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Safe Sense 360° with Instant Reporting

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ABSTRACT
In a real-time monitoring and alerting system that detects temperature, gas, and smoke levels for remote notifications in emergency scenarios faces challenges in sending alerts on time and monitoring local premises. This project aims to design a real-time monitoring and safety system that detects temperature, harmful gas, and smoke levels while activating suction fans for ventilation and sending alerts via a GSM module for timely intervention. The system incorporates DS18B20 (temperature sensor), MQ-series (gas sensor), and a smoke sensor, alongside a GSM module (e.g., SIM800L) for communication and suction fans controlled by a microcontroller (e.g., Arduino). The system monitors environmental parameters, activates suction fans to reduce hazardous conditions when thresholds are exceeded, and sends SMS alerts via the GSM module to predefined mobile numbers for timely action.

I. INTRODUCTION

Ensuring safety in homes, industries, and public spaces is a critical concern due to the increasing incidents of gas leaks, smoke accumulation, and fire hazards. Traditional safety systems often rely on manual intervention, leading to delayed responses and potential loss of life and property. With advancements in IoT and smart sensor technology, automated safety systems can provide real-time monitoring, early detection, and instant alerts to mitigate risks.

One of the major concerns during gas leaks or fire incidents is the accumulation of toxic gases and smoke, which can make evacuation difficult. To overcome this, our system includes suction fans that automatically activate when hazardous gases or smoke levels exceed the threshold. This feature not only helps in improving air quality but also reduces the risk of explosions in case of gas leaks. By automating this process, we ensure that corrective actions are taken without human intervention, reducing response time and minimizing risks.

Furthermore, data storage and analysis play a key role in improving safety measures over time. This project uses ThingSpeak IoT software to store real-time sensor data, allowing users to analyze trends and take preventive actions. Historical data can be reviewed to understand patterns of gas leaks, smoke buildup, or sudden temperature spikes, enabling better decision-making and improved safety protocols. The use of IoT technology ensures that all data is accessible remotely through cloud-based monitoring, making it an efficient and scalable solution.

The advancement of IoT-based safety systems has gained significant attention in recent years due to the increasing risks associated with gas leaks, smoke accumulation, and fire hazards. Traditional fire and gas detection systems rely on standalone alarms and human intervention, which often result in delayed responses. Researchers have explored various sensor-based, GSM-integrated, and IoT-enabled safety mechanisms to enhance real-time monitoring and automated alert systems.

II. Related work

Traditional Fire and Gas Detection Systems

Early fire and gas detection systems were primarily based on ionization and photoelectric smoke detectors and semiconductor gas sensors. These systems effectively detected hazardous gases and smoke but lacked real-time communication capabilities. As a result, they could not provide instant alerts to users who were away from the affected area. Studies by Kumar et al. (2021) highlighted the limitations of these conventional systems, particularly in large-scale industries where human intervention is delayed.

Sensor-Based Detection Techniques

Recent research has focused on the integration of multiple sensors to improve the accuracy of detection. Studies conducted by Patel et al. (2022) demonstrated that combining flame sensors, gas sensors (MQ-6, MQ-135), and smoke sensors (MQ-2) reduces false alarms and enhances system reliability. These sensors work

together to detect fire hazards more efficiently compared to standalone smoke detectors, making them ideal for industrial and residential applications.

GSM-Based Alert Systems

The introduction of GSM modules in fire and gas detection systems has significantly improved emergency response times. According to Sharma & Gupta (2024), GSM-based alert mechanisms allow real-time transmission of alerts via SMS or phone calls, ensuring that users receive immediate notifications about potential hazards. This technology is particularly useful in remote areas or unoccupied buildings, where early detection can help prevent major disasters.

IoT and Cloud-Based Monitoring

With the growth of the Internet of Things (IoT), researchers have explored cloudbased monitoring solutions for fire and gas safety systems. According to Fernandez et al. (2021), integrating IoT platforms such as Thing Speak enables real-time data storage, remote access, and historical trend analysis. This feature allows users to monitor environmental conditions remotely and take preventive actions before critical situations arise.

III. DESIGN AND IMPLEMENTATION

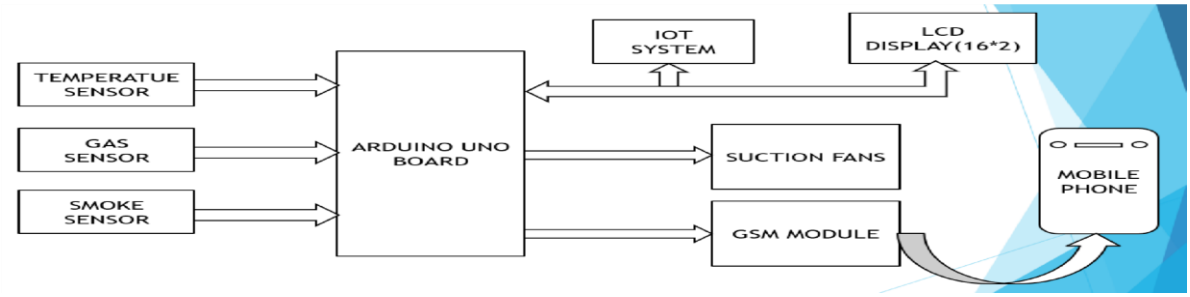

FIG. Block Diagram

The block diagram represents the working of the Safe Sense 360° with Instant Reporting system, which is designed to detect gas leaks, smoke, and temperature variations. It consists of various sensors, an Arduino Uno microcontroller, a GSM module for instant alerts, suction fans for ventilation, an IoT system for cloud data storage, and an LCD display for real-time updates. Each component is connected to ensure a smooth and automated safety mechanism.

The input section includes three main sensors: temperature sensor (DS18B20), gas sensor (MQ-6/MQ-135), and smoke sensor (MQ-2). These sensors continuously monitor environmental conditions and send real-time data to the Arduino Uno board. If any of the sensor readings exceed a predefined threshold, the system takes immediate action by triggering appropriate responses.

The Arduino Uno microcontroller serves as the central processing unit of the system. It receives input from the sensors, processes the data, and controls the output devices. Based on the received signals, the Arduino decides whether to activate the suction fans, send alerts via the GSM module, or update the IoT cloud storage. The LCD display (16x2) is used to show real-time sensor readings and system status.

The output section comprises three key components: the GSM module, suction fans, and IoT system. The GSM module sends emergency SMS alerts to predefined mobile numbers in case of a hazardous situation. The suction fans automatically turn on when high gas concentrations or smoke are detected, ensuring proper ventilation and reducing risks. Additionally, the IoT system (ThingSpeak) collects and stores sensor data for remote monitoring and future analysis.

The system also provides a mobile notification mechanism. When an alert is generated, the GSM module immediately notifies the user through a text message. This ensures that safety actions can be taken promptly, even if no one is present at the location. The combination of real-time monitoring, automation, and cloud integration enhances the effectiveness of the system.

Overall, this IoT-based gas, smoke, and temperature detection system ensures quick response to potential hazards, improving safety in homes, industries, and workplaces. By integrating multiple sensors with automated response mechanisms, the system minimizes risks and enhances environmental monitoring.

IV. PROPOSED SYSTEM

The Safe Sense 360° with Instant Reporting system is designed to provide an automated, IoT-based safety solution that continuously monitors gas levels, smoke concentration, and temperature fluctuations. The system integrates multiple sensors, a GSM module, suction fans, and IoT-based data storage to ensure real-time detection

and response to hazardous situations. Unlike traditional safety measures that rely on human intervention, this system operates automatically, reducing response time and enhancing safety.

The core of the system consists of gas sensors (MQ-6, MQ-135), a smoke sensor (MQ-2), and a temperature sensor (DS18B20/LM35). These sensors are strategically placed in an environment to detect the presence of toxic gases, smoke, or sudden temperature spikes. When any of these values exceed a predefined safety threshold, the system instantly triggers an alert mechanism.

To notify users and authorities in case of a detected hazard, the system includes a GSM module (SIM800L). This module sends real-time SMS alerts to predefined mobile numbers, ensuring that immediate action can be taken even if no one is physically present at the location. Additionally, a buzzer alarm and LCD display provide local notifications, making it easy to identify potential dangers within the premises.

Another critical feature of the proposed system is its automated ventilation mechanism. If gas levels or smoke concentration exceed safe limits, suction fans are automatically activated to reduce the accumulation of harmful gases and improve air circulation. This helps prevent fire hazards and reduces health risks associated with inhaling toxic gases.

The system also incorporates IoT-based data storage and monitoring using ThingSpeak IoT software. Sensor data is continuously logged and stored in the cloud, allowing users to remotely monitor real-time readings, analyze historical data, and identify patterns that could indicate potential safety risks. This feature enables preventive measures to be taken before an emergency occurs.

Overall, the proposed system provides a cost-effective, automated, and scalable safety solution that enhances fire prevention, gas leak detection, and real-time alerting. By integrating IoT, GSM technology, and automated ventilation, this system ensures early detection, immediate response, and improved safety standards for homes, industries, and public spaces.

V. RESULTS &VALIDATIONS

The prototype of the IoT-based gas, smoke, and temperature detection system consists of hardware components connected to an Arduino Uno for real-time hazard monitoring and automated response. This system is designed to detect hazardous conditions, activate safety measures, and send alerts to users via SMS and IoT platforms.

The hardware setup includes gas (MQ-6/MQ-135), smoke (MQ-2), and temperature (DS18B20/LM35) sensors, which continuously monitor environmental conditions. These sensors provide analog or digital signals to the Arduino Uno, which processes the data and determines whether safety measures need to be triggered. A GSM module (SIM800L/SIM900A) is used to send SMS alerts in case of emergencies, while an LCD display provides real-time updates on sensor readings.

When hazardous conditions are detected, the Arduino Uno triggers multiple actions. A buzzer alarm produces an audible warning, while suction fans are activated to ventilate toxic gases or smoke. If gas levels exceed a predefined threshold, the system sends an SMS alert to a predefined phone number, ensuring users are informed immediately. Additionally, all sensor data is stored in the ThingSpeak IoT platform, enabling remote monitoring through a web or mobile interface.

The prototype is built on a breadboard or PCB, with sensor modules, a relay module (to control suction fans), and a power supply (12V adapter for high-power components). The components are interconnected using jumper wires, ensuring stable communication between sensors and the microcontroller. The system is powered by a 5V/12V power source, with careful grounding to prevent signal interference.

This prototype effectively demonstrates the functionality of an automated safety system, providing real-time hazard detection, alert generation, and preventive action. Future improvements could include battery backup, Wi-Fi connectivity, and AI-based predictive analysis for enhanced safety and monitoring. The system is particularly useful in homes, industries, storage facilities, and public spaces, ensuring proactive and automated risk mitigation.

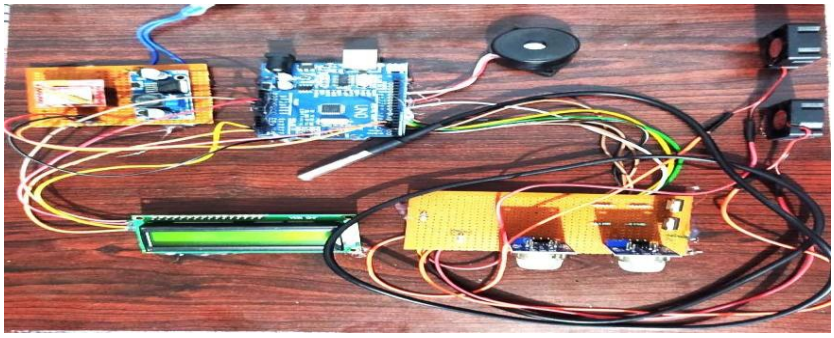

Fig Prototype Model

The IoT-based gas, fire, and smoke detection system consists of sensors, a microcontroller, a GSM module, and suction fans for ventilation. The key sensors include a gas sensor (MQ series) for detecting harmful gases, a smoke sensor for smoke detection, and a temperature sensor for fire detection. These sensors continuously monitor the environment and send real-time data to a microcontroller, which processes the information and takes necessary actions.

When hazardous levels of gas, smoke, or temperature are detected, the system instantly triggers an alert via the GSM module, sending notifications to predefined contacts. Simultaneously, the suction fans are activated to improve ventilation and reduce the concentration of harmful gases. The system also utilizes IoT connectivity with ThingSpeak to log sensor data for real-time monitoring and analysis.

INITIALIZATION :

Fig. Initialization output

The GSM module in the IoT-based gas, fire, and smoke detection system enables real-time alerts via SMS or calls when hazardous conditions are detected. It communicates with a microcontroller using AT commands to establish a network connection and send notifications. When a sensor detects dangerous gas levels, smoke, or high temperature, the system instantly sends an alert to predefined contacts. The module periodically checks network status and retries sending messages if needed to ensure reliability. Some implementations support voice calls for urgent warnings, increasing the chances of user awareness. Advanced setups may integrate acknowledgment mechanisms for confirmation. This GSM-based alert system enhances safety by providing instant and remote monitoring capabilities.

INITIALIZATION OF GSM MODULE:

Before using the GSM module for sending SMS alerts, it must be initialized and configured properly. Below are the key steps involved in initializing the GSM module:

Hardware Setup:

- Connect the GSM module (SIM800L/SIM900A) to the microcontroller (ESP8266/Arduino UNO).
- Use a 5V power supply (with proper current rating ~2A) for stable operation.
- Insert a valid SIM card with sufficient balance for SMS alerts.
- Connect TX (GSM) → RX (Microcontroller) and RX (GSM) → TX (Microcontroller) for serial communication.
- Use GND for common grounding.

VI. CONCLUSION &FUTURE SCOPE

CONCLUSION

The Safe Sense 360° with Instant Reporting system is an IoT-based real-time safety solution designed to detect gas leaks, smoke accumulation, and temperature variations in various environments. By integrating gas (MQ-6/MQ-135), smoke (MQ-2), and temperature (DS18B20/LM35) sensors with an Arduino Uno, the system provides continuous monitoring and ensures immediate hazard detection. The incorporation of a GSM module (SIM800L/SIM900A) allows for instant SMS alerts, notifying users of potential dangers, while suction fans automatically activate to improve ventilation and reduce risk.

The system successfully addresses the limitations of traditional safety mechanisms by automating responses and enabling remote monitoring. The use of ThingSpeak IoT cloud storage ensures that sensor data is logged for historical analysis and preventive decision-making. This allows users to track environmental conditions over time and take necessary precautions to avoid potential disasters.

One of the major advantages of the Safe Sense 360° system is its ability to operate with minimal human intervention, making it an ideal safety solution for homes, industries, laboratories, and storage facilities. The system is cost-effective, scalable, and highly reliable, ensuring that even small-scale implementations can benefit from enhanced safety measures.

Future improvements to the system may include Wi-Fi connectivity for remote control, AI-based predictive analysis for risk assessment, and integration with emergency response systems. Adding battery backup and solar power support would ensure uninterrupted operation during power failures, making the system even more robust.

In conclusion, the Safe Sense 360° with Instant Reporting system provides an effective, real-time, and automated solution for hazard detection and prevention. With its sensor-based monitoring, GSM alert functionality, and IoT integration, the system ensures a safer environment by minimizing risks associated with gas leaks, fire hazards, and poor air quality.

FUTURE SCOPE

- AI-Powered Early Detection – Integration of AI and machine learning to predict fire and gas leakage risks based on sensor data patterns.
- Smart Automation – Automatic activation of suction fans and fire suppression systems based on real-time hazard levels.
- Cloud-Based Monitoring – Remote monitoring and control via cloud platforms and mobile apps for instant alerts.
- Integration with Smart Cities – Connection with municipal fire departments and emergency services for faster response.
- Battery Backup & Solar Power – Ensuring uninterrupted operation during power failures using renewable energy sources.
- Wireless Sensor Networks – Use of LoRa, Zigbee, or 5G for long-range, low-power communication between sensors and control units.

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