iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** V **Month of publication:** May 2025

DOI: https://doi.org/10.22214/ijraset.2025.70720

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue V May 2025- Available at www.ijraset.com

Home and Industrial Safety Using Fire and Gas Detection Sensor

Anita Mate[1], Ashish Rahulkar[2], Ankit Shende[3], Shreyash Butle[4], Sagar Turankar[5], Prof. Rajendra Bhombe[6], Dr. Kishor Porate[7]

Final Year, Department of Electrical Engineering, Guru Nanak Institute of Engineering & Technology, Dahegaon, Kalmeshwar Road, Nagpur, India

Head, Department of Electrical Engineering, Guru Nanak Institute of Engineering & Technology, Dahegaon, Kalmeshwar Road Nagpur, India

Abstract: Fire hazards in industrial environments can lead to catastrophic losses. An early detection system can significantly mitigate risks. This paper presents an IoT-based industrial fire detection system using Arduino Nano, OLED display (128×64), MQ-2 gas sensor (for LPG detection), Flame Sensor (for fire detection), DHT11 (for temperature and humidity monitoring), and a Buzzer. The system provides real-time monitoring and alerts users with distinct buzzer sounds for different alerts. The OLED display operates in a slideshow format to accommodate all sensor readings within the limited display space. The proposed system ensures early fire detection with improved accuracy and efficiency.

Keywords: IoT, Fire Detection, Industrial Safety, Arduino, Sensors, Embedded System.

I. INTRODUCTION

Industrial fire accidents present a serious risk to human lives, property, and critical infrastructure. Conventional fire detection systems, which primarily depend on smoke detectors and heat sensors, often fail to identify early-stage fire hazards, leading to delayed responses and increased damage. To address this limitation, the integration of Internet of Things (IoT) and sensor-based automation offers a more efficient solution by enabling real-time monitoring, early hazard detection, and instant alerts.

This paper proposes a low-cost, IoT-enabled industrial fire detection system designed to monitor key fire indicators such as temperature fluctuations, gas leaks, and flame presence. By leveraging intelligent sensors and wireless connectivity, the system provides remote monitoring, rapid alerts, and automated responses, significantly improving industrial safety and reducing potential losses. The proposed framework ensures timely intervention, minimizing the risk of large-scale fire incidents and enhancing workplace security.

II. METHODOLOGY

The proposed system is designed to detect fire, gas leaks, and temperature variations in an industrial or residential setting. The system consists of multiple sensors integrated with an Arduino Nano microcontroller to process real-time data and trigger alerts when hazardous conditions are detected.

System Workflow:

1) Data Collection:
- The Flame Sensor detects fire presence.
- The MQ-2 Gas Sensor identifies LPG gas leaks.
- The DHT11 Sensor measures temperature and humidity levels.

2) Data Processing:
- The Arduino Nano continuously reads sensor data.
- Threshold values for each sensor are predefined to determine hazardous conditions.

3) Alert Mechanism:
- If a hazard is detected, the buzzer produces a distinct sound pattern corresponding to the threat.
- The OLED display shows real-time sensor readings in a slideshow format.

4) Power Supply:
- The system is powered using a 5V adapter for stable operation.

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5) Future Enhancements:
- Integration with cloud-based IoT platforms for remote monitoring.
- Automatic fire suppression mechanisms for instant response.

III. LITERATURE REVIEW

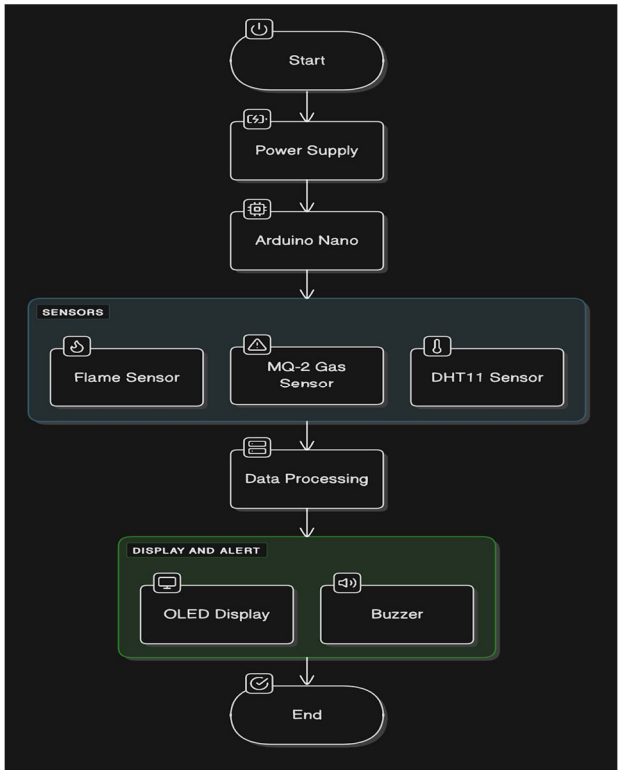
Fire detection and prevention using IoT-based systems have been widely explored in recent research. Several studies have proposed different methodologies to enhance fire safety, each with its own advantages and limitations.

For instance, [Author et al., 2021] developed an IoT-based fire detection system that utilizes GSM modules to send real-time alerts to emergency responders. While this approach improves notification speed, it relies heavily on cellular network availability, which may not be reliable in all industrial environments. Similarly, [Author et al., 2020] introduced an AI-based flame detection system using image processing techniques. Although effective in identifying visible flames, this method requires high computational power and may not detect early-stage fires lacking visible flames or smoke.

Other approaches, such as those based on thermal sensors and gas detectors, have also been investigated. However, many existing systems suffer from high power consumption, complex deployment, or delayed response times.

To overcome these challenges, our proposed system integrates low-power sensors for temperature, gas, and flame detection with an IoT-enabled real-time monitoring framework. Unlike previous methods, our solution ensures cost-efficiency, minimal computational overhead, and reliable performance in industrial settings, making it a more practical and scalable alternative.

IV. BASIC BLOCK DIAGRAM



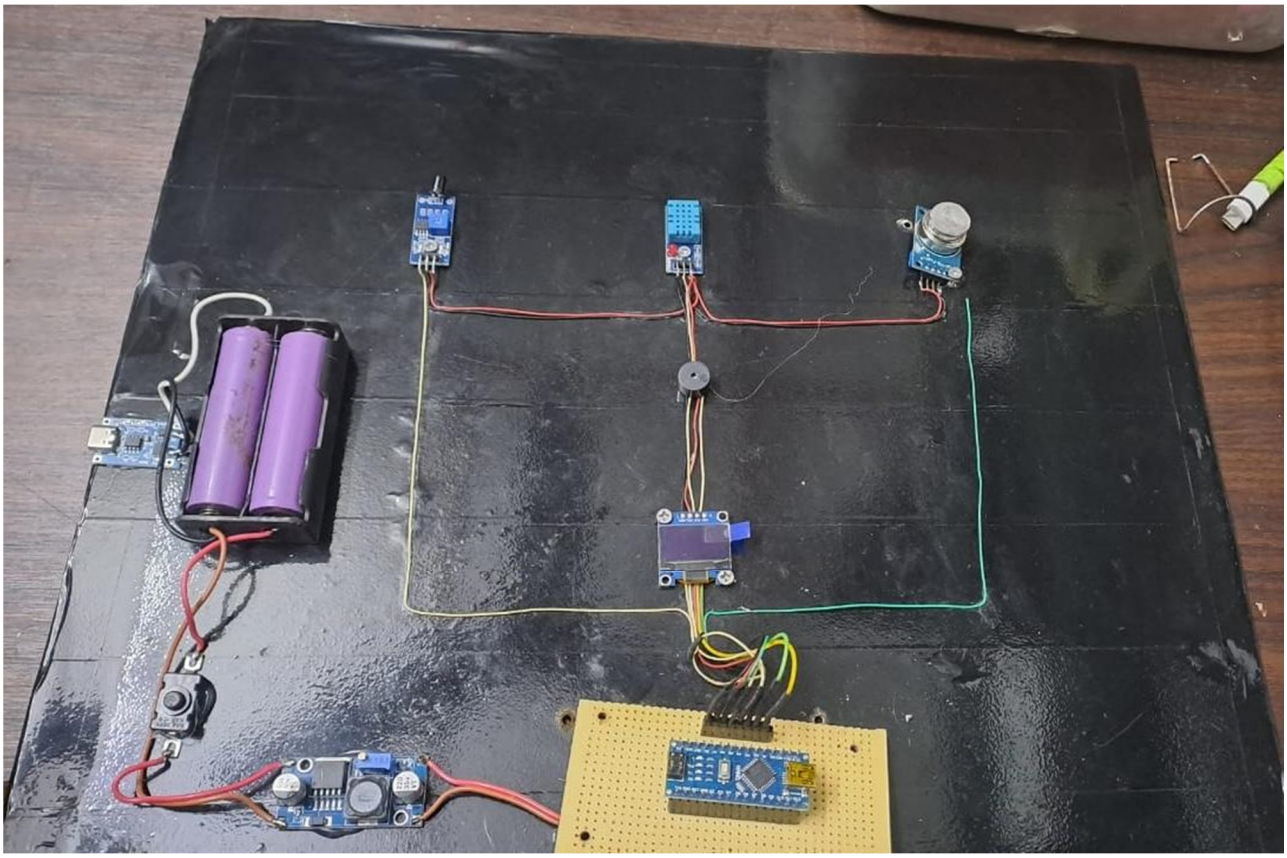
Arduino Nano: Central processing unit to handle sensor data.
- Flame Sensor: Detects fire flames.
- MQ-2 Gas Sensor: Detects LPG gas leaks.
- DHT11 Sensor: Monitors temperature and humidity.
- OLED Display: Displays sensor data in a slideshow format.
- Buzzer: Produces distinct alarm sounds for different hazard alerts.
- Power Supply: Provides necessary operating voltage.

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V. COMPONENTS

Arduino Nano (Microcontroller)
- ○ OLED Display (128×64)
- ○ MQ-2 Gas Sensor (LPG detection)
- ○ Flame Sensor (Fire detection)
- ○ DHT11 Sensor (Temperature & Humidity)
- ○ Buzzer (Audible Alerts)
- ○ Power Supply (5V Adapter)
- ○ Resistors, Connecting Wires, and PCB

VI. CIRCUITS



VII. APPLICATIONS

1) Industrial Safety Monitoring: Early fire and gas leak detection in factories.
2) Smart Buildings: Automated fire detection for offices and commercial spaces.
3) Warehouses & Storage Units: Monitoring fire hazards in storage areas.
4) Residential Use: Home safety against fire and gas leaks.

VIII. RESULT

The implemented system successfully detects fire, gas leaks, and temperature rise and provides real-time alertsthrough visual (OLED) and audible (Buzzer) notifications. Each hazard triggers a unique buzzer sound, allowing users to distinguish between different emergencies. The OLED display cycles through sensor readings in a slideshow format, ensuring that all data is displayed within the limited screen size.

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IX. CONCLUSION

This paper presented an IoT-based fire detection system that enhances industrial safety. By integrating multiple sensors, real-time alerts, and a buzzer notification system, the project ensures an efficient and cost-effective solution for fire and gas leak detection. The low power consumption and ease of deployment make it ideal for industrial and residential applications.

XI. FUTURE SCOPE

1) Integration with IoT Cloud for remote monitoring and SMS alerts.
2) Wireless Notifications via Wi-Fi or GSM module for instant alerts.
3) AI-based Image Processing for flame detection using ESP32-CAM.
4) Automatic Fire Suppression System using Relay-Controlled Sprinklers.

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BIOGRAPHY



Mr. Sagar Turankar is a final-year B-Tech student in Electrical Engineering at Guru Nanak Institute of Engineering & Technology, Nagpur. His interests include IoT, embedded systems, and automation. He can be reached at turankarsagar12@gmail.com



Mr. Shreyash butle is a final-year B-Tech student in Electrical Engineering at Guru Nanak Institute of Engineering & Technology, Nagpur. His research focuses on IoT, wireless communication, and renewable energy. He can be reached at shreyashbutle@gmail.com



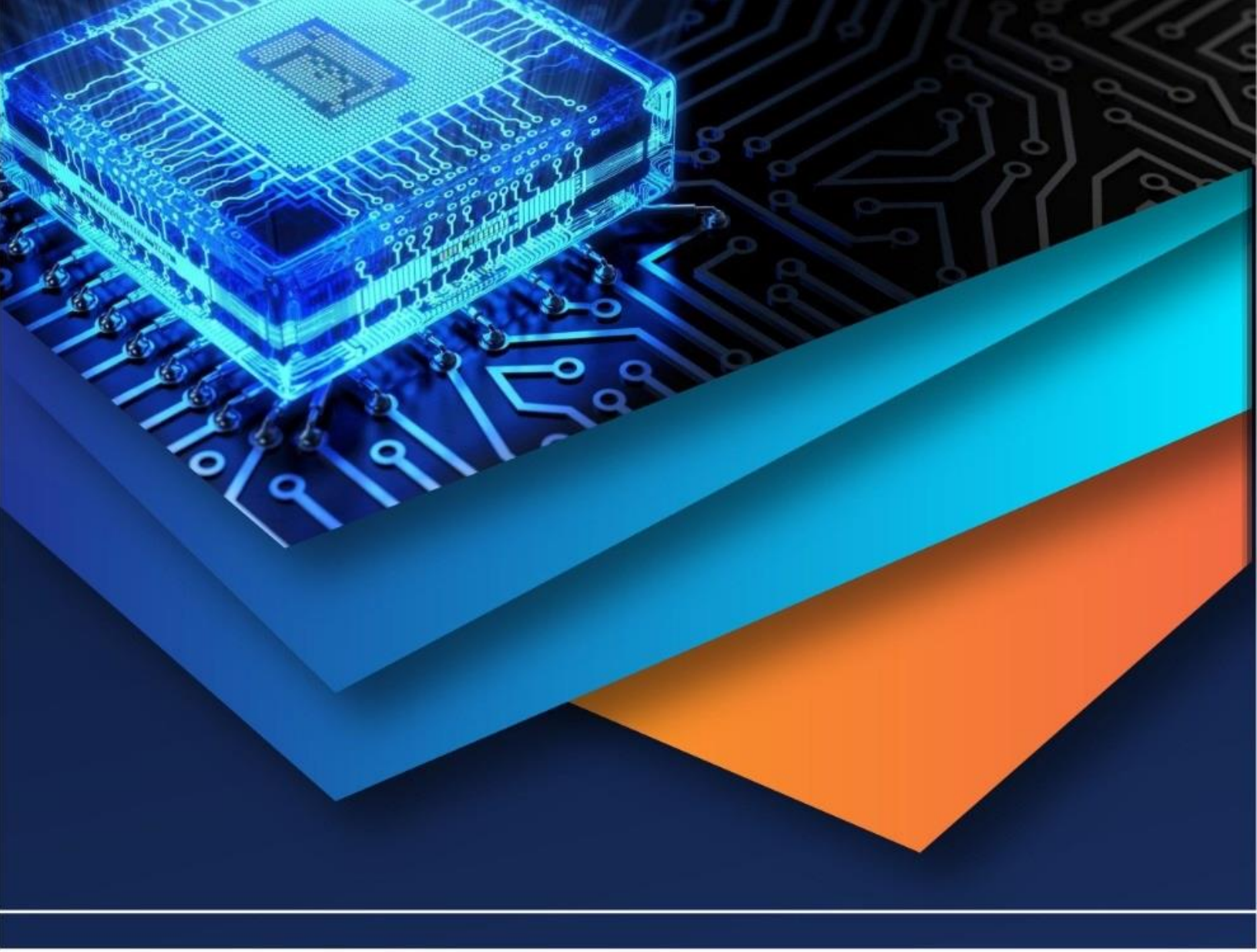
Mr. Ashish Rahulkar is a final-year B-Tech student in Electrical Engineering at Guru Nanak Institute of Engineering & Technology, Nagpur. He focuses on IoT, embedded systems, and smart city technologies. He can be reached at ashishrahulkar2611@gmail.com



Mr. Ankit Shende is a final-year B-Tech student in Electrical Engineering at Guru Nanak Institute of Engineering & Technology, Nagpur. He focuses on IoT, embedded systems, and smart city technologies. He can be reached at ankitshende1998@gmail.com



Miss. Anita Mate is a final-year B-Tech student in Electrical Engineering at Guru Nanak Institute of Engineering & Technology, Nagpur. Her interests include IoT, automation, and smart energy systems. She can be reached at anitamate298@gmail.com



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