Development of Gas Leakage Detector Using GSM for Factory Safety

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Abstract: Nowadays a lot of news that plants exploding occur and because of that a lot of people die, to overcome this problem an idea arises to build a safety system which is a Gas Leakage Detector with GSM for factory safety, this system will detect the gas leakage in a factory environment. if have is any gas leak in that factory it will give an alert by triggering the alarm to notify the worker, it also gives the notification using GSM to the authority which is the authority's factory that can take some action to avoid unwanted scene happening. With this system, it can prevent from any explosion happening cause of the gas leak. With the addition of GSM in this system, it will improve the safety of the factory because it will immediately call the person in charge.

Keywords: Factory safety, Gas Leakage Detector, GSM, Arduino

1.0 INTRODUCTION

In the rapid expansion of oil and gas factories, a lot of accidents happen especially factory explodes. This happens cause of many factors one of them being gas leakage. The type gasses such as Liquefied Petroleum Gas (LPG) is a very flammable gas [1]-[3] because it consists of the main composite of propane and butane which is both gases highly flammable. Arduino is an open-source platform and it provides an electronic prototyping platform. Arduino boards are capable to read various inputs based on the environment and they can also affect the surrounding by controlling alarms, lights, and other actuators. The microcontroller on the Arduino board needs to be programmed using the Arduino programming language, the program needs to suit the connection made depending on the project situation. Arduino project is not a just stand-alone product it also can interact with other software work on the computer. Arduino boards also can interface with a lot of modules such as the Wireless Fidelity (WIFI) module, Global System for Mobile communication (GSM) module, and others [4]-[6]. GSM is a digital mobile network It is a widely used mobile communication system in the world. GSM is a cellular technology used for distributing data services and mobile voice. GSM module is not a stand-alone because it's not had a processor combined with it. Arduino will act as a processor for the GSM module, Arduino will communicate with the GSM module to be able to operate correctly [7]-[10].

2.0 MATERIALS AND METHODS

2.1. Material

Figure 1 shows the Arduino Uno R3 board, Arduino is an open-source physical computing application based on a basic I / O board and a programming framework that incorporates the Processing / Wiring language [11]-[13]. The Arduino will be a microcontroller for my project which will process the data from input and control the output, for example when the MQ2 sensor the LPG gas the data will collect by Arduino and after that, it will send the pulse to the output such as GSM and alarm. The technical specification for Arduino is shown below.

Figure 1: Arduino Uno R3 Board

❖ Using ATmega328P microcontroller
❖ The operating voltage is 5V
❖ The limit of the input voltage is 6-20V
❖ Recommended input voltage is between 7-12V
❖ 6 optical I / O pins given by PWM and analog input pins
❖ There are 14 digital I/O pins (6 of them are the PWM output)
❖ DC present of 50 mA for a 3.3V pin
❖ DC is 20 mA per I / O pin
❖ Flash Memory is 32 KB (ATmega328P), and 0.5 KB is employed by the bootloader [14].

Figure 2 shows MQ2 sensor, is a crucial part of this project because this sensor will sense the gas leakage. The sensitive substance of the gas sensor MQ-2 is SnO2, which in clear air has lower conductivity. As the gas content rises as the intended combustible gas happens, the sensor's conductivity is greater [15]-[18]. Using a basic electro circuit, transform the conductivity shift to balance the gas concentration output signal. Especially sensitive to LPG, propane, and hydrogen, the gas sensor MQ-2 can also be used for methane [19]-[21].

Figure 2: MQ2 Sensor

Figure 3 shows the GSM module, the SIM900A, used in many cell phones and PDAs, is a readily accessible GSM / GPRS module. IoT (Internet of Things) and Embedded Software can also be created with the module [22]. The SIM900A is a dual-band GSM / GPRS operating engine at frequencies 900MHz and 800MHz. SIM900A features GPRS multi-slot class 10/ class 8 (optional) and supports the GPRS coding schemes for CS-4, CS-3, CS-2, and CS-1 [23,24].

Figure 3: Sim 900a

2.2. Methodology

Figure 4 MQ2 shows the sensor will act as an input that will detect the gas and process the data and send it to the Arduino. After that Arduino will process the input from the MQ2 sensor and Arduino will send a pulse to trigger the alarm, Arduino also will communicate with the GSM to give the notification to the user about the gas leak. GSM is a communication system that allows 2-way communication between the user and the system.
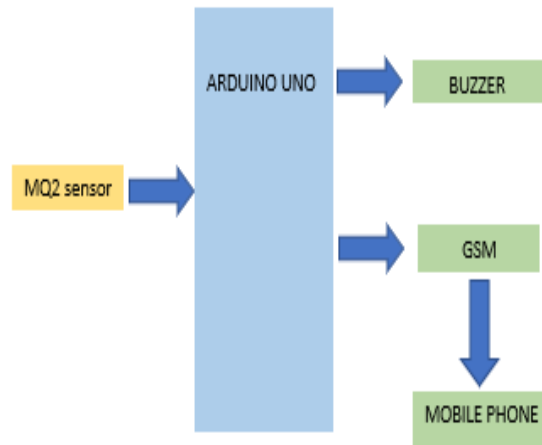

Figure 4: Block Diagram of System

Figure 5 shows that the research flowchart process which is consist of two main parts. the main part includes the software setup and development of hardware which is to establish the connection of GSM. For hardware build the Arduino UNO board will be integrated with a sensor, alarm, and GSM.
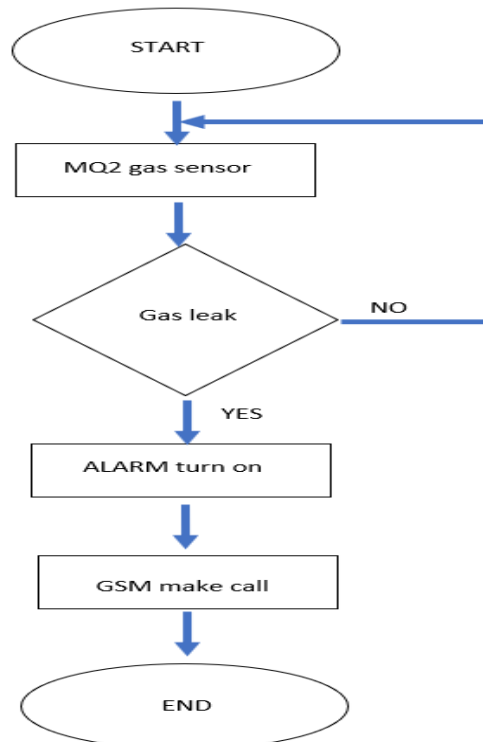

Figure 5: Flowchart of Project

The software involved in the system simulation was Proteus and Arduino IDE. The process starts with assembling the hardware and the wiring of the project shown in Figure 6. The MQ 2 sensor will connect to an A5-pin Arduino. The buzzer will connect to pin 10 Arduino, the most important part which is GSM needs to make sure to connect with Tx and Rx from gsm to pin-8 and pin-9 at Arduino pin because when the connection is wrong the GSM not able to make calling and messaging. The connection virtual terminal is Rx and Tx must connect to tx and Rx at Arduino if not will not able to see the project output.

50cm	1s	50cm	1.3s
100cm	1.5s	100cm	3s
200cm	1.9s	200cm	5s
300cm	2.4s	300cm	7s

Figure 7 shows a reading of the MQ2 sensor after turning on the system. the sensor value has reached 71 because of the sensitivity of the sensor itself.

Figure 6: Circuit Diagram Of Project

3.0 RESULT AND DISCUSSIONS

The development of a gas leakage detector using GSM for factory safety measurement resulted in two different environments which are indoor and outdoor.

Table 1 shows the time taken after the gas has been released at a certain distance, with the result slightly different between indoors and outdoors. Outdoors take much more time compared to indoors this may be because the space and the surroundings influence the movement of the air. When the distance increases the time taken to sensor detection also increases.

Table 1: Measurement Result

Indoor		Outdoor	
Distance	Time	Distance	Time
10cm	0.5s	10cm	0.5s
30cm	0.7s	30cm	0.9s

Figure 7: Arduino Serial Monitor

Figure 8 shows the sensor value after the gas has been released. After the sensor value exceeds 100 the Arduino will trigger the GSM to start calling and messaging
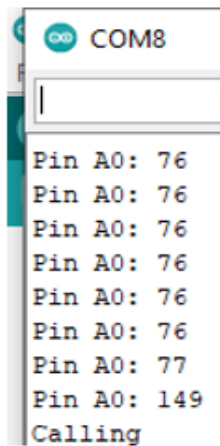
Figure 8 Arduino Serial Monitor After the Sensor Detect the Flammable Gas

Figure 9 shows the result after the MQ2 sensor detects gas leaks. After the gas leak is detected the Arduino starts triggering the GSM to make calls and messages to the registered number in the coding.
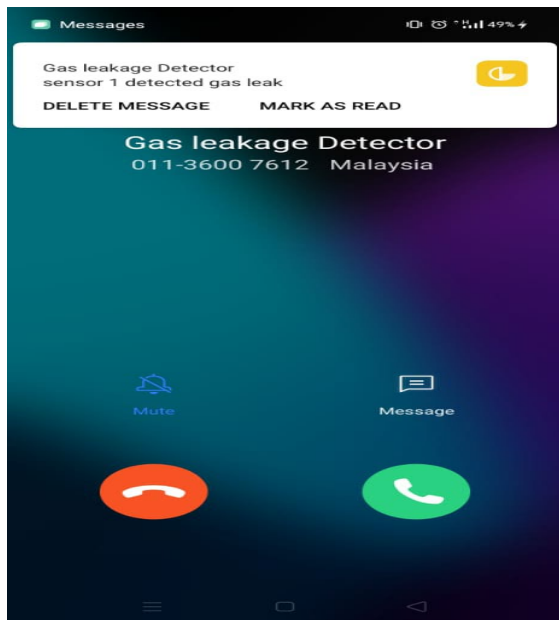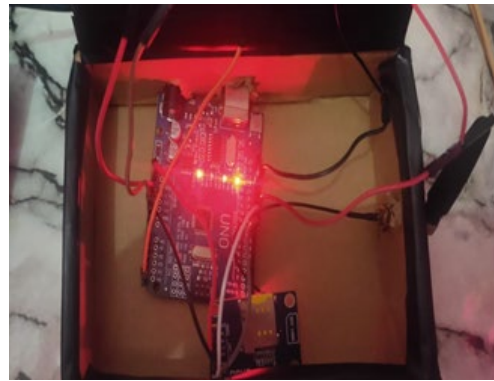

Figure 9: GSM Make Calling to Mobile Phone

Figure 10 shows the project prototype. The sensor and buzzer will place at the top of the box for ease sensor to detect the presence of gas. GSM and Arduino will put inside the box this is to cover it from substances that can make defects to the component. After the system prototype, once again the test has been carried out this is to make sure the system function correctly as before.

(a) Top View

(b) Full View

Figure 10: (a) Top View (b) Full View of Project Prototype

Figure 11 show that text message sends by the system this text message will send straightly after the gas has been detected.
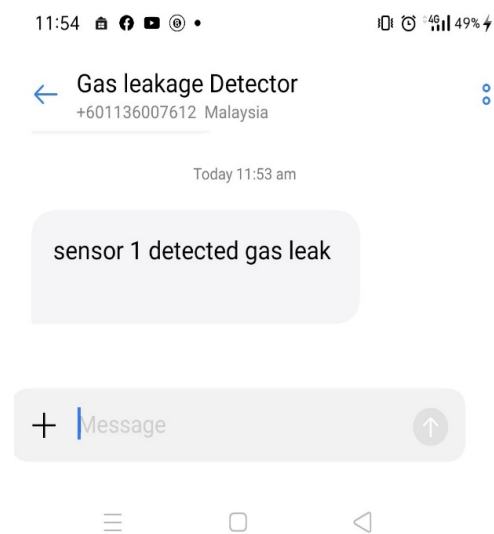

Figure 11: Message Text from GSM.

4.0 CONCLUSION

To conclude the project progress of the Development of a Gas Leakage Detector Using GSM for Factory Safety is successful. The system functions can detect the presence of flammable gas and give alertness to the user through an alarm system and also through GSM. The essential of this system is to prevent a factory explosion caused by gas leaks which can take many lives by detecting the gas before it will explode, this system also will protect the company property from losses caused by the explosion.

More crucial, this system does not need human high skill to use, because it just needs to be ON and placed at the nearest Gas tank. When the tank leak "the development gas leakage detector using GSM for factory safety" will detect the gas leak and give an alert to humans around them by triggering the alarm it also will call and message the factory person in charge to take some action.

5.0 RECOMMENDATION

The hardware development gas leakage detector using GSM for factory safety is complete. But some improvements in terms of design and additional functions can be made, to make this project more efficient and more priceless.

i. The sensor used in this project is only one gas sensor, we know that factory has huge coverage to cover to detect the gas leak. Adding more gas sensors will give more coverage to detect a gas leak.

ii. The protection of the sensor, in this system sensor, does not have waterproof features. This will make the life cycle of the sensor short, especially when doing maintenance, it will cause a short circuit, to overcome the problem, use the gas sensor that has protection.

iii. Adding a cutoff switch the function of this switch is to close the main switches that can react with the flammable gas this feature is also very essential in preventing the explosion.

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