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Connecting Safety: IoT Innovations in LPG Leakage Detection

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Abstract - *Gas leakage remains a pervasive challenge in industrial sectors and residential spaces, demanding innovative solutions for enhanced safety. This project introduces a cutting-edge approach using IoT technology to detect gas leakage promptly and mitigate potential hazards. With the escalating concerns surrounding home security due to the rising instances of gas leaks, a comprehensive gas leakage detection system is proposed. The focal point of this system is the utilization of the MQ-2 sensor, integrated into a smart framework that not only detects gas leakage but also triggers responsive actions. Upon detecting gas concentration exceeding predefined thresholds, the system employs a combination of alert mechanisms, including a buzzer and instant messages to notify users. Furthermore, the system initiates preventive measures such as opening ventilation using a servo motor and shutting down power through relays.*

***Key Words*: MQ-2 Sensor, Relays, Servo Motor, Node MCU, IoT**

1. INTRODUCTION

Gas, specifically natural gas and liquefied petroleum gas (LPG), plays a pivotal role in our daily lives for cooking and heating. However, the inherent flammability of these hydrocarbon gases poses a significant risk. This project focuses on leveraging gas sensors, such as MQ-2 and MQ-4, to detect the presence of these combustible gases. The alarming increase in gas-related accidents underscores the importance of effective detection systems.[1]

To address this, the proposed system employs preventive measures and utilizes advanced technologies. Smoke detectors, fire alarms, and fire extinguishers are conventional methods, but this project introduces a more proactive approach. The system aims to provide early awareness and safety by integrating the MQ-2 sensor with IoT technology, ensuring timely alerts and responsive actions.

2. RELATED WORKS

Several noteworthy projects have explored gas leakage detection using IoT. Hilton Paul et al. introduced a system incorporating a GSM module for instant user notifications. Athish Subramanian et al. utilized MQ-5 gas sensors and Arduino for real-time data collection and analysis. Md. Rakibul Islam et al. presented a comprehensive system with LoRa wireless communication, GPS, and multistage safety features. Gautami G. Shingan et al. explored smart gas cylinders using sensitive gas sensors.[2]

3. METHODOLOGY

The proposed system comprises three key components: sensing unit (MQ-2 sensor), control unit (NodeMCU). The system's operation involves self-calibration of the MQ-2 sensor, with the NodeMCU facilitating communication with an IoT platform for user notifications. Responsive actions, including opening ventilation and shutting down power, are triggered based on detected gas levels.

4. PROCEDURE

4.1 Arduino UNO

Arduino Uno serves as the central controller in this system. As an open-source electronics platform, it provides an easy-to-use interface for reading various inputs, such as sensor data, and translating them into desired outputs.

Arduino boards can interpret signals from different sensors, enabling functionalities like activating motors, turning on LEDs, or even communicating online.

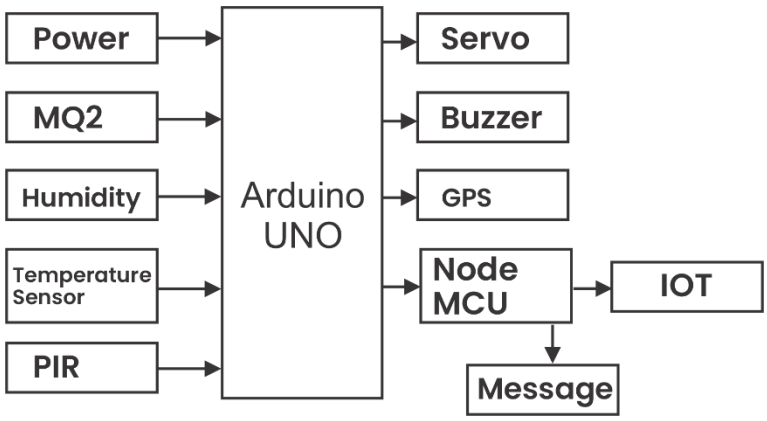
4.2 Node MCU

Node MCU acts as a crucial interface connecting Arduino Uno to the cloud. It serves as a pathway for data transfer from Arduino to the cloud, facilitating storage and analysis of information. Operating on an open-source platform, Node MCU utilizes Wi-Fi protocols to establish connectivity between objects and enable seamless data transmission.[3]

4.3 MQ2 Sensor

The MQ2 gas sensor is deployed for the detection of gas concentration in the air, specifically targeting gases like methane, butane, LPG, and smoke. This electronic sensor incorporates a sensing material whose resistance undergoes changes upon contact with gas. The variation in resistance serves as the basis for detecting the presence of gas in the environment.[4]

5. BLOCK DIAGRAM



The initial phase of this project involves the creation of an alarm circuit to be integrated into the prototype. Once the receiver circuit identifies the presence of gas leakage, it transmits signals to the relay circuit. Consequently, the alarm system is automatically triggered to alert users of the potential gas leakage.

Moving on to the subsequent stage, the second part entails designing the emergency shutdown valve circuit. In this phase, a circuit is devised that incorporates a Servo Motor. The primary function of this circuit is to automatically open the windows when a gas leakage is detected. This action allows the leaked gas to disperse outside the room, mitigating the potential for severe consequences resulting from the incident. [5,6]

6. WORKING

A gas detector serves as a safety device designed to identify the presence of gases within a specified area. When a gas leak is detected, the gas detector activates an alarm, providing operators in the vicinity with an immediate alert to evacuate. Its capabilities extend to the detection of combustible, flammable, and toxic gases, as well as monitoring oxygen levels. Subsequently, in the event of continuous leakage, the system initiates actions such as sending messages to users. [7,8]

7. IMPLEMENTATION

The implemented part of the gas detection shown below:

FIG-1 FULL WORKING SYSTEM

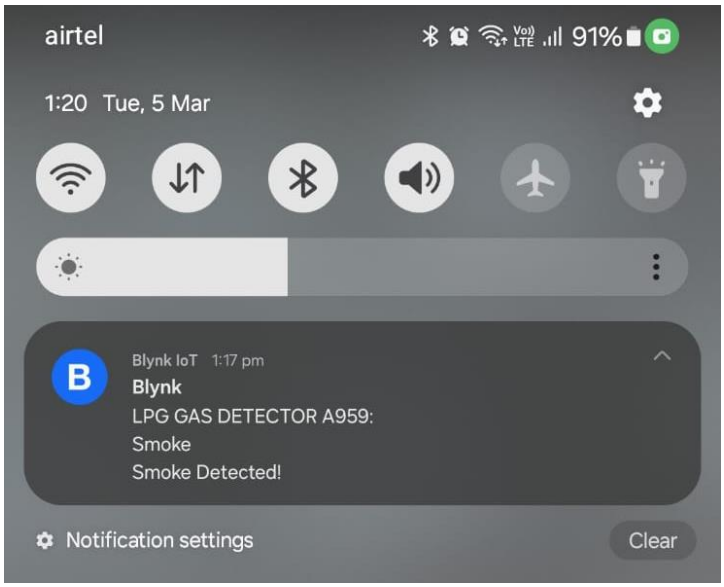


FIG-2 Mobile application Notification

a) The system uses the MQ-2 Gas Sensor and micro-controller to collect and process the sensor data, and it uses Wi-Fi and Blynk IoT App to transmit and receive alerts.
b) If a gas leak is detected, the system activates the alarm and sends a notification to the user through the Blynk app.
c) The user can then take appropriate action based on the notification.

8. DISCUSSION

In this model, our focus has primarily been on the detection and indication of gas leakage, marking the initial phase of technological exploration. While we have reached a pinnacle in this era, ongoing developments continue to propel this technology forward. Our future endeavours aim to elevate this project by incorporating additional features beyond mere gas leakage indication.

The envisioned enhancements include functionalities such as automated door opening and electricity shutdown, expanding the scope of preventive measures. This extended project scope is motivated by a desire to delve deeper into the prevention of flammable gas leakage, fostering a comprehensive understanding of the intricacies involved. This forward-looking approach aligns with our commitment to continuous learning and technological advancement. [9]

9. CONCLUSION

In contemporary households, the widespread adoption of LPG, spanning from traditional cylinders to the integration of petroleum pipelines, has become increasingly prevalent. However, this technological transition brings forth a significant concern—security. Our project stands poised to address and mitigate this challenge, proving to be a valuable asset for both households and industries alike.

The work presented in this project outlines a methodology for detecting gas leaks in the environment, leveraging current technology. Notably, our system offers a cost-effective solution that can be effortlessly installed in various settings, including vehicles. This accessibility and affordability make our project a versatile and practical choice for enhancing safety measures associated with gas usage in diverse environments.

10. REFERENCES

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