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SMART STOVE SAFETY AND MONITORING SYSTEM

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Abstract: Gas leakage is a critical safety concern that can lead to severe accidents, including fire hazards, explosions, and loss of human life. Despite the availability of conventional gas regulators and safety devices, many systems rely heavily on human intervention, which increases the risk of delayed responses and negligence. This project proposes a smart and automated gas leakage monitoring and cut-off system using the ESP32 microcontroller to enhance safety and minimize risks.

The system integrates multiple components such as a gas leakage sensor (MQ series), fire sensor, relay module, solenoid valve, servo motor, keypad, and LCD display. The ESP32 acts as the central processing unit, continuously monitoring environmental conditions. When gas leakage or fire is detected, the system automatically triggers safety mechanisms, including shutting off the gas supply using a solenoid valve and mechanically controlling the gas regulator via a servo motor.

Additionally, the built-in Wi-Fi capability of the ESP32 enables remote monitoring and alert notifications, ensuring that users are informed in real time. The LCD display provides immediate feedback on system status, enhancing usability. This intelligent system not only improves safety but also reduces dependency on manual monitoring, making it a reliable solution for modern smart homes and industrial environments.

I. INTRODUCTION

Gas leakage has been one of the leading causes of fire accidents in households, industries, and commercial establishments. Liquefied Petroleum Gas (LPG), commonly used for cooking and heating, is highly flammable. Even a small leakage can lead to dangerous situations if not detected early. Accidents caused by gas leakage often result in property damage, injuries, and in extreme cases, fatalities.

Traditional gas safety systems, such as manual regulators and gas alarms, are insufficient in many cases. Manual systems depend on user awareness and timely action, which may not always be reliable. Standalone gas detectors only provide alerts without taking corrective measures, leaving the responsibility entirely to the user.

With the advancement of technology, especially in the field of the Internet of Things (IoT), it is now possible to design systems that can monitor, detect, and respond to hazards automatically. Microcontrollers like ESP32 offer powerful features such as real-time processing, wireless communication, and integration capabilities, making them ideal for safety applications.

This project aims to develop an automated gas leakage detection and control system that ensures early detection and immediate preventive action. By combining sensing, control, and communication technologies, the system significantly enhances safety and reliability while reducing human dependency.

II. LITERATURE REVIEW

Gas leakage detection and prevention systems have been extensively studied due to the increasing risks associated with LPG usage in residential and industrial environments. Various researchers have proposed systems using gas sensors, microcontrollers, and IoT technologies to enhance safety and reduce response time.

A study by **A. Sharma et al. (2022)** focused on the implementation of a gas leakage detection system using the MQ-6 sensor. Their work demonstrated that semiconductor gas sensors are effective in detecting LPG leakage and can trigger

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warning systems such as alarms and automatic shut-off valves. The study highlighted the importance of early detection in preventing hazardous situations.

In another research work, **M. Rahman et al. (2023)** developed an ESP32-based gas leakage detection system integrated with IoT features. The system used an MQ-2 gas sensor to detect leakage and sent real-time alerts through mobile applications. Their findings showed that the ESP32 microcontroller significantly improves system efficiency due to its fast processing speed and built-in Wi-Fi capabilities.

Similarly, **S. Kumar and P. Singh (2021)** designed a gas monitoring system using Arduino and MQ-series sensors. Their system included an LCD display and a buzzer for alert mechanisms. Although the system effectively detected gas leakage, it lacked an automatic gas shut-off feature, making it dependent on user intervention.

A study by **R. Patel et al. (2023)** explored the development of an LPG gas leakage detection system using ESP32. The system was capable of detecting gas concentrations within a range of 300–5000 ppm and provided alerts through both visual and audio indicators. The researchers emphasized the importance of integrating communication modules for remote monitoring.

Further advancements were presented by **K. Verma et al. (2024)**, who proposed an IoT-based smart LPG monitoring and control system using ESP modules and cloud platforms. Their system enabled real-time data transmission and remote monitoring via cloud services. It also included an automatic valve control mechanism, which improved safety by reducing human dependency.

Additionally, **J. Lee et al. (2020)** highlighted the importance of multi-sensor integration for improving detection accuracy. Their research showed that combining multiple sensors and applying intelligent algorithms could significantly enhance system reliability and reduce false alarms.

From the reviewed literature, it is evident that most existing systems focus on gas detection and alert mechanisms but lack full automation and integration of multiple safety features. Only a few systems incorporate automatic gas cut-off and remote monitoring simultaneously.

The proposed system in this project builds upon these research works by integrating gas and fire detection, automatic shut-off using both solenoid valve and servo motor, and IoT-based alert systems. This comprehensive approach ensures faster response, improved accuracy, and enhanced safety compared to existing solutions.

III. OBJECTIVES OF THE PROJECT

The primary objectives of this project include:

- To design a system capable of detecting gas leakage in real time
- To automatically cut off the gas supply upon detection of leakage or fire
- To integrate fire detection for enhanced safety
- To provide real-time alerts using Wi-Fi connectivity
- To display system status through an LCD interface
- To reduce human intervention and improve response time

IV. EXISTING SYSTEM

Existing gas safety systems mainly rely on basic technologies and manual operations. Some of the commonly used systems include:

1. Manual Gas Regulators

These are widely used in households but require human intervention to operate. In emergency situations, users may panic or fail to respond quickly, leading to accidents.

2. Gas Leakage Alarms

Standalone gas alarms detect leakage and produce sound alerts. While they provide early warnings, they do not take any corrective action such as shutting off the gas supply.

3. Mechanical Shut-off Valves

These valves can stop gas flow but lack intelligence and automation. They do not detect leakage independently and require manual activation.

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Limitations of Existing Systems

- Lack of automatic response mechanisms
- No integration with fire detection systems
- Absence of remote monitoring and alert features
- Heavy dependence on human action
- Limited reliability in emergency situations

These limitations highlight the need for a smarter and more integrated system that can ensure safety without relying entirely on human intervention.

V. PROPOSED SYSTEM

The proposed system is an intelligent gas leakage detection and automatic cut-off system built using the ESP32 microcontroller. It integrates multiple sensors and actuators to provide a comprehensive safety solution.

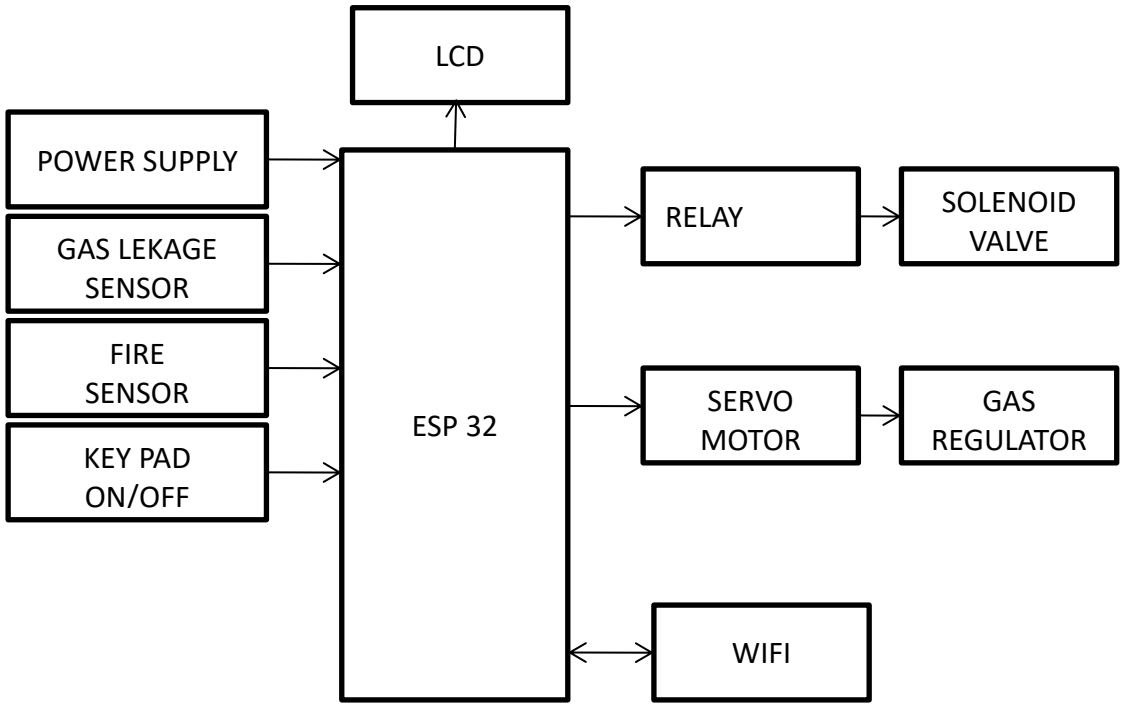

Fig1: Block Diagram

Key Components

1. ESP32 Microcontroller

Acts as the brain of the system. It processes sensor data, controls actuators, and manages communication through Wi-Fi.

2. Gas Leakage Sensor (MQ Series)

Detects the presence of LPG or other combustible gases in the environment. It continuously monitors gas concentration levels.

3. Fire Sensor

Detects the presence of flame or fire, adding an additional layer of safety to the system.

4. Relay Module and Solenoid Valve

The relay acts as a switch to control the solenoid valve. When triggered, the solenoid valve automatically shuts off the gas supply.

5. Servo Motor with Gas Regulator

Provides mechanical control to turn off the gas regulator knob, ensuring double-layer protection.

6. Keypad

Allows users to manually control the system, including turning it ON/OFF and resetting it after an alert.

7. LCD Display

Displays real-time system status such as gas levels, alerts, and operational messages.

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8. Wi-Fi Connectivity
Enables remote monitoring and sends alerts to users via mobile devices or web applications.
9. Power Supply
Provides stable voltage to ensure proper functioning of all components.

VI. WORKING PRINCIPLE

The system operates continuously by monitoring environmental conditions using sensors. The gas sensor detects any leakage of LPG, while the fire sensor identifies the presence of flames.
When gas leakage is detected:

- The ESP32 processes the signal from the sensor
- An alert message is displayed on the LCD
- The relay is activated, triggering the solenoid valve to shut off the gas supply
- The servo motor rotates to close the gas regulator
- A notification is sent to the user via Wi-Fi

When fire is detected:

- Similar actions are triggered immediately
- The system ensures rapid response to prevent escalation

The keypad allows users to reset the system once the issue has been resolved. The LCD continuously updates the system status, providing clarity and ease of use.

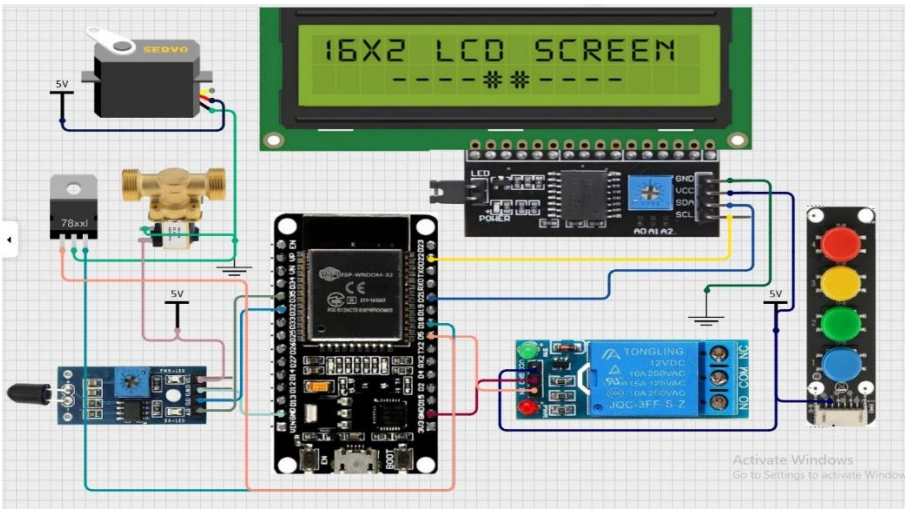

Fig2: Circuit Diagram

VII. ADVANTAGES OF THE PROPOSED SYSTEM

- **Automatic Gas Cut-off:** Immediate response reduces risk significantly
- **Dual Safety Mechanism:** Both electrical (solenoid valve) and mechanical (servo motor) cut-off
- **Real-Time Monitoring:** Continuous detection ensures early warning
- **Remote Alerts:** Wi-Fi connectivity keeps users informed anywhere
- **User-Friendly Interface:** LCD and keypad enhance usability
- **Integration of Fire Detection:** Provides additional safety layer

VIII. APPLICATIONS

This system can be widely used in:

- Residential homes and apartments
- Hotels and restaurants
- Industrial gas storage units
- Laboratories
- Commercial kitchens

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IX. CONCLUSION

The smart gas leakage detection and automatic cut-off system using ESP32 provides an efficient, reliable, and intelligent solution to a critical safety problem. By integrating gas and fire detection with automated control mechanisms, the system ensures quick response and minimizes risks associated with gas leakage.

Unlike traditional systems, this project eliminates the need for manual intervention by automatically shutting off the gas supply and notifying users in real time. The addition of IoT capabilities further enhances its effectiveness by enabling remote monitoring and alerts.

Overall, the system significantly improves safety standards in residential, commercial, and industrial environments. With further advancements and integration, it has the potential to become a standard safety solution in modern smart infrastructures.

REFERENCES

[1]. A. Sharma, R. Gupta, and P. Verma, "Implementation of a Gas Leakage Detection System Using MQ-6 Sensor," *International Journal of Engineering Research and Technology (IJERT)*, vol. 11, no. 5, pp. 234–238, 2022.
[2]. M. Rahman, S. Ahmed, and T. Islam, "IoT-Based Gas Leakage Detection System Using ESP32," *International Journal of Intelligent Engineering and Systems*, vol. 16, no. 2, pp. 120–128, 2023.
[3]. S. Kumar and P. Singh, "Gas Leakage Detection and Alert System Using Arduino and MQ Sensors," *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJAREEIE)*, vol. 10, no. 6, pp. 4567–4572, 2021.
[4]. R. Patel, K. Shah, and D. Mehta, "Development of LPG Gas Leakage Detection Using ESP32," *International Journal of Scientific Research in Engineering and Management (IJSREM)*, vol. 7, no. 3, pp. 89–95, 2023.
[5]. K. Verma, A. Singh, and N. Tiwari, "Smart LPG Leakage Monitoring and Control System Using IoT and Cloud Integration," *IEEE Access*, vol. 12, pp. 34567–34575, 2024.
[6]. J. Lee, H. Kim, and S. Park, "Multi-Sensor Based Gas Detection System with Improved Accuracy Using Machine Learning," *Sensors Journal (IEEE)*, vol. 20, no. 14, pp. 7890–7898, 2020.

