

Gas Leakage Detection System Using IoT And cloud Technology : A Review

V Praveen Sharma^{1*}, *Dr Raman Dugyala*², *Dr V Padmavathi*³, *Vijendar Reddy Gurram*⁴

¹Department of Computer Science and Engineering, Chaitanya Bharathi Institute of Technology, Hyderabad-500075

² Department of Computer Science and Engineering, Chaitanya Bharathi Institute of Technology, Hyderabad-500075

³Department of Computer Science and Engineering, Chaitanya Bharathi Institute of Technology, Hyderabad-500075

⁴Department of Information and Technology, Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad-500090

Abstract. In industries and other locations gas leakage causes number of negative health effects .so an early detection of gas leakage and alertness will reduce the damage and save human life's. Gas leakage techniques, trends and sensors are constantly evolving, and it is important for developers and researchers to stay up-to-date on the latest advancements. This paper conducts a systematic literature review on current state of gas leakage detection using Internet of Things (IOT) and Cloud technology. It explores the various sensor-based and non-sensor based IOT systems available for gas leakage detection, and their relative advantages and disadvantages. Additionally, this review summarizes current trends and challenges in the field of gas leakage detection, and discusses future research directions for improving the reliability and accuracy of these systems. This literature review highlights the need for more efficient, cost effective, and scalable IOT-based solutions for gas leakage detection.

Keywords: IoT , MQ Sensor and Arduino.

1.1 Introduction

A collection of physical objects or things that are part of a network and have sensors, software, and other technologies built into them so they can connect to and share data with other systems and gadgets. These gadgets range from basic home furnishings to sophisticated industrial machines. Healthcare, agriculture, traffic monitoring, safety management, and environmental monitoring are just a few of the areas where IoT has become more significant. Due to the world's growing population, IoT applications like IoT

* Corresponding author: Praveensharmavivilala@gmail.com

in agriculture address the rising need for agricultural products. [1]. However, when young people relocate to large cities, the human resource essential for agricultural growth becomes unstable. In order to automate farming processes and supply food to the world, the Internet of Things and related technologies might be extremely important. It is crucial for managing safety protocols in the chemical industry, such as by keeping an eye on gas levels and ordering an evacuation in the event of a gas leak, as well as for monitoring and tracking the effects of chemical production on the environment, such as by calculating the emissions of hazardous substances and monitoring the disposal of waste. Due to the fact that the gas leakage detection system is different from other types of data sources, researchers face a number of challenges when using the IoT. We believe that security is the most crucial issue that has to be handled for IoT, which is one of the major concerns. Because the engineers working on your IoT programming lack security knowledge, your code is vulnerable to a number of bugs and your devices are open to unauthorised access [2]. Most consumers are usually taken aback by the entire prices, despite the fact that the infrastructure that IoT requires is expensive in and of itself. IoT projects are no different from other important initiatives in that they all have unforeseen costs. The cost of improvements, maintenance, design, replacing outdated equipment, and acquiring the requisite technical skill sets may quickly mount. Strong connectivity is a must for IoT devices to collect and transmit data, but this isn't always the case. When connecting several physical devices, cloud servers, and apps, connectivity is essential to the success of your project. Chemical disasters may have catastrophic impacts on humans, resulting in deaths as well as damage to the environment and property. Chemical disasters pose the greatest risk to industrial plants, their staff, residents of neighbouring towns, tenants of nearby buildings, and the general public.1) Failures of the process and safety mechanisms are one way that chemical disasters might happen. 2) Personal weaknesses Mistake in technical terms 4) Error in management The greatest chemical accident in history took place in India. The deadliest industrial chemical disaster in history, the Bhopal Gas Tragedy, happened in India in 1984. Due to the unintended release of the lethal gas methyl isocyanide (MIC), the Bhopal Gas catastrophe—the most horrific chemical disaster in history—saw the deaths of over 2500 people. These mishaps cause severe wounds, agony, suffering, deaths, property destruction, and environmental degradation. India kept having a run of chemical catastrophes even after Bhopal revealed the nation's susceptibility. About 130 catastrophic chemical accidents with 259 fatalities and 563 major injuries in India during the previous 10 years have been recorded. The most often utilised industrial gases include butane, propane, hydrogen, oxygen, acetylene, and argon. Therefore, early gas leak identification and warning by SMS and other means can aid in preventing casualties from a tragedy.

1.2 Related Work

Gas Leakage Detection using IoT

Proposed a two-way safety stove featuring a gas leak detection feature and a kid lock mechanism. Our main concern is that a child wouldn't understand how to turn on the burner. Our gear consists of a Raspberry Pi and a buzzer-equipped gas detecting module. Additionally, for system execution, we use a Haar Cascade object detection method and a deep learning architecture (CNN) [1]. The purpose of this system is to find the leak and provide an alert so that building occupants may maintain appropriate ventilation and stop the leak. The system was built utilizing an integrated circuit and a MQ-9 chemical sensor, and during testing it gave accurate visual information as well as an audible and timely notice [2]. In this article, an IoT-based model for gas detections is presented utilizing an

Arduino UNO (internet of things). Gas leaking odour is discovered using the fuel sensor. The LCD comes on when there is a gas leak. In the case of a gas leak, both the LCD and GSM modem will turn ON. By using a GSM modem, the customer will get SMS messages alerting them to gas leaks [3]. The primary goal of this study is to review the research on gas alarm systems, the difficulties they encounter, and the effects of installing them in people's homes or workplaces for security reasons. Installing a gas alarm detection system is anticipated to aid in preventing such incidents, especially with the Recent technological advancements will help to secure people's homes, businesses, hospitals, industries, and institutions. Our homes can be controlled and watched for fires and explosions with the aid of gas detection systems [4]. The MQ-6 sensor and a solenoid valve are used in a detection system to locate gas leaks and shut off the gas supply. The investigation involved utilizing a preset programmer to evaluate the sensor's voltage. Based on tests conducted by narrowing the gas escape path to give a faster rate effect so that the sensor can detect gas [5]. Liquid petroleum gas (LPG), which is extremely flammable, can burn even a ways from the site of the leak. The key contributing element in the majority of fire incidents is poor construction. Therefore, developing a system to alert of gas leakage is essential. As a consequence, the technique for identifying gas leaks and warning passengers is offered in this paper. The MQ-6 gas sensor is used to find LPG [6]. The purpose of this article is to raise awareness of the dwindling gas weight in the compartment and to implement an IOT gas request. The booking and arrangement for the gas are complete, and support IOT and that a heap cell connected to a microcontroller is used to complete the consistent weight estimation (to contrast and a perfect esteem). In order to ensure the safety of the pack and gas holder, we have a MQ-2 (gas sensor) and LM 35 (temperature sensor) that will identify the local environment in the event of an error [7]. A gas warning device can warn nearby operators of a potential gas leak and give them time to flee using sensors to locate potentially hazardous gas leaks To warn individuals when harmful gas has been identified, these sensors frequently emit an audible alarm. In this work, a design for an Internet of Things-based gas leak detection system that can automatically identify and alert users to gas leaks is proposed. The suggested system also has a warning mechanism for users [8].

Gas leakage detection combining both on IoT and cloud technology

The suggested model is made up of sensor devices that detect environmental values like Voltage, as well as the current characteristics of the many household appliances are used to calculate power usage. The IoT platform Xively gives channel utility to deploy the prototype into an integrated solution and provides the framework for connecting the smart sensor to the internet [9]. This project aimed to prevent industrial mishaps, monitor hazardous chemicals, and communicate alert messages to the industry's safety control board. The central board is an Arduinio Uno R3 board. a microcontroller that is linked to a sensor Including sensors that can continuously monitor their respective environmental conditions, such temperature, gas sensors, and alcohol sensors. Data from the sensor is stored online so that it can be processed further and evaluated to increase safety [10]. Throughout this study, a wireless gas leak detection and localization method is proposed. 60 propane Releases occur using a wireless monitoring network of 20 devices covering 200 m2. The methodology is assessed once the detection and localization methods mentioned here are used on the concentration data that have been gathered. With seven false alarms logged over a three-day period and an average detection latency of 108 seconds, a detection rate of 91% is reached. The localization results indicate a 5 m accuracy [11]. The Internet of Things (IoT) provides the foundation for the proposed monitoring gas leakage detecting system. The system's main microcontroller is a Node MCU ESP8266 Wi-

Fi module. the MQ2 sensor will determine the gas concentration, and the ESP8266 will transmit the data reading from the gas sensor to the Blynk IoT platform [12]. The goal of this project study is to create a tool that effectively identifies and avoids wireless risks using technology and the internet of things (IoT). A gadget composed of the microcontroller Arduino UNO and the node WiFi module and node mcu ESP8266 connected to the internet and communicated with each other to provide notifications and warnings to users. [13]. In order to ensure both personal and environmental safety, the main goals of this work are to perform a review of the literature on IoT-based gas detection systems. The MQ5 gas sensor and Arduino Uno controller used in the gas leakage detection system are combined with cloud storage to collect data as well as store and analyse data [14]. In this study, a novel approach for quick pipeline leakage detection and location identification using lead zirconate titanate (PZT) sensors is suggested. The pipeline's leaking causes a stress wave known as the negative pressure wave (NPW), which travels from the leakage location to both ends of the pipeline. So, hoop strain fluctuation along the pipe wall and the NPW are related. Five manually controlled leakage spots could be located accurately [15]. Pipeline vibration modes with acceleration magnitudes as low as one g were found in the experiment. Spectral integration of time-averaged DAS signals in frequency is a straightforward leak detection technique. Regarding the practical usability of the proposed monitoring strategy, potential advantages and limits were highlighted. We showed that the method may be useful for monitoring short- and medium-length gas pipelines since it may be able to detect and localise leaks in gas pipelines with leak rates as low as 0.1% of the flow volume [16]. The Internet of Things (IoT) provides the foundation for the proposed monitoring gas leakage detector system. Wi-Fi Node MCU ESP8266 which serves as the system's microcontroller, is used. The presence of flammable gases is determined using the combustible gas sensor (MQ2). ESP8266 will transmit the gas sensor's data reading to the Blynk IoT platform via an iOS phone; Using the Things peak IoT Platform, data visualization is performed. A fan will also turn on as soon as a leak appears coupled that buzzes alarmingly [17]. Using the Sim900 SMS Gateway, Arduino Uno R3 Microcontroller, and MQ2 gas sensor as its core components, the gas leak detecting system's technological improvement is discussed in this article [18]. The goal of this project is to create a system for tracking and detecting liquefied petroleum gas leaks. Gas sensor is used to identify gas leaks confined to LPG gas only. For gas detection, a physical alarm alert with a buzzer is installed, but a non-physical alarm alert with email and notice sent to the user via smartphone has been designed, the Blynk application is utilised as an IoT platform for monitoring. [19]. This study looks at how to build a gas detection prototype (software and hardware) and how well it performs in terms of detecting both LPG and natural gas. By connecting them to the Arduino UNO, you can measure humidity and temperature in (oC, oF), as well as (LPG) and smoke using the MQ2 sensor and the DHT11 sensor [20]. In order to detect LPG gas leaks, a wireless sensor network was developed, as described in this study. An XBee, a gas sensor, and an Arduino Nano are all components of the suggested design. The monitoring system, which uses Lab VIEW GUI to show data, receives data from the gas sensor through XBee. The mobile phone unit and microcontroller unit communicated with each other using a GSM module [21]. In order to detect LPG fuel leakage we have developed a system. The use of a MQ5 gas detection sensor in the construction of the device is encouraged by us at this time. A gas leak from storage will be detected if the LPG sensor detects one. Utilizing, this signal is tracked both the microcontroller and it will detect the gas leak [22]. The auto-correlation function (ACF) of the normal concentration segment is used in this paper to provide a detection method to address these issues. By computing the correlation coefficients between ACFs, the feature of each normal segment is determined. A non concentration threshold is chosen to detect the real-time data in accordance with the statistical analysis's properties. Furthermore, the

weighted fusion technique using the sensors' separation data from multiple sensors is combined, and a virtual leak source is used [23]. The goal of this project is to create a system that is affordable and uses an Arduino microcontroller to detect residential LPG leaks while yet allowing for some user interaction. This system includes a MQ2 gas leakage sensor and an ESP8266 Wi-Fi module that utilizes the "Internet of Things" to send the user a warning message through email using the Blynk app, so long as there is an internet connection [24]. The study creates an, LPG gas leakage detector. The presence of gas is discovered using MQ2 gas sensors. Automatic notification and warning sent to user's smartphone using Blynk If leaking occurs, users can access an app on their phone [25]. Building a method to find liquefied petroleum gas leaks is the aim of this project. Since people don't usually notice when gas leaks happen, the methodology and objective of this article are to develop a gas leak detector using IoT and a variety of notification techniques to inform users the presence of a gas leak. By means of a software called Proteus, the circuit for the LPG leakage detection system is built With the help of the smartphone app Blynk [26]. The purpose of this article is to raise awareness of the dwindling gas weight in the compartment and to implement an IOT gas request. The booking and arrangement for the gas are complete, and support IOT and that a heap cell connected to a microcontroller is used to complete the consistent weight estimation (to contrast and a perfect esteem). In order to ensure the safety of the pack and gas holder, we have a MQ-2 (gas sensor) and LM 35 (temperature sensor) that will identify the local environment in the event of an error [27]. The proposed system will constantly check the environment for leaks. It will notify the user of any leakage using a buzzer, Both an Android application and an Ethernet shield module were used. Additionally, utilizing social media, it will alert the user to environmental factors such as the temperature and gas level at the installation site. via social media platforms like Twitter or email notice [28]. The idea offers a fresh approach to protecting residential and commercial structures from starting fires while simultaneously informing the user as soon as gas and fire are detected. It uses the IOT system to notify the user through an application when a fire is detected. The module turns off the neighboring circuit board using an H-bridge as soon as the gas is detected, preventing any nearby electrical devices from becoming a fire source. Additionally, it activates the ventilator fan to release the gases [29].

2 Technologies used in Gas Sensing

Gas detectors frequently use the scaling approach to locate hazardous gases. When a dangerous gas crosses the top threshold of the scale and rises over its base level, an alarm is generated. Gas sensors typically recognise flammable and toxic gas kinds. Catalytic sensors can be used to find combustible gases. The resistance varies when a gas concentration increases and comes into touch with the catalytic surface, which activates the alarm. If a gas crosses the path of light between the transmitter and the receiver, an infrared sensor, which is also a light detector, can detect it. Electrochemical sensors are often used to detect hazardous substances by using signals produced on the electrode. MOS technology comes in a variety of forms, designated by the letters MQ-2 through MQ-9. It is possible to detect H₂, LPG, CH₄, CO, alcohol, smoke, or propane with the Gas Sensor MQ2 gadget. This module, Gas Sensor MQ3, is useful for detecting alcohol, benzoine, CH₄, hexane, and LPG[30]. The MQ-4 Natural Gas Sensor is a reliable, rapid way to detect natural gas as well as methane, propane, and butane. Using the Gas Sensor MQ5 module, you can find gas leaks. It may be used to find alcohol, H₂, LPG, CH₄, and other substances. The MQ-6 is a simple-to-use instrument for measuring LPG airborne concentrations. In pure air, MQ-7's conductivity is diminished. It uses a cycle of high and low temperatures to detect CO. Use

the MQ-8 Hydrogen Gas Sensor to measure the quantity of hydrogen (H₂) in the atmosphere. The MQ-9 Analogue Gas Sensor has a high sensitivity for carbon monoxide, methane, and propane.

3 Conclusions & Future Scope

A potential approach for enhancing the efficiency, accuracy, and scalability of gas detection procedures has been identified as the integration of IoT and cloud technologies in gas leakage detection systems. Real-time monitoring, data analysis, and gas leak response are made possible by the combination of these technologies. Furthermore, the use of cloud-based computing and storage makes it possible to handle data effectively and include advanced analytics and machine learning algorithms for better system performance. The evaluation also emphasizes the necessity for resolving privacy and security issues related to the use of cloud-based gas leak detection technologies. Therefore, future research in this field should give priority to the creation of plans that can satisfactorily solve these issues and guarantee the security and safety of these systems. The implementation of a gas leakage detection system using IoT and cloud technologies is advised based on the literature review. The integration of a GPS module to identify the location of gas leaks should be part of this system, along with cloud-based storage for sensor data. Smoke leaking can also be discovered using a smoke sensor. A GSM module, Arduino microcontroller, fire sensor, and MQ 2 Gas sensor should also be included in the system for optimum performance. In conclusion, there is a lot of potential for revolutionising gas leakage detection procedures through the integration of IoT and cloud technologies, hence assuring the safety and security of gas-based detection systems. Future research and development efforts in this field have hope thanks to the suggested gas leakage detection system, which makes use of IoT and cloud technologies.

References

- [1] Chandran, Ananya, and S. Kavitha. "A Smart Gas Stove with Gas Leakage Detection and Multistage Prevention System Using IoT." *International Journal of Modern Developments in Engineering and Science* 1.9 (2022)
- [2] Falohun, A. S., et al. "Dangerous gas detection using an integrated circuit and MQ-9." *International Journal of Computer Applications* 135.7 (2016).
- [3] Ravisankar, B., et al. "Smart Detection System for LPG Gas Leakage using IoT." *2022 6th International Conference on Computing Methodologies and Communication (ICCMC)*. IEEE, 2022.
- [4] Baballe, Muhammad Ahmad, and Mukhtar Ibrahim Bello. "Gas leakage detection system with alarming system." *Review of Computer Engineering Research* 9.1 (2022)
- [5] Tommy, Alexander. "Implementation of a Gas Leakage Detection System Using the MQ-6 Sensor." *Brilliance: Research of Artificial Intelligence* 2.1 (2022).
- [6] Leavline, E. Jebamalar, et al. "LPG gas leakage detection and alert system." *International Journal of Electronics Engineering Research* 9.7 (2017): 1095-1097.
- [7] Rajan, B., et al. "IoT Based Smart Gas Cylinder Platform Senses LPG Gas Leakage and Reorder Booking System.
- [8] Woishe, Methila Farzana, et al. "A Secured Model of IoT-based Smart Gas Detecting and Automatic Alarm System." *International Journal of Computer and Information System (IJCIS)* 3.2 (2022)

- [9] Sinha, Nitin, Korrapati Eswari Pujitha, and John Sahaya Rani Alex. "Xively based sensing and monitoring system for IoT." *2015 International Conference on Computer Communication and Informatics (ICCCI)*. IEEE, 2015.
- [10] Srinivas, Chalasani, and Ch Mohan Kumar. "Toxic gas detection and monitoring utilizing internet of things." *International Journal of Civil Engineering and Technology* 8.12 (2017)
- [11] Chraim, Fabien, Yusuf Bugra Erol, and Kris Pister. "Wireless gas leak detection and localization." *IEEE Transactions on Industrial Informatics* 12.2 (2015)
- [12] Jumaa, Noor Kareem, et al. "IoT Based Gas Leakage Detection and Alarming System using Blynk platforms." (2022).
- [13] Rosli, Amirul Afiq, and Mohammad Faiz Liew Abdullah. "Automated Smoke and Gas Leakage Detector with IoT Monitoring System in Rural Area." *Evolution in Electrical and Electronic Engineering* 3.1 (2022)
- [14] Subramanian, M. Athish, et al. "Gas Leakage Detection System using IoT with integrated notifications using Pushbullet-A Review." *2020 Fourth International Conference on Inventive Systems and Control (ICISC)*. IEEE, 2020.
- [15] Zhu, Junxiao, et al. "Gas pipeline leakage detection based on PZT sensors." *Smart Materials and Structures* 26.2 (2017)
- [16] Stajanca, Pavol, et al. "Detection of leak-induced pipeline vibrations using fiber—Optic distributed acoustic sensing." *Sensors* 18.9 (2018)
- [17] Jumaa, Noor Kareem, et al. "IoT Based Gas Leakage Detection and Alarming System using Blynk platforms." (2022).
- [18] Tombeng, Marchel Thimoty. "Prototype of gas leak detector system using Microcontroller and SMS Gateway." *Cogito Smart Journal* 3.1 (2017)
- [19] Ab Ghafar, Aimi Syamimi. "Liquefied Petroleum Gas (LPG) leakage detection and monitoring system." *Journal of Science and Technology* 10.3 (2018).
- [20] Burjes, Ammar Yaseen, Ghader Salim Aziz, and Haneafa Yahya Najm. "Design a mobile gas sensing system using arduino Uno with recording and monitoring data." *Web of Scientist: International Scientific Research Journal* 3.8 (2022)
- [21] Mujawar, T. H., et al. "Development of wireless sensor network system for LPG gas leakage detection system." *International Journal of Scientific & Engineering Research* 6.4 (2015)
- [22] Leavline, E. Jebamalar, et al. "LPG gas leakage detection and alert system." *International Journal of Electronics Engineering Research* 9.7 (2017)
- [23] John, Alan M., et al. "LPG/CNG gas leakage detection system with GSM module." *International Journal of Advanced Research in Computer and Communication Engineering* 6.5 (2017): 536-540
- [24] Dong, Linxi, et al. "The gas leak detection based on a wireless monitoring system." *IEEE Transactions on Industrial Informatics* 15.12 (2019).
- [25] Hannan, M. Abdul, et al. "Development of LPG leakage detector system using arduino with Internet of Things (IoT)." *Journal of Telecommunication, Electronic and Computer Engineering (JTEC)* 10.2-7 (2018)
- [26] Subri, Siti Sunaidah Sukma Bt, Rosniza Bt Ramli, and Norkiah Bt Mat Zaki. "LPG Gas Leakage Detector Using Blynk Application." (2022).
- [27] Shamsudin, Asma Afifah Ahmad, and Elfarizanis Baharudin. "IoT-based LPG Leakage Detector System with Safety Alert Mechanism." *Evolution in Electrical and Electronic Engineering* 2.2 (2021)
- [28] Rajan, B., et al. "IoT Based Smart Gas Cylinder Platform Senses LPG Gas Leakage and Reorder Booking System.""
- [29] Shruti Bhoir , Snehanjali Goregaonkar "IoT Based Gas Detection System"

- [30] Kumar, Mendi Manoj, et al. "Design and implementation of IOT based Gas detection & fire extinguishing System." *International Journal* 9.7 (2021).