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Automatic LPG Gas Leakage Detection And Cut-Off System

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Abstract: This is a huge development in the area of safety at home. While gas cylinders are common in most homes, earlier, safety measures used were merely simple toxic-gas sensors with alarm. In this system, however, advanced gas sensors are combined with an automatic cut-off facility that ensures protection by cutting off the supply of gas immediately on leakage at the very first instance so that further risk does not arise. It also gives real-time monitoring by sending instant alerts to connected mobile devices so that users can respond to the potential hazards even when away from home. This, besides adding to user convenience, also makes for swift action to prevent accidents or damage. In essence, the innovative solution introduces state-of-the-art safety features, providing a new benchmark in the detection of gas leaks and emergency response. It underlines a proactive approach to the security of homes by guaranteeing real-time detection, monitoring, and management of risks associated with gas.

***Keywords*—ARDUINO UNO R3, MQ-5 Gas Sensor, Servo Motor, Buzzer.**

1. Introduction:

Liquid petroleum gas (LPG) is composed of a blend of hydrocarbon gases, making it highly inflammable. It is a widely used fuel for cooking and as a vehicle fuel. A mixture of propane and butane is commonly used in various LPG formulations, which can be applied in multiple industries [1]. However, due to its in flammability, LPG poses a significant risk of fire accidents, particularly during cooking. Regulatory authorities globally have established guidelines and regulations to

ensure the safe use of LPG in homes. Despite these regulations, negligence and lack of awareness continue to lead to numerous accidents daily.

Given the frequency of such incidents, it is crucial to develop safety mechanisms that are efficient and responsive enough to prevent harm and minimize property damage [2]. Current safety protocols for LPG leakage detection primarily rely on conventional gas detectors and alarm systems, however, these systems frequently fall short in delivering the necessary efficiency and immediacy to effectively mitigate risks.

A promising solution to this issue is the development of automatic LPG gas leakage detection and cut-off systems [3]. These systems can detect gas leaks and quickly trigger a shut-off mechanism, reducing the likelihood of accidents and limiting the potential harm caused by gas leaks. Furthermore, they can provide immediate notifications to users, allowing them to take swift action even from remote locations [4]. This proactive approach significantly enhances gas safety procedures and can prevent devastating accidents related to gas leaks.

LPG cylinders are extensively utilized in both residential and industrial environments, highlighting the necessity of enforcing strong safety measures to prevent potential gas leaks. The increasing reliance on LPG in homes, particularly in countries like India, where the use of LPG for cooking has risen significantly, makes it essential to ensure the safety of such systems [5]. Although LPG is an odourless gas, a small amount of ethanol is added to give it a distinctive smell, helping users detect leaks early. However, LPG remains an explosive gas, with a flammability range between 1.8% and 9.5% when mixed with air, emphasizing the critical need for reliable and responsive safety measures in households and industries alike [6].

2. Literature Review

Nagib Mafuz et al., Intelligent IoT-Based Gas Level Monitoring, Booking, and Leak Detection System “IEEE 7th International Advance Computing Conference” issue-1-3 2017 [7]. This paper presents an innovative method for monitoring LPG gas leaks using IoT technology. The system is designed to trigger an alarm in the event of a gas leak. It has good performance, Accurate output measured from LPG sensor. Low maintenance and low operating costs. The sensor offers

outstanding sensitivity and a rapid response time. Due to GSM cost of product will be increased and using Arduino does not contain wi-fi module. M.Anitha et al., Intelligent LPG Gas Monitoring and Automated Cylinder Reservation System "International Journal of Recent Technology and Engineering (IJRTE)" ISSN:2277-3878, Volume-9 Issue-1 May 2020 [8]. Proposed methodology will perform by this technology is detecting LPG leakage, displaying the weight of cylinder through which we can determine in how many days it cylinder will be out of gas. LPG weight measurement and display the level of Gas Remaining and leakage detection is having 90% accuracy. LPG Leakage and Weight detection This help to customer to analyse their cylinder and easily conclude how many gasses remaining. Due to GSM the cost of product will be increased and also maintenance charge will increase and we have to provide two batteries which will increase the cost. Ajay Kumar, Mukesh Kumar, Design and Implementation of smart LPG Trolley With Home Safety "2016 2nd International Conference on Next Generation Computing Technology (NGCT-2016)" Issued on 16 October 2016 [9]. Weight measuring and display weight using along with automatic booking. The mobile application showcases the desired outputs and results, notifying the user accordingly. Weight Measurement and Display of value is accurate with no delay. Automatic booking and display the remaining gas status in LPG cylinder. No leakage detection, Due to Bluetooth range is short. Jayesh Gupta et al., Intelligent LPG Monitoring and Automated Booking System Utilizing IoT," International Journal of Engineering Research & Technology (IJERT)" ISSN: 2278-0181 Vol. 9 Issue 04, April-2020 [10]. The proposed methodology will simultaneously take action upon detecting a gas leak and help customers by easing the process of booking their cylinders with the distributor company, Accurate weight measurement, leakage detection and system is reliable. Gas detection Fire alarm SMS sending to agency if gas finished before. No cloud data based will stored due to Raspberry pie and GSM cost of product will be increased so not efficient for normal customers as well as agency. Maintenance cost also will increase this is not affordable.

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3. Design And Simulation

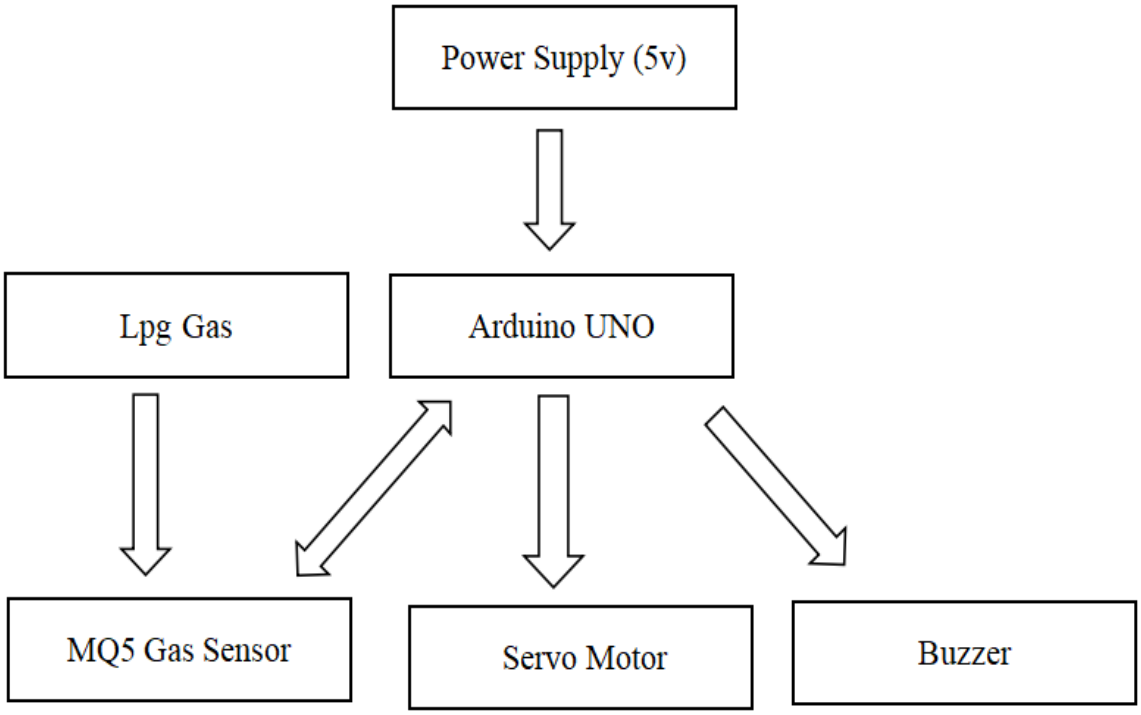

Figure 1. Block diagram of Gas Leak Detection Module

The LPG gas detection and automatic cut-off system functions by employing an MQ-5 gas sensor to continually track the levels of LPG present in the environment. When the sensor detects the presence of LPG, it sends an analog signal to the Arduino, which processes this signal and determines if the gas concentration exceeds a predefined safety threshold. If the threshold is surpassed, the Arduino triggers a buzzer to sound an alarm, alerting individuals nearby of the potential danger. Concurrently, the Arduino sends a command to a servo motor is linked to the gas valve, rotating it to close and stop gas flow, effectively preventing any further leakage. This integrated system ensures that gas leaks are detected promptly, and both auditory alerts and automatic shut-off mechanisms are activated to enhance safety and prevent hazardous situations.

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3.1 Simulation Parameters:

Table 1. Components Required for Designing the Circuit

Component	Power	Ground
Arduino UNO	5 V	GND
MQ5 Gas sensor	Vin(5v)	GND
Servo Motor	Vin(5v)	GND
BUZZER	Vin(5v)	GND

4. Result Analysis

The servo motor is capable of being used to manage the gas pipeline regulators. Upon detecting a gas leak, sensors send a signal to the micro-controller, which then acts to communicate with the servo motor to activate the cut-off mechanism and cut the gas supply. This acts to ensure prompt response to help reduce the risk of accident caused by leakage of the gas.

Besides this, there is a mechanism such as a position sensor or a limit switch as a kind of feedback arrangement within the servo motor in order that the gas pipeline regulators might be placed quite correctly and thus enable the cut-off to take place with a little better system reliability and also better efficacy. The accurate regulation offered by the servo motor lets the cut-off become possible accurately in case leakage from gas supply is realized. Coupled with the micro controller and with the servo motor, automation becomes possible for the shutdown procedure which shall enhance the safety measures involved so that gas leak incidents cannot find entry. The servo motor constitutes one of the components in a gas leakage detection system-automation cut-off

mechanism. It works to enhance safety and further risk factors associated with gas leaks.

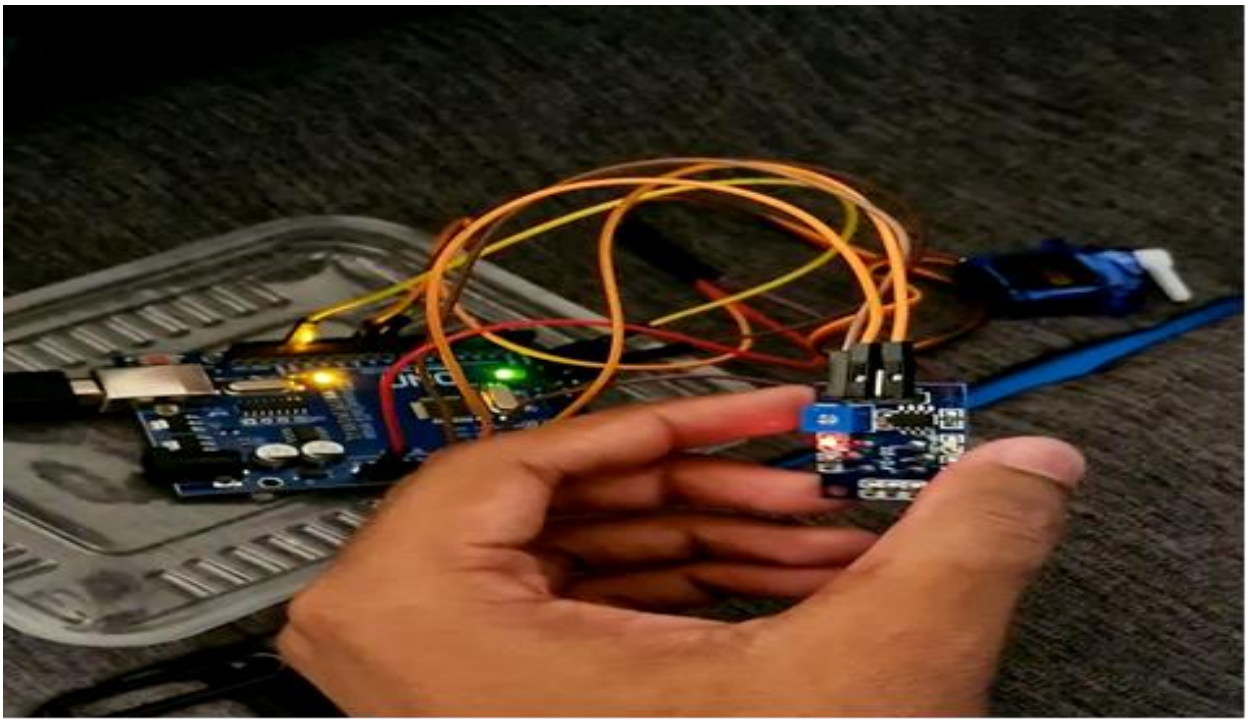

Figure 2. Hardware Implementation

5. Conclusion

The Automated LPG Gas Leak Detection and Shut-Off System is one of the new innovations in gas safety. Based on advanced IoT integration with cutting-edge technology, this system has improved the protocols for residential and industrial areas. It is designed with an MQ-5 flammable gas sensor and comes with an automatic shut-off mechanism. It is very prompt and quickly activating the servo motor to reduce the risk of accidents. Through a web-based application, users obtain real-time gas level insights with alerts and updates on the status of systems, allowing proactive response and allowing remote control capabilities. The system is designed to meet regulations on safety standards, keeping the operation of the unit in strict adherence to all legal requirements while enhancing its safety. The Automated LPG Gas Leak Detection and Shut-Off System offers an efficient and reliable solution for managing gas safety. By equipping users with

advanced tools and technology, it minimizes the risks associated with gas leaks, protecting both lives and property.

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