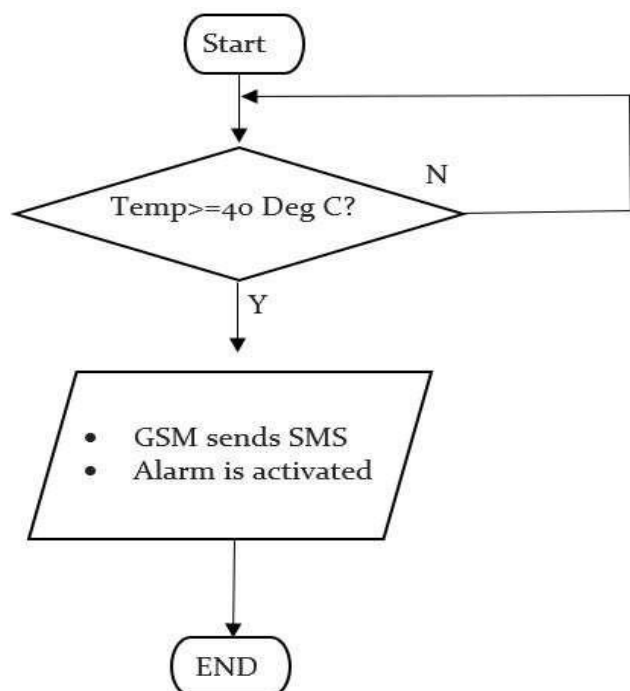Figure 4.2: Pseudo code for the system based on the flow chart



Figure 4.3: Flowchart of the home fire alert system

# CHAPTER-5
# RESULT

Few tests were done to observe the system's performance. The tests were completed by applying heat near to the Flame Sensor. This will show the condition which the Flame sensor is in ready mode (ready to detect fire but detect none). It will be activated when Flame sensor detected fire and alert message will be sent to the user .
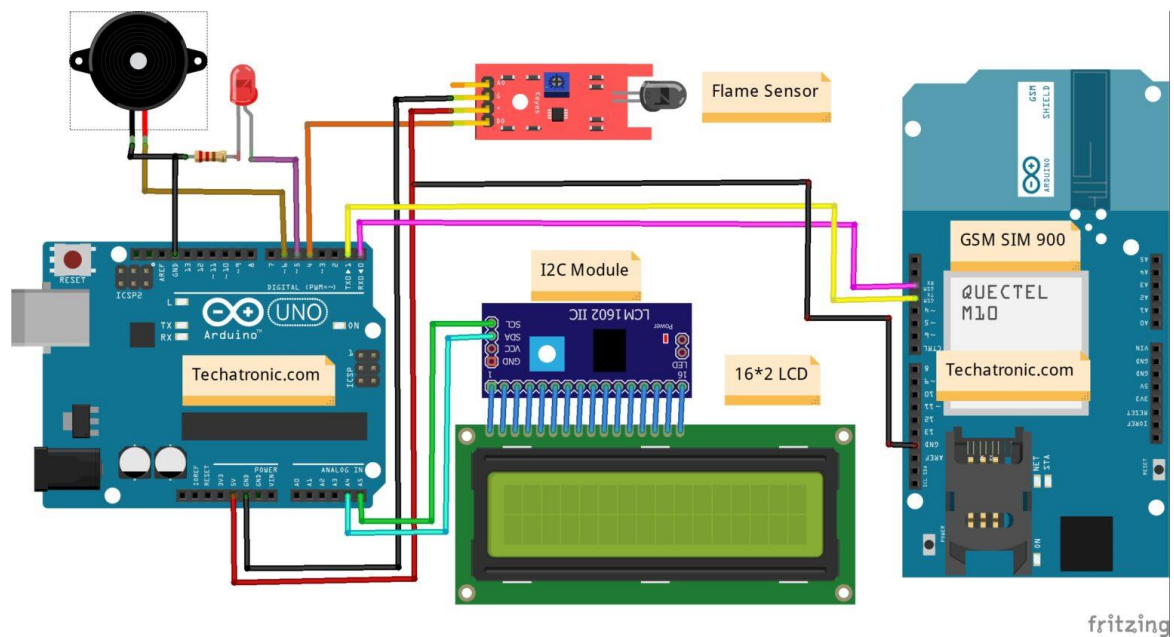


Figure 5.1 Design and Components of system

**Table 5.1. The analysis of the output temperature and GSM module.**

| Components | Before detecting fire | When detecting fire | After detecting fire |
|---|---|---|---|
| Result | "Fire scan – on" | "Fire alert!" | "Fire shut! Safe now" |
| GSM | - | Fire in HOUSE! | - |

Table shows the analysis of the output temperature during the test measurements. When fire is noticed, sensor is ready to detect fire. As soon as sensor detects fire, GSM will be triggered, and SMS will be sent to the registered number as "Fire alert. After fire has been stopped, the system will also stop, and Buzzer will also be turned off.



Figure 5.2: SMS received by the user to notify the fire existence.

# CHAPTER – 6

# APPLICATIONS , ADVANTAGES AND DISADVANTAGES

## 6.1   Applications:

1. This system can be used in shopping malls, Offices.

2. Hotel rooms and changing rooms where steam and water mist can cause problems.

3. To protect valuable in go-downs.

4. Museums.

5. All electric departments.

6. School/ College Labs

7. Industries

8. Residential areas

9. Industrial and Non-Industrial building

10. Institutional buildings

11. Apartments

12. Hostel & Hospital

13. All Industries

14. Multi stored complexes

15. Control rooms

16. Electric Vehicles

## 6.2 Advantages And Disadvantages

### 6.2.1 Advantages:

**1.** Activates automatically (without human intervention) within the first few minutes of a fire breaking out.

**2.** Improves the chances of survival by limiting the speed of flames and the production of smokes.

**3.** Reduces risk of damage.

**4.** Accidents reduced.

**5.** Low power consumption.

**6.** Reduces death rates.

### 6.2.2 Disadvantages:

**1.** Falls alarms will lead to some people not responding to the alarm with the alacrity.

**2.** In general, fire alarm system and devices will not work without power and will not function properly unless they are maintained and tested regularly.

# CHAPTER - 7

# CONCLUSIONS

Fire is the thing or incident that can take place at any time and any place. If it is not controlled in time, it may cause huge damage to the environment and livelihood. Hence to avoid this fire accidents Fire alarms are designed.

Based on the tests and outputs that have been carried out, it can be concluded that the design of an Arduino-based home fire detection system and SMS gateway can provide information on fires that occur quickly to homeowners and rescue fires to reduce losses and minimize possible fatalities. When tested in the actual environment, it runs as desired, with ten successful attempts to send SMS and sound the alarm. Thus, if the test is carried out in something similar to our test environment, then the system is expected to run according to what has been determined.

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