IMPLEMENTATION OF IOT BASED SMART LPG GAS MONITORING AND AUTOMATIC BOOKING SYSTEM

By

BHAGYA SRI R. *   VEERANA BABU K. **   AJAY KUMAR DHARMIREDDY ***

* Department of Information and Technology, Sir C.R.Reddy College of Engineering, Eluru, Andhra Pradesh, India.
** Department of Electronics and Communication Engineering, West Godavari Institute of Science and Engineering, Tadepalligudem, Andhra Pradesh, India.
*** Department of Electronics and Communication Engineering, Sir C.R.Reddy College of Engineering, Eluru, Andhra Pradesh, India.

Date Received: 01/04/2025   Date Revised: 16/05/2025   Date Accepted: 15/06/2025

ABSTRACT

This paper presents a solution to a common issue associated with household LPG gas usage. With increasingly busy lifestyles, monitoring the gas level in cylinders and scheduling timely refills typically becomes difficult. To address this challenge, an IoT-based Smart LPG Gas Monitoring and Automatic Booking System is proposed. Given the high demand for LPG in daily life, the system enables continuous monitoring of gas consumption and provides timely alerts. When the gas flow reaches a predefined threshold, the system sends an alert notification to the user through an IoT-based application. Additionally, the system automates the booking of a new cylinder, enhancing user convenience. A flow sensor is used to measure the amount of gas consumed, while the MQ-4 gas sensor detects any potential gas leakage. Upon detecting a leak, the MQ-4 sensor sends an analog signal to the ESP32 microcontroller, which in turn communicates with the cloud platform to notify the user through the IoT app. This system not only streamlines gas management but also ensures household safety. Given that LPG is highly flammable, timely detection of leaks is crucial to prevent accidents, property damage, or loss of life. By integrating monitoring, alerting, and automated booking, the proposed solution provides an effective, reliable, and secure approach to domestic gas management.

Keywords: IoT, ESP32 Microcontroller, Flow sensor, Exhaust Fan, Buzzer, LED.

INTRODUCTION

Liquefied Petroleum Gas (LPG) is extensively utilized in households, hotels, and hostels as a primary fuel for cooking. LPG is a highly inflammable gas, and accidental leakage can cause significant damage to both life and property. As a result, it should be handled with caution, and extra precautions should be taken to avoid any accidental leaking of gas. The Internet of Things (IoT) has significantly transformed various industries, including home automation and energy management. One such innovative application is the IoT-based Smart LPG Gas Monitoring and Automatic Booking System, which enhances safety, convenience, and efficiency in household and commercial LPG usage. This literature survey reviews existing research, methodologies, and technological advancements in this domain. Because LPG is heavier than air, it does not disperse rapidly and can cause suffocation problems when it is inhaled. When the spilled gases are ignited, they might cause an explosion. The number of people who have died as a result of the gas explosion. This explosion may be due to faulty cylinders, broken valves, or fitted regulators. The proposed system will detect the leakage of the gas using the MQ-4 sensor and alert the user in order to avoid the explosion. In today's fast-paced lifestyle, it is typically difficult for individuals to book a new cylinder before the existing one is completely exhausted. During peak cooking hours, if

i-manager Publications
Member of: SDG Publishers Compact
This paper has objectives related to SDG
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

the cylinder becomes empty, it becomes difficult to refill or purchase a new one immediately. To address this issue, a gas monitoring system is proposed that tracks the amount of gas consumed, displays the data on an LCD, and enables cylinder monitoring through an IoT application.

Internet of Things

The Internet of Things refers to a network of interconnected devices, such as mechanical, digital, or biological, that are assigned unique identifiers (UIDs) and can transmit data without human interaction. Examples include cardiac monitors, sensor-equipped vehicles, or tagged objects capable of sharing data over the internet. IoT is widely adopted across industries to enhance productivity, decision-making, customer satisfaction, and overall business value. Figure 1 shows a basic IoT system, illustrating the fundamental structure and interaction of connected devices.

1. Literature Survey

A gas sensor is an apparatus that, typically as part of a safety system, detects the presence of gas in a particular region. This equipment finds gas leaks and can connect to a control system to immediately stop the gas flow. A gas sensor can detect leaks and provide timely warnings. Such systems are significant because harmful gases pose serious risks to humans, animals, and other living organisms, thereby endangering biological life.

Keshamoni and Hemanth (2017) presented an IoT-based system incorporating automatic booking features for gas level monitoring and leak detection. Gas monitoring systems were further enhanced with predictive alerting features through sensor integration (Varma et al., 2017). A smart gas monitoring system focusing on sensor reliability and real-time alarms was developed (Anandhakrishnan et al., 2017).

The versatility of IoT across disciplines was demonstrated through hardwaresoftware integration, as shown in the ARM Cortex-based agricultural automation systems (Dharmireddy & Suneetha, 2023; Dharmireddy et al., 2023). Applications in medical imaging and space electronics were also investigated, emphasizing technological insights and diverse use cases (Dharmireddy et al., 2024a; Prithvi & Dharmireddy, 2013; Shashidhar et al., 2023).

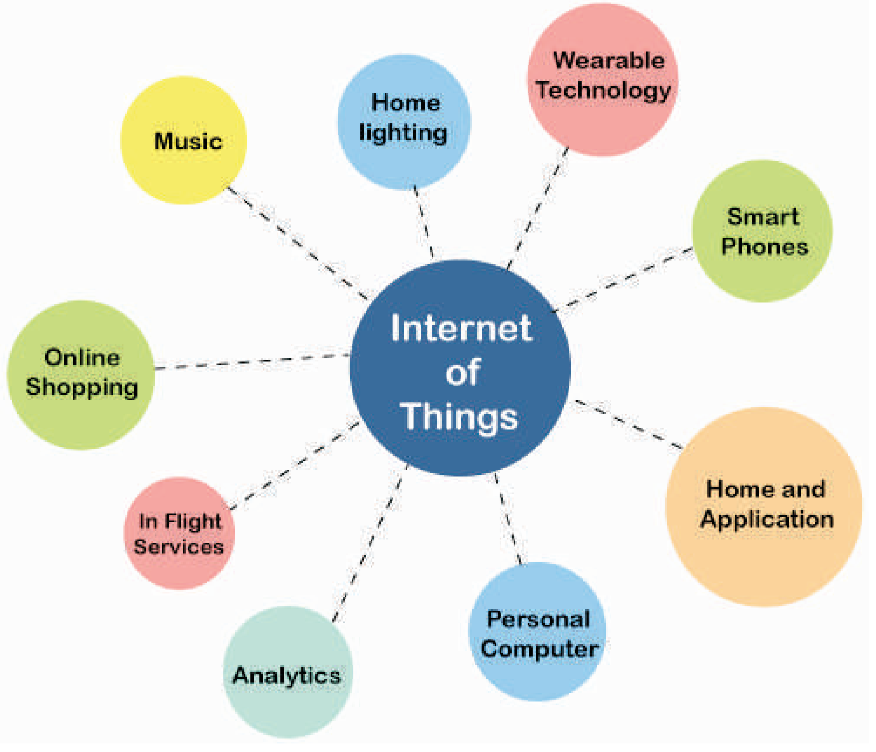

Figure 1. Basic IoT System

Early LPG monitoring designs were with limited automation and cloud capabilities (Raj et al., 2015; Shivalingesh et al., 2014). A related study proposed monitoring methods but without automated booking or cloud integration (Priya & Babu, 2014). IoT-enabled leak detection systems employing wireless modules and ultrasonic sensors were later introduced, showing strong real-time performance but encountering network reliability and supply-chain integration challenges (Balogun et al., 2024; Kumar et al., 2023; Sharma et al., 2023).

Research on smart home systems concentrated on automation and AI-based booking processes (Jain et al., 2022; Reddy & KN, 2022). More recent studies incorporated AI technologies and cloud platforms, enabling predictive analytics and cloud-based visualization for gas usage. However, despite these advancements, automated shutdown features and active safety components, such as fans or buzzers, were frequently excluded due to higher implementation costs. A user-friendly notification system using Blynk and NodeMCU was also proposed, though it lacked cost analysis and deeper automation (Jumaa et al., 2022).

These studies emphasize the efficiency of IoT-based monitoring in detecting gas levels and leaks. However, many rely on GSM-based SMS alerts, which can be unreliable in areas with poor network coverage (Dharmireddy et al., 2024b). These systems effectively automate booking processes but require reliable network connectivity and proper integration with gas service providers' APIs. Enhancing IoT-based LPG systems with predictive analytics and automatic shut-off mechanisms significantly improves safety (Chakradhar et al., 2024; Swathi et al., 2024). However, false alarms and system calibration remain challenges. Moreover, the majority of existing solutions utilize relatively expensive or power-hungry microcontrollers. In contrast, the ESP32-based implementation offers a low-cost, energy-efficient, and Wi-Fi-enabled alternative, making it well-suited for scalable and real-time LPG monitoring applications, especially in resource-constrained environments.

Gas sensors can be used to sense toxic gases. The some of the gases that the gas sensor detects are butane, methane, hydrogen, alcohol vapors. This type of device is extensively used in factories or industries to detect gas leakages. Gas leak discovery styles come after the effects of dangerous feasts on mortal health is discovered.

There are different types of gas detectors for detecting gas leakages such as electrochemical, catalytic bead, photoionization, infrared point, infrared imaging, and semiconductor, ultrasonic.

An MQ-4 sensor is used for gas detection. When gas is present, the sensor generates an analog signal, which is processed to identify the leakage. Based on the detection, appropriate actions can be initiated to prevent hazardous explosions.

2. Components

- *Gas Sensor:* Detects LPG leakage in the environment. The MQ4 gas sensor detects propane and butane gases in the air and generates an analog voltage based on the gas concentration is shown in Figure 2.Triggers an alarm and sends an alert if gas leakage is detected.
- *Flow Sensor:* A flow sensor is a device used to measure the flow rate of a liquid or gas passing through a pipe or system is shown in Figure 3. These sensors help monitor and control fluid movement in various applications, including industrial processes, medical devices, automotive systems, and HVAC systems.
- *Wi-Fi Module (ESP32):* Enables wireless data transmission to cloud servers or mobile apps.

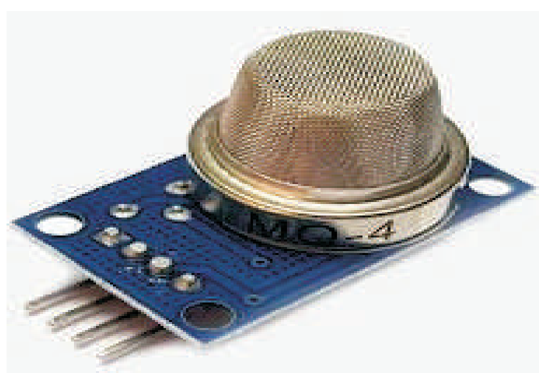

Figure 2. MQ-4 Gas Sensor

Figure 3. Flow Sensor

Connects to a Wi-Fi network and sends sensor data to the IoT platform for real-time monitoring is shown in Figure 4. Provides remote access through mobile applications or web dashboards.

- *Exhaust Fan:* An exhaust fan for a heat sink is typically used to dissipate heat from electronic components, such as CPUs, GPUs, power supplies, and industrial equipment is shown in Figure 5. These fans help maintain optimal operating temperatures by enhancing airflow over the heat sink, preventing overheating and improving performance.
- *16 x 2 LCD display:* An LCD screen is a kind of electronic display module that uses liquid crystal to create a visual image shown in Figure 6. Alerts users about gas leaks or low gas levels. The buzzer produces sound and LED blinks when a gas leak is detected. Provides audible and visual alerts to warn users in case of an emergency.
- *IoT Cloud Platform (Thingspeak, Blynk):* Stores and processes sensor data for real-time monitoring. Displays gas level trends on a web dashboard. Send

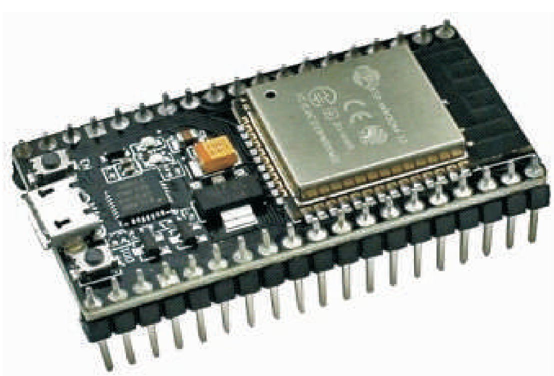

Figure 4. Wi-Fi Module

Figure 5. Exhaust Fan

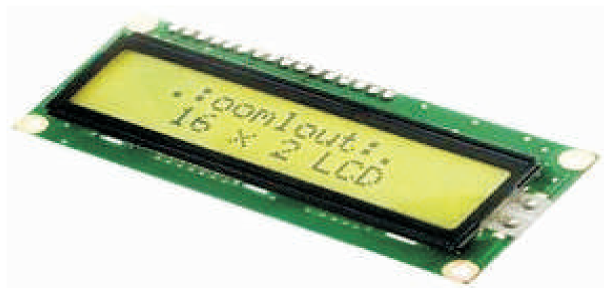

Figure 6. LCD Display

notifications to users and suppliers. Triggers automatic cylinder booking when the gas level is low.

- *Application (Android/iOS):* Provides real-time monitoring and alerts to users. Users can check gas levels remotely. Receives leakage alerts and automatic booking confirmations. Allow manual booking in case of emergency refilling.
- *Embedded Programming (Arduino IDE, Python, C++):* Controls the microcontroller and sensor operations. Reads sensor data and processes it. Controls the GSM/Wi-Fi module to send alerts. Manages automatic booking requests.

3. Proposed Methodology

The main components used in this system are Flow sensor, ESP32 Microcontroller, LCD display, LED, MQ-4 Sensor, and Buzzer. It contains weight monitoring and a gas leakage detection system. Flow sensors are used to monitor the weight of the cylinder by measuring the remaining gas in kilograms and calculating the percentage of gas consumed. The measured values are displayed on the LCD. Notifications are sent to the user through an IoT application when the cylinder usage reaches 25%, 50%, 75%, and 100%. Additionally, when the cylinder reaches 75% usage, the system automatically notifies the gas agency to initiate cylinder booking. Whenever gas leakage is detected by the sensor, a corresponding analog signal is generated and transmitted to the ESP32, which then sends the data to the cloud. The user is notified through an alert on the IoT application. In the event of a leakage, the exhaust fan is automatically switched on to reduce the concentration of gas, while the LED is turned off to prevent potential ignition from heat energy released by the light. Figure 7 shows the proposed design.

4. Results and Discussion

Figure 8 shows the project hardware along with the connections of the individual components. Figure 9 depicts the notification of the percentage of gas consumed as received on a mobile device, while Figure 10 illustrates the continuous monitoring of cylinder weight through an IoT application. In this display, the green color represents the remaining gas in kilograms, whereas the orange color represents the percentage of gas consumed. Figure 11 shows the mobile notification generated in the event of a gas leakage. The project

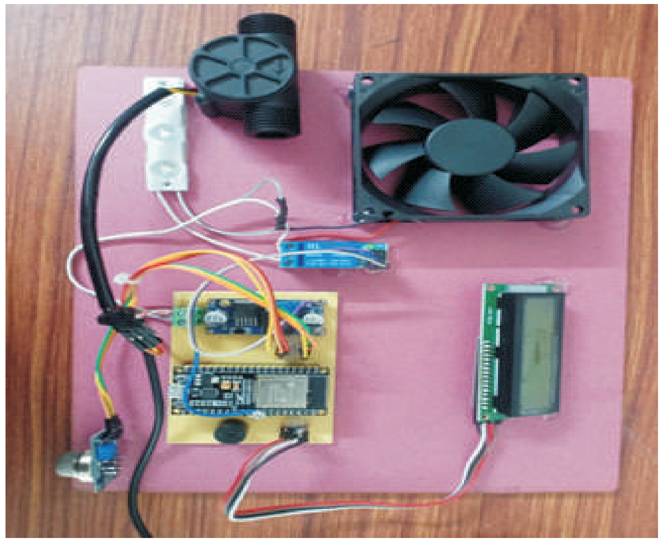

Figure 8. Hardware Implementation of Proposed Design

hardware and the connections of the individual components were implemented and tested. Notifications of the percentage of gas consumed were displayed on a mobile device, along with continuous monitoring of cylinder weight through an IoT application. In this display, the green color represents the remaining gas in kilograms, whereas the orange color represents the percentage of gas consumed. In addition, mobile notifications were generated to alert users in the event of gas leakage.

Conclusion

The proposed system demonstrates a prompt response

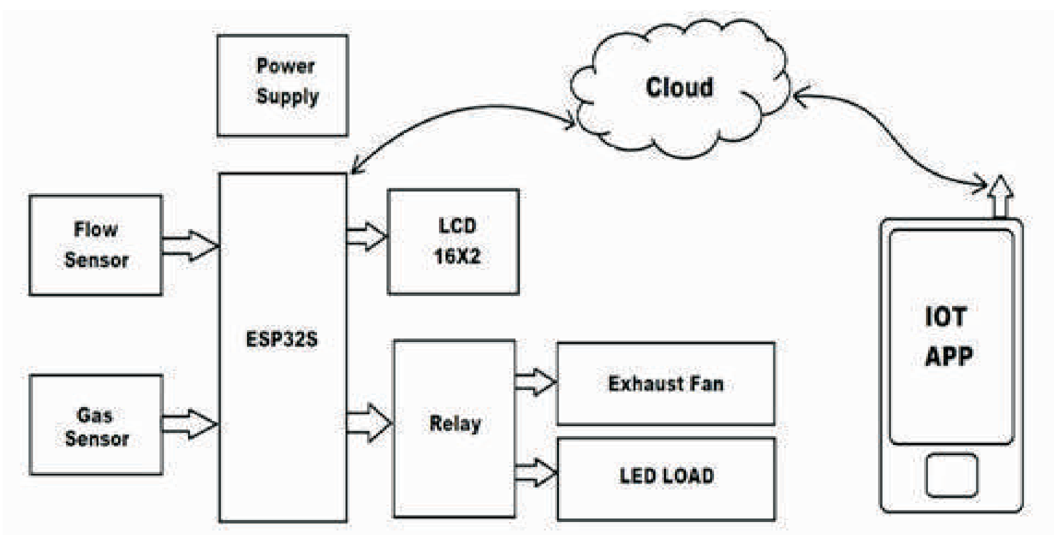

Figure 7. Design of Proposed Design

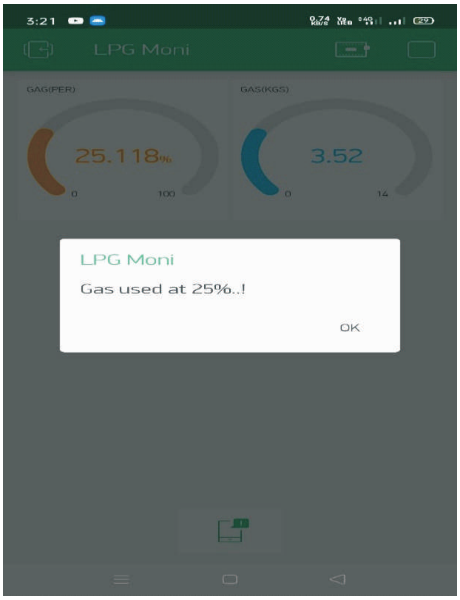

Figure 9. Gas Usage Shown in App

Figure 10. Percentage of Gas Usage

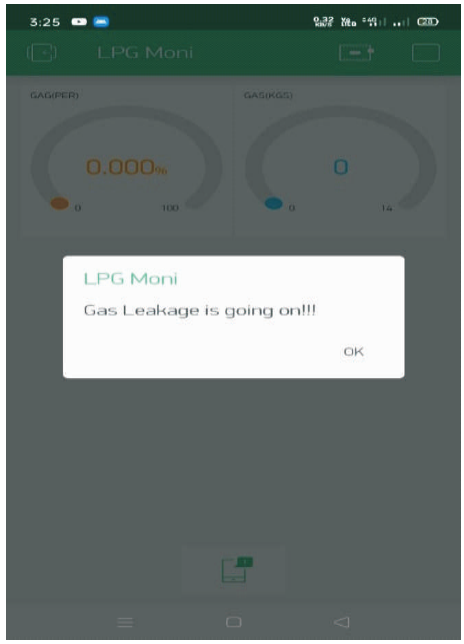

Figure 11. Gas Leakage Shown in App

time, with an average detection delay of just 2.1 seconds from the onset of gas leakage to the alert notification. In today's fast-paced lifestyle, continuous gas monitoring is typically overlooked, despite the potential hazards posed by gas leaks. Such leaks can result from faulty cylinders, broken valves, or improperly fitted regulators, leading to severe damage to both life and property. To address these challenges, this paper presents a smart gas monitoring and leakage detection system. The system enables real-time monitoring of LPG levels and facilitates automatic gas booking without the need for human intervention, thereby saving users valuable time. Furthermore, in the event of a gas leak, immediate alerts are triggered, allowing timely preventive action to avoid potential explosions. Overall, the proposed solution enhances household safety and provides an added layer of security for users.

Future Scope

Future scope involves predictive maintenance and anomaly detection for proactive safety, Hybrid IoT models using GSM, Wi-Fi, and LoRa for better reliability, User-friendly interfaces with voice commands and multilingual support and Encrypted data transmission to prevent cyber threats.

References

[1]. **Anandhakrishnan, S., Nair, D., Rakesh, K., Sampath, K., & Nair, G. S. (2017).** IoT based smart gas monitoring system. *IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE)* (pp. 82-87).

[2]. **Balogun, D., Shamim, S., Sipai, U., Kothari, N., Trivedi, T., & Patel, V. (2024).** LPG smart guard: An IoT-Based solution for real-time gas cylinder monitoring and safety in smart homes. *Engineering Proceedings,* 82(1), 9. https://doi.org/10.3390/ecsa-11-20471

[3]. **Chakradhar, A., Dharmireddy, A., Sudhkar, H., Lavanyai, K., Krishna, M. V., Madhava Rao, C. H., & Hareesh, P. (2024).** Arduino based GPS tracking alert system for women's protection. In *AIP Conference Proceedings,* 2971 (1), 030013. AIP Publishing LLC. https://doi.org/10.1063/5.0195875

[4]. **Dharmireddy, A. K, Srinivasulu, P., Greeshma, M., & Shashidhar, K. (2023).** Soft Sensor-Based remote monitoring system for industrial environments. In *Blockchain Technology for IoT and Wireless Communications* (pp. 103-112). CRC Press.

[5]. **Dharmireddy, A. K., & Suneetha, N. (2023).** A Blockchain based cyber thread detection system for IIoT networks. *i-manager's Journal on IoT and Smart Automation,* 1(2), 16-22.

[6]. **Dharmireddy, A. K., Ravikumar, M., & Kumar, B. V. (2024a).** Identifying chronic kidney failure through machine learning. *i-manager's Journal on IoT and Smart Automation,* 2(1), 1. https://doi.org/10.26634/jcom.13.1.21745

[7]. **Dharmireddy, A., Chakradhar, A., Akram, S. V., Deepak, R. S., Akash, S., Rajasekhar, T., & Anatha, T. (2024b).** Dermatological disease detection and preventative measures using deep Convolution Neural Networks. In *AIP Conference Proceedings,* 2971 (1), 030014. AIP Publishing LLC. https://doi.org/10.1063/5.0195880

[8]. **Jain, A., Meghana, H. M., & Annaiah, H. (2022).** Automatic booking of LPG and leakage detection system using IoT. *Trust Based Communication Systems for Internet of Things Applications* (pp. 291-312). https://doi.org/10.1002/9781119896746.ch12

[9]. **Jumaa, N. K., Abdulkhaleq, Y. M., Nadhim, M. A., & Abbas, T. A. (2022).** IoT based gas leakage detection and alarming system using blynk platforms. *Iraqi Journal for Electrical and Electronic Engineering,* 18(1), 64-70. https://doi.org/10.37917/ijeee.18.1.8

[10]. **Keshamoni, K., & Hemanth, S. (2017).** Smart gas level monitoring, booking & gas leakage detector over IoT. In 2017 *IEEE 7th International Advance Computing Conference (IACC)* (pp. 330-332). IEEE. https://doi.org/10.1109/IACC.2017.0078

[11]. **Kumar, R., Khan, R. L., Singh, R., Singh, A., Vijay, R., & Ather, D. (2023).** Development and evaluation of an IoT-based gas leakage detection system using Arduino Uno. In *International Conference on Cyber Intelligence and Information Retrieval* (pp. 307-319). Springer Nature Singapore. https://doi.org/10.1007/978-981-97-3594-5_25

[12]. **Prithvi, J. M., & Dharmireddy, A. (2013).** Multitrack simulator implementation in FPGA for ESM system. *International Journal of Electronics Signals and Systems,* 2, 81-84.

[13]. **Priya, D. H., & Babu, L. (2014).** Gas leakage system. *International Journal of Scientific and Research Publications,* 4(9), 1–3.

[14]. **Raj, A., Viswanathan, A., & Athul, T. (2015).** LPG gas monitoring system. *International Journal of Innovative Technology and Research,* 3(2), 1957-1960.

[15]. **Reddy, S., & KN, R. P. (2022).** LPG gas detection and monitoring using IoT. In 2022 *International Interdisciplinary Humanitarian Conference for Sustainability (IIHC)* (pp. 693-697). IEEE. https://doi.org/10.1109/IIHC55949.2022.10060195

[16]. **Sharma, V. P., Dugyala, R., Padmavathi, V., & Gurram, V. R. (2023).** Gas leakage detection system using IoT and cloud technology: A review. In *E3S Web of Conferences,* 391, 01063. EDP Sciences. https://doi.org/10.1051/e3sconf/202339101063

[17]. **Shashidhar, K., kumar Dharmireddy, A., & Rao, C. M.**

(2023). Anti-theft fingerprint security system for motor vehicles. In *Blockchain Technology for IoT and Wireless Communications* (pp. 89-101). CRC Press.

[18]. Shivalingesh, B. M., Ramesh, C., Mahesh, S. R., Pooja, R., Preethi, K. M., & Kumuda, S. (2014). LPG detection, measurement and booking system. *International Journal of Research and Scientific Innovation,* 1(6), 7-10.

[19]. Swathi, V., Dharmireddy, A. K., Kumar, M. R., Kumar, B. V., & Prasad, P. S. (2024). Suggestion of tablets with machine learning and IoT for women. *i-manager's Journal on IoT and Smart Automation,* 2(2), 13-20.

[20]. Varma, A., Prabhakar, S., & Jayavel, K. (2017). Gas leakage detection and smart alerting and prediction using IoT. In 2017 *2nd International Conference on Computing and Communications Technologies (ICCCT)* (pp. 327-333). IEEE. https://doi.org/10.1109/ICCCT2.2017.7972304

ABOUT THE AUTHORS

Bhagya Sri R., Department of Information and Technology, Sir C.R.Reddy College of Engineering, Eluru, Andhra Pradesh, India.

Veerana Babu K., Department of Electronics and Communication Engineering, West Godavari Institute of Science and Engineering, Tadepalligudem, Andhra Pradesh, India.

Ajay Kumar Dharmireddy, Department of Electronics and Communication Engineering, Sir C.R.Reddy College of Engineering, Eluru, Andhra Pradesh, India.