LPG gas sensor detection using IoT

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ABSTRACT – The number of deaths due to the explosion of gas cylinders in Malaysia has been increasing in recent years. The hazardous situation can be reduced with implementation of a system to detect and provide warning on the leakage of LPG remotely and in realtime. This paper reports on the prototype design of a system to detect and monitor any Liquefied Petroleum Gas (LPG) leakage to ensure the safety of the operator and authorized personnel. This is an IoT based solution which offers mobile application and web-based interface for convenience and easy access to information. This system use Arduino based microcontroller and Wi-Fi shield module as a tool to collect data, process and sending the data to the IoT platform. A highly sensitive LPG gas sensor was employed to detect any leakage in close vicinity to highly flammable compound**.**

1. INTRODUCTION

Gas leakage leads to various accidents resulting into both financial loss as well as human injuries. The risk of fires, explosion, suffocation, all are based on their physical properties such flammability, toxicity etc. The number of deaths due to the explosion of gas cylinders has been increasing in recent years. The reason for such explosion is due to sub-standard cylinders, old valves, worn out regulators and lack of awareness using gas cylinders add to risks. Of all the system proposed by 3 previous projects (reference [1],[2] and [3]) none of them proposed the system that covers the IoT part. The present work aims at designing a system that detects gas leakage and alerts the subscriber through an alarm by buzzing the buzzer and sending the notification or data via the IoT to the management team or person in-charge. The management team or person in-charge will receive the notification through their smart phone and they will take an immediate action.

2. METHODOLOGY

The design of a wireless LPG leakage monitoring system is proposed for industry application. The system is detecting the leakage of LPG gas and alert the employee in the factory about the leakage. Whenever the system detects any increase in the concentration of the LPG it immediately sends alert by activating a buzzer and transmit data over IoT.

Several list of gas sensor was studied and analyzed to make sure its specification and features are suitable for the intended application. MQ-6 has been selected as the gas sensor for this purpose due to its high sensitivity to LPG, iso-butane and propane. The sensor is also very fast in response and requires a simple driving circuit as shown in Figure 1. The algorithm used in the microcontroller system depends on detecting the change of gas concentration levels and therefore the output voltage of the sensor. A gas reading of 0.4% of LPG in the air will activate the system through its high quality and sensitive sensor [4]. This process may need a proper calibration when installed at the intended site due to many factors such as open or close compound, the distance from the sensor and others. For simplicity, a variable preset is used to vary the sensitivity of the sensor as shown in Figure 1. The sensor requires 5V for operation to heat up the chemical element inside so that any gas leakage can be sensed by the chemical element and output a varying voltage level based on gas concentration.

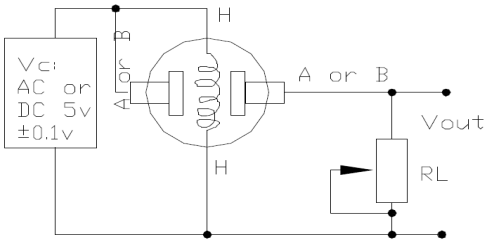

Figure 1: LPG sensor circuit.

Circuit with the sensor, electronic components and microcontroller were constructed using proteus IDE software for the purpose of simulation as employed by Salmani [5]. The program code for this project were written using Arduino IDE software. The circuit was designed in Proteus to produce the printed circuit board for hardware interface to Arduino microcontroller system. Once hardware has been built, the program code written in C language together with functions available in related libraries were compiled and built into an executable file. Compiling may result either logical or syntax error. Syntax error can be easily solved for a beginner or an intermediate level programmer, but logical error must be diagnosed via hardware functionality. After several iteration of troubleshooting process, the final executable file was loaded into the microcontroller.

Figure 2 shows general system connection from the gas sensor to microcontroller which outputs the data to LCD display, buzzer and wifi communication module for transmitting data to IoT cloud database. The wifi shield is a module to interface the Arduino board with aligned pin connection for easy interface. This wifi module is responsible to perform wifi connection and transmit data to the cloud server using a specific Application Program Interface (API) key.

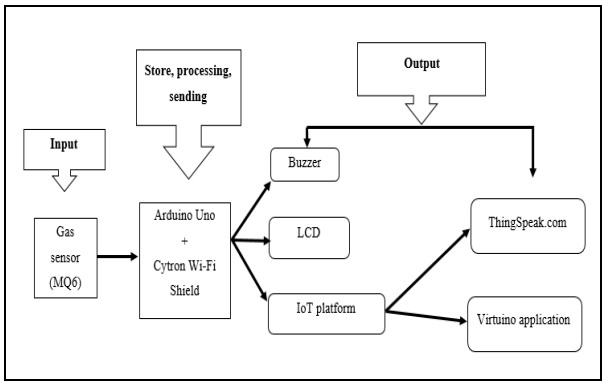

Figure 2: General system connection

3. RESULT & DISCUSSION

The program flow chart and C program code using Arduino IDE was not able to be shown due to the space limitation. However, the program flow could be referred as in Figure 2 for a general system connection showing arrow of data flow.

The sensor detects the LPG at different concentration since the sensitivity is directly related to the distance from the leakage source as reported by Anindya [6]. The output in the ThingSpeak is as shown in Figure 3.

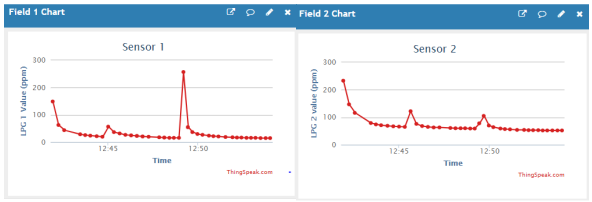

Figure 3: Thingspeak IoT data showing two sensors separated by 2 meters apart and source of LPG were tested from different places.

The mobile apps were implemented using Virtuino apps where the data were extracted from Thingspeak via its API key. The Virtuino interface is as shown by Figure 4. These data however did not indicate the parts per million (ppm) standard gas concentration as a standard since the purpose of the application is to indicate the alarming level of LPG leakage. Other than that, the system were designed with additional feature such short message service (SMS) to notify the intended personnel for system trigger.

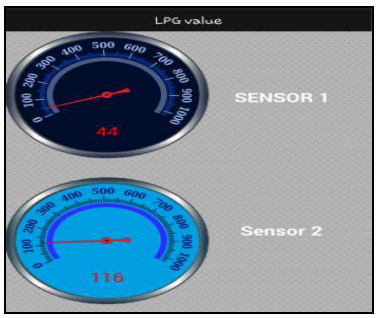

Figure 4: Virtuino application showing sensor reading.

4. CONCLUSIONS

The project has been successfully been implemented using Arduino microcontroller system and ThingSpeak IoT platform. The placement of the gas sensor is very important part to implement this system. This is because the sensor must be placed near/closer to the gas cylinder to increase the sensitivity.

This prototype can be expanded to serve various applications like indoor/outdoor LPG or any type of gaseous monitoring system, home automation system, smart building management, environmental monitoring system Further improvement may be required to ensure that the product is industry ready which offers as much feature as possible to increase the product commercial value and its marketability.

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