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Smart Gas Leakage Detection Using IOT

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Abstract
A gas leak results in financial and personal loss. Great efforts have been focused on avoiding such a leak and creating trustful methods of detection of leaks by sensors. Such sensors typically give an alarm after sensing a harmful gas near them. The following is a system that detects a gas leakage from cylinders that alerts the user through the application. The system is composed of an LPG gas leakage sensor that transmits an alarm signal. The primary aim is to establish an Internet of Things (IoT) system for gas leakage, combined with voice notification and automated exhaust fan switching. It is safer by way of fast response to gas leakage, and hence it can be used in diverse environments, ranging from domestic settings to industrial compounds. The project facilitates environmental conservation, energy efficiency, and accessibility in promoting safer and more sustainable communities. Upon sensing a gas leak, the system reacts with real-time voice alarms, alerting occupants in real-time and enabling them to make necessary precautions. At the same time, automated exhaust fan controls are triggered to dissipate the gas and mitigate the environmental impact.

Keywords: *Gas Leakage Detection, Internet of Things (IOT), Liquefied Petroleum Gas (LPG), Sensor Technology, Voice Alerts, Automatic Exhaust Fan Activation.*

1. Introduction
Gas leaks are highly dangerous to individual safety and financial security, calling for efficient detection and response measures. Conventional gas detection systems are not able to reach people in time, particularly in tall or big buildings. In this regard, this paper suggests an innovative Internet of Things (IoT) gas leakage detection system from Liquefied Petroleum Gas (LPG) cylinders.

- **Importance of the Work:** Gas leaks are likely to result in serious adverse effects, ranging from damage to property, to injuries, to loss of lives. Demand for improved safety practices in different surroundings, such as homes and workplaces Thus, working on sophisticated gas detection systems is important for boosting safety and reducing risks related to gas leaks.
- **Objective:** The main goal of this study is to develop and establish an IoT-based gas leakage detection system with real-time monitoring and quick response functions to enhance safety in different environments. The system seeks to promote safety and prevent the potential dangers associated with gas leaks [1-3].
- **Project Description and Features:** The suggested system consists of an LPG gas leakage detector with sensitive sensors to detect trace gas concentrations. It has voice alerts through a smartphone app to provide occupants with instant notification of gas leaks, as well as automatic exhaust fan operation for dissipating leaked gas, improving accessibility and ease of use.
- **Social Impact:** By improving gas safety and reducing environmental footprint. The IoT-based gas leakage detection system is likely to have a far-reaching social impact by enhancing safety standards in diverse environments. By offering quick response capabilities, the system prevents accidents, saves lives, and reduces property loss, thus contributing to safer and more resilient communities.
- **Challenges:** The implementation and deployment of the IoT-based gas leakage

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detection system are also accompanied by a number of challenges such as sensor calibration, network connectivity, and reliability of the system. Ensuring sensor reading accuracy and reliability and solving compatibility issues with the installed infrastructure are main challenges that have to be addressed.

- **Limitations:** The implementation and deployment of the IoT-based gas leakage detection system are also accompanied by a number of challenges such as sensor calibration, network connectivity, and reliability of the system. Ensuring sensor reading accuracy and reliability and solving compatibility issues with the installed infrastructure are main challenges that have to be addressed.
- **Organization of the Report:** The report is to give an in-depth overview of the proposed IoT-based gas leakage detection system. The report starts with an introduction, which points out the significance of the work and the research goals. The project description and features section gives elaborate information about the design and functionalities of the system. The following sections present the social impact of the system, the problems faced during development, and the shortcomings of the proposed solution. Lastly, the report ends with a summary of main findings [4-7].

2. Literature Survey

A survey of the literature was undertaken to determine current research and technologies in gas leakage detection systems with emphasis on IoT-based solutions. Several studies have examined various methods for gas detection such as sensor technologies, communication protocols, and IoT platform integration. The survey also determined the efficacy of voice messages and automated exhaust fan operation for maximizing safety and limiting the effects of gas leaks.

- **Methodology Used:** The method used in conducting this research had a number of major steps such as system design, sensor choice, hardware deployment, software creation, and evaluation. System design was aimed at developing the IoT-based gas leak detection system as well as specifying the components and functionalities required. Sensor selection had to do with comparing various gases sensors on factors like sensitivity, reliability, as well as economic viability. Hardware implementation included the development of the gas leakage detector and IoT network integration. Software development included the coding of the smartphone app for remote control and notification. Lastly, thorough testing was carried out to confirm the performance of the system and its effectiveness in detecting and reacting to gas leaks.
- **Merits:** The suggested IoT-based gas leakage detection system has some advantages, such as real-time detection, remote alerting, and automated response. Based on IoT technology, the system improves safety by sending timely warnings to residents and switching on exhaust fans to vent leaked gas, thus minimizing the risk of potential injuries. Additionally, the integration of the system with a mobile app improves accessibility and usability, making it applicable in different environments, ranging from residential houses to industrial parks.
- **Limitations:** Despite its merits, the suggested system has some weaknesses regarding cost, technological sophistication, and interoperability with installed bases. The IoT device deployment and underlying network infrastructure will carry investment expenses upfront, and these will present an impediment to usage, particularly within scarcity settings. Technological complexity with sensor alignment, networking connections, and computation processes could affect the system's efficacy and usability as well. In addition, compatibility problems with installed gas detection systems or building management systems may lead to difficulties in the integration and deployment process.

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- **Future Work:** Future research activities may also aim to rectify the limitations recognized in this study and further develop the proposed IoT-based gas leak detection system. This may entail optimizing sensor technology to improve accuracy and reliability, developing alternative communication protocols for better connectivity, and researching advanced data analytics methods for real-time anomaly identification. In addition, reducing the cost and complexity of the system to allow for more adoption, performing field trials and user studies to measure its impact in actual settings, and looking for opportunities for integration with other IoT devices and smart home systems to expand the functionality and integration features of the system could improve its capabilities and future-proofing, leading the way for smart safety solutions that encompass everything.

3. Requirements

The IoT-driven gas leakage detection system needs hardware elements like gas sensors, microcontrollers, and smartphones, along with IoT network infrastructure. The software requirements are a smartphone application and firmware for the gas detector. Functionalities include real-time monitoring, remote notification, and automatic exhaust fan operation. Performance, security, usability, scalability, and compliance with regulations are key considerations in the design, development, and deployment of the system [8-11].

3.1. Hardware Requirements

- **Arduino:** Arduino is an open-source electronics platform that uses easy-to-program hardware and software. It is a microcontroller board that can be programmed to interact with lights, motors, sensors, and other devices. Arduino is so popular because it is easy to use, so anyone from a beginner to a sophisticated user can create interactive projects using it. It employs an easy-to-use programming language where users can code, upload to the board, and realize their projects, ranging from simple ones like blinking LEDs to more intricate systems such as robots or home automation.
- **Infrared Sensor:** The IR sensor, or infrared sensor, captures infrared radiation given off by objects around it. It is made of an emitter and receiver that collaborate to sense variations in levels of infrared radiation. Widely implemented in proximity sensing and movement sensing applications, IR sensors are prized for their reliability and adaptability in many electronic devices and systems. It is easier to understand.
- **Flame Sensor:** Flame sensor is an electronic circuit that can identify the existence of a fire or flame. The sensor has a photodiode, an amplifier, and comparator circuit. Under the action of flame, the photodiode of the sensor produces an electric signal, which is amplified and compared to the reference voltage through the comparator. When the signal is above the threshold, showing the presence of a flame, the sensor initiates an alarm or safety response. Flame sensors are typically applied in fire prevention and detection systems to issue early warnings and initiate proper responses to reduce fire risks. It is more understood.
- **Exhaust Fan:** Exhaust fan is a mechanical device employed for ventilation to remove air from an enclosed area, a room, kitchen, or bathroom. It is a fan blade housed inside a case attached to a duct that leads out of the building. When switched on, the fan develops a negative air pressure drawing stale or damp air from the room and pushing it outside. Exhaust fans are essential for removing odors, moisture, and pollutants from indoor spaces, promoting better air quality and reducing the risk of mold and mildew growth.
- **Mini Gas Cylinder:** Mini gas cylinders are small, portable cylinders applied for storing relatively small volumes of compressed gases such as liquefied petroleum gas (LPG) or compressed natural gas (CNG). They are miniaturized containers compared to common cylinders and usually applied in applications such as camping stoves, portable gas grill, and

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smaller cooking appliances with limited space available. They have safety measures embedded in their manufacture to make their storage and use safe.

3.2. Software Requirements

- **Cloud Computing Integration:** Cloud is a network of faraway servers to store, update, and process data in the internet, instead of on local computers or dedicated servers. It provides access to data, applications, and services from anywhere through an internet-connected device. Cloud computing provides many types of services like storage, computational power, and computer programs on a pay-as-you-go or subscription service model. Top cloud service providers are Amazon Web Services (AWS), Microsoft Azure, and Google Cloud. The cloud makes scalability, collaboration, and data management much easier, rendering it a foundational element of present-day technology.

4. System Design

4.1. Architectural Design

- **High-Level Architecture Diagram:** The overall design of the gas leakage detection system is aimed at ensuring seamless integration of the components to achieve safety and efficiency in leak detection and response. The system is made up of various inter-linked components: a gas leakage sensor, a microcontroller, a voice notification system, an automated exhaust fan, and IoT connectivity for remote monitoring. At the heart of the system is an LPG gas leak sensor that constantly scans the surroundings for the presence of toxic gases such as LPG. When the sensor senses a gas leak beyond a set threshold, it triggers a signal to a microcontroller, which interprets the data. Should the leak be discovered, the microcontroller initiates an instant reaction by triggering a voice notification system that provides an immediate alarm notice to alert those in the proximity. At the same time, the system automatically activates an exhaust fan to drive out the ventilated air as well as to dissipate the leaked gas and reduce any likely damage. Furthermore, the system also features IoT connectivity, which allows it to alert a mobile app or cloud service. This means that users can observe the gas leak status remotely and receive real-time notifications on their devices. This integration offers a further layer of ease of use and security in that it allows users to take action or observe the system's performance in real time, Shown in Figure 1.

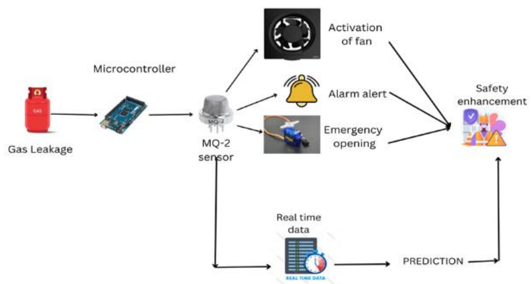

Figure 1 High-Level Architecture Diagram

- **Low-Level Design:** The low-level design discusses the technical details of the gas leakage detection system. The design starts with the gas sensor, which is usually of an MQ-6 or MQ-2 type. The sensor identifies gases such as LPG and provides an analog or digital signal to the microcontroller depending on the concentration of gas present in the environment. The sensor is made to be adjustable in sensitivity so that it is capable of sensing gas concentrations that are above a predetermined level. If the gas level exceeds this level, then the microcontroller senses the signal and interprets the data. The microcontroller, for example, an Arduino or Raspberry Pi, is coded to process the sensor readings. It determines whether the gas concentration detected is hazardous and, in the affirmative, sounds an alarm and turns on the exhaust fan. The microcontroller also operates a voice alert system, for instance, a DFPlayer Mini, to record pre-programmed

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voice warnings such as "Gas leak detected. Evacuate immediately." The voice system is powered by the microcontroller's output. For ventilation, the microcontroller is linked to a relay module that regulates the automatic exhaust fan. As soon as the microcontroller detects a gas leak, it signals the relay to activate the exhaust fan, which assists in venting the gas from the space. This functionality is significant for minimizing the environmental effect of the leak and for the safety of people in the surrounding area. The system further incorporates an IoT module, i.e., an ESP8266 or ESP32, that makes the system compatible to communicate with a cloud platform or mobile app. This provides a means of real-time alerts to be dispatched on the smartphone of the user or a cloud dashboard. The IoT module dispatches information like the present concentration of gas, fan status, and alarm activation, providing the user with complete insight into the working of the system. The cloud service or mobile app gives the user the capability to remotely monitor the status of the gas leak so that they are always aware. The app can also enable the user to operate the exhaust fan or view historical information regarding the gas concentrations in the location, making the system more convenient and giving a greater degree of control. With this integration, the system provides an integrated, real-time, and automatic solution for detecting gas leakage to ensure safety and prompt response to possible hazardous situations:

5. Implementation

Implementation of the gas leakage detection system incorporates hardware and software aspects that operate in tandem to guarantee safety and immediate responses to gas leaks. The system detects LPG gas leaks, provides users with voice alerts, and automatically turns on an exhaust fan to reduce risks.

6. Result

The gas leakage detection system provides encouraging outcomes with regard to its fundamental functionalities, including precise gas leak detection, real-time notification, and automatic fan control. When there is a gas leak, the LPG gas sensor properly identifies toxic gas levels and triggers a signal to the microcontroller. The threshold sensitivity of the sensor makes it react only to major leaks, reducing the risk of false alarms. This makes the system dependable in many environments, be it a residential area or an industrial complex. As soon as a leak is found, the system activates a voice warning system that gives clear and prompt alerts such as "Gas leak detected, evacuate immediately." The voice alarm is loud and clear so that it can be heard by individuals around, and this is vital in case of an emergency. The volume and purity of the sound are maximized to enable people inside to react instantly. Meanwhile, the system powers on the automatic exhaust fan via a relay, assisting in removing the space of gas and reducing the hazard of gas accumulation. The exhaust fan successfully discharges the dangerous gas, dispersing its content and avoiding probable accidents such as explosions or poisoning.

Figure 2 **Implementation**

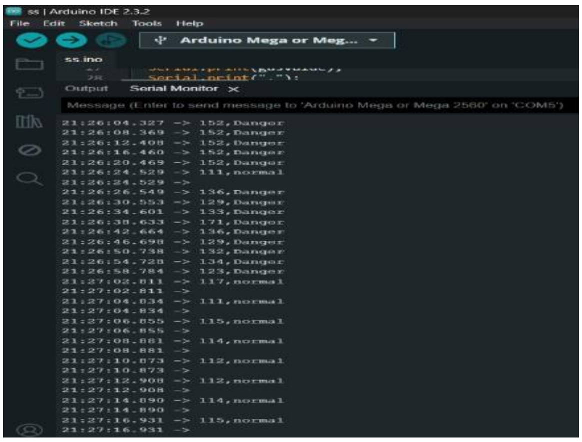

Figure 3 **Results**

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The integration of the system with IoT technology guarantees real-time communication with a mobile application or cloud system. This enables the users to have updates on the status of the gas leak as well as fan operation even from a distance. Remote monitoring is one feature that provides the user with reassurance and access to control over the system when not physically around. In relation to responsiveness, the system captures gas leaks at near-instant speed and operates the alarm and exhaust fan shortly after. It operates non-stop with low downtime, guaranteeing reliability, Shown in Figure 2 & Figure 3.

Conclusion

Gas leakage poses an important issue for safety, and effective gas leakage detection is instrumental in lowering risk and improving people's safety as well as properties. Real-time monitoring, remote notification, and automated responses provided by the proposed IoT-based gas leakage detection system can optimize safety features for various applications. In spite of limitations and challenges, including cost and technical complexity, the integration of cutting-edge technologies in the system promises to develop safer and more resilient communities. Continued research and development in this field will continue to advance innovation and enhance safety standards in gas detection and prevention.

References

[1]. Nadia Mahmood Hussien,Yasmin Makki Mohialden, Nada Thanoon Ahmed,Mostafa Abdulghafoor Mohammed,Tole Sutik "A smart gas leakage monitoring system for use in hospitals", Indonesian Journal of Electrical Engineering and Computer Science, Vol. 19, No. 2, August 2020.

[2]. Muhammad Ahmad Baballe,Mukhtar ibrahim Bello,"Gas Leakage Detection System with Alarming System",Vol. 9, No. 1,2020.

[3]. M.Pradeep, Karpaga Siva K.M, Ayyappa Srinivasan M G,"Arduino based automatic gas leakage detection system",Volume: 9,Issue: 2 ,February 2023.

[4]. Gas Leakage Detection and Prevention System, Shreyas Thorat, Neha Tonape, International Journal of Trendy Research, Vol 4, Issue 7, Dec 2020, ISSN NO: 2582-0958.

[5]. Rohan KH1, Navanika Reddy, Pranamya Maddy, Sachit Girish, Dr. Badari Nath K- “IOT based gas leakage detection and Alerting system”: JRP Publications,Vol. 1(1), pp no. 002-006, February 2021

[6]. Z. H. Salih, G. T. Hasan, and M. A. Mohammed, "Investigate and analyze the levels of electromagnetic radiations emitted from underground power cables extended in modern cities," in 2017 9th International Conference on Electronics, Computers and Artificial Intelligence (ECAI), 2017.

[7]. R. Hasan, M. . Mohammed, Z. H. Salih, M. . B. meedeen, N. Ţăpuş, and M. N. Mohammed, "HSO: A Hybrid Swarm Optimization Algorithm for Reducing Energy Consumption in the Cloudlets," TELKOMNIKA Telecommunication Computing Electronics and Control, vol. 16, pp. 2144-2154, 2018.

[8]. Patchmuthu, R.K., Wan, A.T. and Yaya, M.H.M. (2023) ‘Smart LPG usage and leakage detection using IoT and mobile application’, Int. J. Systems, Control and Communications, Vol. 14, No. 1, pp.1–21.

[9]. 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.

[10]. V Praveen Sharma, Dr Raman Dugyala, Dr V Padmavathi, Vijendar Reddy Gurram,"Gas Leakage Detection System Using IoT And cloud Technology",Conferences 391, 01063 (2023).

[11]. Vasudev Yadav, Akhilesh Shukla, Sofiya Bandra, Vipin Kumar, Ubais Ansari, Suraj Khanna,"A Review on Microcontroller based LPG Gas Leakage Detector",Volume 2 ,Issue 3,Journal of VLSI Design and Signal Processing.