

Lpg Leakage Detection System with Auto Disconnecting Regulator to Prevent Domestic Gas Leakage

Somineni Archana, Bhairavabhotla Krishna Deep, Inampudi Mohith, N. Siva Naga Malleswari, Vanka Saritha

Department of Electronics and Communication Engineering Velagapudi Ramakrishna Siddhartha Engineering College

Abstract: - Liquefied petroleum gas (LPG) cylinders are the main source of cooking in India. The majority of LPG explosions are caused by undetected gas leaks before being identified. Therefore, the use of LPG detection equipment is necessary. The goal of this system is to detect gas leaks, prevent them, and avoid explosions. "LPG gas leakage detection system with an automatic disconnecting regulator", The proposed system is based on a combination of MQ2 gas sensor and microcontroller - Arduino-UNO that monitor gas levels and alerts a user through Buzzer, LCD display, LED Lights when a gas leak is detected. The system also includes a servo motor that turns on and assists the regulator to disconnect, so that it cuts off the gas supply when a gas leakage is detected. The system is low-cost, easy to install, and can be integrated into existing gas supply systems.

Keywords: MQ2 gas sensor, Arduino – UNO, Servo motor, Buzzer, LCD Display, LED Lights.

1. Introduction

Developing an efficient and reliable system for detecting LPG (liquefied petroleum gas) leakage in domestic settings is crucial for ensuring safety and preventing potential hazards. The LPG Leakage Detection System with an Auto Disconnecting Regulator stands at the forefront of innovation, aiming to address these critical concerns while prioritizing user safety and convenience. LPG, widely used in households for cooking and heating purposes, presents a risk of leakage due to its highly flammable nature. This system emerges as a proactive solution to mitigate the risks associated with gas leaks, offering a comprehensive approach toward early detection and prevention. At its core, the system integrates cutting-edge sensors designed to promptly identify even minute traces of gas leakage. These sensors are strategically placed in key areas where gas pipelines or connections are present, ensuring comprehensive coverage throughout the household. Upon detecting any signs of leakage, the system triggers an immediate response, setting off alarms to alert occupants and activating an auto-disconnecting mechanism integrated into the regulator. The beauty of this innovation lies in its swift response mechanism, providing a real-time warning to occupants while simultaneously taking proactive steps to halt the gas flow. This automatic shut-off feature within the regulator prevents further gas leakage, effectively curbing the risk of fire or explosion. Moreover, the system incorporates intelligent technologies that offer remote monitoring capabilities. Users can access real-time status updates and notifications through a dedicated mobile application or a centralized control panel. This functionality enables users to remain informed about the system's performance and take necessary action even when away from home, enhancing peace of mind and ensuring continuous safety. Safety being paramount, the design and development of this system undergo rigorous testing and adherence to industry safety standards. The sensors are calibrated to detect various forms of LPG, ensuring a high level of accuracy in identifying potential leaks. Furthermore, the auto-disconnecting regulator undergoes stringent quality checks to guarantee its reliability and seamless functionality during emergencies. One of the key advantages of this system is its user-friendly interface and easy installation process. Designed to be intuitive, it can be seamlessly integrated into existing gas supply systems without the need for extensive modifications. This user-centric approach not only enhances accessibility but also encourages widespread adoption of the system among households. In addition to its primary function of preventing gas leakage, this system also contributes to environmental sustainability. By

minimizing wastage through timely leak detection and prevention, it aligns with global efforts toward resource conservation and reducing carbon footprints. The implementation of the LPG Leakage Detection System with an Auto Disconnecting Regulator represents a significant leap forward in ensuring domestic safety standards. Its comprehensive approach, combining advanced sensing technology with automatic shutoff features, reflects a commitment to innovation and the well-being of households. As we continue to prioritize safety and technological advancements, the continual refinement and enhancement of such systems promise a future where households can enjoy the benefits of LPG with enhanced peace of mind, knowing that their safety is prioritized through proactive measures and reliable detection mechanisms.

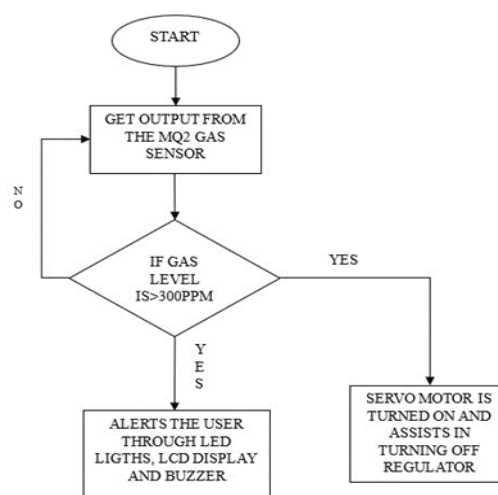
2. Objectives

Developing an LPG leakage detection system with an auto-disconnecting regulator involves a core focus on safety, efficiency, and user convenience, primarily aimed at reducing risks associated with domestic gas leaks. Swift identification of any scale of LPG leaks is pivotal, aiming to prevent accidents and enhance household safety. Early detection capabilities are central, designed to spot even minor leaks promptly, preventing their escalation and subsequent risks. The auto-disconnecting regulator plays a critical role, swiftly cutting off the gas supply upon detecting any leakage, significantly mitigating fire or explosion risks. Real-time monitoring ensures continuous gas level surveillance and prompt leak detection, triggering timely alerts for homeowners or authorities to take preventive measures. The user interface is intuitively designed for swift homeowner responses in case of a detected leak. Seamless integration with existing LPG setups is essential, ensuring easy implementation without extensive modifications. Key considerations encompass reliability, durability, and cost-effectiveness, aiming for a system resilient to various conditions and accessible to diverse households. Adherence to safety standards and regulations governing domestic gas systems is fundamental for effectiveness and legal compliance. Equally crucial is educating users about system functionality, maintenance, and response protocols, fostering awareness and strengthening safety measures within households. These objectives collectively create a robust system prioritizing household safety and risk reduction.

3. Methods

The LPG gas leakage detection system has been meticulously designed to incorporate the following key operations:

- 1.The system utilizes an MQ2 sensor to effectively detect any potential LPG gas leakage, promptly alerting the user to ensure safety.
- 2.A servo motor is integrated into the system to facilitate the automatic turning off of the gas regulator.



LPG gas primarily comprises propane, butane, and additional unsaturated components, namely propene and butene. By leveraging the capabilities of the MQ2 sensor, our system can identify and detect the presence of propane and butane, enabling effective gas leakage detection. Our design ensures continuous monitoring of gas levels using the MQ2 sensor. Amount of gas is known by measuring the weight of gas cylinder. To measure the

weight, Load cell a weight sensor is used. It measures the weight of the cylinder and displays on lcd display and send an SMS through gsm module. A threshold level is set before the gas is completely consumed. And if the weight of the gas cylinder is less than the threshold, it is indicated using an indicator and an email is also sent to the gas agency and the cylinder is booked automatically. MQ2 gas sensor is used to sense the gas leakage. MQ2 sensor module can detect LPG, smoke, alcohol, hydrogen gas etc. In this project it continuously measures the concentration of gases and the concentration is displayed. whenever there is LPG gas leakage, concentration increases and the increase is displayed and if the increase concentration is more than a specified level it is dangerous, so an indicator is used to indicate this and an alert message is sent to mobile. In the event that the concentration exceeds 300ppm, an integrated notification system is triggered. The user is promptly notified through a combination of a buzzer, an LCD display, and LED lights, effectively alerting them to the potential danger. Simultaneously, the servo motor is activated to assist in the immediate shut-off of the regulator's power supply, effectively preventing any further leakage of LPG gas. By implementing these crucial features, our LPG gas leakage detection system offers a robust solution to enhance safety measures and mitigate the risks associated with gas leaks.

4. Results

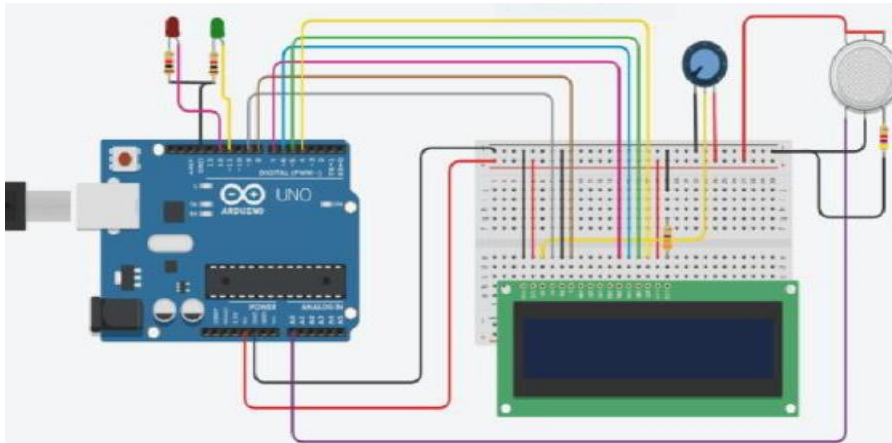


Fig.7.Connections in Wokwi simulator

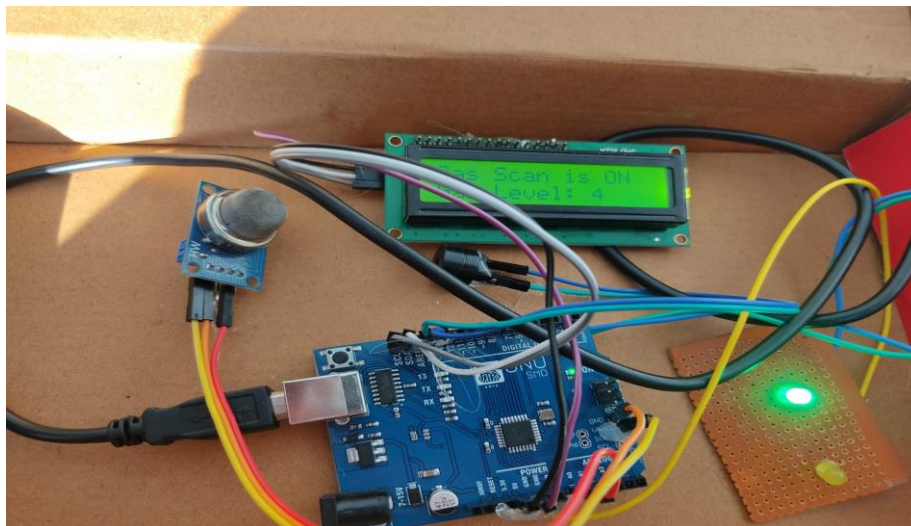


Fig.8.Output of the LPG gas leakage detection system

5. Discussion

Interpretation of the Results:

The LPG leakage detection system with an auto-disconnecting regulator signifies a breakthrough in domestic gas safety, offering a robust shield against potential hazards. Its core strength lies in prompt detection, swiftly identifying even minor gas leaks to prevent escalation and mitigate risks. The auto-disconnecting regulator acts as a rapid-response mechanism, instantly cutting off gas supply upon detection, significantly reducing accidents or fire hazards. Real-time monitoring ensures continuous surveillance of gas levels, triggering immediate alerts for quick preventive actions. User-friendly interfaces empower homeowners to respond effectively in case of a leak, enhancing the system's disaster prevention capability. Its seamless integration with existing LPG setups ensures accessibility, reliability, and cost-effectiveness across diverse households. Compliance with safety standards and regulations reinforces its credibility, assuring users of its effectiveness and legal adherence. Educational initiatives bolster safety measures by informing users about system functionality and safety protocols, fostering responsible LPG usage. In essence, this system redefines domestic gas safety through early detection, swift response, user-friendliness, and regulatory compliance. Its comprehensive approach ensures a secure environment, offering assurance to households relying on LPG for their daily needs.

Prospective Uses and Consequences:

- 1) **Enhanced Safety:** The system significantly reduces the risks associated with LPG gas leaks by promptly detecting any signs of leakage. The auto-disconnecting regulator swiftly shuts off the gas supply upon detection, minimizing the potential for accidents, fires, or explosions.
- 2) **Early Detection:** Its capability to detect even minor gas leaks early on prevents their escalation, ensuring swift action to mitigate risks before they become severe, thereby enhancing household safety.
- 3) **Risk Mitigation:** By preventing gas leaks from escalating, the system effectively minimizes the risk of fire hazards and potential health-related issues caused by prolonged exposure to leaked gas.
- 4) **Real-Time Monitoring:** Continuous monitoring of gas levels enables timely leak detection, triggering immediate alerts to homeowners or authorities. This proactive approach enables quick preventive action, reducing the chances of accidents.
- 5) **User-Friendly Interface:** The system is designed with a user-friendly interface, facilitating easy understanding and swift homeowner responses in case of a detected leak. This empowers users to take immediate action, enhancing overall safety.
- 6) **Integration and Compatibility:** Its seamless integration with existing LPG setups ensures easy implementation without extensive modifications, making it accessible to a wide range of households.

Perspectives on the Difficulties and Limitations:

Economists or financial analysts may focus on the initial investment required for implementing such a system. They might discuss how the high setup costs could pose financial barriers for some households, impacting widespread adoption. Additionally, they may explore the long-term cost-benefit analysis, weighing the upfront expenses against potential safety benefits over time. The MQ2 gas sensor can detect only methane, butane, propane, smoke, Liquefied Natural Gas but it cannot detect other gases. The designed System is limited to certain range of distance it's mainly designed as the household safety measure.

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