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Real-time Gas Leakage Alert System Using Microcontroller and SMS

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Abstract: ***Gas leaks pose serious threats in residential and industrial spaces, often resulting in health hazards, fires, or even explosions if left undetected. Traditional detection methods are either costly or fail to provide instant notifications. This work introduces a that employs the ESP8266 microcontroller in combination with an MQ-2 sensor. The system continuously measures gas levels and, upon detecting concentrations above a defined threshold, sends an SMS alert to a registered mobile number through GSM-based communication. Unlike internet-dependent IoT solutions, SMS ensures fast alerts even in areas with limited connectivity. Testing results demonstrate reliable operation, rapid detection, and SMS delivery within seconds. The system is designed to be low-cost, energy efficient, and suitable for kitchens, storage rooms, and industrial facilities, ensuring timely intervention to reduce accidents [1][2][4].***

I. INTRODUCTION

The widespread use of natural gas and LPG in homes and industries has increased the likelihood of leaks, which can lead to catastrophic accidents [2]. Inadequate monitoring and delayed response often contribute to fires, explosions, or suffocation risks. Many traditional systems either depend on manual supervision or require expensive infrastructure, making them unsuitable for small-scale users.

Recent advances in embedded technology have enabled microcontrollers like the **ESP8266** to deliver affordable and efficient safety solutions. The ESP8266 provides faster processing, built-in connectivity options, and smooth integration with sensors such as the MQ-2. The MQ-2 is capable of detecting a variety of gases including LPG, methane, and butane, producing analog outputs proportional to concentration levels [3]. When gas exceeds a set threshold, the ESP8266 instantly triggers an **SMS alert**, informing the user and allowing immediate action. This design removes the reliance on continuous internet access while offering scalability for integration into smart safety networks [4][5].

II. LITERATURE SURVEY

Earlier studies have explored microcontroller-based gas monitoring systems. Ahmed et al. (2021) utilized Arduino Uno with a GSM module for SMS alerts, demonstrating effective monitoring but limited scalability [1]. Patel et al. (2022) developed an ESP8266-based cloud system with app notifications, but internet dependence reduced reliability in remote areas [2]. Rajesh and Singh (2022) focused on advanced AI-enhanced detection for industries, which prove
d costly for household applications [3].

More recent work highlights the importance of SMS-based communication for wider accessibility. World Scientific News (2024) reported success with hybrid systems integrating both SMS and environmental monitoring [4]. Vijayalakshmi et al. (2024) showed ESP8266's effectiveness in real-time LPG monitoring with mobile alerts [5]. This research builds on these contributions by focusing on SMS-enabled ESP8266 integration to achieve affordability, reliability, and simplicity.

III. METHODOLOGY

The system design followed embedded engineering practices, including component selection, calibration, and programming.

1) Hardware Components

- ESP8266 NodeMCU: central processing and communication unit
- MQ-2 Gas Sensor: detection of methane, butane, and LPG
- Power Supply: stable 5V regulated input

2) Operation

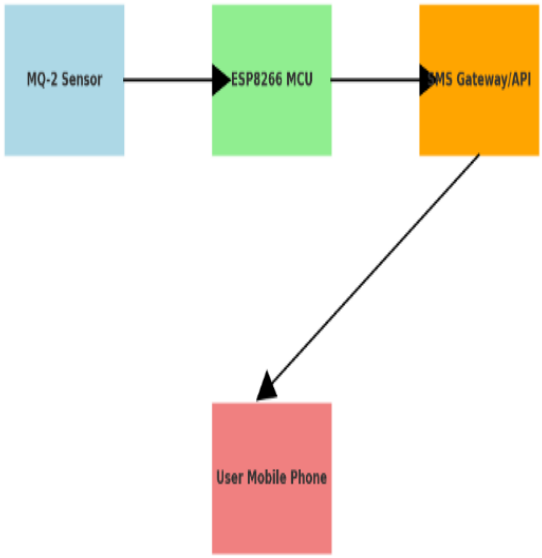
- The MQ-2 continuously senses gas levels.

- The ESP8266 reads sensor output, compares it to a preset threshold (e.g., 300 ppm).
- When gas concentration exceeds the threshold, ESP8266 sends an SMS alert to the user.
- Once notified, the user can act immediately to prevent hazards.

3) Benefits of ESP8266 over Arduino Uno

- Enhanced processing speed
- Built-in Wi-Fi for optional IoT features
- Lower energy consumption
- Larger memory for handling extended functionality

IV. SYSTEM ARCHITECTURE DIAGRAM



V. RESULTS

System testing was carried out under controlled leakage conditions:

- Detection occurred within 2–3 seconds of exposure.
- SMS alerts were delivered within 5–8 seconds consistently.
- The MQ-2 exhibited stability after calibration and did not generate false alarms under safe conditions.
- The ESP8266 processed data efficiently with minimal latency [2][4].

The results confirm that the design is effective, low-cost, and dependable for real-world use.

VI. CONCLUSION

This research presented by a ESP8266 and MQ-2. By leveraging SMS-based communication, the design overcomes limitations of internet-only solutions and ensures fast notifications during emergencies. Testing validated its quick response time and reliability. In future work, the system can be expanded with IoT dashboards, cloud storage, or integration into smart home automation networks for enhanced safety and control [3][5].

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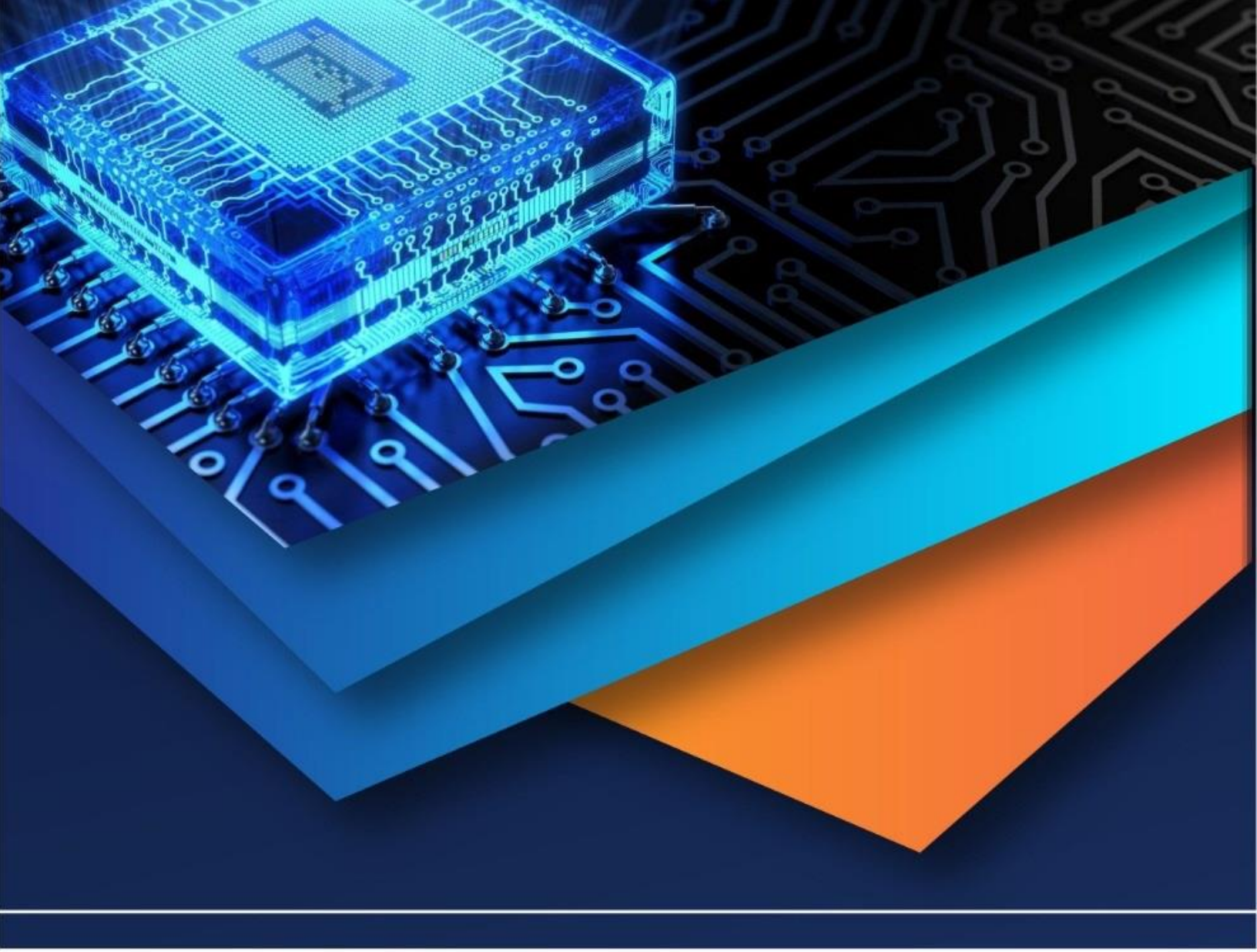

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