LPG Gas Detection with Automatic Valve Control

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***Abstract*—Growing dependence on Liquefied Petroleum Gas (LPG) for household and industrial usage has raised concern about gas leak accidents and their potentially devastating outcomes. This paper presents an integrated intelligent system for early leak detection of LPG gas, with automatic shutoff and real-time notification capabilities. The system uses an MQ-6 gas sensor for accurate leak detection, a servo motor-based shutoff mechanism for automatic closing of the gas regulator, and a GSM module for the sending of SMS notifications to users. An added mobile application interface for remote monitoring and control provides increased user interaction and security. The system is continuously monitoring ambient gas concentration, and on detection of concentrations above the predetermined thresholds, it automatically initiates the shutoff mechanism and notification messages. The system reduces response times and safeguards against gas leak dangers. In comparison to conventional manual detection, the system provides increased accuracy, improved response, and increased user protection. Its cost-effective nature makes it applicable in residential and commercial settings, offering a scalable solution to gas-related accidents. Employing real-time monitoring, automatic control, and user notification places this system at the cutting edge of safety solutions in settings that employ LPG.**

***Index Terms*—Arduino, LPG (Liquified petroleum gas), gas sensor, gas regulator, GSM module**

I. INTRODUCTION

Liquefied Petroleum Gas (LPG) has emerged as a common fuel for domestic and industrial purposes because of its efficiency, accessibility, and affordability. Nevertheless, increased application of LPG has also raised very critical safety issues in the form of gas leaks. LPG leaks tend to create very risky situations in the form of fire, explosion, and health risks because of the highly inflammable and toxic nature of the gas. Conventional leak detection methods are mostly dependent upon vision or odor, which are not very efficient and timely to prevent accidents effectively.

To overcome these problems, there is emerging technology that provides smart gas leak detection systems that continuously scan and respond rapidly. The combination of gas sensors, microcontrollers, and communication modules has enabled the creation of automated safety systems that identify leaks early and respond in time to prevent danger. The systems not only enhance safety by minimizing human error, but also provide convenience by automating the response and detection process. This study aims to create an integrated system that integrates these technologies to effectively detect and prevent LPG leaks.

The core of the proposed system is the MQ-6 gas sensor, which is very sensitive to the concentration of LPG. In case the gas concentration is more than a safe threshold, the sensor provides a signal to a microcontroller that operates a servo motor-based shutdown system to automatically turn off the gas regulator. This prompt response prevents further leakage of the gas, thereby preventing accidents. There is an additional GSM module integrated to send real-time SMS alert to the user, thereby keeping him informed even when he is not at the location.

Apart from that, the system also features a mobile app interface for remote monitoring of gas levels and remote control of the gas regulator by the users. The feature offers greater user interaction and security, enabling timely intervention and peace of mind. With real-time monitoring, automatic shut-down, and remote alarms, the system provides an end-to-end cost-effective and scalable solution to LPG leak risks,

and thus apt for residential as well as commercial use.

II. LITERATURE REVIEW

In recent years, the detection of Liquefied Petroleum Gas (LPG) leaks has been a highly studied topic with many researchers studying gas sensors and microcontrollers to detect leaks in LPG gas concentrations and showing success in their results. For example, Singh et al . [2] introduced an LPG gas detection system using an MQ-6 sensor and an Arduino microcontroller, while Kumar et al. [3] developed an LPG gas detection system, using an MQ-2 sensor and Raspberry Pi microcontroller. Collectively, these two studies have shown the use of gas sensors and microcontrollers to detect LPG leakage. Gas sensors (e.g., MQ-2 and MQ-6) are also used to detect LPG leaks or gas leaks in general due to their great sensitivity and accuracy [4], [5]. Gas sensors measure LPG gas leak concentrations based on changes in either electrical resistance or change in voltage (or amperage). Microcontrollers (like Arduino and Raspberry Pi) detect the gas sensors data and analyze the output to trigger alarms and notifications when the gas reaches above standard threshold measurements [6], [7]. More recently, wireless communication technologies like GSM and Wi-Fi were developed as methods to send and receive data of a LPG gas leaks to remote servers and mobile devices [8], [9]. The use of these technologies continues to enable gas detection systems to monitor concentrations at real time and send alerts for LPG gas leaks.

III. METHODOLOGY/EXPERIMENTAL

A. Components

1.Arduino Uno Board

Based on the ATmega328P the Arduino Uno board functions as a microcontroller which includes 14 digital I/O pins together with 6 analog input pins. The board functions using a 16 MHz clock speed with power supply options either through a USB connection or an external 7-12V system. Electronic hobbyists choose the Arduino Uno because it provides user-friendly operation and affordable pricing and extensive support networks.

2.*LCD DISPLAY 16X2*

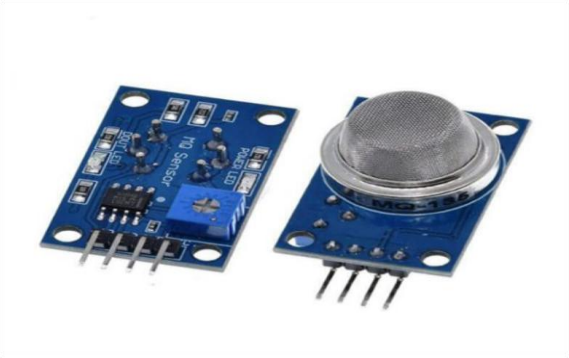
An LCD Display 16x2 presents two lines with each containing sixteen characters through its liquid crystal display module. This display module has several attractive features that make it popular in electronics project applications. The display module contains an HD44780 controller which allows users to connect using either a 4-bit or an 8-bit data bus interface

3.GSMSIM900A

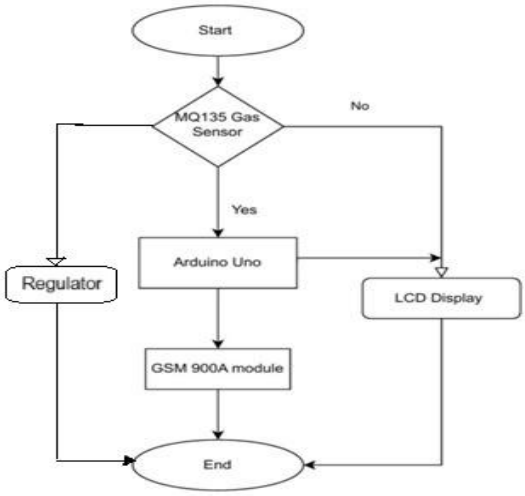
Quadband GSM/GPRS wireless technology for communication purposes. The GSM/GPRS 850/900/1800/1900 MHz capability together with serial communication interface is one of this device's features. The SIM900A module serves numerous IoT projects and M2M applications alongside wireless sensor networks because of its compact design and its low power efficiency and simple integrating features.

4.*MQ-3 Sensor*

The MQ-3 sensor module operates as a tool that detects liquefied petroleum gas (LPG) and natural gas and propane gas ingredients. The device contains a metal oxide semiconductor (MOS) sensor that creates resistance changes during gas encounters. MQ-3 produces a basic analog output through which users can interface their projects with Arduino microcontrollers thus making it suitable for gas detection applications.



B. Flowchart



IV. RESULTS AND DISCUSSIONS

This project investigated an automatic LPG gas leakage detection system using the MQ-3 sensor for accurate detection and servo motor for automatic shut down. The GSM module offers real-time SMS alerts, and the mobile application offers remote monitoring and control. Testing indicated fast response times and reliable leak detection, adding to safety over manual methods. Drawbacks are sensor calibration and network dependency, which may be enhanced in future models. Overall, the system offers an efficient, cost-effective, and scalable solution for LPG safety enhancement.

V. LIMITATION

Along with lot of features the project offers lot of cons too.

The very first issue that can be faced is the sensitivity of the MQ-3 sensor , the reason is because of its sensitivity towards other gases too which may include alcohol , smoke and so on which can cause the sensor to detect false signals leading to a false alarm. Other factor that can lead to decrement in the accuracy can be the humidity and moisture in the atmosphere causing interruption in the proper working of the mechanism. Other drawback can be the power supply, our project is required of a continous power supply and if not then it otherwise it would disable the leakage detection. Talking about the very next limitation that can occur is in various areas with poor internet services would not be able to avail the benefit of our project as GSM module would not be able to send any message to us because of network interruption. It may not offer long range of areas which makes it useless for the large-scale industrial use. Since it has a brilliant detection system with automatic shutdown and alert features, but it is slow enough that it could lead to a minor leakage of the LPG gas which is not a great deal.Other major con that can be faced is the cost. Though it can be quite cheaper if you want to setup the project there in the houses but when it comes in case of large industries more additional hardware components would be required leading to increment of cost which can make it more difficult to afford.

VI. FUTURE SCOPE

The system can be further enhanced by incorporating low-power wireless sensors and solar power to enhance portability and energy efficiency. Automated dispatch of help through integration with emergency services and inclusion of more than one sensor (gas, smoke, temperature) will provide greater safety. Incorporating AI-based controls and voice interfaces will make the system more adaptive and user-friendly.

VII. CONCLUSION

This project delivers a safe LPG gas leak detection system through sensor monitoring, auto-shutdown, and real-time alert to provide improved safety. The integration of the MQ-6 sensor, servo motor valve, GSM alert, and mobile app allows for timely detection and response, minimizing the chance of accidents. Its affordability and scalability guarantee its application in households and industries. Future expansion can be to IoT connectivity and smarter analysis for improved reliability and user-friendliness.

VIII. ACKNOWLEDGMENT

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