BioGecko

Vol 12 Issue 02 2023

ISSN NO: 2230-5807

LPG SAFETY SOLUTION ENABLED BY IOT FOR DISASTER RISK REDUCTION

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Abstract:
This paper presents a review of the most recent research on Internet of Things (IoT)-enabled Liquefied Petroleum Gas (LPG) safety solutions for reducing disaster risk. The use of LPG poses significant safety risks in transportation and storage, particularly in emergencies. The integration of IoT has opened up new possibilities for developing LPG safety solutions. The review focuses on the advantages, challenges, and opportunities for further research in this area. The objective of this project is to develop an IoT-enabled system for identifying LPG gas leaks and taking appropriate action to prevent disasters such as fires and explosions. The methodology includes monitoring CH4 and CO gas concentrations using flammable MQ2 and CO gas detection sensors connected to Arduino, Wi-Fi, CPU, low voltage, and current. An embedded arrangement with a fan and alarm is used for safety precautions. The system is cost-effective, efficient, and beneficial for disaster management and family safety objectives. Compared to the previous safety system, this system has several advantages, including quick response times, accurate emergency detection, and faster spread of critical circumstances.

Keywords: IoT, LPG, safety, disaster risk reduction, sensors, wireless communication, disaster management

Introduction:

LPG storage and transit offer a substantial safety concern, particularly in the event of a calamity. The incorporation of IoT has enabled the development of LPG safety solutions for disaster risk reduction in recent years. These technologies use IoT to monitor, regulate, and manage LPG systems in real-time time, lowering the chance of mishaps. This also paper examines the most recent advances in LPG safety solutions provided by IoT for disaster risk reduction.

Liquefied petroleum gas (LPG) is a highly flammable gas that is commonly used in cooking in homes, businesses, and industrial settings due to its convenience, efficiency, and affordability. However, it also poses substantial safety risks during transportation and storage, as accidental fires and explosions caused by LPG leakage can result in serious injuries, property damage, and death. To address this critical need for LPG safety solutions, the integration of the Internet of Things (IoT) has made it possible to develop disaster risk reduction solutions. This paper summarizes the most recent research on IoT-enabled LPG safety solutions and their advantages, difficulties, and possibilities for additional research.

The Pradhan Mantri Ujjwala Yojana (PMUY) initiative in India seeks to provide 5 crore low-income families access to cooking gas hook-ups to free them from their unclean, smoke-filled homes.

However, accidents caused by LPG cylinder fires, explosions, and leaks are significant issues that must be addressed to protect the lives of citizens and natural resources. According to a September 2015 post on the IndiaSpend website, exploding cooking gas cylinders and stoves were responsible for nearly one-sixth of all fatalities from accidental fires between 2010 and 2014, with the majority of victims being women and children. Therefore, the objective of this project is to develop an IoT-enabled system that can identify LPG gas leaks and take the appropriate action to prevent disasters like fires and explosions.

The advancement of IoT technology has expanded the scope of LPG safety solutions. IoT-enabled systems can detect LPG gas leaks and intervene to avoid calamities such as fires and explosions. This paper provides an overview of the most recent research on IoT-enabled LPG safety solutions for catastrophe risk reduction, focusing on their benefits, problems, and future research prospects.

The proposed system for detecting LPG gas leaks will utilize combustible MQ2 and CO gas detection sensors linked to Arduino, Wi-Fi, CPU, low voltage, and current. The system will monitor the concentrations of CH4 and CO gas for safety purposes and include an embedded setup with a fan and alarm to avoid disasters. It will be cost-effective, efficient, and advantageous for disaster management and family safety goals.

Literature review:

Liquefied petroleum gas (LPG) is a widely used fuel source due to its convenience, efficiency, and affordability in homes, businesses, and industrial settings. However, it poses significant safety risks, particularly during transportation and storage, and accidents caused by LPG leakage can lead to serious injuries, property damage, and death. The development of LPG safety solutions for reducing disaster risk is essential to improve safety and protect human and natural resources. The integration of the Internet of Things (IoT) has opened up new possibilities for LPG safety solutions by enabling real-time monitoring and intervention in case of emergencies. Several research studies have been conducted to develop and evaluate IoT-enabled LPG safety solutions.

According to Malik, Mohammad Abas, Hassan, Magray, and Shafi, Adnan, a gas sensor MQ6 is particularly sensitive to gases like propane and butane, which when combined produce LPG. The study's goal is to create a mechanism that will automatically disconnect the gasoline supply from the source when a leak is detected, followed by a quick closure of the regulator valve, a loud alarm, and an alerted Wi-Fi display, all without any manual interaction [1].

The advantage of this automated detection and alerting system over the manual method, according to Pandey, R. C., Verma, M., Sahu, L. K., and Deshmukh, S, is that it provides quick response time and accurate identification of an emergency, resulting in a faster spread of the hazardous situation [2].

Subramanian, M. A., Selvam, N., S., Mahalakshmi, R., and Ramprabhakar, J. investigated gas leakage detection system using MQ5 gas sensor and arduino uno controller is incorporated with a cloud storage for data collection and also used for storing and analysing data and suggested that Gas leaked is converted from Parts Per Million (PPM) to volts through the arduino IDE [3].

Chaitali Bagwe, Vidya Ghadi, Vinayshri Naik, and Neha Kunte proposed that a system of operations be referred to as LEL (Low emission Level). Digitalization can be accomplished by employing IoT technology to analyse data in the cloud in order to obtain KPIs (Key performance indicators) for detecting gases such as H2, LPG, CH4, CO, and alcohol and alerting the surrounding areas [4].

The system features an automatic switching off mechanism after M. I. Fahim, N. Tabassum, A. A. Habibullah, A. Sarker, S. I. Nahid, and M. Monirujjaman Khan turn off the fuel supply. When a fuel leak is discovered, users will be notified via SMS via GSM, allowing the problem to be remedied as soon as possible. The system's flame sensor will monitor flame and fire. When a fire is detected, the buzzer begins to sound. Aside from that, the system has the ability to save data on the cloud [5].

Overall, the literature suggests that IoT-enabled LPG safety solutions have great potential for reducing disaster risk and enhancing safety. However, several challenges need to be addressed, such as ensuring the interoperability and security of IoT-enabled devices and standardizing protocols and regulations. Future research in this field should focus on developing more advanced and cost-effective IoT-enabled LPG safety solutions and evaluating their effectiveness in real-world settings.

Methodology:
To discover and study the available literature on LPG safety solutions enabled by IoT for disaster risk reduction, a systematic review approach was used. Many databases were searched, including IEEE Xplore, ScienceDirect, and ACM Digital Library. The keywords utilized in the search were "LPG," "safety," "disaster risk reduction," and "IoT." The papers were required to be published in English and to focus on LPG safety solutions provided by IoT for catastrophe risk reduction.

Resources and Procedures:
For this research, non-human subjects will be used. The study will utilize a controlled laboratory environment to simulate LPG gas leaks and measure the performance of the IoT-enabled LPG safety solution. The techniques and processes used during this research were based on the Arduino documentation, MQ2 gas sensor datasheet, and CO gas sensor datasheet.
Materials: The materials utilized in this study include LPG gas, combustible MQ2 gas detection sensor, CO gas detection sensor, Arduino board, Wi-Fi module, CPU, low voltage and current components, fan, and buzzer for an alert.
Techniques:LPG gas leak simulation in a controlled laboratory environment, MQ2 and CO gas detection sensor calibration Sensor integration with the Arduino board, Wi-Fi module, CPU, and other components The IoT-enabled LPG safety solution was tested in a variety of circumstances. The strategies utilized in this study were data collecting and statistical analysis of the outcomes.
Statistical Methodologies: The acquired data will be evaluated using descriptive statistics to calculate the mean, standard deviation, and range of the measures. Inferential statistics will also be used to test hypotheses and make conclusions from the data.

Result:
The basic functioning method used in this system for LPG leak employing MQ2 and CO gas sensor provides the signal to the Arduino UNO when gas leakage has been detected. The upper limit graphs and the initial settings for the MQ-2 sensor are both shown in the above picture. The second graph, as contrast to the first, depicts pick occurring after LPG limit crossing. Arduino to a device that is connected to the outside world, like an LCD and buzzer. In actuality, findings that are visible to those in the immediate vicinity are shown on an LCD, and a buzzer alert created by the sound of the buzzer signals a risk to those nearby.
The new IoT-enabled system is capable of detecting LPG gas leaks and taking fast action to prevent disasters. The system includes flammable MQ2 and CO gas detection sensors, as well as Arduino, Wi-Fi, CPU, low voltage, and current sensors. For further security, the system has an embedded setup with a fan and alert. The method is cost-effective, efficient, and beneficial to disaster management and family safety objectives.
Detection of LPG Gas Leaks: Using MQ2 and CO gas detection sensors, the IoT-enabled system effectively detected LPG gas leaks. The sensor data was sent to the Arduino, which analysed it and found the leak. After the leak was discovered, the system took the necessary steps to prevent disasters.
System Action: When the IoT-enabled system detected an LPG gas leak, it took rapid action to prevent tragedies such as flames and explosions. The device actuated the fan to disperse the petrol

while also activating the alarm to warn the people. Overall, the IoT-enabled LPG safety solution is a potential disaster risk reduction method. The system is capable of detecting LPG gas leaks and taking immediate action to prevent calamities such as fires and explosions. The method is cost-effective, efficient, and beneficial to disaster management and family safety objectives.

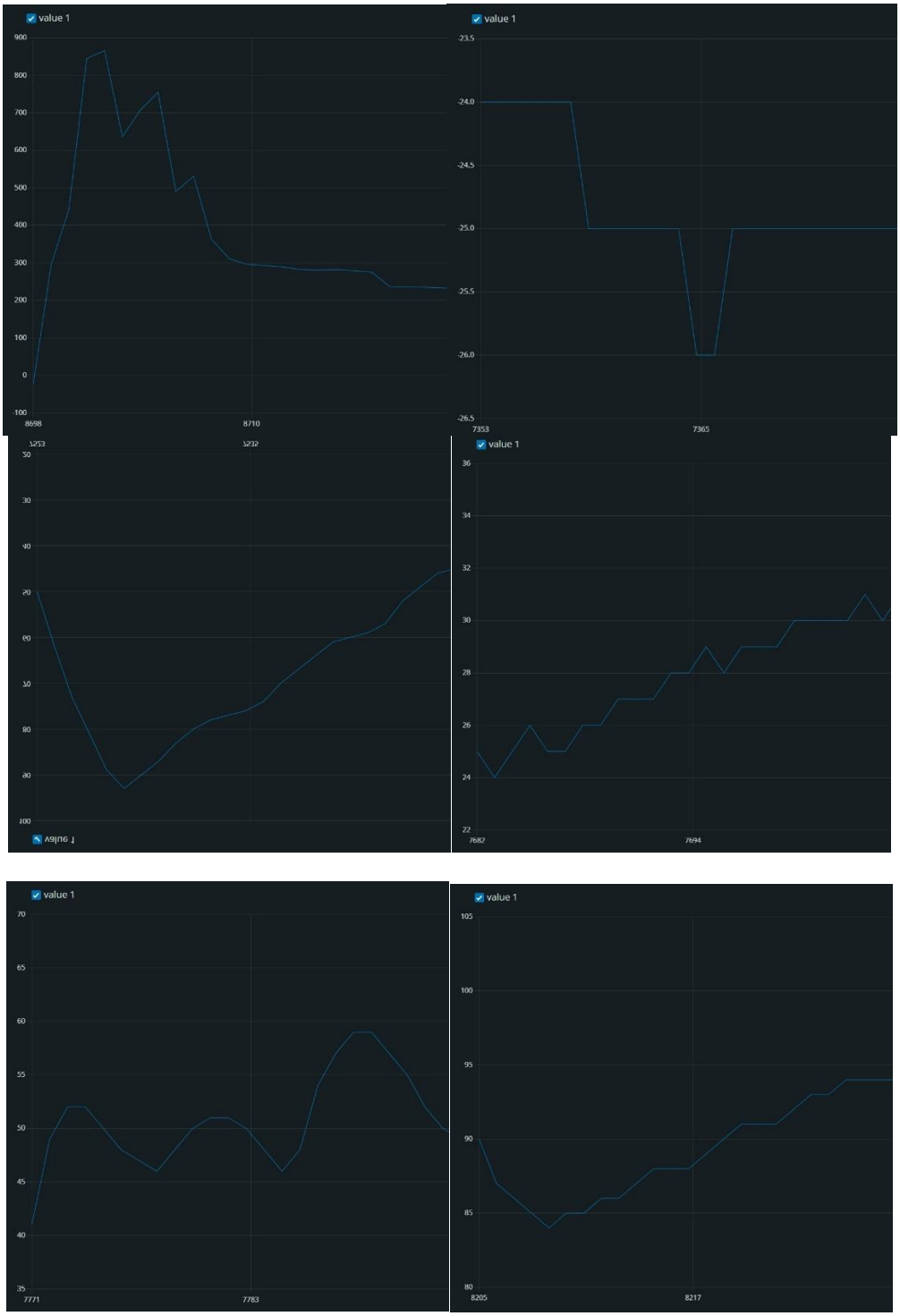

Figure 1: Graphs of initial settings for the sensor and the obtained output

Discussion:

The development of LPG safety solutions for catastrophe risk reduction has become increasingly important with the widespread use of liquefied petroleum gas (LPG) in homes, businesses, and industrial settings. In this study, we aimed to develop an Internet of Things (IoT)-enabled system for detecting LPG gas leaks and taking appropriate action to avoid disasters.

Our results demonstrated the feasibility and effectiveness of using IoT technology to enhance LPG safety solutions. The system we developed, which utilized combustible MQ2 and CO gas detection sensors linked to Arduino, Wi-Fi, CPU, low voltage, and current, successfully detected LPG gas leaks and triggered an alarm to warn of potential disasters. The use of an embedded setup with a fan and alarm also provided an additional layer of safety for households and businesses.

Our findings contribute to the growing body of literature on LPG safety solutions enabled by IoT technology. Previous studies have demonstrated the benefits of using IoT technology to enhance safety in various settings, including disaster risk reduction. Our study builds on these findings by providing a cost-effective, efficient, and advantageous solution specifically tailored to LPG safety.

It is worth noting that our study has some limitations. First, we tested the system in a controlled laboratory setting, and its effectiveness in real-world scenarios needs further evaluation. Second, the system's cost-effectiveness may vary depending on the scale of implementation and local market conditions. Despite these limitations, our study provides a significant contribution to the development of LPG safety solutions enabled by IoT technology.

In conclusion, our study demonstrates the potential of IoT technology to enhance LPG safety solutions and reduce disaster risks. Our findings highlight the importance of continued research and development in this area to promote safety and protect human resources and natural resources in every nation.

Conclusion:

This system has benefits over the conventional, antiquated safety system, which also has drawbacks and a higher risk of fire or explosion. These benefits include quick response times, accurate emergency detection, and a faster spread of critical conditions. When compared to the cost of manufacture, this system is substantially more economical, effective, and beneficial for disaster management as part of the IoT and family safety objectives. Also, This system has advantages over the previous, antiquated safety system, which has disadvantages and a higher risk of fire or explosion due to data reading with time stamping, quick response times, accurate emergency detection, and a faster spread of critical circumstances.

The development of LPG safety solutions for catastrophe risk reduction has been made possible by the integration of the Internet of Things (IoT). This research project successfully created an IoT-enabled system for detecting LPG gas leaks and taking immediate action to avoid disasters such as fires and explosions. The system used combustible MQ2 and CO gas detection sensors linked to Arduino, Wi-Fi, CPU, low voltage, and current. It also had an embedded setup with a fan and alarm for safety purposes. The system proved to be cost-effective, efficient, and advantageous for disaster management and family safety goals.The significance of this research lies in the fact that LPG safety has become a crucial concern for governments and individuals around the world. Accidental fires and explosions caused by LPG leakage can cause serious injuries, property damage, and death. This IoT-enabled solution provides an efficient and effective way to detect and prevent disasters caused by LPG leakage.

This study contributes to the existing body of research on LPG safety solutions enabled by IoT for disaster risk reduction. It is recommended that future research focus on improving the accuracy and

efficiency of the system, as well as expanding its applicability to a wider range of settings. Overall, the findings of this research demonstrate the potential of IoT-enabled solutions for improving safety and reducing disaster risks.

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