IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 8.414 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 14, Issue 3, March 2026

DOI: 10.17148/IJIREEICE.2026.14318

"IOT BASED GAS LEAKAGE DETECTION AND AUTOMATION CONTROL"

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Abstract: Industrial gas leakage poses serious risks to human life, industrial assets, and the environment. Accidental leakage of toxic or combustible gases can lead to catastrophic events such as explosions, fires, equipment damage, and severe health hazards to workers. Therefore, early detection, continuous monitoring, and rapid control of gas leaks are essential to ensure industrial safety and minimize potential losses. This project, titled "IoT-Based Industrial Gas Leakage Detection & Automated Control," proposes an intelligent, automated, and reliable system for real-time detection and management of hazardous gas leakage in industrial environments.

The proposed system employs sensitive gas sensors to continuously monitor the presence and concentration of harmful gases in the surrounding atmosphere. The sensor data is processed by a microcontroller equipped with internet connectivity. When the detected gas concentration exceeds a predefined safety threshold, the system immediately initiates automated safety actions. These actions include activating audible and visual alarms to alert nearby personnel and closing the gas supply through a servo motor-controlled valve to prevent further leakage. This automated response significantly reduces the dependency on manual intervention and minimizes reaction time during emergency situations.

In addition to local safety measures, the system integrates Internet of Things (IoT) technology to provide real-time monitoring and remote accessibility. Gas concentration data, system status, and emergency alerts are transmitted to a cloud-based IoT platform and can be accessed through a web or mobile application. This enables industry operators and safety authorities to monitor conditions remotely, analyze data trends, and take timely preventive or corrective actions even from distant locations.

The proposed system is designed to be cost-effective, energy-efficient, and easy to implement, making it suitable for both small-scale and large-scale industrial setups. By combining sensing, automation, and IoT-based communication, the system enhances workplace safety, reduces the risk of industrial accidents, and improves overall operational reliability. The solution can be effectively deployed in chemical plants, oil refineries, gas pipelines, storage facilities, manufacturing industries, and other hazardous environments where gas leakage detection and control are critical.

I. INTRODUCTION

Gas leakage is a major safety issue in industries, laboratories, and residential environments. Leakage of hazardous gases such as LPG, methane, carbon monoxide, or other industrial gases can lead to dangerous situations including fire accidents, explosions, environmental pollution, and serious health problems. Therefore, early detection and quick response to gas leaks are essential to ensure the safety of people, equipment, and infrastructure.

Traditional gas detection systems often depend on manual monitoring or standalone alarms that only alert nearby people. These systems may not provide real-time monitoring, remote alerts, or automatic control mechanisms. As industries are becoming more automated, there is a growing need for smart systems that can detect gas leaks quickly and respond automatically to prevent accidents.

The Internet of Things (IoT) technology provides an effective solution for this problem. IoT enables devices and sensors to connect to the internet and communicate with each other in real time. In an IoT-based gas leakage detection system, gas sensors are used to continuously monitor the concentration of gases in the environment. When the gas level exceeds a safe threshold, the system immediately detects the leakage and sends alerts to users through the internet using mobile applications or cloud platforms.

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In addition to detection and alerts, the system can also perform automated control actions. These actions may include activating alarms or buzzers, turning on exhaust fans to remove the gas, or closing gas valves using servo motors to stop the gas supply. This automation helps to reduce response time and minimize the risk of accidents.

Thus, the IoT-Based Gas Leakage Detection and Automated Control system provides a smart, reliable, and efficient solution for continuous monitoring, early detection, remote notification, and automatic control of gas leaks. This technology improves safety, reduces human intervention, and helps prevent major industrial and residential disasters.

II. LITERATURESURVEY

Here is a simple literature review / literature survey you can use for the topic "IoT-Based Gas Leakage Detection and Automated Control." You can use this in a mini project report, seminar, or thesis.Literature Review: IoT-Based Gas Leakage Detection and Automated Control

1. Overview of Gas Leakage Detection Systems: Gas leakage is a major safety hazard in industries, homes, and laboratories because it can cause fires, explosions, and health risks. Traditional gas detection systems rely on manual monitoring or basic alarm systems, which may not provide timely alerts. The development of Internet of Things (IoT) technology enables continuous monitoring, remote alerts, and automated control mechanisms to improve safety and reliability.

IoT-based gas detection systems use gas sensors, microcontrollers, communication modules, and cloud platforms to detect gas leaks and automatically trigger safety actions such as alarms, ventilation, or gas supply shutdown.

2. Existing Research Works: Study 1: IoT Enabled Gas Leak Detection and Safety Automation System A research study proposed an IoT-based gas leak detection system using MQ-6 gas sensor and NodeMCU ESP8266 microcontroller. The system continuously monitors gas concentration levels and sends real-time alerts when gas levels exceed a thres hold. The system also performs automated actions such as:
* Triggering buzzer and LED alerts
* Shutting off gas supply using a solenoid valve
* Opening windows using a servo motor for ventilation. This system improves safety by providing real-time monitoring and automatic response mechanisms.

Study 2: Portable IoT Gas Leak Detection System Another study proposed a portable gas leak detection system using IoT sensor nodes. Sensors are placed close to potential leakage points to detect hazardous gases quickly. The collected sensor data is processed using a microcontroller and transmitted wirelessly to a monitoring station through IoT connectivity. The system generates audio and visual alerts when gas leakage is detected.This method enables remote monitoring and faster response, reducing damage caused by gas leakage.

Study 3: IoT-Based Smart LPG Gas Leakage Monitoring System A smart home-based LPG gas leakage detection system integrates ESP32 microcontroller, MQ-2 gas sensor, buzzer, and mobile applications for monitoring gas levels.

The system sends notifications through a mobile application when abnormal gas levels are detected. This allows users to monitor gas levels remotely and take quick preventive actions.

Study 4: IoT Monitoring System for Smoke and Gas Detection Another research study developed a gas and smoke detection system using Arduino UNO and NodeMCU Wi-Fi module. The device detects gas leaks and sends warning notifications via IoT connectivity. Experimental testing showed that the system achieved approximately 83% detection efficiency, proving its ability to monitor gas leakage in real environments.

3. Technologies Used in IoT Gas Leakage Detection Common technologies used in gas leakage detection systems include:

Gas Sensors
* MQ-2 sensor
* MQ-6 sensor
* MQ-135 sensor

These sensors detect gases such as LPG, methane, carbon monoxide, and smoke.

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Microcontrollers
* Arduino UNO
* NodeMCU ESP8266
* ESP32
They process sensor data and control the system.
Communication Technologies
* Wi-Fi
* GSM/GPRS
* Cloud IoT platforms
These technologies allow remote monitoring and alert notification.

4. Automated Control Mechanisms
IoT-based gas leakage systems often include automated safety actions such as:
* Turning buzzer or alarm ON
* Sending SMS or mobile notifications
* Closing gas valves automatically
* Activating ventilation systems or fans
* Sending data to cloud monitoring systems
These automated controls reduce response time and prevent accidents.

5. Research Challenges
Although IoT gas leakage systems provide many advantages, several challenges still exist:
* Sensor calibration and accuracy
* False alarms due to environmental factors
* Power consumption of IoT devices
* Network reliability and latency

III. PROBLEM STATEMENT

Gas leakage in industries, laboratories, and residential areas is a major safety concern that can lead to fire accidents, explosions, environmental pollution, and health hazards. Traditional gas detection systems often require manual monitoring and may not provide real-time alerts or immediate control actions. Due to the absence of continuous monitoring and automated response systems, gas leaks may remain undetected for a long time, increasing the risk of severe damage and loss of life.Therefore, there is a need for an intelligent system that can continuously monitor gas levels, detect leakage at an early stage, and automatically take necessary actions. An IoT-based gas leakage detection and automated control system can help in real-time monitoring of gas concentration using sensors and transmit data through the internet. When a gas leak is detected beyond a safe limit, the system can automatically trigger alarms, send alerts to users, and control devices such as exhaust fans or shut-off valves to minimize danger and ensure safety.

IV. BLOCK DIAGRAM

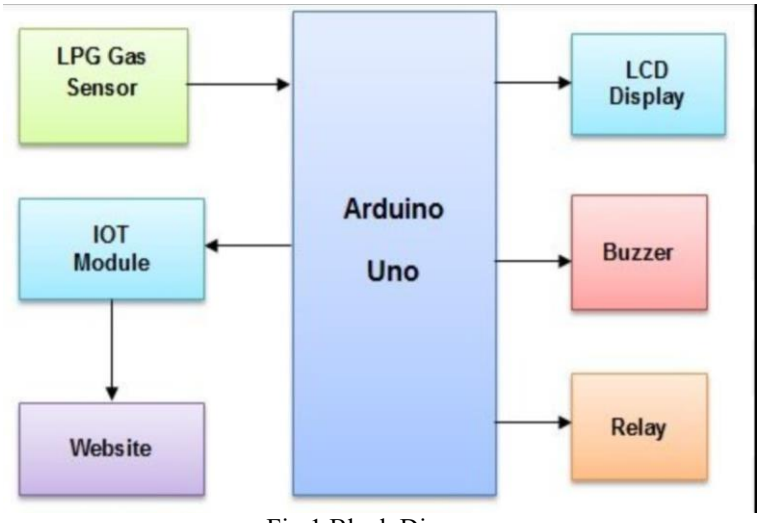

Fig:1 Block Diagram

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V. CIRCUIT DIAGRAM

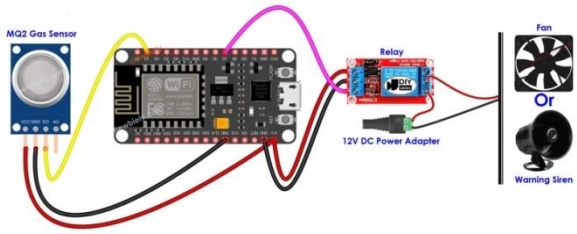
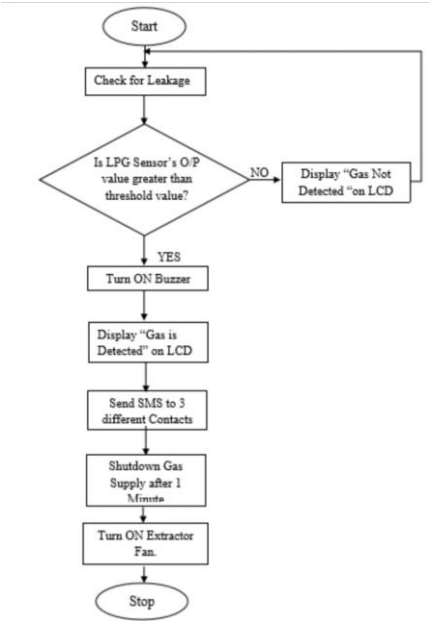


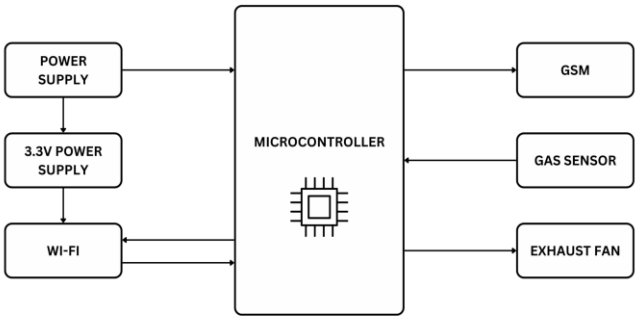
Fig:2 circuit diagram

VI. FLOW CHART



VII. SYSTEM ARCHITECTURE OVERVIEW

An IoT-based gas leakage detection and control system provides a proactive safety net by integrating real-time monitoring with automated physical responses. At its core, a gas sensor (like the MQ series) continuously monitors the air for specific concentrations of LPG, butane, or methane. When gas levels exceed a safe threshold, a microcontroller (such as an ESP32 or Arduino) immediately triggers a local buzzer and activates a solenoid valve or motor to physically shut off the gas supply. Simultaneously, the system uses Wi-Fi connectivity to send data to an IoT cloud platform, pushing instant emergency alerts to a user's smartphone via SMS, email, or a dedicated app. This loop ensures that even if no one is home, the leak is contained at the source while the owner is notified of the danger.



System architecture of iot based gas leakage detection and automated control

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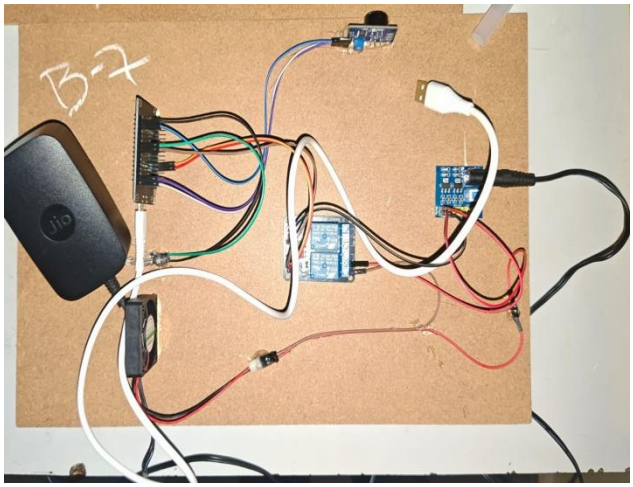
VIII. WORKING PRINCIPLE

The working principle of an IoT-based gas leakage detection and automated control system is based on continuous monitoring of gas concentration using sensors connected to a microcontroller and the Internet. In this system, a gas sensor (such as an MQ-series sensor) detects the presence and concentration of hazardous gases like LPG, methane, or carbon monoxide in the surrounding environment. The sensor converts the gas concentration into an electrical signal, which is sent to a microcontroller (such as Arduino or NodeMCU). The microcontroller processes this data and compares it with a predefined safety threshold. If the gas level exceeds the safe limit, the system immediately triggers alerts such as a buzzer or notification to a mobile application or cloud platform through the Internet of Things (IoT). At the same time, the automated control mechanism activates safety devices like exhaust fans, relays, or servo motors to shut off the gas supply or ventilate the area. This ensures early detection, real-time monitoring, and automatic response to prevent accidents, fires, or health hazards in industrial or domestic environments.



IX. RESULTS AND DISCUSSION

The proposed approach can be implemented in IOT basics and stored in thinkspeaks.com. The graph representation provides the field chart for gas leakage and monitoring levels. We can monitor the sensors anywhere and anytime using cloud framework. The chart represents for gas sensor levels to identify the gas leakage. The ThinkSpeak is a Cloud in which it can receive the sensors data via Wi-Fi Module and it can represent the data as a field graph in the various parameters. The ThinkSpeak can generate the api key. The Api key can be given in source code. By Giving SSID and Password we can connect the wi-fi module with the thinkspeak services.

X. CONCLUSION

The IoT-Based Gas Leakage Detection and Automated Control system provides an effective solution for improving safety in industrial and domestic environments. By using gas sensors, microcontrollers, and IoT communication technologies, the system continuously monitors gas concentration levels and detects leakage at an early stage. When a gas leak is identified, the system automatically triggers alerts and activates control mechanisms such as shutting off gas supply or turning on ventilation systems. This helps in preventing accidents like fires, explosions, and health hazards. The integration of IoT also allows real-time monitoring and remote access through mobile or web applications, making the system more efficient and reliable. Overall, this technology enhances safety, reduces human intervention, and ensures quick response to gas leakage situations.

XI. FUTURE WORK

The future scope of IoT-based gas leakage detection and automated control systems is very promising due to the rapid growth of smart technologies and industrial automation. In the future, these systems can be integrated with advanced sensors and artificial intelligence (AI) to improve the accuracy and speed of gas leak detection. Real-time data analytics and cloud computing can help industries monitor gas levels continuously from remote locations and take immediate preventive actions. Additionally, the system can be connected with smart safety mechanisms such as automatic shut-off valves, alarm systems, and emergency ventilation to minimize risks. With the development of smart industries and smart cities, IoT-based gas monitoring systems can also be used in homes, hospitals, laboratories, and public places to enhance

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safety. Overall, future improvements in IoT technology, wireless communication, and machine learning will make gas leakage detection systems more reliable, efficient, and widely used.

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