Gas Leakage Detector (GD-M5) for Alarming System.

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Abstract
There are many accidents that occurred in business premises and houses that involved in flammable gases that caused explosion last year. The cooking gas cylinder was introduced half a century passed but still the cooking gas cylinder explosion still consider as a common cases. To avoid any accident or tragedy, an effective LPG detector system is built as a product that can detect gas leaks at an early stage that has safety features to notify users. This system's primary objective is to alert the user as soon as a gas leak threat is present through auditory and visual. This system operated well when coupled with the Global System for Mobile Communication (GSM), MQ-5 Sensor, and Arduino Uno. When the MQ-5 sensor detects a gas leakage above a predetermined level, it will send a signal to the Arduino Uno and activate all the preventative hardware, including the led, buzzer, and GSM Module. The system will alert the user of the gas leakage using a CSM module. Therefore, our initiative will try to avoid any casualties and property damage.

Keywords: flammable gasses; gas cylinder, global system; mobile communication; leakage)

Introduction

Even though gas leak accidents are uncommon, they are catastrophic and cause significant harm to both people and property (Babale & Bello, 2022). A flammable mixture of hydrocarbons known as liquefied petroleum gas (LPG) is used as fuel for vehicles, culinary utensils including stoves, and heating appliances. Most home stoves use this gas for cooking purposes. The LPG, like other energy sources, can be hazardous if handled incorrectly, which could result in fires and gas poisoning if too much of the gas is inhaled (Sirdah et al., 2013; Odunola et al.,2008). Over the years, explosions from gas leaks at home have caused many injuries and fatalities in Malaysia (Malay Mail, Dec 2022; The StarTV, Jan 2023). In the most recent incident, which happened last month, a doctor was severely burned on 95% of his body in a blast and is currently fighting for his life.

There was also report that claims that one of the most frequent causes of admission to the nation’s hospital burns departments right now is gas explosions. In addition, most of the cases requires high levels of intensive care, they must be managed in government facilities due to their complexity and severity (Cellaletin et al., 2010). The death rate is extremely high and closely relates to the implicated body surface area. LPG is naturally colorless and odorless, but for safety purposes, all gas

suppliers add an odorant called ethyl mercaptan to the gas to aid in gas detection. Safety precautions are put in place from the planning stage on, and strictly follow the guidelines outlined in the Suruhanjaya Tenaga-regulated Gas Supply Act 1993 and Gas Supply Regulation 1997. This regulation does not ensure the safety of the component because, if the user does not periodically inspect the component, it may result in mechanical failure and leakage. An explosion brought on by a gas leak within a house can result in fatalities as well as property damage.

From the issues above, there was a product developed which can detect any gas leakage with some features. A gas leakage detector can notify the user whenever the sensor is not working and automatically detect a low battery. These features can help users to replace the battery in time and know if something is wrong with the sensor. However, the feature is limited only to users around the house. Besides that, a simple gas leak detector has only a basic feature that is Red LED flashes with an acoustic alarm. This basic product offer user a cheap and reliable product that most people can afford it. Aside from that, a high-quality gas leakage detector can give notifications through vibration, sound, LED display, and high-security measures. This product also has big screen to display real-time of the gas concentration. However, this product is much more expensive than others gas leak product as it offers more features with high quality hardware (Redmile, 2023).

However, there are also shortcomings in this product, where it needs to top up its sim card once a year to maintain its active period. In addition, this product does not integrate with any application where it is only able to send SMS messages to users. Users cannot check directly like other products that use the app. Users also cannot know the information on gas concentration readings which most competitors have that feature.

Based on the discussion above, there is a lot of room for improvement for our products to be competitive with other products. Interesting features can be added to give more added value and give users more flexibility whether inside or outside their home area. Therefore, our primary objective is to design a product that will alert the consumer by activating the safety system through the MQ5 sensor. Other than that, we want to design a device/product that can alert the consumer through auditory using a buzzer, and also through visual using LED, and lastly to alert consumer through messages without any usage of Wi-Fi.

Methodology

Figure 1 shows the block diagram of the proposed proof of concept development of a gas leakage detector using an MQ-5 sensor (GD-M5). This is the block diagram of the implementation of the entire system. In this circuit, used the MQ5 sensor for gas leakage detection. M~~q~~5 Q5 are sensitive to a range of gasses and are used indoors at room temperature. Examples of the gaseous are butane, methane, and LPG. The O/P is an analog signal and can be read with an analog input of the Arduino. O/P comparator is fed to Arduino UNO and the corresponding coding will be displayed through all the output. If gas leakage exceeds 250 ppm, then the led will turn red, and the buzzer will turn on while GSM will send a message to alert the user wherever he may be.

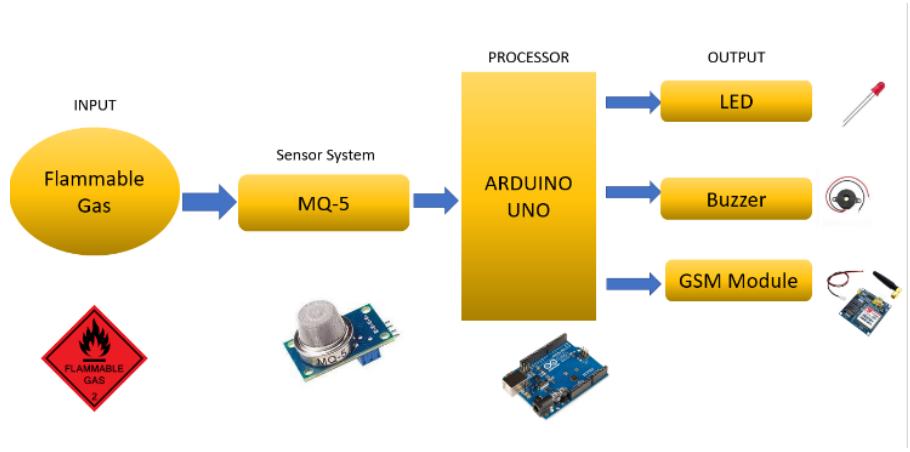

Figure 1: The block diagram of gas leakage detector (GD-M5)

The flow chart of the system operational is shown in Figure 2. The project starts with the presence of a gas that will be detected by the MQ5 sensor. Whenever the sensor detects the concentration of gas exceeds 250 ppm which is in a dangerous condition the buzzer, exhaust fan, and GSM will turn on which GSM will send an alert SMS to the user while the LED notification will turn red meaning danger. However, if the gas concentration didn't exceed 250 ppm the led notification will turn green, the led red turns off, the buzzer turns off and the GSM module did not send any message to the consumer.

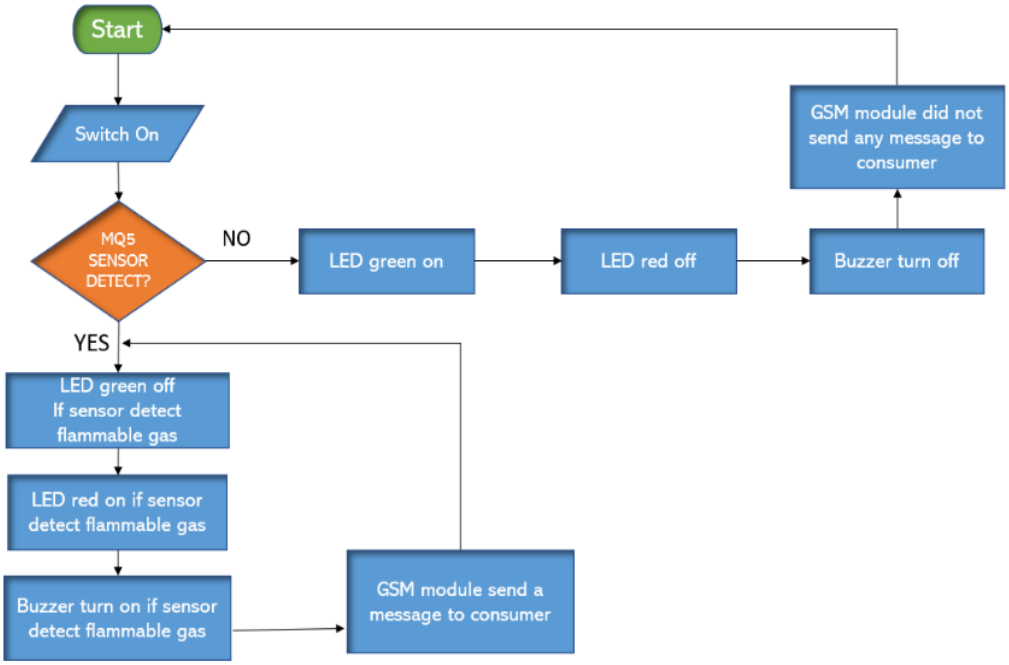

Figure 2: The flowchart of gas leakage detector (GD-M5)

The circuit diagram shown in Figure 3 consists of 6 hardware, one of which is a processor known as Arduino Uno, and the rest of them is a features/outputs for the processor such as blue and red LED, GSM module, MQ5 sensor, and buzzer. The crucial part of the diagram is the input given by the processor towards each of the outputs, the positive part of the green led goes to number 8 of digital while the red part went to number 5 of digital, and the i/o for buzzer will be set on number 7 of digital, the mq5 sensor is set on A0 analogue of the Arduino and the transmit and receive part of the GSM module is set on number 10 and 11 of digital. Each of the input set for every feature is meant for a specific reason the digital system is meant to give an output of either turn on or turn off only but the analogue system works also the same just it adds up a measurement and condition of turning on or off the system. The circuit diagram above concludes the importance of properly setting up and understanding the circuit and how each input works to achieve the desired output.

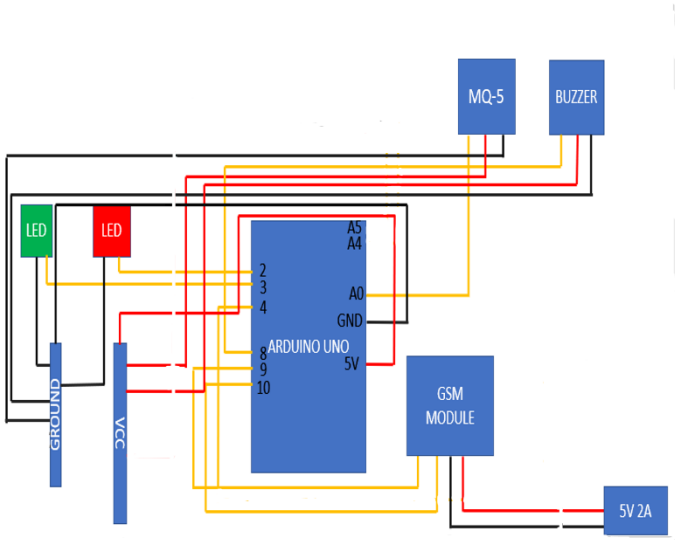

Figure 3: Circuit diagram of gas leakage detector(GD-M5)

Results and Discussion

This project was developed to detect any gas leak and to notify users based on the limit of the gas leak by auditory and visual. The developed prototype is shown in Figure 4. However, in this project prototype, we only use butane gas from a gas lighter to trigger the system. Figure 4 shows the actual proof of concept circuit developed in this project. To start the system evaluation, the respective Arduino Uno file codes were downloaded and run on the Arduino Uno microcontroller.

Figure 4. Prototype of gas leakage detector (GD-M5)

It should be noted that issues a warning message whenever any of the gas leaks are detected. For example, if the gas leak was more than 250 ppm, a notification (Table 1 & Figure 5) is activated to alert the user.

Table 1: Warning system through Led notification based on the gas level.

Gas level (ppm)	Led notification	Buzzer	GSM Module
Below < 250	Led green on, Led red off	Turn Off	Not send SMS alert
More > 250	Led green off, Led red on	Turn On	Send SMS alert

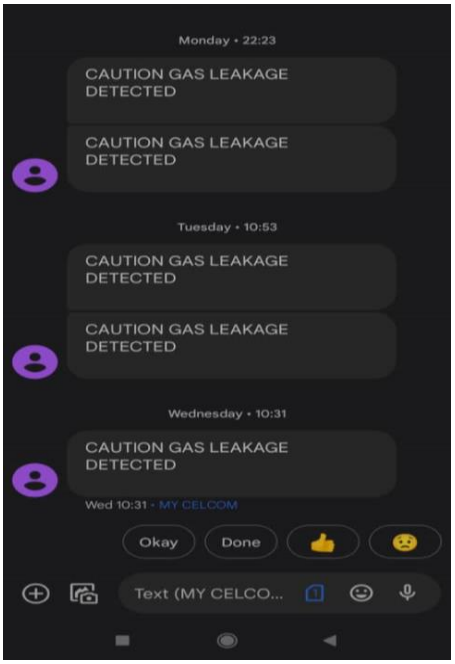

Figure 5: The message was sent to the user if there was a gas leakage

In this experiment, we added a more alternative to warn consumers who are outside or far from home by using a GSM Module. This tool can send an SMS to the consumer if the user has telco coverage.

Depending on the amount of gas loss, Table 1 displays various results. Buzzer, GSM module, and green LED all signal that the gas leakage is categorized as safe based on the gas level measured by the MQ-5 sensor when the gas level falls below 250 ppm (parts per million). However, if the gas level surpasses 250 ppm, every output component will be activated, including the siren, sending a warning to the user through GSM, and turning the LED indicator red to signal danger. The buzzer can warn users who are near the house in addition to warning neighbors if there is a gas leak. Through LED notification, it can increase the effectiveness of our product to warn users through red and green LEDs were green means safe and red otherwise. With the last feature, we want to give warning notifications to users if they are outside their home area either they are working or shopping, yet they can still receive alerts via SMS sent by the GSM module.

In general, a working system of gas leakage has been accomplished despite some drawbacks like the MQ-5's limited ability to detect gas leaks across large areas. Because of a well-constructed circuit, which served as evidence of a job well done, the project's output displays positive and satisfactory results. Technically speaking, it shows functioning equipment that can handle the output from gas leakage in the immediate vicinity, such as automatically turning on the buzzer and reading gas level leaking. By sending the user an SMS when a gas leak is detected, this intelligent LPG detection system will avoid the time-consuming human decision-making procedure. With some restrictions, it will help the project in various ways.

Besides that, students can learn Arduino programming and hardware simulation through this project, among other possibilities. After finishing, we learn a lot about our product, including its advantages in being marketed to both domestic and international markets. Finally, completing this project will assist the student in learning about and applying the field of the project process.

Conclusion

In conclusion, through this study a gas detector through alarm system had successfully build. This system may be greatly improved to read gas levels more accurately and to be more stable in future. To employ such system more time is needed to study and enhance this idea.

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