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IoT Based Gas Level Detection and Auto Booking System

Dr. S. Malathi
Department of Information Technology, Sri Krishna Adithya College of Arts and Science, Coimbatore, Tamil Nadu, India
malathis@skacas.ac.in

Ashwin S
Department of Information Technology, Sri Krishna Adithya College of Arts and Science, Coimbatore, Tamil Nadu, India
ashwinsanthosh0705@gmail.com

Abstract

Liquefied Petroleum Gas (LPG) is extensively used in domestic households, commercial kitchens, and small-scale industries because of its efficiency and cleanliness. However, gas leakage and improper monitoring of gas levels often lead to serious safety hazards and inconvenience. This paper presents an IoT-based gas level detection and auto booking system that continuously monitors gas leakage and remaining gas quantity in an LPG cylinder. The system uses gas sensors to detect leakage and a load cell to measure the cylinder's weight, enabling accurate estimation of gas levels. A microcontroller processes the sensor data and transmits it to a cloud platform using wireless communication. When gas leakage is detected, immediate alerts are sent to the user, and safety actions can be initiated. Additionally, when the gas level falls below a predefined threshold, the system automatically places a booking request for a new gas cylinder. The proposed system enhances user safety, reduces manual intervention, and ensures uninterrupted gas supply. This approach provides a smart, reliable, and cost-effective solution suitable for modern smart homes and industrial environments.

Introduction

Liquefied Petroleum Gas (LPG) plays a vital role in meeting the daily energy requirements of both households and industries due to its high calorific value, clean-burning nature, and ease of storage and transportation. It is widely used for cooking, heating, and various industrial applications, making it an essential fuel in modern society. However, despite its numerous advantages, LPG poses significant safety risks because it is highly flammable and naturally odorless. Although a strong odorant is added to help detect leaks, gas leakage incidents continue to occur frequently due to factors such as faulty regulators, worn-out rubber hoses, improper installation, aging equipment, and human negligence. These leakages can lead to serious accidents, including fires, explosions, and health hazards, resulting in loss of life and property.

In addition to safety concerns, users often face practical inconveniences related to LPG usage. One of the most common problems is the unexpected exhaustion of gas cylinders, which can disrupt daily activities, especially during peak usage hours or in critical environments such as restaurants, hospitals, and hostels. Manual monitoring of gas levels is unreliable and often overlooked, leading to delayed refills and

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unnecessary inconvenience. This challenge highlights the need for a smarter and more dependable solution to manage LPG consumption efficiently.

Recent advancements in Internet of Things (IoT) technology have paved the way for the development of intelligent systems capable of real-time monitoring, automation, and remote access. IoT-based solutions enable seamless interaction between sensors, microcontrollers, and communication modules, allowing data to be transmitted and analyzed continuously. Through mobile applications or web dashboards, users can receive instant alerts, monitor gas usage patterns, and take timely action when abnormal conditions are detected.

An IoT-based gas level detection and automatic booking system effectively addresses both safety and convenience by integrating gas leakage detection, real-time gas consumption monitoring, and automated refill booking into a single unified platform. This approach minimizes dependency on manual supervision, reduces human error, and enhances system reliability. Moreover, such a system aligns with the growing trend of smart homes and digital service automation, offering a proactive, user-friendly, and efficient solution for safe LPG management. By leveraging modern technologies, the proposed system contributes to safer living environments and improved quality of life in today's digitally connected world.

Literature Study

Numerous studies have been carried out in the field of gas leakage detection and LPG monitoring using embedded systems and wireless communication technologies. In the early stages, research primarily focused on basic gas detection systems that utilized MQ-series gas sensors interfaced with microcontrollers. These systems were designed to detect the presence of hazardous gases and trigger local alerts such as buzzers, LEDs, or warning displays. While these solutions were effective in identifying gas leakage at the source, they were limited in scope as they lacked remote monitoring and notification capabilities, making them less reliable in situations where immediate human intervention was not possible.

As technology evolved, researchers began incorporating GSM modules into gas detection systems to enhance safety and responsiveness. These GSM-based systems were capable of sending SMS alerts to users or authorities when gas leakage was detected, thereby significantly reducing response time and potential damage. Parallel to this, several studies explored the use of load cells and weight sensors to monitor LPG cylinder levels. By measuring the cylinder's weight, these systems could estimate the remaining amount of gas and notify users when the gas level dropped below a predefined threshold, helping prevent unexpected gas shortages.

With the rapid growth of the Internet of Things (IoT), more advanced solutions emerged that integrated Wi-Fi-enabled microcontrollers, cloud platforms, and web services. These IoT-based systems enabled real-time data monitoring, storage, and analysis, allowing users to access gas status information from anywhere using mobile applications or web dashboards. Some studies also introduced automation features such as automatic shut-off valves to prevent accidents during leakage events, further improving system safety.

Despite these advancements, most existing systems tend to focus on either gas leakage detection or gas level monitoring as standalone functionalities. Only a limited number of studies attempt to combine both features into a single, cohesive solution, and even fewer extend this integration to include an automatic LPG booking mechanism. As a result, users still need to

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manually monitor gas usage and initiate cylinder booking, which can be inconvenient and inefficient.

This research aims to address these limitations by proposing a fully integrated IoT-based system that combines gas leakage detection, real-time gas level estimation, and automatic LPG booking. By unifying safety monitoring and convenience-oriented services into one platform, the proposed system enhances user safety, reduces manual effort, and ensures uninterrupted gas supply, thereby offering a more comprehensive and practical solution for modern households and commercial environments.

Significance of the Study

The significance of this study lies in its ability to improve safety, convenience, and efficiency in LPG usage. Gas leakage incidents can result in severe accidents, including fires and explosions, causing loss of life and property. Early detection and timely alerts play a crucial role in preventing such incidents. The proposed system ensures continuous monitoring and instant notification, thereby enhancing user safety.

Another important aspect is the automation of gas booking. Manual monitoring of gas levels is often inaccurate and inconvenient, leading to unexpected shortages. By automatically detecting low gas levels and placing refill orders, the system eliminates human error and ensures uninterrupted gas supply. This is particularly beneficial for elderly users, busy households, and commercial establishments.

Furthermore, the study contributes to the advancement of smart home technologies by integrating IoT, sensors, and cloud services. The system is scalable, cost-effective, and adaptable to both domestic and industrial environments, making it a valuable solution in the context of modern digital living.

In addition, the proposed solution promotes efficient energy management and supports preventive maintenance by analyzing usage trends and identifying potential risks in advance. By combining safety, automation, and digital connectivity, this system represents a practical step toward intelligent living environments and highlights the role of modern technology in enhancing everyday safety, comfort, and operational efficiency.

Proposed System

The proposed IoT-based gas level detection and auto booking system consists of sensing, processing, communication, and application layers. Gas sensors such as MQ-2 or MQ-6 are used to detect LPG leakage by measuring gas concentration in the surrounding environment. A load cell with an HX711 amplifier module is employed to measure the weight of the LPG cylinder, enabling accurate estimation of the remaining gas.

The proposed IoT-based gas level detection and automatic cylinder booking system is designed to provide a smart, reliable, and efficient solution for monitoring LPG usage and ensuring user safety. The system integrates sensing units, a processing unit, communication modules, and a cloud-based monitoring platform to achieve real-time gas level monitoring, leakage detection, and automated service initiation.

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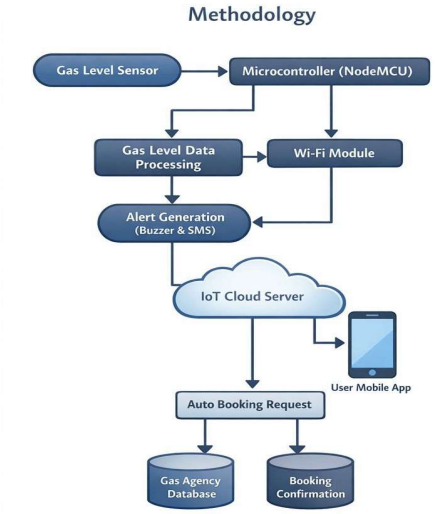
A microcontroller, such as Arduino or ESP32, collects data from the sensors and processes it according to predefined thresholds. Wireless communication is achieved using Wi-Fi or GSM modules, which transmit data to a cloud platform for storage and analysis. The cloud server generates alerts and notifications that are sent to the user via SMS, email, or a mobile application.

When the gas level drops below a minimum threshold, the system automatically triggers a gas booking request to the distributor. This integrated approach ensures safety monitoring, real-time updates, and automated service execution.

Methodology

The methodology of the proposed system begins with continuous data acquisition from gas sensors and load cells. The gas sensor detects the presence of LPG in the air, while the load cell measures the cylinder's weight to calculate the remaining gas quantity. These sensor readings are fed into the microcontroller for processing.

In addition to real-time monitoring and automation, the system incorporates threshold-based decision logic to ensure accurate and reliable operation. The microcontroller is programmed with predefined gas concentration and minimum weight limits, which are continuously compared with incoming sensor data.



The microcontroller compares the sensor values with predefined threshold levels. If gas leakage is detected, the system immediately activates alerts and sends notifications to the user. Simultaneously, the data is transmitted to a cloud platform through a Wi-Fi or GSM module. For gas level monitoring, when the measured weight falls below the preset limit, the system automatically initiates the gas booking process.

All sensor data and system activities are logged on the cloud server, allowing users to monitor gas usage patterns through a web or mobile interface. This systematic methodology ensures reliability, real-time response, and efficient automation.

Limitations

Despite its advantages, the proposed system has certain limitations that must be considered. The system relies heavily on continuous internet or GSM connectivity for real-time data transmission and automated booking. Any network failure may delay alerts or booking requests.

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Sensor accuracy is another limitation, as gas sensors can be affected by environmental factors such as temperature and humidity. Load cells also require periodic calibration to maintain accurate weight measurements. Additionally, the initial installation cost may be higher than traditional gas monitoring methods, which could limit adoption among cost-sensitive users.

Power supply dependency is another concern, as uninterrupted operation requires a stable power source or backup system. Addressing these limitations through improved sensors, calibration techniques, and power management solutions can enhance system reliability.

Conclusion

This paper presented an IoT-based gas level detection and auto booking system designed to enhance safety and convenience in LPG usage. By integrating gas leakage detection, gas level monitoring, cloud connectivity, and automated booking, the system provides a comprehensive solution for modern households and industries. The use of IoT enables real-time monitoring, remote access, and timely alerts, significantly reducing the risk of gas-related accidents.

The automated booking feature ensures uninterrupted gas supply and minimizes user effort, making the system practical and user-friendly. Although the system has certain limitations related to connectivity and sensor accuracy, these can be addressed with future technological advancements. Future work may include AI-based gas consumption prediction, integration with smart home ecosystems, and enhanced security features. Overall, the proposed system represents a significant step toward safer and smarter energy management.

The IoT-based gas level detection and automatic cylinder booking system presented in this study offers an effective and intelligent solution to the challenges associated with conventional LPG monitoring methods. By integrating gas sensors, load cells, microcontrollers, and cloud-based communication, the system enables continuous real-time monitoring of gas levels and early detection of gas leakage, thereby significantly enhancing user safety.

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