



Implementation of Gas Leakage Monitoring and Prevention System Using IoT

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Abstract: Gas leakage is one of the major concerns with residential, commercial LPG users, industries and LPG/CNG gas powered transportation vehicles. Gas leakage is very big threat in our day to-day lives and can be hazardous to human health and environment; even a small leak into a building or other confined space may gradually build up an explosive or lethal concentration of gas that may cause a death of human beings. One of the simplest methods to take preventive measures is to avoid the hazard associated with gas system is to install gas leakage detectors at vulnerable locations and provide mechanisms for remote monitoring. There will be some observance to take a quick action to prevent the explosion accidentally. We have proposed gas leakage monitoring and prevention system using IOT principles for monitoring the safety measure using mobile app. This paper describes the system that detects the spillage of the gas in a particular area using gas sensor and immediately alerts the individual in the form of blinking the light and using Wi-Fi to send the alert messages via Blynk app, and exhaust fan is used to scattered gas concentration to cut down the damages and save the lives.

Index Terms - Component, formatting, style, styling, insert.

I. INTRODUCTION

Nowadays it is very essential to monitor the gas level based on the gas leakage incidents that happen earlier. The reason behind these incidents is, there is no such system that will create awareness among the people about the gas leakage, so this may lead to a gas explosion and damages the human environment. It is noticed that due to gas leakage, accidents like a gas explosion, open space may get filled with dangerous gases, and so on. Internet of Things (IoT) is the networking of things by which physical things can communicate with the help of sensors, software, and connectivity. This automation technology became an important factor nowadays for our home and office. Day-to-day activities are getting smart and easier with the help of advanced technology. The development of home automation has made people make things smarter with the smart home concepts. So, 'Internet of things (IoT)' is one such platform to make things smarter and automated. As only the regular works have become smart, the things used are still the same as a Gas cylinder in homes [1]. These systems do not require any human interaction and the same is the case with IoT-based gas monitoring and controlling system.

II. RESEARCH METHODOLOGY

The Liquefied petroleum gas (LPG), carbon dioxide, or propane, is a flammable mixture of hydrocarbon gases used as fuel in many applications like homes, hostels, industries, automobiles, and vehicles because of its desirable properties. LPG is highly inflammable and heavier than air, so it gets collected at the lowest spot in case of leakage which causes suffocation. This energy source is primarily composed of propane and butane which are highly flammable chemical compounds and these gases can catch fire easily and home fires have been frequently observed and often became a threat to human lives because of LPG gas leakages. The damages because of the release of harmful gases to air may lead to risks of explosion, fire, suffocation is based on their physical properties such as toxicity, flammability, etc. Safety plays a significant role in determining how we interact with our environment and it's very important to have knowledge about safety measures to be taken in case of any emergencies. Nowadays, the use of LPG gas has displaced other forms of fuels like coal, firewood, etc., that we make use of since it is a clean source of energy [2-3]. Despite this advantage, the use of LPG gas is accompanied by a high level of risk because of its combustion in nature and flammable which enables it to diffuse and burn easily even at a significant distance from its main source whenever it leaks [4]. Leakage of LPG gas can lead to uncontrollable fire explosions and asphyxiation when the leakage is not detected and controlled on time [3-4]. By considering these losses, a new application called Gas leakage monitoring and prevention system has been implemented. On the off chance that gas spillage happens, this framework identifies it and makes a message alert connected with the circuit [5].

III. GAS LEAKAGE MONITORING AND PREVENTION SYSTEM

While the gases like LPG is a major fundamental necessity of every family, its leakage may cause a disaster. In order to detect the gas leakage and to intimate the surrounding people, we build a NodeMCU based gas detector which will give caution about the gas leakage. The system is to detect the gas leakage in the system installed areas like residential, commercial gas pipelines and to notify the system user in the right time and to control the gas concentration which will provide alert message about gas scattered area and automatically make that area gas free.

The goal of the system is to a develop a smart automatic gas leakage monitoring and prevention system. The system consists of two sections namely, gas detection part and control system. Gas detection system include the microcontroller NodeMCU (ESP8266), MQ-5 gas sensor, LED's and buzzer. The control system includes a relay module, exhaust fan. Refer to Figure 1 for the block diagram of the proposed system.

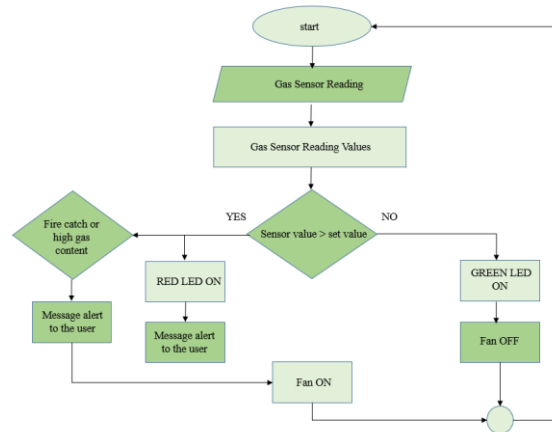


Figure 1. Block diagram of Gas monitoring and prevention system

On assembling all these components of both gas detection system and control system with the power supply, the system will take the following steps.

- 1) MQ-5 gas sensor will start scanning for any gas leakages found in the system installed area.
- 2) If no gas leakage found, then serial monitor display will show the gas level and a message - 'No Gas Leaking'.
- 3) If any gas leakage found, then serial monitor will display the gas value and also an alert message - 'Alert: Gas Leakage'.
- 4) Smart Alarm: The user will be notified through buzzer sound and blinking of red LED. Since the system uses microcontroller with built-in Wi-Fi, will send a text message and e-mail notification regarding gas leakage with the help of Blynk App used.
- 5) On getting notification about gas spillage, system will trigger the relay module to switch the exhaust fan automatically to make the area gas free.
- 6) Now the system will continue for scanning the gas value if it crosses the threshold value.

IV. IMPLANTATION

The MQ-5 sensor used in this project are connected to NodeMCU microcontroller which will continuously monitor the gas leakage. If there is any change in the gas level, then the serial monitor of the Arduino IDE will show the changed gas value and an alert message. The user will also get the notification by the Blynk application used in the user's mobile. The Wi-Fi module will act as the communicator for the Arduino and the Blynk server. The widgets of the Blynk application will help to get the notification in the user's cell phone. The pin diagram of the system is shown below.

The microcontroller NodeMCU with the in-built wi-fi will be loaded with the Arduino code written in Arduino IDE which acts as the communicator between microcontroller and Blynk server.

- The MQ-5 gas sensor which is having three pins will be have the connection with NodeMCU as:
 - A0 pin of gas sensor will be connected to A0 pin of NodeMCU
 - GND pin is connected to GND of NodeMCU
 - VCC pin connected to 3.3V voltage pin
- The resistors are used to maintain the voltage fluctuation in which one end of the two resistors and positive pin of both red and green LEDs are given to micro-controller pins D4 and D5. The other end of resistor and negative pin of both LED's is given to GND (ground).
- The buzzer with the positive terminal will be given to pin D0 and negative terminal to GND.
- Connect VCC pin and GND of relay module to the 3.3V and GND of NodeMCU respectively. Connect signal input pin of relay module to pin D1 on NodeMCU.
- Now, connect positive terminal of fan to NO port in relay module and negative terminal to GND on NodeMCU. The COM port on relay module is connected to 3.3V on NodeMCU.
- The Blynk application is integrated with the NodeMCU with the help of wi-fi module (in-built).
- The user can create project in the Blynk using the authentication token sent to registered e-mail and hotspot connected. The Blynk app will provide number of widgets for the project such as notification widget, e-mail, slider, buttons and so on.
- The user can use the notification and e-mail widget and gauge widget to get the gas concentration in the area;
- On scanning the gas leakages, MQ-5 gas sensor checks for scanned value that crosses the threshold value.

- If there is any change in the gas concentration detected, buzzer and led will notify the user; and also, text message and e-mail will be sent to the user's cell phone. And relay module will trigger the fan to make gas-free area.
- If there is no any change detected, then sensor will continue for scanning the gas concentration.

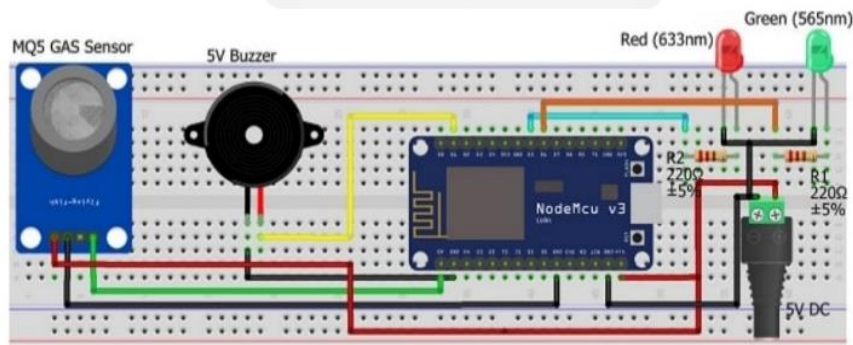


Figure 2. Pin diagram of Gas leakage monitoring and prevention system

V. EXPERIMENTAL RESULTS

Figure 3 shows the system output with green LED blink indicating that there is no gas leakage.



Figure 3. Output when no Gas leakage

Figure 4 depicts the serial monitor showing the message 'no gas leakage detected' with the exact gas concentration values in the area. The gas concentration values can also be seen in the Blynk application using gauge widget as shown in the figure below.

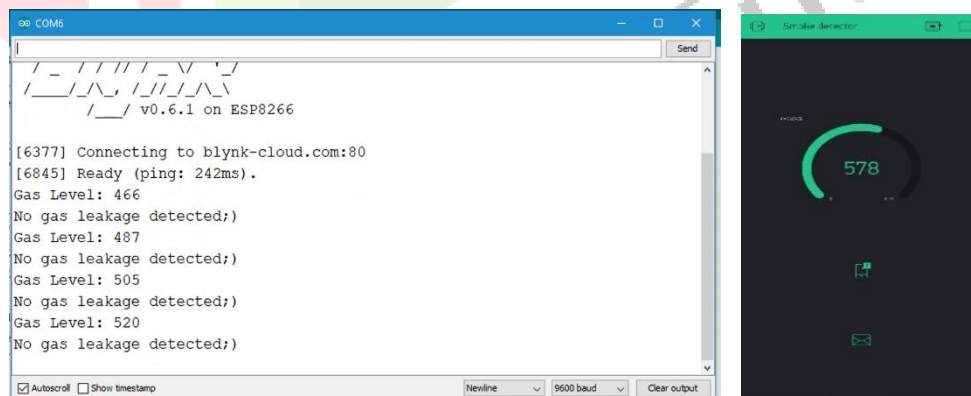


Figure 4. MQ-5 sensor values when no Gas leakage

Figure 5 shows the system output with red LED blink indicating that there is a gas leakage and the fan is switched on automatically by triggering the relay module. During this, the in-built wi-fi technology of the NodeMCU micro-controller will communicate with the Arduino and the Blynk server, so the user will get the notification about the gas leak in their cell phone.

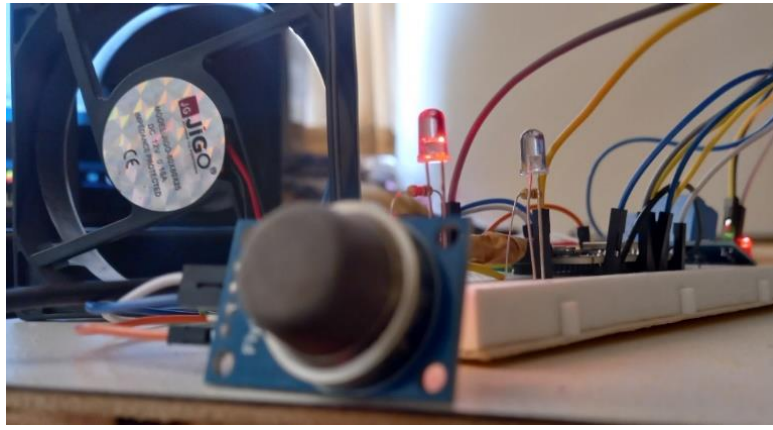


Figure 5. Output when Gas leakage was detected

Figure 6 depicts the serial monitor showing the message 'buzzer alert' and 'gas leakage detected' with the exact gas concentration values in the area. The gas concentration values can also be seen in the Blynk application using gauge widget and there is text message pop-up displaying the gas leak message as shown in the figure below.

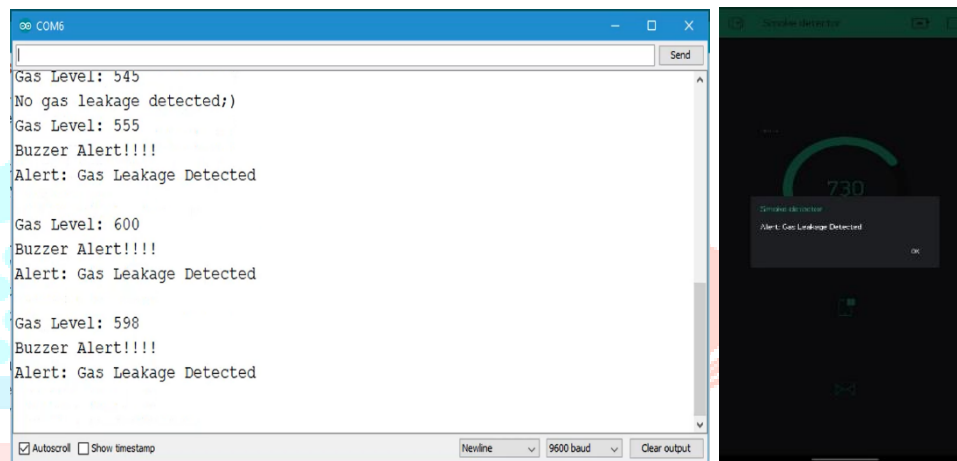


Figure 6. MQ-5 sensor values when Gas leakage detected

VI. CONCLUSION AND FUTURE WORK

The gas leakage monitoring and prevention system is proposed mainly to meet the safety standards and to avoid accidents because of gas leakage. An embedded system for hazardous gas detection has been implemented to detect the gas spillage. The gas sensors will detect hazardous gases either in domestic areas such as educational institutions, residential and industrial areas which avoids endangering of human lives. This system provides quick response rate and the diffusion of the critical situation can be made faster than the manual methods. As soon as the sensor detects more of the edge value of LPG or CNG or any hazardous gas content in the system installed area, LED light glows and SMS is often sent to the user's cell phone and thus notifies the user before any accident if the user is out of the sound range. The device can be used to avoid fire incidents and to provide gas free area. To make this project more comprehensive, the following could be addressed in future works pertaining to this project.

- To make the reduction of concentration of the gas more efficient, an extractor should be used in place of the exhaust fans because it would then take the leaked gas out of the room thus reduce the concentration of the gas.
- A valve should be placed at the nozzle of the cylinder to stop any further leakage.

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