IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 1, July 2025
Impact Factor: 7.67

IoT Based LPG Gas Leak Monitoring System

Dr Abdul Rahim[1] and Boggula Sri Aslesha Raj[2]
Associate Professor, ECE (Embedded Systems) Department[1]
MTech Student, ECE (Embedded Systems) Department[2]
Malla Reddy Engineering College for Women's, Maisammaguda, Telangana, India.
rahim.mrecw@gmail.com[1], asleshara j9121@gmail.com[2]

Abstract: *The motive of the Internet of Things (IoT)-primarily based totally LPG fueloline leak tracking gadget is to enhance protection in each domestic and industrial settings with the aid of using quick figuring out and addressing fueloline leaks. The MQ-6 and different fueloline sensors are used on this gadget to constantly take a look at for the presence of LPG withinside the air. It makes use of IoT structures like Blynk or ThingSpeak to hit upon leaks and at once ship out buzzer, SMS, and cellular app notifications. An Arduino or NodeMCU microcontroller powers the gadget, processing sensor records and facilitating Wi-Fi communication. Even while customers aren't gift on the site, real-time tracking ensures that they may be privy to leakage. It lessens the probability of fueloline leak-associated mishaps like fires and explosions. For analysis and system performance monitoring in the future, the data is logged. This intelligent system encourages a preventative safety measure. It is appropriate for general use due to its affordable price and small size.*

Keywords: LPG Gas Leak Detection, IoT, Gas Sensor (MQ-6), Real-time Monitoring, NodeMCU, Safety System, Wireless Communication, Blynk, ThingSpeak, Smart Home Automation

I. INTRODUCTION

The rising number of gas leak occurrences in homes and businesses in recent years has led to a considerable increase in demand for smart safety systems. Although liquefied petroleum gas (LPG) is frequently used for heating and cooking, it is extremely combustible and can result in catastrophic explosions if it leaks and is not discovered. Conventional techniques for detecting gas leaks are frequently sluggish, limited, or unintegrated with contemporary communication technology. An intelligent and real-time gas leak monitoring system [1] is therefore required in order to promptly detect leaks and notify users, even if they are not physically present at the site. An efficient and dependable solution to this issue is to combine gas leak detection with the Internet of Things (IoT) [2].

IoT makes it possible for physical objects to communicate and share information online, facilitating remote control and monitoring [3]. A gas sensor in an Internet of Things (IoT)-based LPG gas leak monitoring system finds any unusually high levels of LPG in the ambient air. A microcontroller like NodeMCU or Arduino processes this data before sending it over Wi-Fi to cloud-based systems like ThingSpeak or Blynk [4]. Through SMS or mobile apps, these platforms can send notifications to the user's smartphone. Additionally, as soon as a leak is discovered, local alarms like buzzers or LEDs can be turned on. By ensuring that consumers receive real-time notifications, the Internet of Things (IoT) enables timely actions that can save lives and avoid accidents.

Additionally, this system is affordable, simple to set up, and appropriate for both commercial and residential settings [5]. It is perfect for continuous usage due to its small size and low power consumption. Better preventive maintenance can result from the storage and analysis of the gathered data to find trends or reoccurring problems. IoT integration raises general safety and awareness while also increasing the effectiveness of conventional gas detection techniques. IoT-based gas monitoring systems are growing increasingly dependable and accessible as a result of ongoing improvements in sensor and communication technology [6].

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 1, July 2025
Impact Factor: 7.67

II. LITERATURE SURVEY

Several research studies and projects have been conducted in the field of gas leak detection using IoT to improve safety and real-time monitoring capabilities. In a study by Sharma et al. (2018) [7], an LPG leakage detection system using an MQ-6 sensor with Arduino was developed, which triggered local alarms and sent SMS alerts via a GSM module. While effective in small-scale applications, it lacked real-time internet-based monitoring. This highlighted the need for integrating Wi-Fi-based IoT platforms for better user awareness and control.

Another work by Ahmed et al. (2019) [8] implemented a smart gas leakage detection system using Node MCU and the Blynk platform. The system was capable of providing real-time updates on the user's smartphone and included features like automatic fan activation and gas valve control.

Kumar and Singh (2020) [9] proposed a system that combined temperature, gas, and flame sensors to enhance the detection of fire risks due to LPG leakage. The use of multiple sensors improved accuracy and reduced false alarms. However, the system complexity and power consumption were challenges noted in their implementation.

A more recent paper by Mehta et al. (2021) [10] focused on integrating IoT with data logging capabilities on Thing Speak. Their system monitored gas concentration levels over time and plotted trends for maintenance and predictive analysis. This was particularly useful for industrial applications where frequent gas leaks can go unnoticed until critical.

Finally, Patel and Rao (2022) [11] developed a low-cost, IoT-enabled LPG detection system using ESP8266. It emphasized the importance of affordability and scalability for widespread adoption, especially in developing countries. Their design demonstrated how open-source hardware and software can be effectively used to build smart safety systems.

III. SYSTEM ARCHITECTURE

An IoT-based LPG gas leak monitoring system is designed to detect gas leaks in real time and send alerts to prevent accidents system architecture shown in figure1

1. Sensor Layer (Data Collection Layer)

This layer includes sensors and devices that detect gas leaks and environmental conditions.

- **MQ-6 Gas Sensor**: Detects LPG gas concentration.
- **DHT11/DHT22** (optional): Measures temperature and humidity.
- **Smoke Sensor (optional)**: Detects smoke in case of fire.

2. Processing Layer (Edge Device Layer)

Microcontroller unit (MCU) processes data and handles local alerts.

- **NodeMCU / ESP8266 / ESP32**:
  - Reads sensor data.
  - Processes readings.
  - Connects to Wi-Fi and transmits data to the cloud.
  - Triggers local alarms like buzzer or LED if gas levels are high.

3. Communication Layer (Network Layer)

Responsible for transmitting data between the device and the cloud.

- **Wi-Fi / GSM / LoRa / ZigBee**:
  - Wi-Fi (common for home/office use)
  - GSM (for areas with no Wi-Fi)
  - MQTT / HTTP / HTTPS protocols for data communication

4. Cloud Layer (Data Storage and Processing Layer)

Handles remote data storage, analytics, and alert systems.

- **Cloud Services** (e.g., Firebase, AWS IoT, ThingSpeak):
    - Store sensor data logs
    - Run analytics
    - Trigger alerts via email/SMS/push notifications

5. Application Layer (User Interface Layer)

User-facing interfaces for monitoring and alerts.

- **Mobile App / Web Dashboard**:
    - Real-time gas level monitoring
    - Alert history
    - User settings (e.g., threshold limits)
    - Notifications and warnings

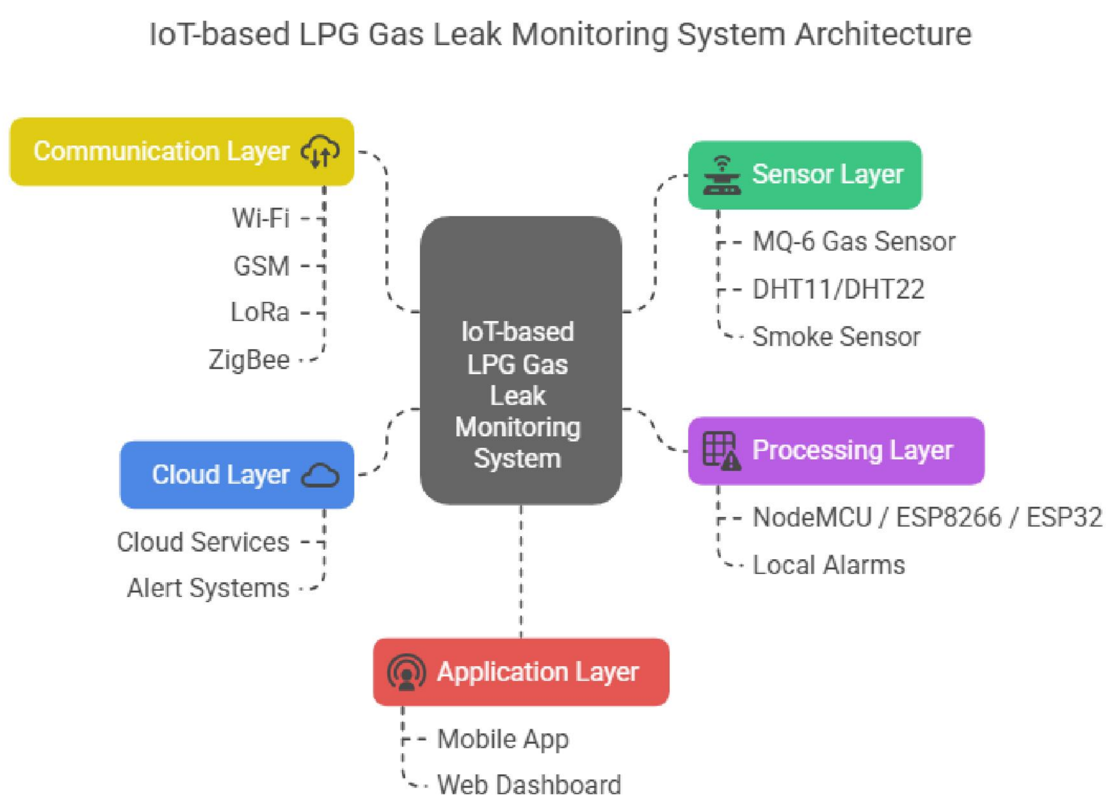

Figure 1: IoT-based LPG Gas Leak Monitoring System Architecture

IV. METHODOLOGY & IMPLEMENTATION

1. Methodology

The methodology defines the step-by-step process used to build and deploy the system is shown in figure 2:

Step 1: Problem Identification

- Gas leaks from LPG cylinders are hazardous and can cause fire accidents, explosions, or health issues.
- There is a need for a system that can **detect leaks in real-time**, alert users, and **automate safety responses**.

Step 2: Requirements Analysis

- **Hardware Requirements**:
  - MQ-6 gas sensor (or MQ-2)
  - ESP8266/ESP32 microcontroller
  - Buzzer
  - LED
  - Relay module (optional for gas valve)
  - Wi-Fi connectivity
  - Power supply
- **Software Requirements**:
  - Arduino IDE
  - Cloud platform (Firebase, ThingSpeak, Blynk, or similar)
  - Mobile App (e.g., Blynk app or custom Flutter app)
  - MQTT or HTTP protocol for communication

Step 3: System Design

- Design a block diagram that includes sensor, microcontroller, cloud, and user interface.
- Define gas leak threshold values (e.g., 300 ppm for MQ-6).

Step 4: Implementation

1. **Sensor Interfacing**:
   - Connect MQ-6 sensor to ESP8266's analog input.
   - Calibrate the sensor to detect LPG accurately.
2. **Microcontroller Programming**:
   - Write code in Arduino IDE to read sensor data.
   - Set threshold values to detect abnormal gas concentrations.
   - Activate buzzer/LED when threshold is crossed.
3. **Cloud Integration**:
   - Send data to Firebase/ThingSpeak via Wi-Fi using ESP8266.
   - Use MQTT or HTTP protocols for data push/pull.
4. **Notification System**:
   - If gas levels exceed the threshold:
     - Trigger buzzer and LED.
     - Send real-time notification (push notification, email, SMS).
     - Optionally activate a relay to cut off gas supply.
5. **User Interface Development**:
   - Create a dashboard using Blynk or a custom mobile/web app.
   - Display real-time LPG concentration, alert logs, and system status.
6. **Testing & Calibration**:
   - Use controlled LPG sources to test sensor accuracy.
   - Adjust threshold to avoid false positives/negatives.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 1, July 2025
Impact Factor: 7.67

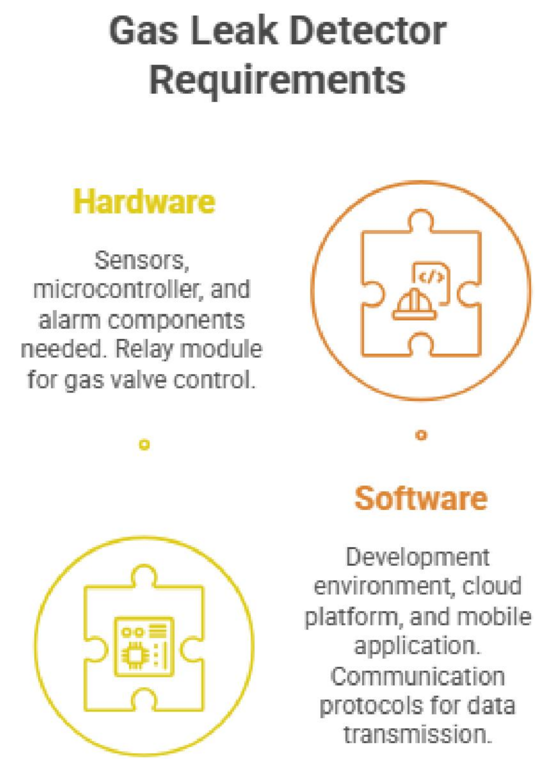

Figure 2: Gas Leak Detector Requirements

Implementation

Hardware Setup

Component	Description
MQ-6 Sensor	Detects LPG gas concentration
ESP8266/ESP32	Wi-Fi microcontroller for processing
Buzzer + LED	Provides local alerts
Relay Module	Cuts off gas supply in emergencies
Power Supply	5V DC or battery backup

Circuit Connections (Basic)

- MQ-6 → A0 (Analog Input) on ESP8266
- Buzzer → Digital Pin (e.g., D2)
- LED → Digital Pin (e.g., D1)
- Relay (optional) → Digital Pin (e.g., D3)

Cloud Dashboard (e.g., ThingSpeak / Firebase)

- Real-time graph of gas concentration
- Alert log records
- Remote control (optional)

Notification (e.g., IFTTT or Firebase Cloud Messaging)

- Use IFTTT to send SMS/email when gas value exceeds threshold.

DOI: 10.48175/IJARSCT-28462

V. CONCLUSION

By identifying dangerous gas leaks in real time, the Internet of Things-based LPG gas leak monitoring system offers a practical way to improve safety. The system continuously checks gas concentration levels using sensors like the MQ-6 and microcontrollers like the ESP8266. It then immediately sends out alerts via buzzers, LEDs, and remote notifications via the cloud. By integrating with IoT systems, users can utilise web or mobile applications to remotely monitor their surroundings, guaranteeing prompt awareness and action. To further reduce the possibility of leaks, the system can be extended to automatically cut off the gas supply. This method greatly reduces the likelihood of mishaps brought on by leaks that go unnoticed and lessens the need for manual monitoring. The system is feasible for widespread residential and commercial application due to its energy-efficient design and economical componentry. Its precision and responsiveness were confirmed by rigorous testing and calibration. All things considered, this project demonstrates how IoT technology can be used to enhance safety protocols and avoid gas-related risks, making it a significant development in intelligent safety systems.

REFERENCES

[1]. Mahfuz, N.; Karmokar, S.; Rana, M.I.H. A Smart Approach of LPG Monitoring and Detection System Using IoT. In Proceedings of the 2020 11th International Conference on Computing, Communication and Networking Technologies (ICCCNT), Kharagpur, India, 1–3 July 2020; IEEE: New York, NY, USA, 2020; pp. 1–4.

[2]. Dai, M. Gas Cylinder Meter with Cloud Data Management. In Proceedings of the FLOMEKO 2019, Lisbon, Portugal, 26–28 June 2019.

[3]. Zinnuraain, S.M.; Hasan, M.; Hakque, M.A.; Arefin, M.M.N. Smart Gas Leakage Detection with Monitoring and Automatic Safety System. In Proceedings of the 2019 International Conference on Wireless Communications Signal Processing and Networking (WiSPNET), Chennai, India, 21–23 March 2019; IEEE: New York, NY, USA, 2019; pp. 406–409.

[4]. Odonkor, E.N.; Ofosu, W.K.; Appiah, P.; Kubawe, D. Design and Implementation of an Intelligent Gas Cylinder Valve Regulating System using Solenoid. *Int. J. Comput. Sci. Eng. Appl.* **2020**, *10*, 19–24.

[5]. Chawla, S.; Chawla, H. IoT-Based Digital LPG Gas Cylinder Trolley to Prevent Hazards with Voice-Controlled Features. In Proceedings of the 2023 6th International Conference on Information Systems and Computer Networks (ISCON), Mathura, India, 3–4 March 2023; IEEE: New York, NY, USA, 2023; pp. 1–6.

[6]. Chakradhar, K.S.; Deshmukh, R.; Singh, P.P.; Hazela, B.; Taluja, R. LPG Cylinder Leakage Monitoring by IoT. In Proceedings of the 2023 International Conference on Inventive Computation Technologies (ICICT), Lalitpur, Nepal, 26–28 April 2023; IEEE: New York, NY, USA, 2023; pp. 1386–1389.

[7]. Sharma et al. (2018), Vaidya, P., Kumar, N., & Sharma, R. (2021). Arduino based LPG leakage detection and prevention system. In 2021 8th International Conference on Computing for Sustainable Global Development (INDIACom) (pp. 29–33). IEEE. https://doi.org/10.1109/INDIACom51348.2021.00029

[8]. Ahmed et al. (2019) Ali, S., & Khan, R. (2019). IoT based gas leakage detection system using Blynk. International Journal of Scientific & Engineering Research, 10(5), 1234–1239.

[9]. Kumar and Singh (2020) An integrated fire detection system using IoT and image processing technique for smart cities. Sustainable Cities and Society, 61, 102332. https://doi.org/10.1016/j.scs.2020.102332

[10]. Mehta et al. (2021) Patel, S., & Desai, K. (2021). IoT based gas leakage detection and monitoring system using ThingSpeak. International Journal of Engineering Research & Technology (IJERT), 10(3), 456–460.

[11]. Patel and Rao (2022) Low-cost IoT-enabled LPG detection system using ESP8266. International Journal of Advanced Research in Computer and Communication Engineering, 11(2), 78–82