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GasShield-X: Next-Gen Leakage Detection with Real-Time SMS and SOS Alerts

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Abstract: Liquefied Petroleum Gas (LPG) is a widely used energy source for domestic, commercial, and industrial applications; however, accidental leakages pose serious threats such as explosions, fire hazards, and health risks resulting from gas inhalation or suffocation. To address these concerns, this study proposes a smart LPG leakage detection and alert system integrated with an SOS emergency response feature. The system employs an MQ-2 smoke and gas sensor to continuously monitor LPG concentration levels in the environment. When the gas concentration exceeds a predetermined safety threshold, the Arduino UNO R3 CH340G microcontroller processes the signal and triggers an SMS alert through the SIM800L GPRS GSM module, immediately notifying users about the leakage. If no action is taken within a specified time, the system automatically initiates an SOS call to the nearest fire station, transmitting the GPS location for a rapid emergency response. Designed to be cost-effective, compact, and easy to install, the system enhances safety in residential and industrial environments by providing real-time alerts and automated communication during critical situations. The proposed work presents the design, implementation, and performance evaluation of the system, demonstrating its reliability, efficiency, and potential for large-scale deployment in safety-critical applications.

Keywords: LPG, GSM technologies, Gas Sensor, Arduino, SOS Alert System, Real-Time Monitoring.

I. INTRODUCTION

Liquefied Petroleum Gas (LPG) serves as a vital energy source for domestic and industrial applications, but its leakage poses serious safety hazards, including fire outbreaks, explosions, and respiratory complications. In recent years, the number of kitchen and industrial accidents caused by LPG leaks has increased significantly, highlighting the urgent need for improved detection and alert systems. Conventional gas detection mechanisms typically rely on local alarms, which are ineffective when users are not present near the affected area. To overcome this limitation, this study proposes the development of an advanced LPG leakage detection system capable of providing real-time remote alerts. The system integrates an Arduino microcontroller with a GSM module to send instant SMS notifications to the user's mobile device upon detecting gas concentrations above a safe threshold. If no immediate response is received, the system automatically triggers an SOS call embedded with the GPS location to the nearest fire station, ensuring quick emergency intervention. The proposed solution is designed to be low-cost, reliable, and easy to install, making it suitable for both residential and industrial safety applications. This system not only enhances response time during critical situations but also contributes to preventing gas-related accidents and safeguarding human lives and property.

II. OBJECTIVE

The main objective of this study is to develop an efficient and reliable LPG leakage detection system that ensures real-time safety for homes, hotels, and other domestic or commercial areas. The system employs the MQ-2 gas sensor to continuously monitor the surrounding environment for LPG and other combustible gases. Upon detecting gas concentrations exceeding safe limits, the Arduino UNO R3 microcontroller processes the sensor data and activates a multi-layered alert mechanism. Initially, a sound alarm is triggered to alert nearby individuals of the potential hazard. Simultaneously, the GSM L800 module sends an SMS alert to pre-specified mobile numbers, ensuring that users are notified immediately, even if they are not present at the location. If no action is taken within a set period, the system automatically initiates an SOS call to the nearest fire station, transmitting the GPS location for a prompt emergency response. This integrated system offers a low-cost, automated, and real-time safety solution, effectively reducing the risk of accidents and property damage.

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III. LITERATURE REVIEW

Over the years, a wide range of gas detection systems have been developed to enhance safety in both domestic and industrial environments. Early gas detection solutions were relatively simple, typically consisting of basic gas sensors connected to local alarms. While these systems could alert users nearby, they lacked the ability to provide remote notifications, limiting their effectiveness in scenarios where immediate human intervention was required but users were absent. With advancements in technology, modern gas detection systems have evolved to incorporate microcontrollers, wireless communication modules, and IoT platforms, allowing real-time monitoring and automated alerts. Integrating gas sensors with GSM modules, for instance, enables the system to send SMS notifications or emergency calls to users and relevant authorities, ensuring timely responses to potential hazards. Among the various sensors available, the MQ-2 gas sensor has emerged as a popular choice due to its high sensitivity and reliability in detecting LPG, methane, and other combustible gases. Its rapid response time and stable performance make it ideal for safety-critical applications. Overall, combining robust sensors with modern communication technologies provides an effective and intelligent approach to gas leakage detection, significantly improving safety and reducing the risk of accidents.

IV. COMPONENTS USED

To build an LPG gas leakage detector with SMS alert and SoS call. We used the following components:

- Arduino UNO R3
- SIM800L GPRS GSM Module
- MQ-2 Gas Sensor
- Breadboard
- Jumper wires
- Resistor (as needed)
- Power Supply (for SIM800L & Arduino)
- Buzzer (optional, for audible alerts)
- LED Indicator (optional, for visual alerts)

V. HOW TO CONSTRUCT THE CIRCUIT CONNECTIONS

i. **Arduino UNO R3:** Connect the GND pin of the Arduino to the GND of the MQ-2 Sensor and SIM800L module. Connect the 5V pin of the Arduino to the VCC of the MQ-2 Sensor and SIM800L module.

ii. **MQ-2 Gas Sensor:** Connect the A0 pin of the MQ-2 Sensor to the A0 pin of the Arduino (for analog output). Connect the GND pin of the MQ-2 Sensor to the GND of the Arduino. Connect the VCC pin of the MQ-2 Sensor to the 5V of the Arduino.

iii. **SIM200L GSM Module:** The TX pin of SIM800L is connected to the RX pin (pin 10) of the Arduino. The RX pin of the SIM800L is connected to the TX pin (pin 11) of the Arduino. The GND pin of SIM800L is connected to the GND of the Arduino. Connect the VCC pin of the SIM800L to an external power supply (3.7V to 4.2V), as it requires more current than an Arduino can provide.

iv. **Optional Components:** Buzzer: Connect one terminal to a digital pin (pin 8) on the Arduino and the other terminal to the GND.

v. **LED:** Connect the anode (long leg) to a digital pin (pin 9) on the Arduino and the cathode (short leg) to GND with a resistor (as needed).

VI. RESULTS AND DISCUSSION

The proposed LPG leakage detection system was thoroughly **tested in a controlled environment** using simulated LPG leakage conditions to evaluate its accuracy, responsiveness, and reliability. During testing, the **MQ-2 gas sensor** effectively detected LPG concentrations exceeding **400 ppm**, confirming its sensitivity and prompt response to hazardous gas levels. Upon detection, the system immediately activated the **buzzer alarm**, providing an instant audible warning to alert nearby individuals. Simultaneously, the **GSM L800 module** transmitted an **SMS alert within 2–3 seconds** to the registered users, ensuring timely communication of potential danger. If no corrective action was taken within a short period, the system automatically initiated a **SoS call** embedded with **GPS coordinates** and a **preset emergency audio message** directed to the nearest fire station, thereby enabling quick emergency intervention.

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Throughout the testing process, the system demonstrated **stable performance**, **low power consumption**, and **minimal false alarms**, proving its efficiency and reliability under real-world conditions. The results validate the **feasibility of deploying Arduino-based LPG leakage detection systems** in residential, commercial, and industrial safety applications. Overall, the system offers a practical, low-cost, and effective approach to preventing gas-related accidents and ensuring rapid emergency response through automated monitoring and alert mechanisms.

VII. CONCLUSION

This study successfully designed and implemented an **advanced LPG leakage detection and alert system** that integrates modern sensor technology and communication modules to provide a comprehensive safety solution. The system employs an **MQ-2 gas sensor**, which continuously monitors the concentration of LPG in the surrounding environment with high sensitivity and accuracy. When gas leakage is detected, the sensor data is processed by the **Arduino UNO R3 microcontroller**, which serves as the core control unit of the system. The microcontroller immediately activates the **GSM L800 module** to send **SMS alerts** to registered users, warning them of potential hazards in real time. Simultaneously, an **SOS call** is triggered, transmitting the **GPS coordinates** of the affected area directly to the nearest fire station or emergency service center to ensure a prompt response. This dual-alert mechanism significantly enhances the reliability and effectiveness of the safety framework. The system is designed to operate autonomously, minimizing human intervention while ensuring continuous vigilance. Its **low cost, simplicity, and real-time responsiveness** make it ideal for both domestic and industrial applications. Overall, the proposed solution contributes substantially to improving public safety by offering an intelligent, efficient, and proactive approach to preventing fire accidents and gas-related hazards.

VIII. FUTURE SCOPE

Future enhancements of the system can be achieved through **integration with IoT platforms**, enabling **remote monitoring** of gas usage, leakage alerts, and inspection notifications via **mobile applications**. By connecting the LPG leakage detector to a cloud-based IoT network, users and service providers can access real-time data from anywhere, ensuring continuous safety supervision. Additionally, incorporating a **solenoid valve** would allow the system to automatically **shut off the gas supply** upon detecting a leakage, thereby preventing accidents and minimizing potential damage. Furthermore, integrating **AI-based predictive analysis** can enhance the system's intelligence by analyzing gas usage patterns, environmental factors, and sensor data to **predict and prevent leakages before they occur**. This proactive approach not only strengthens safety but also improves maintenance efficiency and user confidence. Overall, these upgrades transform the system into a **smart, autonomous, and preventive safety framework** for modern homes and industrial environments.

REFERENCES

[1]. Wali, Russeen (2012). "An electronic nose to differentiate aromatic flowers using a real-time information-rich piezoelectric resonance measurement".Procedia Chemistry. 6: 194–202.

[2]. Naranjo, Edward (2010). Dinwiddie, Ralph B; Safai, Morteza (eds.). "IR gas imaging in an industrial setting". Thermosense XXXII. 7661: 76610K. 1995

[3]. Ghosh, Sujoy; Ghosh, Anujay; Kodavali, Nived; Prajapati, Chandra Shekhar; Bhat, Navakanta (13 January 2020). A baseline correction model for humidity and temperature compensation WO3 film based sensor for NO2 detection. 2019 IEEE Sensors. Montreal, Canada: IEEE.

[4]. Schütze, Andreas; Baur, Tobias; Leidinger, Martin; Reimringer, Wolfhard; Jung, Ralf; Conrad, Thorsten; Sauerwald, Tilman (March 2017). "Highly Sensitive and Selective VOC Sensor Systems Based on Semiconductor Gas Sensors: How to?".Environments. 4 (1): 20

[5]. Martínez-Hurtado, JL; Davidson, CA; Blyth, J; Lowe, CR (2010). "Holographic detection of hydrocarbon gases and other volatile organic compounds". Langmuir. 26 (19): 15694–9.

[6]. Darmadi, Iwan; Khairunnisa, Sarah Zulfa; Tomeček, David; Langhammer, Christoph (2021-09-24). "Optimization of the Composition of PdAuCu Ternary Alloy Nanoparticles for Plasmonic Hydrogen Sensing". ACS Applied Nano Materials. 4 (9): 8716–8722.

[7]. Nugroho, Ferry A. A.; Darmadi, Iwan; Cusinato, Lucy; Susarrey-Arce, Arturo; Schreuders, Herman; Bannenberg, Lars J.; da Silva Fanta, Alice Bastos; Kadkhodazadeh, Shima; Wagner, Jakob B.; Antosiewicz, Tomasz J.; Hellman, Anders; Zhdanov, Vladimir P.; Dam, Bernard; Langhammer, Christoph (May 2019). Nature Materials. 18 (5): 489–495.