

# A Sustainable and Efficient IoT Approach for Fire Department Alerting System

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**Abstract.** The creation of sophisticated fire detection systems is necessary given the rising danger of fire occurrences. The system described in this abstract uses IoT components such as an Arduino board, flame sensor, buzzer, SIM800L module, and SIM800L to detect fires in real time and inform users. The flame sensor is the main element of the system, and it uses infrared radiation to identify flames when they are present. The Arduino board receives the signal from the sensor and activates the alarm system when it detects a flame. A loud audible alarm is produced by the buzzer when it is linked to the Arduino board to alert residents to a potential fire threat. The system includes the SIM800L module to support distant notifications in addition to local alerts. Once a fire has been identified, the Arduino board and SIM800L module connect to send an SMS or place a call to preset emergency contacts. This makes it possible to quickly take the necessary action, even if the affected properties are unattended. The IoT device connection with the Arduino board gives the fire detection system flexibility and scalability making it reliable and sustainable. By adding more sensors or integrating with current home automation systems, it is simple to customize and expand. Real-time fire detection, remote alerting capabilities, and IoT ecosystem integration are just a few of the advantages the suggested fire detection system has over conventional fire alarm systems.

## 1 Introduction

The focus of this research is to develop advanced methodologies and technologies that ensure rapid and precise fire detection. With the ability to avoid calamities, save lives, and reduce property damage, this initiative has enormous value for communities all across the world improving sustainability. The initiative aims to revolutionize fire detection approaches and improve people's overall safety and security by utilizing cutting-edge technology. This intends to identify fires in their early stages using cutting-edge sensors, machine learning algorithms, and data analytics, allowing for quick reaction and successful mitigation. To establish a complete fire detection infrastructure, this integrates numerous components such as smoke detectors, heat sensors, video analytics, and networked systems. The Internet of Things-based fire department warning system, which employs an Arduino Uno, SIM800L module, flame sensor, buzzer, and battery, is a game-changer in fire detection and emergency response technology. With a rising number of fire-related accidents posing substantial threats to people and property, this new technology attempts to successfully manage such concerns. The use of IoT technology enables smooth connection and real-time monitoring, allowing

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the system to identify fires quickly and notify the proper authorities. The Arduino Uno, a flexible microcontroller that orchestrates data flow and decision-making, lies at the core of this system. The SIM800L module allows the system to connect to the GSM network, allowing important SMS alerts to be sent to chosen emergency contacts and ensuring that fire departments and related staff are alerted as soon as possible. The flame sensor is critical in detecting any symptoms of fire or flames in the surrounding environment, while the buzzer functions as an instant, on-site alarm to inform adjacent inhabitants and reduce any danger. The IoT-based fire department alert system adds an extra layer of safety in residential structures, business enterprises, and industrial facilities, enabling quick and targeted responses to fire occurrences. Its capacity to identify flames at an early stage can drastically minimise the spread and severity of fires, perhaps averting disastrous effects. This system revolutionises fire safety procedures by integrating modern technology with quick communication capabilities, saving lives, minimising property damage, and increasing overall safety in a variety of scenarios.

## 2 Literature Survey

Ravi Kishore Kodali et.al., [1] In their research, titled “IoT Based Smart Emergency Response System for Fire Hazards,” in National Institute of Technology , the IEEE study described above emphasizes the importance of the Internet of Things (IoT) as an emerging technology in the creation of smart cities. It highlights the potential of IoT to provide smart solutions, notably in the area of smart city development. The article discusses the deployment of a smart emergency response system for fire threats, which uses IoT standards to prioritize rapid rescue actions.

Hamood Alqourabah et.al, [2] In their research titled “A Smart Fire Detection System using IoT Technology with Automatic Water Sprinkler,” in College of Computer and Information Sciences, Prince Sultan University, a Smart Fire Detection System with Automatic Water Sprinkler Using IoT Technology is a game changer in the realm of fire safety. Using the Internet of Things (IoT), this system provides a proactive and efficient way to detecting and combating fire breakouts in a variety of environments. [18] The system is built on a network of linked sensors strategically distributed across a structure or area prone to fire threats. These sensors have enhanced fire detection capabilities, such as smoke and heat sensors, which continuously monitor the surroundings for indicators of fire. The sensor data is wirelessly transferred to a central control unit, where it is processed and analyzed in real time.

Barge Yash Uday et.al, [3] In their research titled “SMART FIRE ALERT SYSTEM USING IOT,” in J.S. Polytechnic, Pune , when the system detects a fire, it activates an alarm mechanism that creates an SMS message. The SMS provides critical information regarding the fire occurrence, such as the location, severity, and any other pertinent information. This information is critical for authorities and emergency responders to make quick and educated decisions. The intelligent fire alarm system guarantees that notifications reach the target recipients in a timely way by using SMS as the communication channel.

H. Alquhayz et.al, [4] “IoT Based Smart Fire Detection System Using Deep Learning and Fuzzy Logic,” in Dept. of computer science and Engineering, University of Liberal Arts Bangladesh. An novel way to identifying and preventing fire threats in varied situations is an IoT-based smart fire detection system that uses deep learning and fuzzy logic. This system combines Internet of Things (IoT) technology, which allows devices, sensors, and data exchange to be connected, with sophisticated techniques such as deep learning and fuzzy logic. The system is made up of a network of interconnected sensors that are strategically

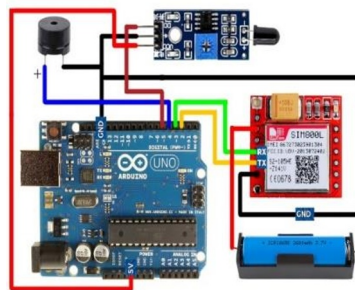
placed to monitor temperature, smoke, and other pertinent characteristics in real time. These sensors continually collect data and send it to a centralized control unit.

M. A. Al-Mistarihi et.al, [5] “A Smart IoT-Based Fire Detection and Alarm System for Industrial Safety Applications” is a cutting-edge technology developed to improve industrial safety measures.[12] This system uses the power of Internet of Things (IoT) technology to identify and respond to fire emergencies, minimizing potential damage and assuring worker and asset safety. The linked sensors strategically distributed across the industrial complex comprise the IoT-based fire detection and alarm system. These sensors have enhanced fire detection capabilities, such as smoke and heat sensors, as well as gas and flame detectors. They constantly scan the environment for signs of fire or dangerous situations.

Akshatha et.al, [6] In their research in “IoT Based Home Automation,” in Asst Professor, Malnad college of Engineering, the paper focuses on a Wi-Fi- based home automation system that utilizes temperature sensors for fire detection. These temperature sensors are strategically placed within the home environment to continuously monitor temperature levels. In the event of a fire or a significant increase in temperature, the sensors detect the change and provide corresponding data through a Wi-Fi module. [23] The system leverages Wi-Fi connectivity to transmit the temperature data to a central control unit or a remote monitoring system in real-time. This enables prompt monitoring and analysis of temperature changes, facilitating early detection of potential fire incidents. By analysing the temperature data, the system can identify abnormal temperature patterns indicative of a fire. Once a fire or high-temperature event is detected, the system can initiate appropriate actions such as activating alarms, sending notifications to homeowners or emergency services, and even triggering fire suppression systems [7-26]

### 3 Methodology

The IoT-based fire department alert system is a sophisticated technology designed to identify and respond to real-time fire occurrences. It contains necessary hardware components such as an Arduino Uno, SIM800L module, flame sensor, buzzer, and battery. Setting up the hardware components, programming an Arduino sketch to operate the system's functions, and assuring continuous monitoring for fire detection are all part of the system's technique. When the flame sensor detects a fire, the system activates the buzzer, which sounds an alarm locally while also sending SMS warnings to pre-defined emergency contacts, such as the fire department. To lessen the severity of the fire, safety precautions are put in place, such as the ability to turn off gas or power supply if judged safe. The technology is rigorously tested before deployment to ensure its accuracy and compliance with safety rules. Regular maintenance is stressed to maintain the system's dependability and effectiveness, allowing it to be an effective and efficient instrument in fire detection and emergency response scenarios.



**Fig. 1.** Block Diagram

Algorithm:

Step 1: Initially connections should be setup with Arduino uno boards 800L module, flame sensor and Buzzer to their respective pins on Bread board.

Step 2: Upload the Arduino code into the Arduino uno board, make sure that all the connected components are working properly.

Step 3: Compile the Arduino code before Uploading the code into Arduino uno board.

Step 4: Now after uploading the code, fire should be given near flame sensor using lighter.

Step 5: Then flame sensor detected fire and immediately alerts with buzzer.

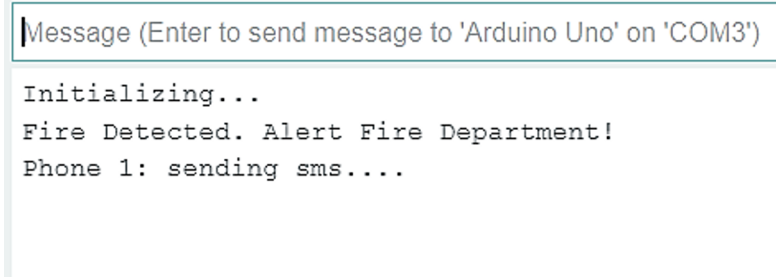
Step 6: After getting the alert with buzzer immediately the Fire Department is Alerted with the help of SMS and phone call.

Step 7: Using Sim 800L module the fire department gets alert with the help of SMS and phone call.

step 8: Finally, the fire department is alerted and the rescue the place of fire occurrence and people over there.

## 4 Result

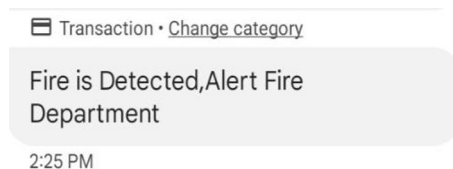
In the implementation, we used a flame sensor to detect whether or not a fire has occurred. If a fire is detected by the flame sensor, it will alert through a buzzer and send an SMS and phone call to the fire department using the Sim 800L module, which contains a sim. Through that sim, a message is sent to the fire department stating that a fire has been detected, alert the fire department so that the fire department will be alerted and this helps in rescuing.



```
Message (Enter to send message to 'Arduino Uno' on 'COM3')
Initializing...
Fire Detected. Alert Fire Department!
Phone 1: sending sms....
```

**Fig. 2.** Serial Monitor Output

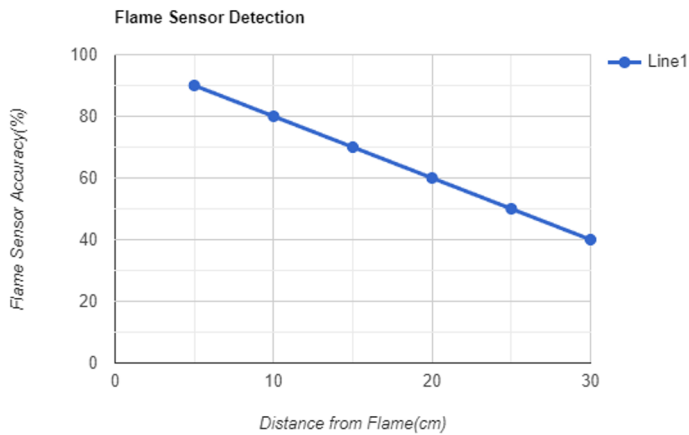
The serial monitor will provide information about the output. If a fire is detected, it will first display Initializing and then OK, indicating that a fire has been detected. After that, it will say "Fire Detected, Alert Fire Department." Following that, it will appear as sending an SMS to the fire department's phone number, as well as phoning the phone number specified in the Arduino code. Serial Monitor includes all of these features.



**Fig. 3** SMS Alerts

**Table 1.** Flame Sensor Detection

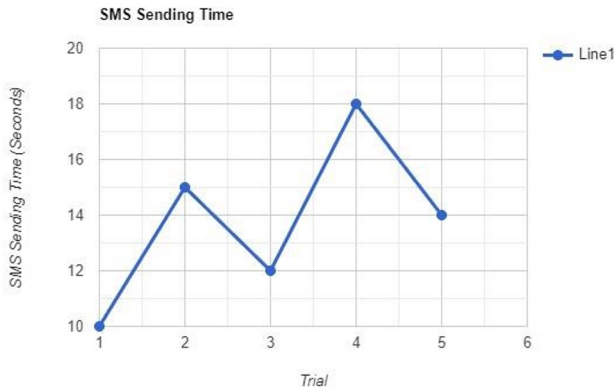
| <b>Distance from Flame (cm)</b> | <b>Flame Sensor Accuracy (%)</b> |
|---------------------------------|----------------------------------|
| 5                               | 90                               |
| 10                              | 80                               |
| 15                              | 70                               |
| 20                              | 60                               |
| 25                              | 50                               |
| 30                              | 40                               |



**Fig. 4.** Distance from Flame(cm) vs Flame Sensor Accuracy (%)

**Table 2.** SMS Sending Time

| <b>Trial</b> | <b>SMS Sending Time (Seconds)</b> |
|--------------|-----------------------------------|
| 1            | 10                                |
| 2            | 15                                |
| 3            | 12                                |
| 4            | 18                                |
| 5            | 14                                |



**Fig. 5.** Trial vs SMS Sending Time (Seconds)

## 5 Conclusion

Finally, the creation of an IoT-based fire detection and warning system based on Arduino, SIM800L, and a fire sensor has tremendous promise for improving fire safety measures. This system uses IoT connection and real-time data processing to identify fire occurrences quickly and inform key stakeholders for timely response. The device may monitor the surrounding environment for indicators of fire by combining an Arduino microcontroller with a SIM800L GSM module and a fire sensor. It provides instant notifications to designated contacts, such as property owners, fire agencies, or security employees, upon detection, allowing them to take required action quickly. This technology not only improves fire detection speed and accuracy, but it also reduces the danger of potential damages, injuries, and loss of life. The usage of Arduino and SIM800L provides a cost-effective and scalable solution that can be used in a variety of contexts such as homes, offices, industries, and public areas. We can expect ever more complex and efficient fire detection and warning systems to develop as IoT and sensor technologies evolve, leading to a safer and more secure environment for everyone.

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