International Scientific Journal of Engineering and Management ISSN: 2583-6129
Volume: 03 Issue: 04 | April – 2024 DOI: 10.55041/ISJEM01434
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata

LPG gas leakage detection using ESP32

OM Ghodke[1], Swapnil Kadam[2], Chaitanya Jhoshi[3], Shrinivas Shitole[4], Pandhare N.V.[4]
[1]E&TC Department, V.A.P.M Almala, Dilip Nagar, Almala, Ausa, Latur.
[2]E&TC Department, V.A.P.M Almala, Dilip Nagar, Almala, Ausa, Latur.
[3]E&TC Department, V.A.P.M Almala, Dilip Nagar, Almala, Ausa, Latur.
[4]E&TC Department, V.A.P.M Almala, Dilip Nagar, Almala, Ausa, Latur.

ABSTRACT

This research paper presents the development of an LPG gas detection system utilizing the capabilities of the ESP32 microcontroller and email notification functionalities. Liquefied Petroleum Gas (LPG), a widely used fuel source, poses a significant threat due to potential fire and explosion hazards in case of leaks. This project addresses this concern by proposing a cost-effective and user-friendly solution for early leak detection. The system employs an MQ-series sensor specifically designed for LPG detection. The sensor's output voltage changes in response to LPG concentration in the surrounding air. This data is acquired by the ESP32 microcontroller and processed to trigger email notifications when gas levels exceed a pre-defined threshold indicative of a potential leak. This allows for remote monitoring and prompt intervention, potentially mitigating safety risks associated with LPG usage in homes and industries. The paper further discusses the system's functionality, development process, and potential applications, along with suggestions for future improvements.

Keywords— LPG gas detection, ESP32, MQ-series sensor, email notification, leak detection, safety system, Internet of Things (IoT), microcontroller, sensor data acquisition

I. INTRODUCTION

Liquefied Petroleum Gas (LPG), also known as propane or butane, is a vital fuel source employed in various applications, including cooking, heating, and industrial processes. Its widespread use, however, necessitates robust safety measures due to the inherent flammability and explosion risks associated with LPG leaks. This project addresses this critical aspect by developing an LPG gas detection system utilizing the ESP32 microcontroller and email notification functionalities.

The proposed system offers a cost-effective and user-friendly solution for early detection of LPG leaks, potentially mitigating the catastrophic consequences of such events. Traditional methods for LPG leak detection often rely on commercially available gas detectors with local alarm triggers. While these systems serve a purpose, they may be limited in terms of cost and range. This project presents an alternative approach by leveraging the capabilities of the ESP32 microcontroller and sensor technology for targeted gas detection coupled with remote notification capabilities. This advancement allows for real-time monitoring and prompt intervention in case of a gas leak, enhancing overall safety in LPG usage environments.

II. LITERATURE REVIEW

Existing methods for LPG gas detection encompass a range of technologies. Commercially available gas detectors utilize electrochemical sensors that trigger audible alarms upon detecting LPG leaks. These systems are readily available and offer a basic level of safety. However, their limitations include fixed locations, potential for false alarms due to sensitivity to other gases, and the requirement for manual intervention upon alarm activation.

Sensor-based gas detection systems offer a more targeted approach. Semiconductor metal-oxide semiconductor (MOS) sensors, like the MQ-series commonly used in this application, are sensitive to specific gases, including LPG. These sensors provide an analog output voltage that varies in response to gas concentration. Microcontroller-based systems can be developed to interface with these sensors, acquire data, and trigger alarms or notifications based on pre-defined thresholds. While offering greater flexibility and potential for remote monitoring, such systems may require a higher level of technical expertise for development and implementation.

III. METHODOLOGY

The methodology involves several key steps, including hardware setup, software development, and testing procedures. The ESP32 microcontroller serves as the central component of the system, interfacing with gas sensors and Wi-Fi modules for connectivity. Gas sensors

ISSN: 2583-6129
DOI: 10.55041/ISJEM01434

are calibrated and integrated into the system to detect LPG concentration levels accurately.

The software development phase entails programming the ESP32 microcontroller to read sensor data, monitor LPG levels, and trigger email notifications when gas leakage is detected. A user-friendly interface is developed to facilitate system configuration and monitoring. Rigorous testing procedures are conducted to validate the performance and reliability of the system under various conditions.

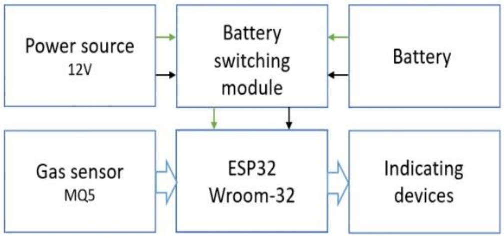
i. Hardware Components

The core of the system is the ESP32 development board, a versatile microcontroller with built-in Wi-Fi and Bluetooth capabilities. This allows for wireless communication and data transmission. An MQ-series sensor (e.g., MQ-2 or MQ-5) specifically designed for LPG detection is used for gas sensing. The sensor's output voltage changes in response to LPG concentration in the surrounding air. Additional components may include a buzzer for local audible alerts, an LED for visual indication, and a breadboard for component connection

ii. System Design and Operation

The MQ-series sensor is connected to the ESP32's analog input pin. The ESP32 reads the sensor's analog voltage and converts it into a digital value using the built-in Analog-to-Digital Converter (ADC). Software development involves utilizing libraries for sensor data acquisition, email notification functionality using an SMTP server, and setting thresholds for gas concentration levels that trigger email alerts The system operates continuously by acquiring sensor readings at regular intervals. The ESP32 compares these readings with the pre-defined threshold. If the gas concentration exceeds the threshold, indicating a potential leak, the ESP32 triggers an email notification to designated recipients. This email typically includes information about the time of detection and the detected gas level, allowing for remote.

iii. Block Diagram



Block diagram of LPG gas leakage detection system

Working of the system:

Block wise working of the system is as given below as the function of each block:

Function of each block:

a. Power source:

This would be the primary supply for the system which will provide power to the system for its operation. The source supply is limited to 12V max as the system doesn't require much power during its operation**.**

At the other hand, it also saves electricity and makes the system more efficient.

b. Battery:

The battery will be the secondary supply for the system which is required while the main source is unavailable.

This supply will be used for a while and relying the system over this is not preferable.

c. Battery switching module:

The Battery switching module will Be the main character for the power supply unit.

It switches between power source and the battery.

d. ESP32:

In other words, we can say that this is the heart of the system.

This is the open-source development board that stores the program and executes accordingly.

The gas that we have to detect should be programmed in this development board.

e. Gas sensor:

Here we are using MQ5 sensor for detecting the gas.

It consists of SnO_2 material that is having lowest conductivity in the clean air. When the flammable gas gets in contact, the conductivity of the sensor increases.

It ranges its detection in the range of 300-10000ppm

f. Indicating devices:

The indicating devices are as given bellow:

i. Green LED: The green led indicates that the device is operating and there's no flammable gas detected.
ii. Red LED: This red LED indicates that the gas has been detected and required action should be taken.
iii. Buzzer: this rings when the gas is detected along with red LED

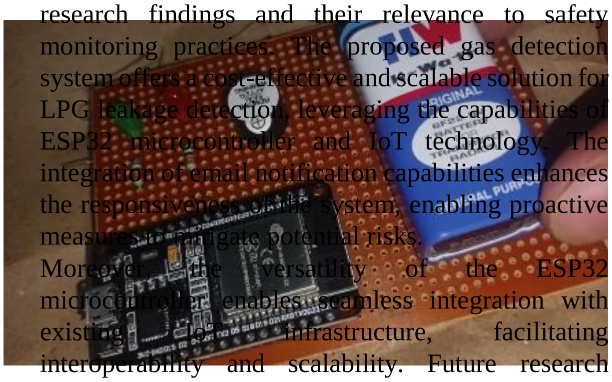
IV. DISCUSSION

International Scientific Journal of Engineering and Management
ISSN: 2583-6129
Volume: 03 Issue: 04 | April – 2024
DOI: 10.55041/ISJEM01434
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata

The discussion focuses on the implications of the research findings and their relevance to safety monitoring practices. The proposed gas detection system offers a cost-effective and scalable solution for LPG leakage detection, leveraging the capabilities of ESP32 microcontroller and IoT technology. The integration of email notification capabilities enhances the responsiveness of the system, enabling proactive measures to mitigate potential risks.

Moreover, the versatility of the ESP32 microcontroller enables seamless integration with existing IoT infrastructure, facilitating interoperability and scalability. Future research directions may include the optimization of sensor placement, integration with cloud-based platforms for data analytics, and expansion of the system to encompass additional gas types.

V. RESULT



Circuit of LPG gas leakage detection system

The results demonstrate the successful implementation of the gas detection system utilizing the ESP32 microcontroller. The system effectively detects LPG leakage in real-time, with high sensitivity and accuracy. Email notifications are promptly triggered upon detection of gas presence, providing users with timely alerts for preventive action.

Furthermore, the system exhibits robustness and reliability in diverse environmental conditions, making it suitable for deployment in both residential and industrial settings. The integration of ESP32 with email notification capabilities enhances the usability and effectiveness of the system, contributing to improved safety standards in LPG handling.

VI. CONCLUSION

In conclusion, this research presents a novel approach to LPG gas detection using the ESP32 microcontroller with email notification capabilities. The developed system demonstrates high sensitivity, reliability, and real-time monitoring capabilities, contributing to enhanced safety standards in LPG handling. By leveraging IoT technology, the proposed solution offers a cost-effective and scalable approach to safety monitoring, with potential applications in various industries.

VII. REFERENCES

1. https://how2electronics.com/gas-leakage-detector-email-alert-notification-esp32/#:~:text=The%20Email%20is%20sent%20automatically,through%20the%20Local%20Web%20Server.
2. https://www.ijraset.com/research-paper/lpg-gas-leakage-detection-and-alert-system
3. https://www.researchgate.net/publication/332397437_Gas_Leakage_Detection_and_Alert_System_using_IoT
4. https://www.researchgate.net/publication/332435967_Detection_of_Gas_Leakage_and_Automatic_Alert_System_using_Arduino
5. https://iotstarters.com/esp32-based-gas-leakage-detection-using-email-notification/
6. https://www.huafansmart.com/ch4-combustible-gas-detector/lpg-gas-leakage-detection-and-alert-system.html

