

## Research Article

### Gas Leakage Detection and Automatic Booking System using IoT

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#### Abstract

Liquefied Petroleum Gas (LPG) is a cooking fuel used for both commercial and domestic purposes. When the gas in the cylinder meets ignition it can easily explode. Furthermore, gas leakage can cause a fire that will lead to serious injury or death and it can also destroy human properties. The leakage of the gases can be detected only by humans nearby and if there are no humans nearby it cannot be detected also it can't be detected by the human that has a low sense of smell. One of the perspective methods to stop accidents associated with gas leakage is to install a gas leakage detection kit at vulnerable places. Now we are having a system of advanced LPG cylinder booking through IVRS or online which is most difficult for the illiterate and scheduled people to book LPG cylinders in advance. This paper aimed to propose and discuss a design of a gas leakage detection that can automatically detect, alert, and can control gas leakage. This proposed system also includes a new system to book a cylinder when the gas can be empty. This system uses the IoT for alerting the user and the sensor for detecting the leakage of the gas in the cylinder.

**Keywords:** Liquefied petroleum gas; Gas leakage detection; IVRS booking; Internet of things.

#### Introduction

The Internet of things (IoT) refers to a vast number of "things" that are connected to the internet so they can share data with other things. As much as IoT helping in automating tasks, the benefits of IoT can also be extended for enhancing the existing safety standards. For the past decades, LPG is used as a cooking fuel in various homes and commercial areas [1]. LPG is a mixture of propane and butane which are highly flammable chemical compounds [1]. In recent years, more number of deaths is due to the explosion of gas cylinders has been increased rapidly.

As we all know the greatest tragedy that occurred due to gas leakage was the Bhopal disaster and the Vizag gas leak. Bhopal gas tragedy was a gas leak incident on the night of 2-3 December 1984 at the Union inorganic compound Asian nation restricted (UCIL) chemical plant in Bhopal, Madhya Pradesh, India [2]. It is considered among the world's worst industrial disasters. Vizag gas leak was an industrial accident that occurred at the LG Polymers chemical plant during the early morning of 7 May 2020. Lots of people were

affected by this tragedy. The main reason behind such an explosion is due to the carelessness of the user, use of old valves, lack of awareness in handling gas cylinders.

Sometimes the user finds it tough to book a refill as a result of they're not tuned in to the remaining quantity of LPG inside the cylinder as they forget the date of installation of the cylinder due to their busy lives and find themselves booking the cylinder either too early or too late[3]. In addition to that most of the rural people have not enough knowledge to book a gas cylinder. So we made this design to detect the gas leakage also alert the user whenever the gas leak occurs and the automatic booking of the gas cylinder.

#### Existing system

In the early days, the leakage of the gas in the cylinder can be detected by spraying soapy water on the valve. If the bubble appears gas leakage can be found. In the 1990s the leakage of gas was detected by using chemically infused paper when gas comes in contact with its color. These detecting methods can be work only with the presence of humans and also it cannot accurate

result for detecting the gas leakage in a cylinder [1]. The system developed thus far has either a gas detection module or automatic cylinder booking module. The proposed system overcomes the shortcomings of the existing system. The Idea focuses on providing functionalities like detecting gas leakage and informing a user of there is possible leakage. Also, a user gets the status of the gas level of the cylinder whenever overflow occurs the solenoid valve cut-off the flow of gas in a cylinder.

## Methodology

Arduino Uno is a microcontroller used for developing the prototype. In the proposed system, the MQ5 gas sensor, Load cell, Solenoid valve are interfaced to the Arduino. This system detects the leakage of the LPG using the MQ5 gas sensor module. These data can be collected and stored in a microcontroller. This Microcontroller controls the solenoid valve for the automatic cut-off. The weight and pressure of the gas cylinder can be measured with help of the load sensor valve. This setup is merged with ESP8266 collects and stores the data and it is interconnected with an Android application to view the status of the cylinder's gas level (Fig. 1) [3].

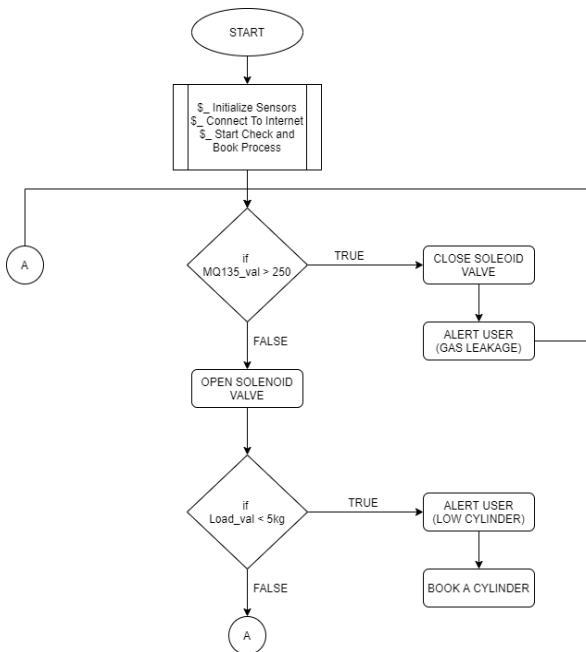


Fig. 1. Flow chart

If the gas within the cylinder indicates the worth wherever the remaining proportion level is crossed below the edge level set for the gas to point or obtaining empty. Then the notification will be delivered to gas enterprises automatically to book the new cylinder. In

addition to that, if the gas leakage was sensed, the app will alert the user by sending a mail automatically.

## Description of hardware components

The major components used in the circuit are shown in Fig. 2.

**Arduino Uno:** Arduino Uno is a microcontroller that can be used by everyone easily. Arduino boards can read inputs on a sensor and turn them into output. This board consists of 14 digital pins and 4 analog pins. It can be programmed with Arduino IDE using a type B USB cable. It is operated at a voltage of 12V [4]. The gas sensor module, load cell, solenoid valve, ESP8266 is connected to this board for processing the sensor readings to the program.

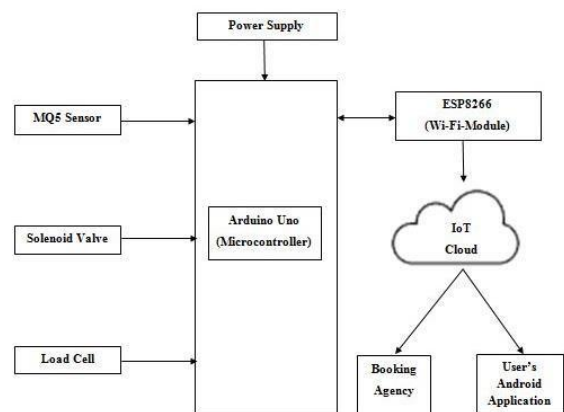


Fig. 2. Block Diagram

**MQ5 Gas Sensor Module:** Gas leakage can be detected by using the MQ5 Sensor. It can detect LPG, i-butane, Methane alcohol, Hydrogen, smoke, and so on [5]. This module has two output possibilities an analog out A0 and output D0. The measurement of gas leakage and volume can be predicted by the analog output. This digital output can be used to detect Gas Leakage and hence trigger an alert system.

**Load Cell:** A load cell is a sensor that converts loads into an electrical signal. A load cell can convert the mechanical energy into electrical energy like a transducer [5]. Whenever, the LPG gas cylinder weight is 20% remaining the system sends a low warning message to the user through the mail. The second critical message is sent when the gas cylinder is about 5% remaining [6]. The actual weight of the LPG gas is calculated by,

$LPG\ weight = Actual\ weight\ received\ by\ weight\ sensor - Actual\ weight\ of\ the\ empty\ gas\ cylinder$

**Solenoid Valves:** Solenoid valve is an associate emergency shut off valve, that cuts off provide of gas, in case of any major hazard caused in Domestic system because of either outflow of a path from Cylinder to cooking stove or failure of equipment like depression regulator, cooking stove, etc. so avoiding any potential grotesque accident [7]. The signal to operate the valve is given by sensing element or a manual switch.

Solenoid valve operation underneath traditional condition

- The valve is operated by a manual switch to show ON and OFF the valve.
- The valve can stay while not dynamic its state until there's an outflow.
- Solenoid valve operation underneath outflow condition[8].

Gas Safe can mechanically shut off the gas provide from the cylinder because of major leakages of gas caused due to:

- The rupturing of a tube or propulsion off the stove or regulator.
- The regulator didn't operate properly.
- The tube catching fire place [9].

**ESP8266:** Next is the Wi-Fi module, ESP8266 which enables data to be sent over the internet[10]. The real-time weight of the LPG cylinder is sent to the mobile application by the internet after port forwarding the Wi-Fi module or through the home Wi-Fi network. ESP8266 (Wi-Fi module) is a self-contained SoC (System on a Chip) with integrated TCP/IP protocol that gives any microcontroller access to a Wi-Fi network [11].

**Android Applications:** As all the people are using the smartphone nowadays, we had developed a mail system for automatic booking and alerting the user whenever the leakage occurs by using the Android application (Fig. 3). We additionally use the Blynk application to show the gas worth within the variety of Gauge, it additionally shows the notification once gas can get detected. Node MCU sends these analog values to the Smartphone to the Blynk application. When the gas value gets increased above 200 the app shows the notification "Gas Detected".



Fig. 3. Android Applications

## Results and discussion

Mobile application is developed that acts as a bridge between the user and also the microcontroller. User can view the desired result by using this mobile application. The user need to register to the present application in order to attach the wifi module. The outputs received from the wifi module area unit hold on within the kind of .xml file within the mobile and might be extracted whenever necessary by retrieving it through file-handling. The daily consumption of gas content is displayed within the graphical kind representational process user friendly interface. Once the user receives the Alertness relating to the booking of cylinder a pop-up message requesting booking directs him/her to the number Dialpad.

By designing this project, we can help the people to provide safety and security by monitoring the gas leakage and providing automatic gas cylinder booking [12]. It is very useful for all industrial, hospitals purpose as well as Home automation purpose. The programming used for this system is simple which is C language and can be easily understood by everyone [13]. By this method, the users may be conscious of their gas level and it additionally avoids the previous and delays booking of the cylinder. And additionally the elements used here square measure commercially low-cost compared to alternative gas detectors (Fig. 4)

[14]. So this idea also can be wide employed in the industries in keeping with their needs.

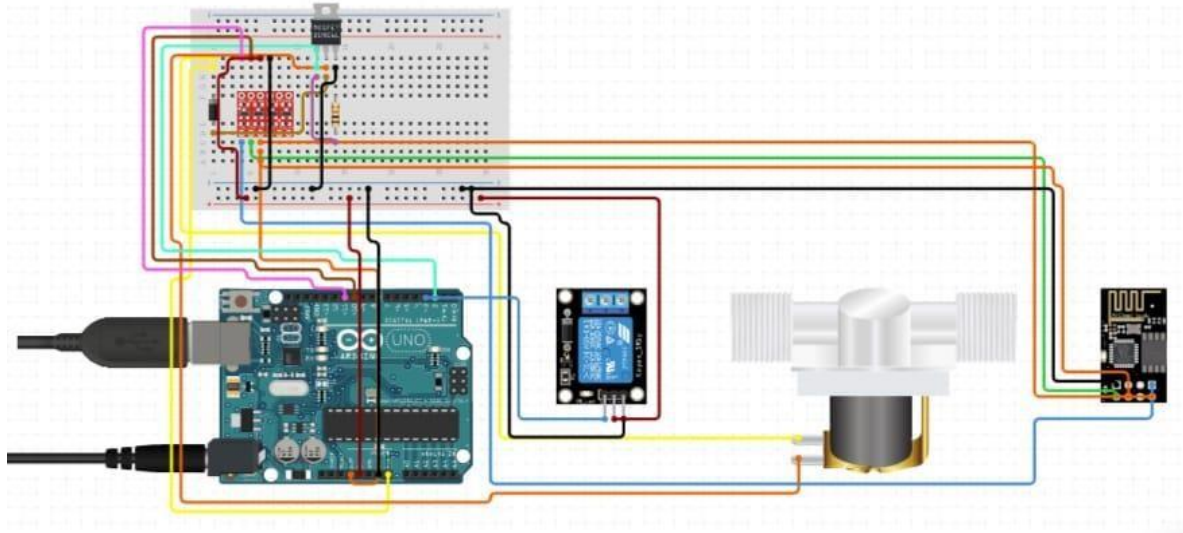


Fig. 4. Connection diagram

### Conclusion

The Internet of things (IoT) is a futuristic technology where the interconnection of devices and the internet is proposed. As safety keeps a vital concern, the projected gas notice on the system makes use of IoT to detect the outpouring and alert the user for preventing the outpouring [15]. This paper deals with another step towards home automation. The primary objective of our proposed system is to detect the leakage of gas in a cylinder and alert the user. The secondary objective is the automatic booking of refill whenever the weight of the cylinder is reduced below the threshold level. The proposed system presents a low cost, low power, and simple design for the control, while the gas leakage occurs. This system can work in the absence of a human in booking and monitoring of LPG cylinder. It minimizing the chances of fire and damage and booking a refill easily. With this system, the number of accidents can be reduced due to gas leakage.

### Conflict of interest

Authors declared no conflict of interest.

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