

Fire Detection And Alarm System Using Temperature Sensor

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Abstract - Fire accidents are one of the major causes of loss of life and property in homes, industries, offices, and public places. Early detection of fire is essential to minimize damage and ensure the safety of people. The Fire Detection and Alarm System Using a Temperature Sensor is a simple, low-cost, and reliable system designed to detect abnormal increases in temperature and provide an immediate warning through an alarm. The system continuously monitors the surrounding temperature using a temperature sensor. When the sensed temperature exceeds a predefined threshold, the controller processes the signal and activates a buzzer to alert nearby people about the potential fire hazard. The system can also be expanded to send notifications through wireless communication.

Keywords: buzzer, DHT11, ESP32Microcontroller, temperature sensor, gas sensor

I. Introduction

A Fire Detection and Alarm System using a Temperature Sensor is an electronic safety system designed to detect the rise in temperature caused by fire and provide an immediate warning through an alarm. Fire accidents can lead to severe damage to life, property, and the environment if they are not detected at an early stage. Therefore, an automatic fire detection system plays a vital role in improving safety in homes, offices, industries, laboratories, and public buildings. The system uses a temperature sensor to continuously monitor the surrounding temperature. Under normal conditions, the sensor measures the ambient temperature. When the temperature exceeds a predefined threshold due to the presence of fire or excessive heat, the sensor sends a signal to a microcontroller (such as an Arduino Uno). The microcontroller processes this signal and activates an alarm, such as a buzzer, and may also turn on an LED indicator or send notifications through communication modules, depending on the system design. Compared to manual fire detection methods, a temperature sensor-based fire detection system provides faster response, improved reliability, lower cost, and reduced human intervention. It is particularly useful in areas where smoke detectors may not be effective, such as kitchens, boiler rooms, and industrial environments with dust or steam.

II. Literature Review

Fire detection and alarm systems are essential safety technologies designed to detect fire hazards at an early stage and alert occupants to minimize damage and loss of life. Temperature sensor-based fire detection systems have gained significant attention because of their simplicity, low cost, reliability, and ease of integration with modern microcontrollers.

Early fire detection systems primarily relied on smoke detectors and manual alarms. However, researchers found that smoke detectors may produce false alarms due to dust, steam, or cooking fumes. To overcome these limitations, temperature sensors were introduced to monitor abnormal increases in ambient temperature, providing a more reliable indication of fire in specific environments.

Several studies have focused on integrating temperature sensors such as the LM35, DHT11, DHT22, and DS18B20 with microcontrollers including Arduino Uno, ESP32, NodeMCU, and Raspberry Pi. These systems continuously monitor temperature values and compare them with predefined threshold levels. When the temperature exceeds the threshold, the controller activates a buzzer, LED indicators, and sometimes sends notifications through Wi-Fi or GSM networks.

III. System Architecture & Methodology

The system architecture of a fire detection and alarm system using a temperature sensor is designed to continuously monitor the surrounding temperature and provide an immediate warning when a potential fire is detected. The system mainly consists of a temperature sensor, an ESP32 microcontroller, a buzzer, an LCD/OLED display, a power supply, and an optional Wi-Fi communication module.

A. Hardware Setup

The hardware setup of a fire detection and alarm system using a temperature sensor is built to sense abnormal heat rise and trigger an alert immediately. The main components include a temperature sensor, an ESP32 microcontroller, a buzzer, an LCD or OLED display, a power supply, jumper wires, and a breadboard or PCB for connections. The temperature sensor is connected to the ESP32 to measure the surrounding temperature and send the readings to the controller. The ESP32 is powered through a regulated supply and serves as the central unit that processes the sensor data. The buzzer is connected to one of the output pins of the ESP32 so that it can produce an audible alarm when the temperature crosses the set threshold. The display module is wired to show the current temperature

and system status in real time. If wireless notification is required, the ESP32 uses its built-in Wi-Fi capability to send alerts to a mobile device or cloud platform. During hardware assembly, all components are connected properly with common ground and correct voltage levels to ensure stable operation. This setup provides a simple, low-cost, and effective hardware arrangement for early fire detection and warning.

Fig.1

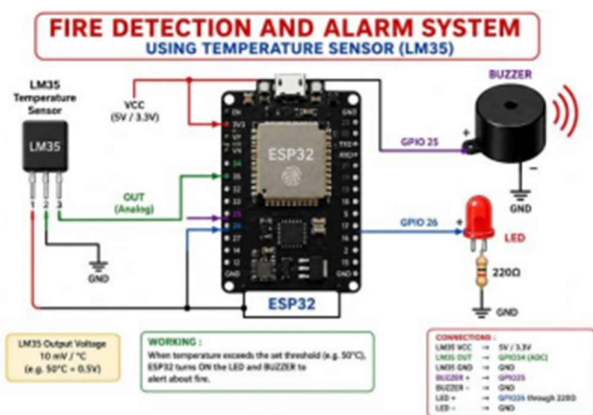


Fig.1 Overall system architecture of fire detection and alarm system using temperature sensor

B. Obstacle Detection and Alert System

An obstacle detection and alert system enhances the safety and reliability of a fire detection system by identifying objects or people that may obstruct emergency exits or block the movement of rescue personnel. An ultrasonic sensor or infrared (IR) sensor is commonly used to detect obstacles within a predefined distance. When an obstacle is detected, the microcontroller (such as an ESP32 or Arduino) processes the sensor data and activates an alert. The alert may include a buzzer, LED indicator, or a notification sent through a mobile application. During a fire emergency, this feature helps ensure that evacuation routes remain accessible and warns users about blocked pathways. By integrating obstacle detection with the temperature-based fire detection system, overall safety is improved and emergency response becomes more effective.

Fig.2

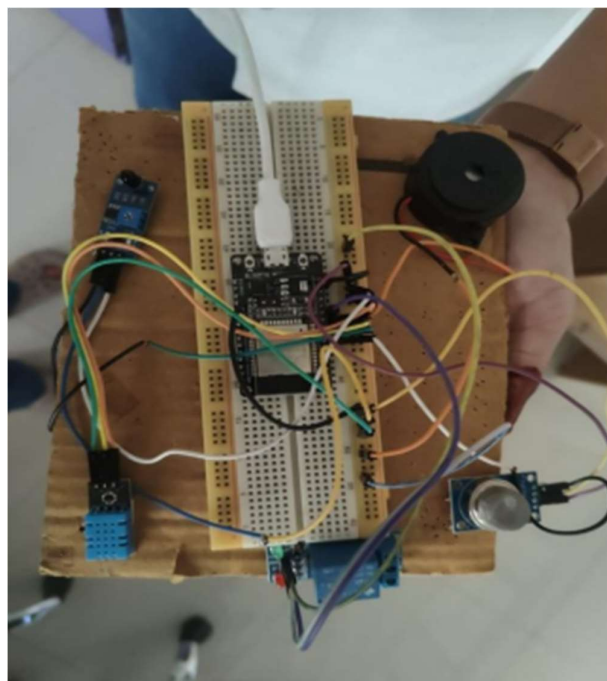
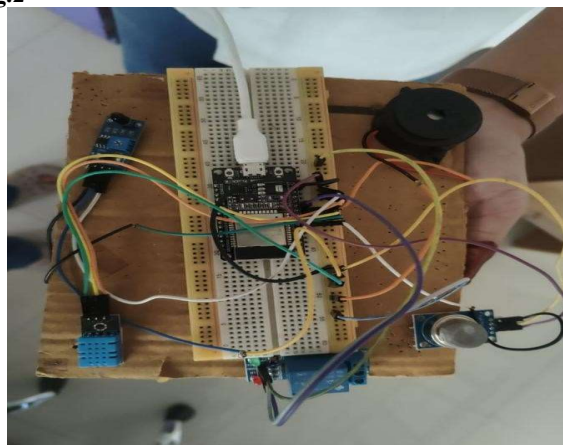


Fig.2 Hardware implementation of the proposed system using temperature sensor, buzzer, flame sensor and gas sensor, DHT11, ESP32

A. Emergency SOS System

An Emergency SOS System is an additional safety feature integrated into a fire detection and alarm system. When the temperature sensor detects a temperature above a predefined threshold (for example, 60–70°C), the microcontroller identifies it as a potential fire. It immediately activates a buzzer and warning LED to alert nearby people. At the same time, the system sends an SOS alert to predefined emergency contacts or the fire department using a communication module such as a GSM module or a Wi-Fi-enabled controller.

B. Power Management

Power Management of Fire Detection and Alarm System Using a Temperature Sensor

Power management is an essential part of a fire detection and alarm system because it ensures continuous and reliable operation, even during power failures. The system is typically powered by a regulated DC power supply (5 V or 12 V), which provides stable voltage to the temperature sensor, microcontroller, alarm circuit, and communication module. During normal operation, the main power supply energizes all components while a rechargeable backup battery remains charged.

IV. Result

The developed Fire Detection and Alarm System using a Temperature Sensor was successfully designed, implemented, and tested. The temperature sensor continuously monitored the surrounding temperature and accurately detected abnormal temperature increases. When the temperature exceeded the preset threshold, the microcontroller immediately activated the buzzer and LED alarm to warn occupants of a potential fire.

The system also displayed the temperature value on the display and, where integrated, sent an emergency SOS notification to predefined contacts through the communication module.

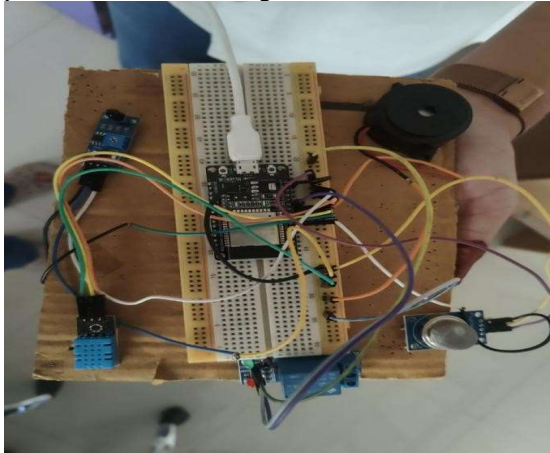


Fig. 3. Real time implementation and experimental setup of fire detection and temperature sensor.

During testing, the system responded quickly and reliably, demonstrating effective fire detection and alert generation. The use of a backup power supply ensured uninterrupted operation during power failures. Overall, the project achieved its objective of providing an efficient, low-cost, and reliable fire detection and alarm system suitable for homes, offices, laboratories, and small industrial environments.

V. Security & Challenges

The security and challenges of a fire detection and alarm system using a temperature sensor are important factors that affect its overall performance and reliability. The system enhances safety by continuously monitoring the ambient temperature and activating an alarm whenever the temperature exceeds a predefined threshold, enabling occupants to respond quickly and reducing the risk of injury and property damage. In IoT-based implementations, secure communication, user authentication, and data encryption help protect the system from unauthorized access and cyber threats, while battery backup ensures uninterrupted operation during power failures. However, the system also faces several challenges. Temperature sensors may generate false alarms due to high environmental temperatures or nearby heat sources, and they may not detect slow-burning fires until the temperature rises significantly. Environmental conditions such as dust, humidity, and sensor aging can reduce detection accuracy, requiring regular maintenance and calibration. In addition, network failures in IoT-enabled systems may interrupt remote notifications, and installing multiple sensors to cover large areas can increase the overall cost. Despite these limitations, the effectiveness of the system can be significantly improved by integrating temperature sensors with smoke or gas sensors, providing reliable power backup, and performing periodic maintenance to ensure accurate and timely fire detection.

VI. Future Scope

The future scope of the Fire Detection and Alarm System using a Temperature Sensor is promising, as it can be enhanced by integrating advanced technologies to improve its efficiency, accuracy, and reliability. In the future, the system can be connected to the Internet of Things (IoT) for real-time monitoring and remote control through mobile applications or web dashboards. Additional sensors such as smoke, flame, gas, and humidity sensors can be integrated to provide more accurate fire detection and reduce false alarms. Artificial Intelligence (AI) and Machine Learning (ML) techniques can be used to analyze sensor data and predict potential fire hazards before they become critical. The system can also be integrated with automatic fire suppression systems, such as water sprinklers and emergency ventilation, to control fire without human intervention. GPS and GSM technologies can be added to send the exact location of the fire to emergency services for faster response. Furthermore, cloud-based data storage can maintain temperature records and alarm history for analysis and maintenance. The use of renewable energy sources, such as solar power with battery backup, can ensure uninterrupted operation during power failures.

VII. Conclusion

The fire detection and alarm system using a temperature sensor is an effective, reliable, and low-cost solution for detecting fire hazards at an early stage. By continuously monitoring the surrounding temperature, the system can identify abnormal heat levels and immediately activate an alarm, helping to reduce the risk of property damage and protect human lives. The system is simple to design, consumes low power, and can be easily implemented in homes, offices, industries, and public buildings. Overall, this project demonstrates that a temperature sensor-based fire detection and alarm system provides an efficient method for enhancing fire safety and can be further improved by integrating additional sensors, wireless communication, and IoT technology for faster and more accurate fire monitoring.

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