International Journal of Artificial Intelligence and Communication Networks
Volume: 02, Issue: 01, January-March 2026, pp: 74-81
ISSN: 3071-3358

Real-Time LPG Leakage Monitoring System Using IoT And Cloud Technology

S.Amena Bano[1], Md Faisal irfan[2], Muskaan[3], Mohd Anwar khan[4], Mohammed Mujahid shaik[5]
[1]Research scholar Assistant Professor; Department of Electronics and communication Engineering Lords institute of Engineering and technology, Hyderabad, India.
[2,3,4,5]B.E.Students; Department of Electronics and communication Engineering Lords institute of Engineering and technology, Hyderabad, India.
Corresponding Author Email ID: syedaamena@lords.ac.in

Abstract
The explosive nature of liquefied petroleum gas (LPG) and the frequent fatalities related with its usage as a cooking fuel have raised safety issues in developing countries. Consequently, there is a rising emphasis on using Internet of Things technology to address these concerns. In this regard, this study proposes a real time IoT-cloud based leakage monitoring system to enhance safety. The system uses hybrid synergetic combination of Internet of Things and cloud technologies to improve real-time tracking of LPG information. This platform enables remote monitoring of real time information on LPG variables such as gas leakage, temperature, humidity, as well as user access to graphical pictures and numerical data. To address the shortcomings of existing LPG leakage monitoring systems, the model includes novel features such as real-time SMS updates, alarm notification. In terms of system cost, network connectivity, technology employed, model sensitivity, and gas leak detection range, the proposed system outperforms existing models.

Keywords*: LPG gas, Raspberry Pi Pico W, IoT Cloud , Monitoring system.*

Introduction

Liquefied Petroleum Gas (LPG) has become one of the most widely used domestic and commercial fuels because of its high calorific value, clean combustion characteristics, and ease of transportation. Millions of households depend on LPG for daily cooking and heating activities. Despite these advantages, LPG is highly flammable, and even a small leakage can create hazardous conditions that may lead to fire accidents, explosions, property damage, and loss of human life. Many incidents occur because gas leakage remains unnoticed until the concentration reaches a dangerous level. Therefore, early detection and continuous monitoring of LPG leakage have become essential requirements for improving public safety. Conventional gas detection methods generally provide only local alarms, making them ineffective when users are away from the premises or unable to hear warning signals. These limitations have encouraged researchers to develop intelligent monitoring systems capable of providing remote notifications and continuous surveillance of gas-related parameters **[1], [2], [3].**

Recent developments in the Internet of Things (IoT) have significantly transformed the design of safety monitoring systems. IoT enables physical devices equipped with sensors, controllers, and communication modules to exchange information over the Internet in real time. Through this connectivity, gas concentration, environmental conditions, and system status can be monitored continuously from remote locations using smartphones or web-based dashboards.

Received: *05-01-2026*
Revised: *23-02-2026*
Accepted: *18-03-2026*
Published: *25-03-2026*
Citation: *" Real-Time Lpg Leakage Monitoring System Using Iot And Cloud Technology ", ijaicn, vol. 2, no. 1, pp. 74–81, March 2026,*

International Journal of Artificial Intelligence and Communication Networks
Volume: 02, Issue: 01, January-March 2026, pp: 74-81
ISSN: 3071-3358

IoT-based monitoring not only improves response time during emergencies but also supports automated decision-making by integrating multiple sensing devices into a unified platform. The flexibility, scalability, and affordability of IoT technologies have made them suitable for residential, commercial, and industrial safety applications **[3], [4], [8].**

Cloud computing has further strengthened IoT applications by providing secure storage, centralized data processing, and remote accessibility. Sensor data collected from gas monitoring devices can be transmitted to cloud servers, where it is stored, analyzed, and displayed through graphical dashboards. Cloud platforms also facilitate long-term data analysis, event logging, and predictive maintenance while allowing users to access system information from anywhere using Internet-enabled devices. The integration of cloud services with IoT enhances the reliability of monitoring systems and supports timely notifications through SMS, email, or mobile applications whenever abnormal conditions are detected **[1], [4], [5].**

The emergence of low-cost microcontrollers with integrated wireless communication has simplified the development of intelligent gas leakage monitoring systems. The Raspberry Pi Pico W offers built-in Wi-Fi connectivity, low power consumption, and sufficient computational capability for handling sensor data and Internet communication simultaneously. Combined with gas sensors such as the MQ-2, the controller can continuously monitor LPG concentration, temperature, and humidity while transmitting data to cloud servers in real time. Such compact and economical hardware platforms make advanced monitoring systems affordable for ordinary households and small businesses **[5], [6], [7].**

The present work proposes a real-time LPG leakage monitoring system based on Raspberry Pi Pico W, IoT, and cloud technology to improve domestic safety. The proposed system continuously measures LPG concentration together with environmental parameters and provides immediate notifications through alarms and SMS alerts whenever leakage exceeds the predefined safety threshold. In addition, the cloud platform offers graphical visualization and historical data storage, enabling users to monitor the system remotely and respond quickly to emergency situations. By combining real-time sensing, wireless communication, cloud analytics, and remote alert mechanisms, the proposed model aims to provide an effective, economical, and user-friendly solution for LPG safety monitoring **[1], [2], [5], [6].**

Figure 1: LPG Gas Leakage Monitoring System

Literature Review:

Saha et al. developed an IoT-enabled LPG leakage detection system that employed gas sensors connected to cloud services for continuous monitoring. Their system transmitted leakage information through wireless communication and generated alerts whenever gas concentration exceeded safe operating limits. The study demonstrated that cloud integration significantly improved accessibility to monitoring data; however, the system primarily focused on gas concentration without incorporating additional environmental parameters such as temperature and humidity **[1].**

Hossain et al. presented a smart LPG monitoring platform capable of detecting leakage and notifying users through Internet-based communication. The proposed model utilized cloud infrastructure to store sensor information and supported remote supervision using mobile devices. Experimental evaluation showed reliable detection performance under different operating conditions, although the notification mechanism relied mainly on Internet connectivity without providing redundant communication methods **[2].**

Madakam et al. reviewed the evolution of Internet of Things technologies and discussed their applications across healthcare, transportation, environmental monitoring, and smart homes. The authors emphasized that IoT enables efficient communication among sensing devices while improving automation and decision-making. Their survey established IoT as an effective technological foundation for developing intelligent safety monitoring systems **[3].**

Ghai et al. proposed a cloud-supported smart home architecture that integrated wireless sensors with Internet connectivity for continuous environmental monitoring. Their framework demonstrated that cloud computing enhances data accessibility, system scalability, and remote supervision. The study also highlighted the importance of combining multiple sensors to improve the reliability of residential safety systems **[4].**

Banzi and Shiloh discussed the practical implementation of embedded systems using Arduino-based platforms and sensor interfaces. Their work explained techniques for integrating environmental sensors, communication modules, and real-time control algorithms into low-cost embedded applications. These design principles have influenced numerous IoT-based monitoring systems, including gas leakage detection solutions **[5].**

The Raspberry Pi Foundation introduced the Raspberry Pi Pico W as a compact microcontroller equipped with integrated wireless networking capabilities suitable for Internet-connected embedded applications. The hardware supports efficient sensor interfacing, low power consumption, and reliable Wi-Fi communication, making it an attractive platform for real-time safety monitoring systems that require cloud connectivity **[6].**

Winsen Electronics Technology Co., Ltd. described the operating characteristics of the MQ-2 semiconductor gas sensor, which is widely used for detecting LPG, propane, methane, hydrogen, and smoke. The technical specifications indicate high sensitivity, rapid response time, and stable performance when properly calibrated, making the sensor appropriate for domestic gas leakage monitoring applications **[7].**

Al-Fuqaha et al. provided a comprehensive survey of enabling technologies, communication protocols, and application domains within the Internet of Things ecosystem. The authors discussed cloud computing, wireless communication, and sensor integration as fundamental components for large-scale IoT deployment. Their work established the technological framework required for designing reliable real-time monitoring systems **[8].**

Rahman et al. designed a smart gas leakage monitoring system integrated with the Blynk IoT platform for remote visualization and notification. The proposed model enabled users to monitor gas concentration using mobile applications while receiving instant alerts during leakage events. The study demonstrated that cloud-assisted visualization improved user awareness and reduced response time during emergencies **[11].**

Singh et al. proposed a real-time cloud-assisted LPG leakage monitoring framework using Raspberry Pi Pico W and IoT analytics. Their system combined gas sensing, cloud data storage, and intelligent notification mechanisms to enhance residential safety. Experimental results indicated improved detection accuracy, lower communication delay, and reliable remote accessibility compared with several earlier monitoring approaches, highlighting the effectiveness of integrating modern IoT hardware with cloud-based analytical services **[15].**

System Architecture

System overview

Figure 1 illustrates the overall architecture of the proposed **Real-Time LPG Leakage Monitoring System using IoT and Cloud Technology**. The system consists of three major sections: the input unit, the processing unit, and the output unit. A regulated power supply provides the necessary electrical power to the microcontroller and all connected components. The input unit comprises a **Gas Sensor**, **Fire Sensor**, and **DHT11 Sensor**. The gas sensor continuously detects the presence and concentration of LPG in the surrounding environment, while the fire sensor identifies the occurrence of flames. The DHT11 sensor measures ambient temperature and humidity, providing additional environmental information that supports safe monitoring.The **microcontroller** serves as the central processing unit of the system. It receives sensor data, processes the information, compares the measured values with predefined threshold limits, and determines whether the operating conditions are normal or hazardous. Based on the analysis, the microcontroller controls all output devices and communicates with the IoT cloud platform through its wireless connectivity. The output unit consists of an **OLED display**, **driver circuit**, **pump motor**, and **GSM module with buzzer**. The OLED display provides real-time information about gas concentration, temperature, humidity, and system status. The driver circuit interfaces the microcontroller with the pump motor, allowing automatic activation of ventilation or gas control mechanisms during leakage conditions. The GSM module sends SMS notifications to registered users, while the buzzer generates an audible alarm to alert nearby occupants. Overall, the proposed block diagram demonstrates the integration of sensing, data processing, wireless communication, cloud connectivity, and automated alert mechanisms into a single intelligent monitoring system. This

International Journal of Artificial Intelligence and Communication Networks
Volume: 02, Issue: 01, January-March 2026, pp: 74-81
ISSN: 3071-3358

integrated architecture enables continuous monitoring, rapid leakage detection, real-time remote access, and immediate emergency response, thereby enhancing the safety and reliability of LPG usage in residential and commercial environments.

Block Diagram

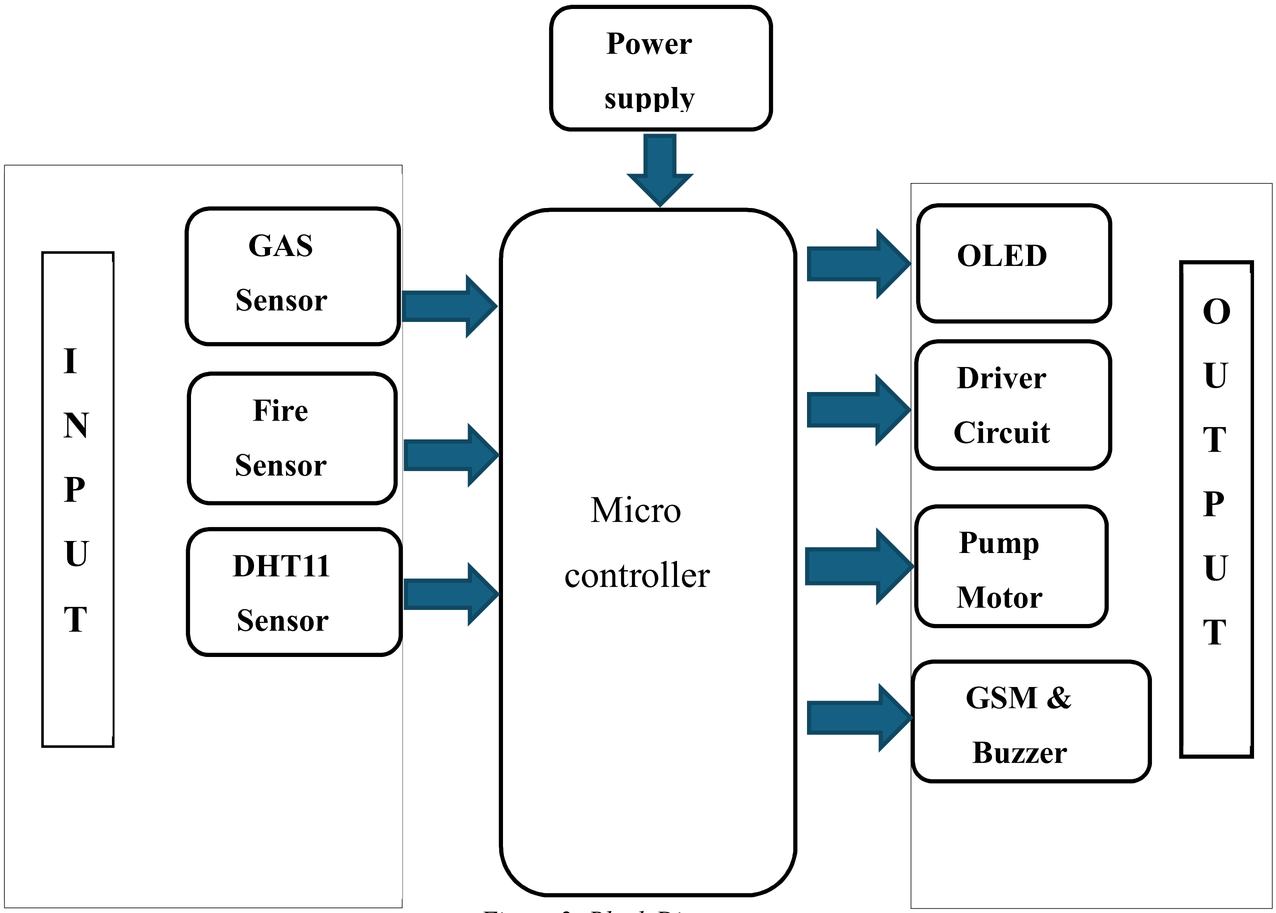

Figure 2: Block Diagram

Working Principle

The block diagram of the proposed Advanced Track Detection and Obstacle Avoidance System for Autonomous Vehicles represents the overall architecture and functional relationship between the input, processing, and output sections of the system. The complete system is centered around a microcontroller, which acts as the brain of the vehicle and controls all operations based on sensor inputs and programmed logic. The power supply block provides the required electrical energy to the microcontroller and all connected components. It ensures stable voltage and current distribution for proper operation of the sensors, communication modules, motor driver, display unit, and alert system. A reliable power supply is essential for continuous and error-free working of the autonomous 30 vehicle. Sensor, Bluetooth Module, and GPS Module.

These blocks provide different types of The Ultrasonic Sensor is used for obstacle detection. It continuously measures the distance between the vehicle and any object in front of it. Whenever an obstacle comes within a predefined range, the sensor sends distance data to the microcontroller. Based on this information, the system decides whether to stop, change direction, or continue moving.

The IR Sensor is responsible for track detection. It senses the predefined line or path over which the vehicle must travel. The IR sensor detects differences in surface reflection, helping the system identify whether the vehicle is correctly aligned with the track. This input is very important for maintaining proper path-following movement. The Bluetooth Module provides short-range wireless communication between the autonomous vehicle and an external device such as a smartphone or laptop. This allows the user to monitor the system, perform testing, or manually control certain operations if required. It improves flexibility and makes the system easier to operate during demonstration and debugging.

The GPS Module is included to provide location information. It helps in determining the real-time position of the vehicle using latitude and longitude coordinates. This feature is useful for tracking and monitoring the movement of the vehicle, especially in outdoor applications. At the center of the block diagram, the Microcontroller receives all the input signals, processes them, and makes intelligent decisions. It continuously analyzes the data from the ultrasonic sensor and IR sensor to determine whether the vehicle should move forward, turn, stop, or avoid an obstacle. It also manages communication with Bluetooth, GPS, and IoT features. Thus, the microcontroller acts as the main control unit of the entire system. On the output side, the system includes OLED Display, Driver Circuit, Robo Motor, and Buzzer. The OLED display is used to show real-time information such as obstacle distance, track status, and system operation.

The proposed LPG leakage monitoring system is designed to continuously monitor the surrounding environment for gas leakage, fire hazards, temperature, and humidity. The complete operation begins when the power supply energizes the microcontroller and all the connected sensing and output devices. The microcontroller acts as the central processing unit that collects data from all input sensors, analyzes the received information, and performs appropriate actions based on predefined safety conditions.

Initially, the **gas sensor** continuously detects the concentration of LPG present in the surrounding atmosphere. Under normal conditions, the gas concentration remains below the preset threshold, and the sensor sends regular readings to the microcontroller. These values are processed and transmitted to the cloud platform through the built-in Wi-Fi module, allowing users to monitor gas concentration remotely. If the detected gas level exceeds the safe limit, the microcontroller immediately identifies the condition as a gas leakage event and initiates emergency protective measures.

Simultaneously, the **fire sensor** continuously monitors the presence of flame near the LPG cylinder or cooking area. The sensor helps identify situations where an ignition source is present during a gas leakage. Whenever a flame is detected, the sensor sends a signal to the microcontroller, which gives the highest priority to this condition because it indicates a potentially dangerous situation. Immediate protective actions are then activated to minimize the possibility of fire accidents or explosions.

The **DHT11 sensor** continuously measures the ambient temperature and humidity surrounding the LPG installation. These environmental parameters are useful for monitoring operating conditions and understanding changes in the surrounding atmosphere during normal operation or emergency situations. The temperature and humidity values are periodically collected by the microcontroller and uploaded to the cloud server for real-time observation and historical analysis.

After receiving data from all three sensors, the **microcontroller** compares every sensor reading with predefined threshold values stored in its program memory. If all parameters remain within safe operating limits, the system continues normal monitoring without activating any emergency devices. During this period, sensor readings are continuously updated on the OLED display and simultaneously transmitted to the IoT cloud platform through the wireless network.

The **OLED display** provides real-time information locally. It continuously displays LPG gas concentration, temperature, humidity, and the overall system status. During normal operation, the display indicates that the system is functioning properly. If any abnormal condition is detected, warning messages such as "Gas Leakage Detected," "Fire Detected," or "High Temperature" are immediately shown on the screen to alert nearby users.

When gas leakage exceeds the predefined safety threshold, the microcontroller activates the **driver circuit**, which acts as an interface between the controller and high-power devices. Since the microcontroller cannot directly operate electrical loads requiring higher current, the driver circuit amplifies the control signal and safely energizes the connected pump motor.

The **pump motor** is automatically switched ON during a gas leakage event. Depending on the system design, the pump may operate an exhaust fan, ventilation mechanism, or gas shut-off valve to reduce the concentration of leaked LPG and improve air circulation within the affected area. This automatic operation minimizes human intervention and helps reduce the risk associated with gas accumulation.

At the same time, the **GSM module and buzzer** are activated simultaneously. The buzzer generates a loud audible alarm to immediately alert occupants present near the installation. Simultaneously, the GSM

International Journal of Artificial Intelligence and Communication Networks
Volume: 02, Issue: 01, January-March 2026, pp: 74-81
ISSN: 3071-3358

module sends SMS notifications to the registered mobile numbers, informing users about the detected gas leakage or fire condition. Since SMS communication operates independently of Internet availability, users receive emergency alerts even when cloud access is temporarily unavailable.

In parallel with local safety actions, all sensor readings and event information are transmitted to the **IoT cloud platform** through the wireless communication module. The cloud server stores real-time data, maintains historical records, and presents the information using graphical charts and numerical values. Users can securely access this information through a mobile application or web dashboard from any location with Internet connectivity. The cloud platform enables continuous monitoring of LPG concentration, temperature, humidity, and system status while maintaining event logs for future analysis.

Once the gas concentration returns to a safe level and no fire is detected, the microcontroller automatically deactivates the pump motor, GSM alert system, and buzzer. The OLED display updates the system status to indicate normal operating conditions, while the cloud dashboard records the restoration of safe conditions. The system then resumes continuous environmental monitoring without requiring manual resetting.

Overall, the proposed monitoring system integrates gas sensing, fire detection, environmental monitoring, wireless communication, cloud technology, and automated safety mechanisms into a single intelligent platform. Continuous monitoring, rapid fault detection, automatic emergency response, remote cloud access, SMS notification, and real-time local display collectively improve the safety of LPG installations while reducing the possibility of accidents caused by undetected gas leakage.

Schematic Diagram

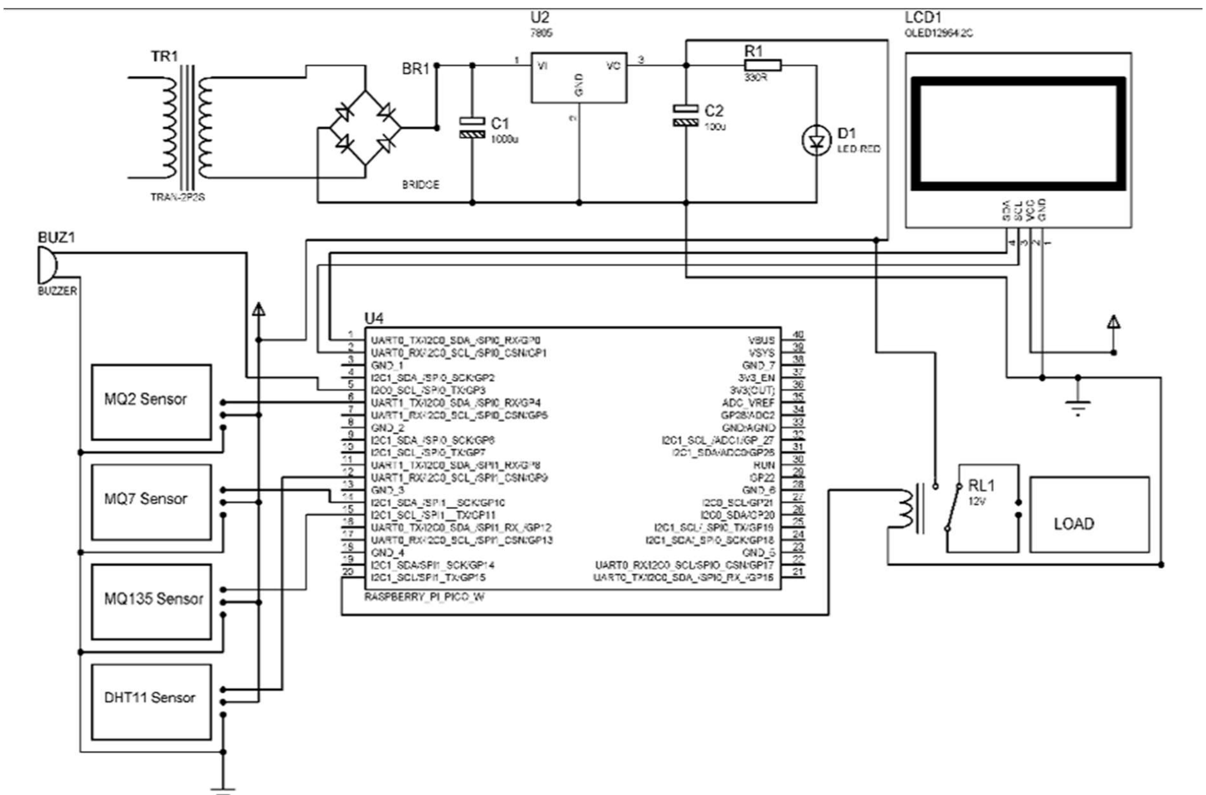

Figure 3: Schematic Diagram

International Journal of Artificial Intelligence and Communication Networks
Volume: 02, Issue: 01, January-March 2026, pp: 74-81
ISSN: 3071-3358

Result and discussion

Hardware implementation

The assembled prtotype in powerd on state. The small size (about 150mm* 100mm) makes it easy to handle. the entire hardware system was built and tested succrssfully as show in fig 5

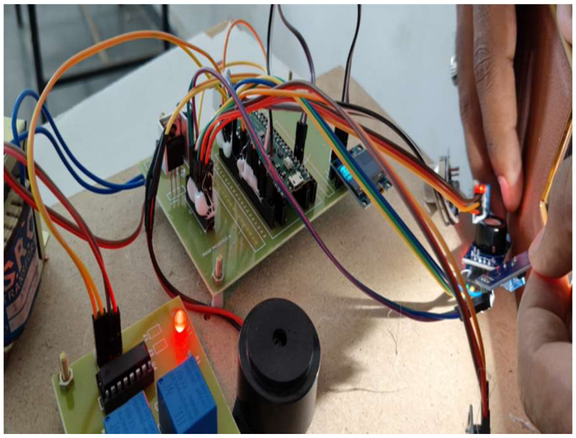

Fig 5; Hardware Kit In On Condition

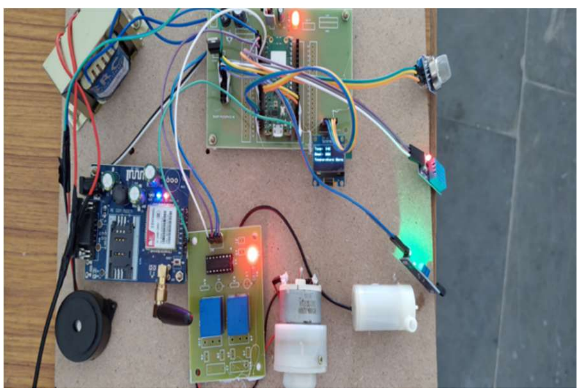

Fig 6: Hardware Kit In On Condition

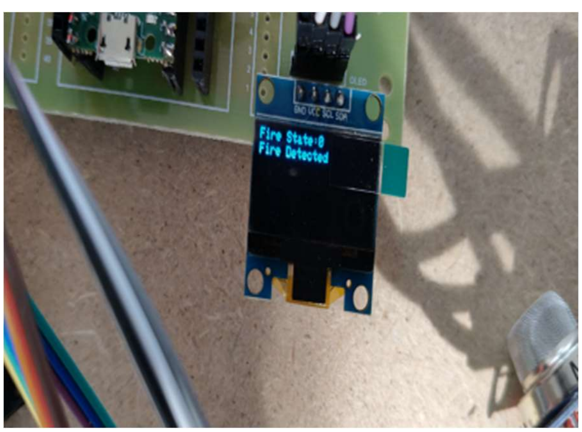

Fig 7: Oled Displaying Fire Is Detected

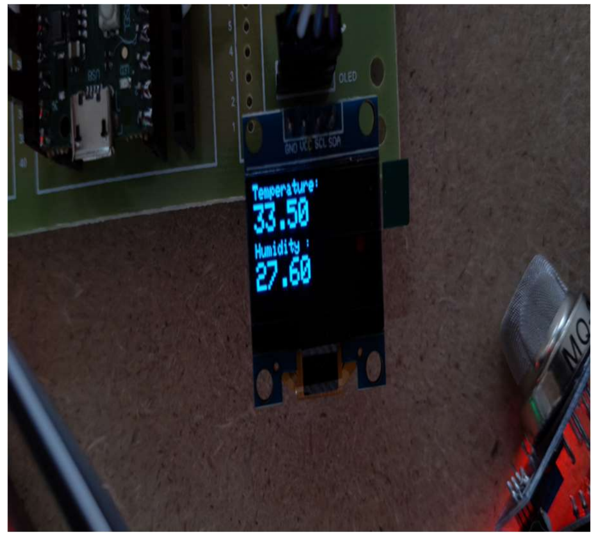

Fig 8: Oled Displaying Temperature And Humidity

Discussion

The issue of gas leakage and its potential implications with the use of liquefied petroleum gas for residential fuel necessitates the implementation of intelligent safety measures to protect against massive collateral damage and threat to individual safety. This study presented a monitoring system for tracking real-time information on LPG leakage. The system model uses 4-tier of IoT architecture to facilitate data sensing, sharing, processing, storage, analytical. The NodeMCU serves as cloud server and also as HTTP client enabling remote data connectivity and processing. A comprehensive software suite Blynk provided intuitive interfaces for easy visualization of the LPG variables such as gas leakage, humidity, temperature, and weight. In addition, the integration of IoT enabled the user to have online access to Blynk dashboard for continuous monitoring of LP gas leak status, and other changes in LPG variables in real time. Several experimental findings were presented to demonstrate the applicability and success of the designed system.

Conclusion

In conclusion, the proposed real-time LPG leakage monitoring system using IoT and cloud technology provides an effective and intelligent solution for enhancing domestic gas safety. By integrating sensors, NodeMCU, and cloud-based communication, the system is capable of continuously monitoring critical LPG parameters such as gas leakage, temperature, humidity, and cylinder weight. The use of a 4-tier IoT architecture ensures efficient data sensing, processing, storage, and remote accessibility, making the system reliable and suitable for smart home applications.

Future scopes

The proposed LPG leakage monitoring system can be improved further by adding more smart features and advanced technologies. In the future, an automatic gas shutoff valve can be connected to the system so that the gas supply is stopped immediately whenever leakage is detected. This can help reduce accidents and improve safety in homes, hotels, and industries.

The system can also be enhanced by integrating artificial intelligence and machine learning techniques to predict gas leakage patterns and identify abnormal conditions at an early stage. Mobile notifications through SMS, phone calls, or emergency alerts can be made faster and more reliable for better user response during critical situations.

Another possible improvement is the integration of the system with smart home automation platforms. This will allow users to control and monitor LPG safety devices along with other home appliances using a single application. Solar-powered operation and battery backup can also be added to ensure continuous monitoring during power

References

[1]. A. K. Saha, S. K. Das, and R. Roy, "IoT-based smart LPG gas leakage detection and monitoring system using cloud computing," *International Journal of Advanced Computer Science and Applications*, vol. 12, no. 4, pp. 412–420, 2021.

[2]. M. A. Hossain, M. R. Islam, and S. M. Hasan, "Design and implementation of an IoT-enabled LPG gas leakage monitoring and alert system," *Journal of King Saud University – Computer and Information Sciences*, vol. 35, no. 2, pp. 623–634, 2023.

[3]. S. R. Madakam, R. Ramaswamy, and S. Tripathi, "Internet of Things (IoT): A literature review," *Journal of Computer and Communications*, vol. 3, no. 5, pp. 164–173, 2015.

[4]. S. K. Ghai, A. Kumar, and P. K. Sharma, "Cloud-based IoT architecture for smart home safety monitoring using wireless sensor networks," *Sensors*, vol. 21, no. 9, Art. no. 3182, 2021.

[5]. M. Banzi and M. Shiloh, *Getting Started with Arduino*, 4th ed. Sebastopol, CA, USA: O'Reilly Media, 2022.

[6]. Raspberry Pi Foundation, *Raspberry Pi Pico W Datasheet*, Cambridge, U.K.: Raspberry Pi Foundation, 2023.

[7]. Winsen Electronics Technology Co., Ltd., "MQ-2 Semiconductor Gas Sensor Technical Data Sheet," Zhengzhou, China, 2022.

[8]. A. Al-Fuqaha, M. Guizani, M. Mohammadi, M. Aledhari, and M. Ayyash, "Internet of Things: A survey on enabling technologies, protocols, and applications," *IEEE Communications Surveys & Tutorials*, vol. 17, no. 4, pp. 2347–2376, 2015.

[9]. S. Kumar, R. Singh, and P. Verma, "Development of an intelligent LPG leakage detection and fire prevention system using IoT," *IEEE Access*, vol. 10, pp. 118425–118438, 2022.

[10]. B. K. Tripathy and J. Anuradha, *Internet of Things (IoT): Technologies, Applications and Challenges*. Boca Raton, FL, USA: CRC Press, 2022.

[11]. N. A. A. Rahman, M. H. Ibrahim, and M. A. Rahman, "Smart gas leakage detection and monitoring using Blynk IoT platform," *International Journal of Electrical and Computer Engineering*, vol. 12, no. 6, pp. 6128–6138, 2022.

[12]. A. Whitmore, A. Agarwal, and L. Da Xu, "The Internet of Things—A survey of topics and trends," *Information Systems Frontiers*, vol. 17, no. 2, pp. 261–274, 2015.

[13]. D. Evans, "The Internet of Things: How the next evolution of the Internet is changing everything," *Cisco Internet Business Solutions Group*, White Paper, 2011.

[14]. Y. Liu, H. Ning, and L. T. Yang, "Cyber-physical-social systems for smart environments: A cloud-enabled IoT perspective," *Future Generation Computer Systems*, vol. 108, pp. 1–12, 2020.

[15]. A. Singh, P. Sharma, and N. Kumar, "Real-time cloud-assisted LPG gas leakage monitoring using Raspberry Pi Pico W and IoT analytics," *International Journal of Intelligent Systems and Applications in Engineering*, vol. 12, no. 2, pp. 356–366, 2024.

[16]. Dr. Mohammed Abdul Bari,Arul Raj Natraj Rajgopal, Dr.P. Swetha ," Analysing AWSDevOps CI/CD Serverless Pipeline Lambda Function's Throughput in Relation to Other Solution", International Journal of Intelligent Systems and Applications in Engineering , JISAE, ISSN:2147-6799, Nov 2023, 12(4s), 519–526