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Survey Paper on LPG Gas Detector With Auto Cut Off Regulator

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Abstract

Liquefied Petroleum Gas (LPG) is widely used in domestic kitchens, restaurants, and small industries, but accidental gas leakage can cause fire, explosion, or asphyxiation. To prevent such hazards, an LPG Gas Detector with Auto Cut-off Regulator using a DC Servo Motor is proposed. The system continuously monitors the surrounding air with a semiconductor gas sensor (such as MQ-6) that is sensitive to propane and butane. Sensor signals are processed by a microcontroller which compares the measured concentration to a preset safety threshold.
When the gas level exceeds this threshold, the controller triggers two immediate safety actions:
1. Alarm Activation: A buzzer and indicator LEDs warn occupants to evacuate or ventilate the area.
2. Automatic Gas Shut-off: A DC servo motor rotates the regulator valve to the OFF position or drives a mechanical cut-off attachment, instantly stopping the gas supply.
The DC servo motor is chosen for its accurate angular control, fast response, and low power requirement, ensuring reliable closure of the gas valve within seconds of leak detection. To enhance dependability, the design can include a rechargeable battery backup for power outages and a manual override for emergency operation.
This integrated approach—early leak detection combined with automatic mechanical isolation—significantly reduces the time window for ignition, offering a cost-effective, user-friendly, and safer alternative to alarm-only systems. It is suitable for retrofit installation on standard domestic LPG cylinders and can be adapted for small commercial kitchens, thereby improving overall safety and protecting lives and property in LPG-dependent environments.

INTRODUCTION

Liquefied Petroleum Gas (LPG) is a widely used fuel source for domestic cooking, restaurants, and small-scale industrial applications due to its high calorific value, portability, and relative cost-effectiveness. Despite its advantages, LPG poses significant safety hazards because it is highly flammable, and accidental leakage can lead to fire, explosions, and asphyxiation. Traditional safety measures rely on manual detection and shut-off of the regulator, which can be slow and unreliable, especially if leakage occurs when occupants are unaware. Hence, there is a growing need for an automated safety

system capable of detecting gas leaks promptly and taking immediate corrective action.

Modern approaches to LPG safety involve electronic gas detection combined with automatic shut-off mechanisms. Semiconductor gas sensors, such as MQ-6, are commonly employed to detect low concentrations of LPG in the surrounding air. These sensors are capable of providing rapid analog signals corresponding to gas concentration levels. When integrated with a microcontroller, these sensors form the core of an automated safety system that can continuously monitor ambient air, process sensor data, and trigger alarms or mechanical interventions.

The addition of a DC servo motor in such systems allows precise mechanical actuation of the LPG regulator knob or a connected valve, enabling automatic cut-off of the gas supply when dangerous concentrations are detected. This approach ensures both early warning and immediate prevention of potential accidents, significantly reducing the risk of fire or explosion. Moreover, by integrating audible and visual alarms, the system not only isolates the gas source but also alerts occupants to take precautionary measures.

Recent studies and prototypes demonstrate that combining IoT-enabled monitoring, dual-sensor systems (MQ-2 and MQ-6), and servo-driven actuation provides a reliable, cost-effective, and retrofit-friendly solution for household and small industrial applications. Such systems can be mounted on standard LPG cylinders without extensive modifications, offering an accessible and practical safety enhancement. Additional features such as battery backup, manual override, and calibration routines further improve reliability and ensure fail-safe operation during power outages or sensor malfunction.

Overall, the integration of gas sensing, microcontroller-based processing, alarm systems, and servo-driven automatic cut-off provides a comprehensive safety solution. It addresses the shortcomings of conventional manual safety practices and offers an advanced, user-friendly approach to prevent LPG-related accidents. The focus of this project is to design, implement, and test a prototype that is both practical and efficient, ensuring the safety of users in domestic kitchens, restaurants, and small-scale industrial environments.

LITERATURE SURVEY

1.Andry Shaputra, Titi Andriani, Ahmad Jaya, and Nova Aryanto (2023) developed an IoT-based LPG Gas Leak Detector with Automatic Valve Closing using a Servo Motor. In their design, an MQ-6 gas sensor continuously monitors the concentration of LPG (propane/butane). When the detected gas level crosses a safety threshold, an ESP32 microcontroller triggers both a buzzer for alarm and a DC servo motor that automatically rotates the gas regulator to the OFF position. Their work highlights how combining IoT with automatic mechanical actuation allows remote monitoring and quick emergency response for household safety.

2.Ali Rosyid P., Ihtiari Prasetyaningrum I., and Denny Hardiyanto (2022) proposed an LPG Gas Leakage Safety System Prototype Using Servo Motor with MQ-2 and MQ-6 Sensors. Their prototype uses two different semiconductor sensors to improve detection accuracy and reduce false alarms caused by kitchen fumes. A microcontroller processes sensor data and commands a servo motor to close the gas supply when leakage is detected. This study demonstrates that using multiple sensors can provide a more reliable and precise detection system.

Lusiana Sinaga, Suratun Nafisah, Khansa Salsabila Suhaimi, and Muhammad Akmal Shani (2022) presented an *IoT-based Regulator Lever Automation on a Household Scale*. Their approach focuses on automating the regulator lever itself, making the system easy to retrofit on domestic LPG cylinders without modifying existing pipelines. The design uses a gas sensor and a microcontroller to activate a servo motor that turns the regulator knob to shut off gas flow. This practical design emphasizes cost-effectiveness and simplicity in domestic environments.

3.Prof. M. Mahabooba, Prof. Vinu M. S., Yogasastha K., Keerthivasan S., Linguraj K., and Santhosh Kumar R. (2021) designed an *Automatic LPG Gas Leakage Detection and Cut-off System*. Their work integrates gas sensors with an automatic shut-off mechanism to provide two levels of protection: early alarm notification and mechanical isolation of the gas supply. Although their study does not focus only on the servo motor, it reinforces the concept of combining electronic detection with automatic cut-off for improved safety.

4.Dr. S. P. Yadav, T. Varsha, P. Shashank, M. Vamshi, and P. Amruth Kumar (2020) proposed a *Gas Leakage Detection and Automatic Off System* using Arduino and a DC servo motor. When the MQ-6 sensor detects leakage, the microcontroller triggers a buzzer and simultaneously operates the servo to close

the regulator valve. Their design shows that even low-cost microcontroller platforms can provide reliable safety mechanisms if properly calibrated and maintained.

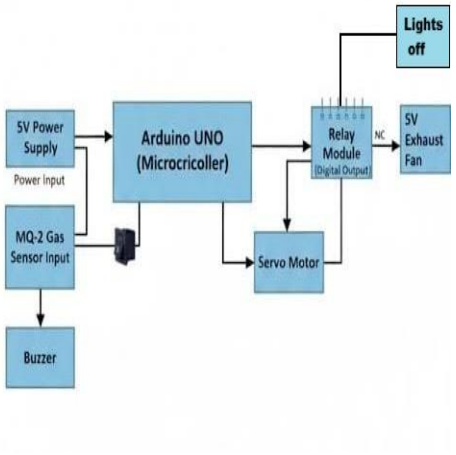
5.Hafifah Darus, Suraya Abu Seman, and Nui Din Keraf (2021) introduced a *Smart LPG Regulator* that integrates an MQ-6 sensor, buzzer, display panel, and a servo motor capable of closing the regulator valve automatically when gas leakage occurs. Their system is designed for user-friendliness, providing real-time leak information and quick mechanical isolation of the gas supply.

METHODOLOGY

The methodology for designing and implementing the LPG Gas Detector with Auto Cut-Off Regulator using a DC Servo Motor involves several integrated stages to ensure reliable detection and rapid gas isolation. Initially, the system requirements are defined, focusing on early LPG leakage detection, alarm notification, automatic regulator shut-off, and operation during power failures with battery backup. Based on these requirements, an MQ-6 semiconductor gas sensor is selected for its high sensitivity to propane and butane. The sensor is positioned near the LPG regulator at a location where leaked gas is likely to accumulate. It is calibrated with known LPG concentrations to establish threshold values, and a moving-average filter is applied in the microcontroller to reduce false alarms caused by transient spikes, temperature, or humidity variations.

The sensor output is continuously read by an Arduino microcontroller, which compares the measured gas concentration against the preset threshold. When a leakage is detected, the microcontroller simultaneously activates an audible buzzer and LED indicators to alert occupants, and sends a PWM signal to a DC servo motor mechanically coupled to the regulator knob. The servo rotates the knob to the fully closed position, effectively cutting off the gas supply within seconds. A manual override is incorporated to allow user control in case of electronic malfunction, and battery backup ensures fail-safe operation during power outages.

For testing and validation, the prototype is evaluated in a controlled environment using calibrated LPG leaks to measure sensor response time, servo actuation speed, and overall system reliability. Multiple tests under varying temperature and humidity conditions verify repeatability, while long-term trials assess sensor drift and mechanical durability of the servo mechanism. This methodology integrates gas sensing, microcontroller-based processing, alarm activation, and mechanical actuation to provide a comprehensive, low-cost, and reliable solution for enhancing domestic and small-scale industrial LPG safety.



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