RESEARCH ARTICLE

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An Intelligent Gas Leak Detection System using IoT

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ABSTRACT

In our day to day existence, Liquefied Petroleum Gas (LPG) is a regular need in families. But, many accidents happen every year due to domestic and industrial gas leakage. LPG is inflammable and if there is any gas leakage and no timely corrective techniques to detect, it can inflict damage to life. Sometimes, the leakage cannot be sensed by any human being because it can be discreet at times. At such situations the gas detection system becomes very necessary so as to keep a constant track of the gas level. Therefore, a Gas leakage detection system with a smart alert system using Internet of Things (IOT) has been developed in this work to avert any mishaps that happens due to the leakage. This system uses sensors along with Node MCU to solve the issue. The user gets notification via an Android-based smart-phone.

Keywords: Gas leak Detection, IoT, Node MCU, MQ5 gas sensor.

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INTRODUCTION

A gas leak occurs when natural gas or another gaseous product escapes from a pipeline or other containment system into an area where it is not supposed to be. It can be harmful to both people and nature. Even small leak into a building, house or any industrial area may gradually build up an explosive or lethal concentration of gas Leakage gas can travel up to 100 feet from the site of the leak to an afflicted tree, posing a threat to human health and animal life. The main feature of LPG is since it is heavier than air; it does not scatter well and can cause suffocation when inhaled. The quantity of passing because of the blast of gas chamber has been expanding as of late. According to the data given by Bureau of Fire Protection in India, LPG leaks cause around 1500 incidents each year. There are many accidents happening due to gas leakage in home as well as in an industry. Recently the Pragyaraj in Uttar Pradesh state on 23 December 2020- the gas leakage accident happened in Indian Farmers Fertilizer Cooperative Limited (IFFCO) and in this accident two people died while 15 employees is injured. There is another accident happened in Visakhapatnam on 7 may 2020 that occurs at the LG Polymers chemical plant. In this industrial accident 11 people died and more than 1000 people became sick after being exposed to the gas.

In [1] the authors have assembled a hydrocarbon sensor structure that includes a sensing cable and an alarm system. Authors in [2] have focused on the research on network system that observes the manufacturing activities in order to detect and avert any healthcare threats in order to improve output. The authors in [3] focus on the idea of smart technology using WSN that could observe the inner

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air quality of a room and potentially unsafe situations. Authors in [4], a prototype has been deigned of Wireless Sensor Network to observe any leakage in gas in a complicated indoor area in real time. Another design has been proposed in [5] where outputs of the two gas sensors were interfaced with the microcontroller and the phone was set with the changes such that an SMS alert will be generated to the users. In [6] for industrial locations, a wireless dispersed gas leak remedy is proposed. Authors in [7] come with a technique to create awareness in customers with the help of IoT. In [8] the authors have designed a prototype for gas detection using Arduino to sense the existence of any gas that is harmful and warn the appropriate individuals. Authors in [9] have designed a gas detection system which aims at decreasing the risks in kitchen using IoT. Authors in [10] propose a system for gas leak within a society with detection setup of hardware in every flat with IoT in use. IoT makes the process of gathering and exchanging information easier, providing consumers with a better understanding while avoiding large damages and large money [11]. A system is proposed in [12] using Arduino which will continuously monitor the gas leakage if any. Authors in [13] have proposed a system where the gas leakage is detected smartly and also the the customer can know when their gas level is below the weight of the set load Authors in [14] have proposed a system where LPG gas detection is done using the required sensor and Arduino. It has fast response time with a good accuracy.

Considering all these, an Intelligent Gas Leak detection model has been designed to eliminate the accidents problem or explosion in buildings, residential houses and industry.

The remaining paper is structured as follows:

The suggested work's methodology is explained in Section II. It is split into three sections, the first of which presents the proposed system's block diagram and its flowchart. The circuit diagram simulation and performance testing are discussed in the second section of Section II. Third part under Section III explains the design and hardware implementation of the protoype. In section III, the results and discussions are focussed , and in section IV, the conclusion is presented.

METHODOLOGY

The aim of the paper is to supply a complete safety by detecting any pressurized facility so as to stop cumulating of inflammable gases in order that user can avert any mishaps that happen due to the leakage. So the purpose of this study is to eliminate the accidents or explosion in buildings, residential houses and industry.The people should be aware about gas leakage in any area and notify them about if gas leakage happen in any building or industry so they are alerted about this situation. The primary advantage of this automated detection and alerting system over the manual method is that it provides real time response and accurate detection of an emergency situation. As a result, the critical situation can be controlled more quickly.

System consists of gas detector sensor, Node MCU i.e. ESP8266 and mobile application i.e Blynk app. The user has to set their internet or Wi-Fi setting that is Wi-Fi name and password and also set the setting in blynk app that is required for get a notification from system. Set the threshold value of gas leak in blynk app. So the values of gas leakage reach the threshold value. Then the system sends notification to the user that is gas leakage detected. In cloud, the sensor readings are also fed which is available from the gas leakage detection arrangement. The analytics may be performed on them to improve the system's precision.

Block Diagram & Flowchart

Figure 1 conveys the whole procedure for the proposed system. In this system the Node MCU is used for input and output. This Node MCU connects to the internet to upload the required code for this purposed system. Output data gives gas leakage alert massage. Further the gas leak is sensed by the sensor and is connected to the Node MCU so as to get all the data about the leakage. Then LED connection shows the visual indication and buzzer for audio indication.

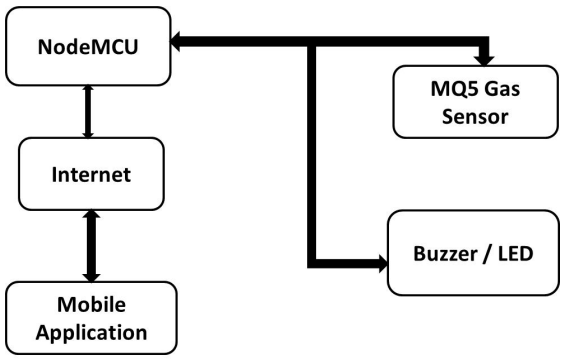

Figure 1: Block diagram for a Gas leakage system

Figure 2 shows the flowchart for the system. That displays how the gas sensor works along with its smart alerting system.

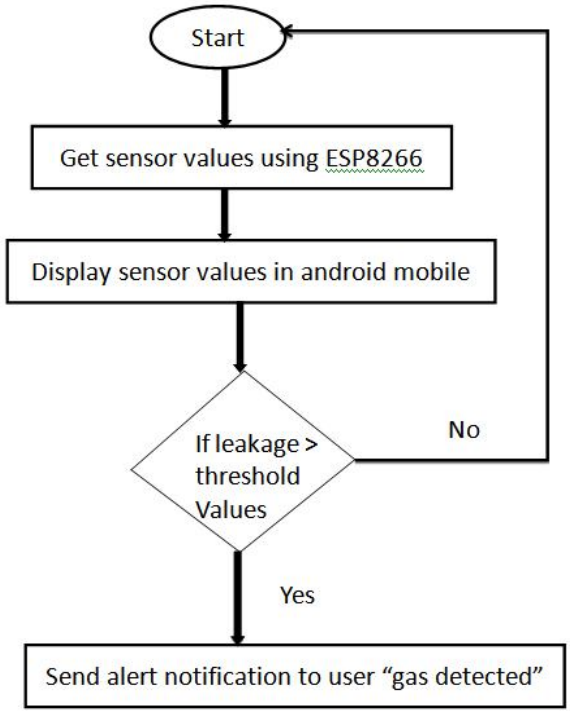

Figure 2: Flowchart for the gas leakage system

Simulation & Performance Testing

The circuit diagram is designed using Proteus software and is shown in Figure 3. The proposed system consists of Arduino UNO and MQ5 gas sensor.

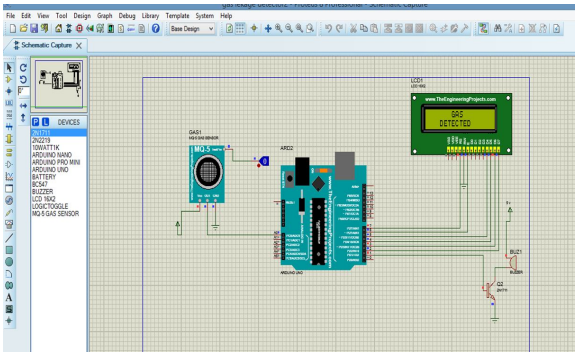

Figure 3: Circuit Diagram

The LPG gas sensor is a MQ-5 gas sensor, the control unit is a PICI6F690 microcontroller, the LCD for showing gas concentration is a buzzer, and the alarm is a buzzer.

A 5V supply is given to the circuit for the simulation to run and some results were observed. If the sensor detects gas in the air, the output should be high. That is if the display shows 1, buzzer will sound and LCD will display "Gas detected" and vice versa. Sensor displays the output in digital format is sent to the Arduino.

When the voltage signal from the MQ-5 sensor exceeds a particular level, the microcontroller detects the presence of a gas and emits an audiovisual alarm. If a gas leak is detected above the predetermined safe level during the procedure, the alarm will sound and the buzzer will ring, alerting the customers to take the necessary action. When a leak is found, it will be stopped in less than two seconds. This technique proves to be one of the well planned and logical systems for automatic detection of the gas leakage.

Design & Hardware Implementation

This section presents development of a prototype model for Gas leak detection and smart alerting technique. This model can be a help for detecting different types of gasses leak in industry, building and residential area.

Figure 4 shows the pin diagram or the connection diagram of Node MCU & MQ5 gas sensor. According to this figure Node MCU is direct connected to the MQ5 gas sensor. In Node MCU there total 30 pins are available and in MQ5 gas sensor 4 pins are available.

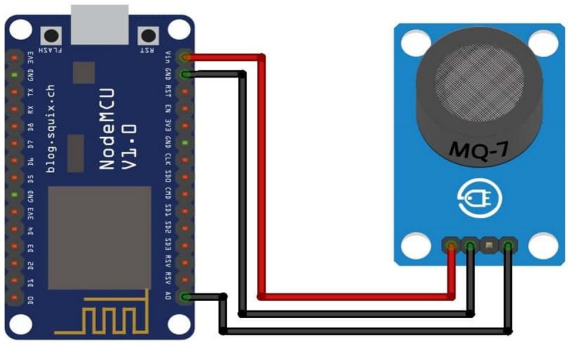

Figure 4: Pin diagram of Node MCU and MQ5 sensor

The coding on Node MCU has been done using inbuilt library function present in the system. Here the Wi-Fi connection of the mobile and one mobile application for display the output has been used.

Figure 5 shows the complete hardware setup implemented for the detection of gas leakage and smart alerting technique using IOT.

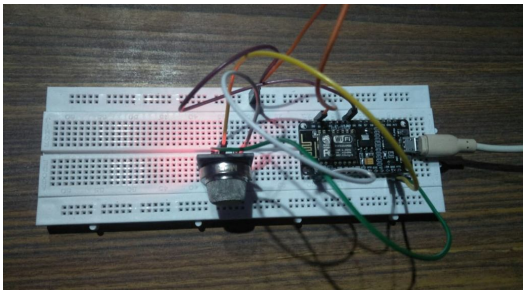

Figure 5: Hardware setup of the Project

The Node MCU is used for controller and gives input to the gas sensor after receiving code. Here MQ5 gas sensor is used for input of the gas or senses or detects the gas leak in the respected area and also get the output from the Node MCU. The 5V supply to the Node MCU is provided through computer using the USB cables (any external 5V or any type of battery). All connections have been done according to the circuit diagram and the code is uploaded in Node MCU. After successfully uploading the code in Node MCU then set the Blynk mobile application according to the requirement. After the Blynk app is installed in the Android phone, the gauge is set along with its pin number setting in the app as it shows the concentration of Gas leakage. The threshold value is adjusted and then the notification bar is set in such a way that the users are properly notified. Here, the notification used to alert the consumer is “Gas Leakage is detected”.

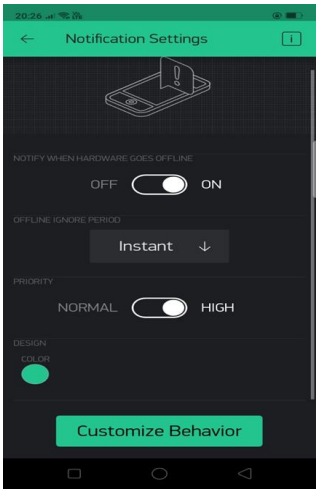

Figure 6: Blynk notification setting

To check if the system is functioning properly, a small amount of gas is spread around the MQ5 gas sensor and is seen whether the gas sensor senses the Gas leak. A lighter is used for the gas dispersion and is placed near the MQ5 Gas sensor which detected the leaking and displayed the results in the Blynk app. Then we get the intended result, and the proposed work is completed successfully. Figure 7 depicts the situation.

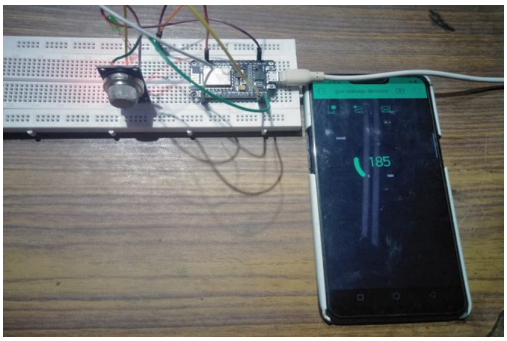

Figure 7: Blynk notification setting

Results & Discussion

Two different cases have been analyzed and are explained below:

Case 1: When the Lighter is brought near to the MQ5 gas sensor, the sensor senses the leak in the area and some values read in the gauge which gradually increases with time. The threshold value is already set and adjusted in the elevator setting that is 500 ppm in the case. The gauge shows the value nearer to the maximum set value but does not equals or move greater than to the set threshold value as shown in Figure 8.

So, if the value of gas leakage on the Blynk app gauge is less than the maximum set value, the system does not give the user a notification.

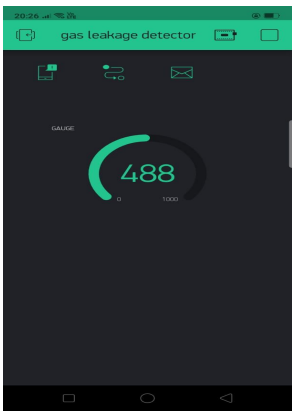

Figure 8: Gas leakage value through Blynk app

Case 2: Gradually the gas leak increases in the area showing a value equal to 500 ppm or a greater value than the one before in the gauge. So, if the value of the gas leakage on the gauge of the Blynk app is equal or more than the maximum set values then the system will send the notification that is "Gas leakage is detected" to the user as shown in Fig.9. This way, people get notified about the gas leak and will stop any harmful explosion or any other losses.

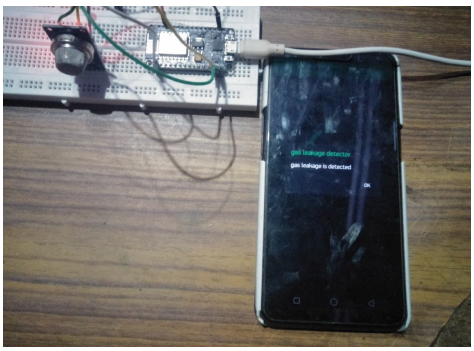

Figure 9: Gas leakage notification

CONCLUSION

The work emphasizes the concept of Smart detection of Gas Leakage caused by LPG in the households and industries. An Intelligent technique is employed to alert the consumers by sending a proper notification to the concerned authority. The model developed wirelessly transfers the data to the internet and internet sends data communication to the respective mobile application regarding the LPG Leakage happening in that particular area after continuous monitoring. The key advantage of this intelligent system is that it delivers real-time response and precise leak detection resulting in greater time for better and early prevention."

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