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# Design And Implementation Of Smart LPG Gas Level Monitoring And Safety System Using Iot

[1]Sana Noushin, [2]Kavadi Joshna, [3]Divya Shamlet

[1]Student, [2]Student, [3]Faculty (guide)

[1]Electronics and Communication Engineering,

[1]Stanley College of Engineering and Technology for Women, Telangana, India

***Abstract:*** The increasing reliance on Liquefied Petroleum Gas (LPG) for residential and commercial applications necessitates the development of advanced monitoring systems to ensure safety and efficiency. The core of smart home automation lies in the deployment of interconnected devices and sensors, facilitated by IoT technology. The proposed system integrates gas sensors, IoT technology, and real-time data processing to provide continuous monitoring of LPG levels and prompt detection of potential leaks. The ESP32 microcontroller with integrated Wi-Fi capabilities not only ensures reliable data transmission but also enables seamless connectivity with other smart devices. The system uses MQ-2 gas sensor to detect gas leakage and also incorporates automatic shut-off mechanism of the cylinder valve to mitigate risks by isolating the gas supply in case of a significant leak. Users can access the system's interface remotely, gaining insights into LPG consumption patterns, gas leakage alerts and real-time status updates through an intuitive mobile application.

***Index Terms*** **– IoT, LPG, Wi-fi, ESP32, MQ2.**

## I. INTRODUCTION

Liquefied Petroleum Gas (LPG) is one of the clean fuel. It is most widely being used in India. It is being used for household as well as for industrial purposes. In case of household use it is mostly used in kitchen for cooking purpose, whereas in case of industrial purpose it is being used in various industrial processes such as gas cutting, gas welding, metallurgical industries, steel plants, glass cutting, pharmaceutical industries etc. Apart from this the LPG gas cylinders are also used in schools, colleges, hospitals, hotels and restaurants and many other places.

LPG cylinders are mostly used for domestic applications for cooking purposes. But it is very difficult to find out the available percentage of LPG present in the cylinder. The problem which is faced by most the users of LPG cylinder is the untimely emptying of the cylinder. All of sudden if the cylinder becomes empty, it is not possible to replace the cylinder with a new cylinder instantly hence it is essential to find out the level of LPG frequently and send the information to the mobile app automatically when the cylinder level is reduced to less than 5%.

In the past years the demand for the usage of LPG have increased sustainably and will continue to rise. But with the increase in demand of the usage of LPG the rate of accidents caused due to it have also increased in the past few years. The majority of the accidents are caused due to the explosion of LPG cylinder. But, sometimes very small quantity of gas leakage is unnoticed and is responsible for the further major accident unknowingly. We have used Google firebase in this project, it is the cloud service which will gather and store the data. To work on it, this project is designed that can measure the gas level and leakage accurately by which necessary considerations can be implemented in advance. In this project work, GSM technology is used to send the gas level information and gas leakage information to the concerned mobile app.

### 1.1 Objective

The main objective of a Smart LPG Monitoring and Safety System is to enhance safety, efficiency, and user awareness in the usage of Liquefied Petroleum Gas (LPG). The system using Wi-Fi represents a significant advancement in LPG safety and management, providing a comprehensive and user-friendly solution for modern households and industries.

### 1.2 Literature Survey

In [1], the developed Liquid Petroleum Gas leakage detection and alert indication system is light weight compact, based on Arduino and by using Global System for Mobile communication modem it sends alert Short Message Service /Call indication to the mobile. In [2], a Smart Liquefied Petroleum Gas Leakage Detector system based on the Internet of Things with the ESP8266 NodeMCU Module is designed and tested. The system uses an MQ-2 detector, IR flame detector, solenoid valve, buzzer, and the Blynk application to monitor and control gas levels. In [3] the Gas Leakage Detector with Alert System was created to prevent fire or explosion in homes or businesses. This gas detector used in this system continually detects gas if it has power. In [4], the project uses microcontroller-based system in which a weight sensor or load sensor are used to find the gas level in the cylinder. The reading is passed to LCD module to show the gas content in the cylinder. In [5] this paper creates awareness about the reducing weight of the gas in the container, and to place a gas order using IOT. The gas booking/order is being done with the help IOT technology and that the continuous weight measurement is done using a load cell which is interfaced with a Microcontroller (to compare with an ideal value). In [6] the system has three sensors; hydrogen sensor, Liquefied Petroleum Gas (LPG) sensor, and methane sensor that serve as switches with different set-points. Every level of gas detected is send to the Arduino that serves as the controller which analyze the level of gas present in the LPG cylinder. The buzzer is activated as the controller detects danger level and the LCD monitor displays the level of gas being detected and the GSM module sends SMS as notification to concern people.

### 1.3 RESEARCH METHODOLOGY:

The Smart LPG level monitoring and gas leakage safety system has two parts one part deals with the percentage of gas remaining in the cylinder, which is found using a detector called load cell, and the percentage of gas remaining in the cylinder is updated continuously to the app that is being used by the user. When the gas level is less than the threshold value, an alert will be given to the user through the buzzer and notified in the mobile app. The other part is the safety feature that is inherent in this home automation system. When gas leakage is detected by the MQ-2 gas detector, it alerts the user via mobile application and also through buzzer. Simultaneously the gas valve is also turned off to prevent from further accidents.

### 3.1 Block Diagram

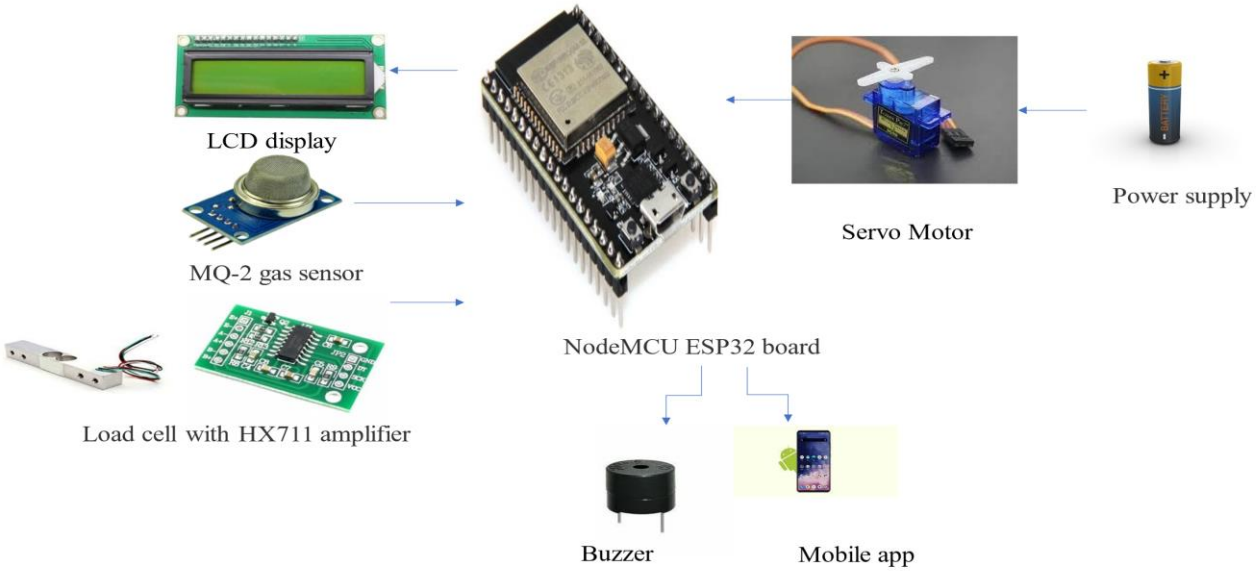


**Figure 1**

The working of this project is classified into two parts. The first module discusses about the gas leakage detection system. The gas leakage detection system consists of Node-MCU ESP32 module, MQ-2 gas sensor, a buzzer. If the MQ-2 sensor finds that there is any concentration of gas in the surrounding environment, then it will sense it and will send a signal to Node-MCU. The module will process the signal and will activate the buzzer depending on the strength of the signal received and the valve is closed. The maximum voltage to the sensor is 5V. When it detects the gas in the surrounding, the resistance of the sensor changes the voltage of the sensor. While in the second module the working of the gas level monitoring system is explained. This system consists of load cell, buzzer, NodeMCU ESP32 module. This system will be placed at the base of the LPG cylinder. The load cell is used to measure the weight of the cylinder placed over it. If the weight of the cylinder is be less than 5% the message is displayed in the Mobile App stating the low weight of the cylinder and to refuel it or to order a new one. When a new cylinder will be placed on the load cell, it will again calibrate the new weight and then measure the weight. The above process will be repeated for every LPG cylinder placed on the load cell. The cloud service used is Google firebase. The data from the sensors are stored in the firebase database from the controller. The link of this database is provided to the Mobile app.

### 3.2 Components Discription

**NodeMCU ESP32 board:** It is a widely used Wi-Fi module, used to send a message to the user cell phone when gas leakage is detected or when the gas level is low.

**MQ-2 gas sensor:** It is used as a gas leakage detecting equipment, it has high sensitivity to LPG, butane and propane.

**Power supply:** The main purpose of a power supply is to power the load. A 5V dc power supply is used in this project.

**Buzzer:** Buzzer acts as an alerting device when there is gas leakage or low gas level.

**Mobile App:** A mobile application is used in this project to the display the information to the user.

**Load cell with HX711 amplifier:** A load cell is a transducer that measures force, and outputs this force as an electrical signal. The load cell is used since it provides the accurate weight. In this project it is used to measure the weight of the LPG cylinder.

**Servo motor:** A servo motor is used as a gas valve, when there is gas leakage the servo motor rotates 90 degree which means the gas valve is turned off and when there is no gas leakage the servo motor comes back to initial position which means the gas valve is on.

**LCD:** The LCD Monitor is used to show the results of various sensors such as the gas sensor and the load cell.

**MIT App Inventor:** MIT App Inventor is a web application integrated development environment which uses a graphical user interface,and allows users to drag and drop visual objects to create an application that can run on android device.

### 3.2 Flow Chart

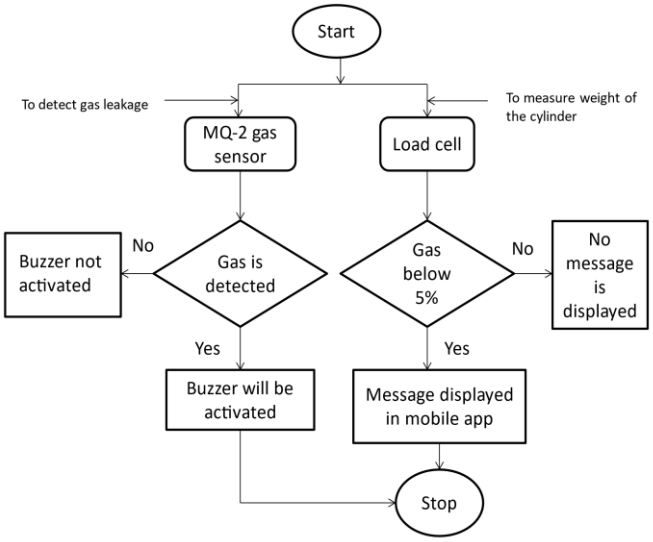


**Figure 2**

## IV. RESULTS AND DISCUSSION

### 4.1 Results

The weight is placed on the stand for the load cell and the readings are observed. The readings given by the load cell is in grams. The gas sensor is tested and the corresponding results are observed.

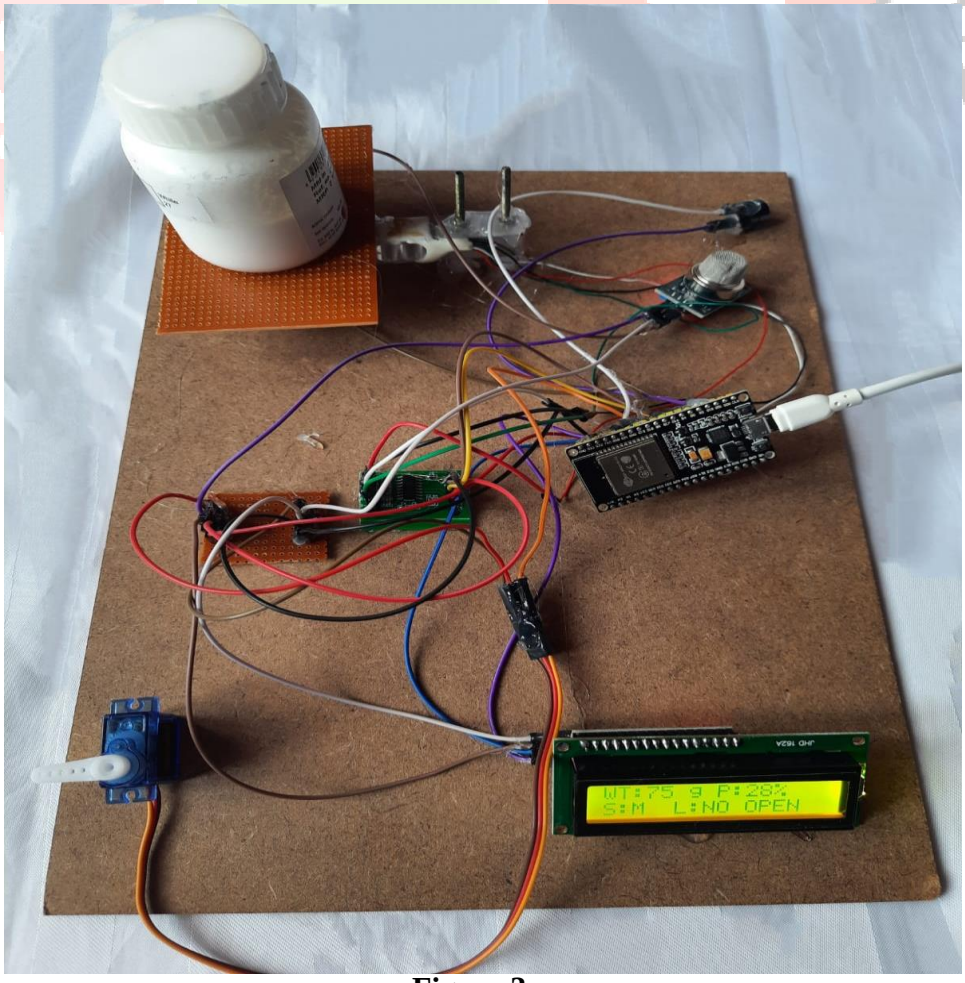


**Figure 3**

Results from the Mobile App showing low gas level and gas leakage alert. The app also has two modes manual, to turn on and

off the gas valve according to the need and other is automatic mode which turns the valve off whenever there is a gas leakage.

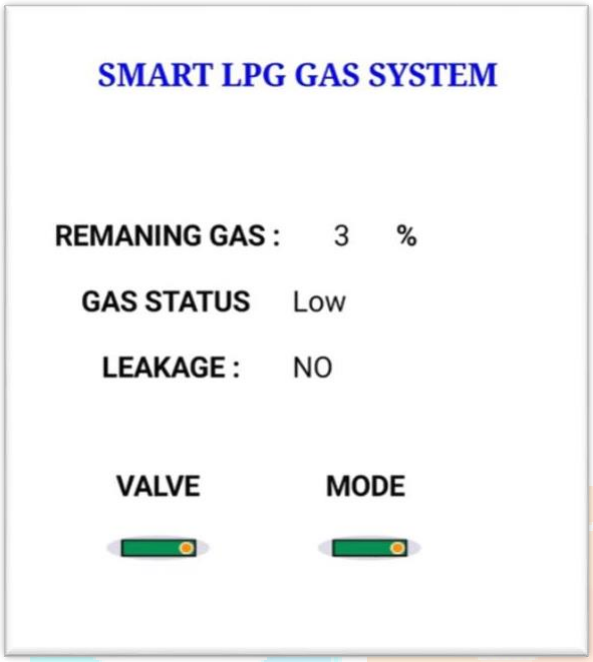


**Figure 4**

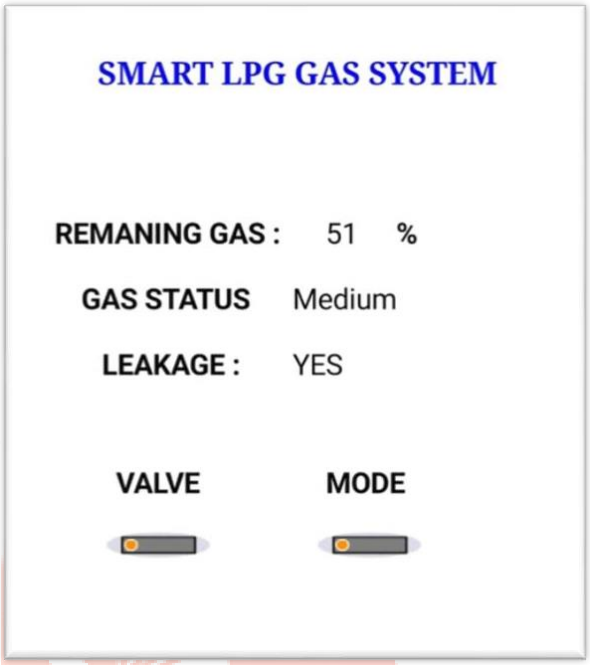


**Figure 5**

### 4.2 Conclusion

The system, is capable of monitoring leakage of gas and fire as well as the weight of LPG present, is successfully designed and is, implemented using various software- Arduino IDE, Google firebase as well as MIT App Inventor. In either case (Gas, or low weight of cylinder), the user will receive an alert message in the mobile app. The gas valve is automatically turned off before the situation worsens, which is caused by leakage, and user can book their gas when they encounter the gas being emptied. It is possible to view the level of gas in the LPG cylinder through the app. Thus, the cost-effective framework can amend the carelessness and reduce the burden of the user. In addition, it saves the lives of people and also minimizes the damages caused due to gas leakage and the spread of fire. With suitable configuration this system can also be scaled for its use in industries where heavy pipelines and cylinders are used. The proposed system when successfully implemented can also be used in mines where gas sensors will detect leakage of harmful gases and can send a signal for the emergency evacuation of workers.

### 4.3 FUTURE SCOPE

Major cities of India are pushing towards smart home application and enhancing industrial safety using IoT. In addition to the developed system another major future scope could be including automatic booking and payment option in an LPG gas monitoring system, this can significantly enhance user convenience. Integration with mobile app could allow users to schedule gas refills based on real-time monitoring data and allows automatic booking of cylinders ahead of time. The system could also incorporate secure payment gateways to facilitate seamless transactions. This system can be implemented in households, industries, hotels and wherever the LPG cylinders are used making the lives of human beings easier.

### 4.4 APPLICATION

- Smart home integration
- Commercial kitchens and restaurants
- Industrial processes
- Remote monitoring

- Healthcare facilities

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