

# **PROJECT REPORT**

Smart Gas Cylinder Monitoring and Alert System

ICT 3052.0 – Embedded Systems

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## ABSTRACT

Gas cylinders are widely used in domestic and small-scale environments, yet manual monitoring of gas level and detecting hazardous leaks remain challenging for users. This project presents a prototype-based Smart Gas Cylinder Monitoring System developed using a 1 kg load cell, MQ-135 gas sensor, 16×2 LCD with I2C interface, and SIM800L GSM module. The system provides automatic gas level indication, real-time leakage detection, visual and audio alerts, and SMS notifications. The proposed solution offers a low-cost, reliable and user-friendly method for enhancing safety and convenience in gas cylinder usage.

## I. INTRODUCTION

Liquefied Petroleum Gas (LPG) cylinders are essential in households; however, users often rely on guesswork to determine the remaining gas. This can lead to unexpected gas depletion and serious safety risks, especially in cases of leakage. To address these issues, automated monitoring systems have become increasingly significant.

This project introduces a Smart Gas Cylinder Monitoring and Alert System, developed as a scaled-down prototype using a 1 kg load cell due to safety concerns and practical limitations related to full-size cylinders. The system integrates gas level monitoring, leakage detection, visual indication, audible alerts, GSM communication, and LCD display output.

By combining embedded technology and low-cost sensors, the system aims to provide an affordable, safe, and convenient solution suitable for household environments.

## II. OBJECTIVES

The objectives of this project are as follows:

- To monitor gas level accurately using a load cell sensor.
- To display real-time gas status and leakage warnings on a 16×2 LCD with I2C module.
- To detect hazardous gas leaks using the MQ-135 sensor.
- To send SMS alerts for gas leaks and normal-status restoration through a SIM800L GSM module.
- To provide visual and audio indicators via LEDs and buzzer.
- To enable automatic low-gas alerts.

- To ensure indicators function independently for reliability.

### III. PURPOSE OF THE PROJECT

The primary purpose of this project is to improve domestic safety through continuous monitoring of LPG cylinders. The system is designed to:

- Prevent unexpected gas depletion.
- Detect LPG leakage promptly.
- Provide multiple forms of alerts (LED, buzzer, LCD, SMS).
- Deliver a functional prototype that can be expanded into a real-world application.

### IV. SCOPE

#### A. Included in Scope

- Gas level detection using weight measurement (1 kg prototype model).
- Gas leak detection using MQ-135.
- Visual and auditory alerts.
- LCD display of gas status and warnings.
- GSM-based SMS notifications.

#### B. Excluded from Scope

- Full-scale gas cylinder weight integration.
- Industrial-grade gas analysis.
- Mobile application support.

### V. LITERATURE REVIEW

Existing gas monitoring solutions typically rely on pressure sensors or standalone leak detectors. Commercial smart regulators are available but are relatively costly and do not commonly integrate SMS alert functionality. Studies indicate that combining weight sensing with gas-leak detection significantly improves monitoring accuracy. This project extends

existing concepts by integrating LCD display, multi-level LED indication, buzzer, GSM alerts, and a fail-safe prototype mechanism.

## **VI. METHODOLOGY**

### **A. Hardware Components**

- 1) Arduino Uno microcontroller
- 2) Load cell (1 kg) with HX711 amplifier
- 3) MQ-135 gas sensor
- 4) SIM800L GSM Module (v2.2)
- 5) 16×2 LCD with I2C interface
- 6) LEDs (Full/Medium/Low + Status LEDs)
- 7) Buzzer
- 8) Breadboard, jumper wires, and 5V power supply
- 9) 3.7 V battery for SIM800L GSM Module (v2.2)

### **B. System Operation**

#### **1) Gas Level Measurement**

A load cell measures weight changes and sends data to the Arduino through the HX711 module. The microcontroller categorizes levels into Full, Medium, and Low. These levels are shown on the LCD and via LED indicators.

#### **2) Automatic Gas-Level Detection**

When the system is powered on, it automatically performs a gas-level check without requiring any push button input. The load cell continuously measures the cylinder weight and updates the LCD display in real time. The system operates under the following conditions:

##### **➤ No Cylinder Detected:**

If the weight is zero or below a minimum threshold, the LCD displays “NO CYL” indicating that no gas cylinder is present.

##### **➤ Cylinder Present – High Level:**

When the measured weight is above the “full” threshold, the LCD displays “HIGH”, and the green LED indicates sufficient gas.

#### Blinking green LED

➤ Cylinder Present – Medium Level:

For weights within the mid-range threshold, the LCD displays “MEDIUM”, informing the user that the gas level has decreased but is still adequate.

#### Blinking orange LED

➤ Cylinder Present – Low Level:

When the weight falls below the low-gas threshold, the LCD displays “LOW”. The system triggers safety alerts through:

- Blinking red LED
- Buzzer alarm
- Warning message on the LCD
- This fully automated approach ensures continuous monitoring without the need for any manual input.

### 3) Automatic Low-Gas Alert

The system continuously monitors weight. When the threshold is reached:

- Red LED blinks
- Buzzer activates
- LCD displays “LOW GAS WARNING”

### 4) Gas Leak Detection (MQ-135)

The MQ-135 sensor detects harmful gases. When concentration exceeds a threshold:

- LCD shows “GAS LEAK DETECTED”
- Buzzer activates
- Blue LED alerts the user

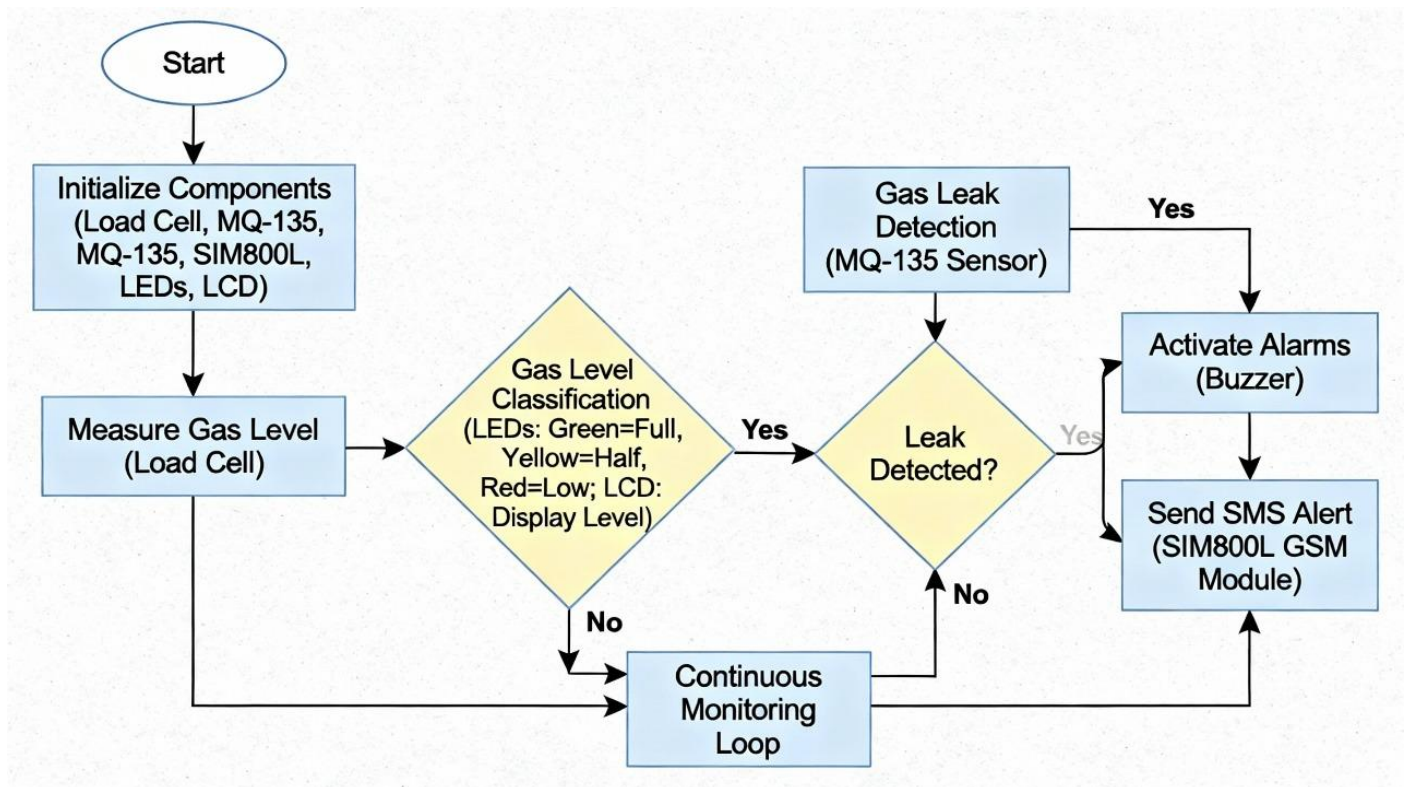
- SIM800L sends SMS notification

## 5) GSM SMS Alerts

The SIM800L module sends:

- Gas leak alerts
- Gas level normal status messages

## VII. SYSTEM DESIGN



## VIII. PROTOTYPE DEVELOPMENT

The system was developed as a prototype using a 1 kg load cell, simulating the weight changes of a typical LPG cylinder. This approach ensures safety and demonstrates core functionality, including:

- Accurate load-cell readings
- Proper LED indications
- LCD outputs for gas level and leak detection
- Gas leak sensing using MQ-135
- SMS alerts from SIM800L
- Correct switching of alert states

## IX. RESULTS

The prototype evaluation yielded the following results:

- Automatic Gas-Level Detection
- Multi-level LED indicators functioned accurately.
- Automatic low-gas alerts activated at correct thresholds.
- MQ-135 successfully detected gas concentrations and triggered leak alarms.
- The SIM800L module sent SMS alerts as programmed.
- LCD provided clear real-time status information.
- All alerts stopped automatically when normal conditions were restored.

## X. DISCUSSION

The system demonstrated accurate behavior under prototype testing conditions. The integration of the LCD displays improved usability, while SMS alerts enhanced reliability and safety. Although the MQ-135 requires calibration for real-world applications, it performed adequately in prototype testing. Scaling the system to real gas cylinder monitoring requires a high-capacity load cell.

## XI. CONCLUSION

This project successfully developed a functional embedded system capable of monitoring LPG cylinder levels, detecting gas leaks, and sending alerts through GSM communication. The solution is cost-effective, portable, and suitable for household use. With further refinement, it can be expanded into a commercial product supporting large-scale safety systems.

## XII. RECOMMENDATIONS

1. Use a 200 kg or higher load cell for real gas cylinders.
2. Add rechargeable battery backup.
3. Use an enclosure to protect the electronics in real deployment.
4. Implement calibration routines for higher accuracy.

## XIII. REFERENCES

- [1] Arduino Official Documentation, 2024.
- [2] SIM800L GSM Module Hardware Design Guide, SIMCom Wireless, 2022.
- [3] MQ-135 Gas Sensor Datasheet, Winsen Electronics, 2023.