International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

Microcontroller Based Automated Gas Leakage Detector

Jerlou B. Sal, Arvin E. Mag-Usara, Michael P. Yujoco, Donald C. Salvador
Faculty, College of Technology, Surigao State College of Technology, Surigao City, Surigao del Norte, Philippines 8400

Abstract— *Due to the existence of hazardous gas leaks, an alarm system is utilized to notify the occupants of a home or facility of the presence of the leaking gas. This type of alarm device uses a buzzer to indicate the presence of the leaking gas. The project uses an Arduino UNO to detect the presence of a gas leak and sends an alert to a cellphone number. The buzzer and the LCD are turned on by the Arduino, which then sends messages to the cellphone number.*

Keywords— *LPG (MQ6)sensor, Arduino Uno, Alarm System.*

I. INTRODUCTION

Today, liquefied petroleum gas is one of the most widely used alternative fuels in the world. It is a by-product of the extraction of natural gas and the refinement of crude oil[1]. It is odorless and non-toxic when it's at room temperature. When it leaks as a liquid, it forms a cloud of vapor that can then be dispersed on the ground. It can also collect in drains and basements. When it meets a combustible substance, it can cause an explosion[2].

A gas leak detection system uses various sensors to identify the source of the gas and alert the occupants. These devices can be used to detect combustible gases, photoionization detectors, and ultrasonic sensors. These sensors can be used in various industrial facilities and residential areas. They can also be found in vehicles and homes[3].

The goal of this project is to prevent the gas from leaking into the atmosphere. Having a gas leak detection system is very important since it can help minimize the risks associated with this natural gas[4]. The researchers involved in this project are eager to develop a practical and cost-effective device that can be used in different applications.

II. RELATED LITERATURE

Gas leak detection is a process that involves the use of sensors to identify potentially hazardous gas leaks[5]. These devices can be used in various industrial and commercial settings, such as construction sites, where exposure to toxic gases can occur[3].

A gas detector is a device that can be used to detect the presence of gases in an area. It can then be connected to a control system to automatically shut down a process[6]. This type of device can also be used to warn operators in the area where the gas leak is occurring. It can detect toxic gases such as chlorine and carbon dioxide, as well as combustible and flammable gases[7]. It can also be used to monitor various industrial processes.

This type of device is commonly used in industries such as oil rigs and factories to monitor various processes. It can also be used in firefighting[8]. The design of an Arduino board is based on the use of various microprocessors and controllers. These components are equipped with sets of analog and digital I/O pins. They can also be used as expansion boards[9].

The programming environment for the microcontrollers is typically built using a dialect of the C and C++ programming languages[10]. This project uses an Arduino UNO board to create a low-cost gas leak detection system. It uses a gas sensor that can be programmed to detect the presence of gases in an area based on the surroundings. The system then generates a sound alert when a dangerous leak is detected.

The project's gas sensor can detect the concentration of gases in ppm using an in-built digital to analog converter. It can then be programmed to set a dangerous level based on the same digital measure[11]. The project also allows the user to set the alarm when the dangerous level matches w the value detected by the sensor.

III. CONCEPTUAL FRAMEWORK

The materials used in the development of a new product are carefully planned, designed, tested, and evaluated in order to achieve its efficiency. This process is presented in Figure 1.

The second box of the process involves the design and fabrication of the product. This stage talks about the various aspects of the project, such as its diagram and connection point.

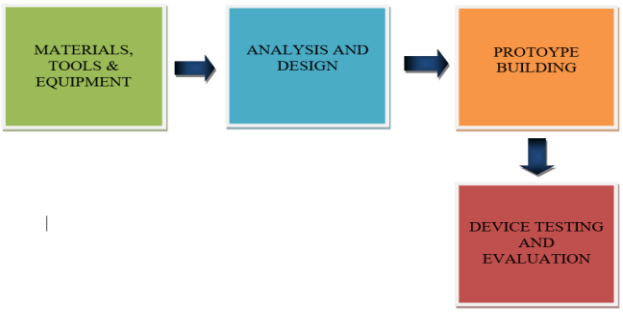

Figure 1. Conceptual Model of the Study

The prototype building stage is the next step in the development process. It provides specifications for a working system[12]. The fourth box provides an evaluation of the project. This part of the process is important to ensure that the project is successful. It should be evaluated to measure its effectiveness.

Jerlou B. Sal, Arvin E. Mag-Usara, Michael P. Yujoco, and Donald C. Salvador, "Microcontroller Based Automated Gas Leakage Detector," *International Research Journal of Advanced Engineering and Science*, Volume 7, Issue 2, pp. 146-149, 2022.

International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

IV. MATERIALS AND METHODS

The sensors used in this project are designed to detect the presence of liquefied petroleum gas (LPG). They can also be used to detect other flammable gases such as Methane. The sensitivity of the sensors and their fast response time make them ideal for various applications[12].

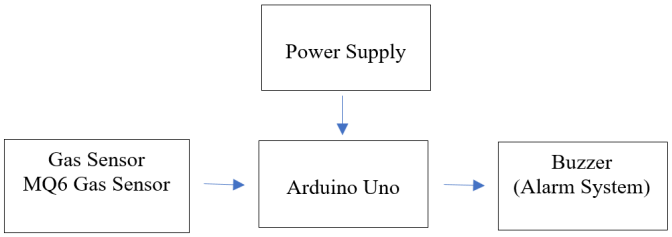

Figure 2. The Hardware of the System

The MQ-6 and the UNO R3 gas sensors are used in this project. If the sensor is able to detect gas in the atmosphere, it will output a digital signal to the Arduino[13].

If the output of the gas sensor is low, the LCD will display the message "Gas detected: No." The buzzer will then determine which button to press and will sound a warning if a preset time has passed.

The buzzer is composed of a series of switches or sensors that are connected to a control unit. These components determine which button to press and whether a preset time has passed. It also sounds warning whenever a light on the control panel is activated.

A. Operationability of the System

To detect LPG gas, the LPG gas sensor module is employed. When it detects LPG gas leaking, it sends a HIGH pulse to its DO pin, which Arduino reads constantly. When Arduino gets a HIGH pulse from the LPG Gas sensor module, it displays the "LPG Gas Leakage Alert" message on a 16x2 LCD and activates the buzzer, which sounds repeatedly until the gas detector module detects no gas in the surroundings. The LCD will display the "No LPG Gas Leakage" alarm message if Arduino receives a LOW pulse from the LPG Gas detection module. The entire system is controlled by Arduino, which reads the output of the LPG Gas sensor module, sends a message to the LCD, and activates the buzzer[11]. This sensor module has an inbuilt potentiometer that may be used to adjust the sensitivity.

B. Project Design

The hardware module is constructed using schematic diagrams, while the software module is written in C++[10]. In the event of a gas leak, the gas sensor will detect the leak and cause the sensor output to have a specific voltage value.

When the curtain's output voltage exceeds the stated limit value (settings), the microcontroller activates the Buzzer, which sounds to inform those who are nearest to the location.

C. Project Development

Project Development shows the whole process of conducting the study from the beginning until the end.

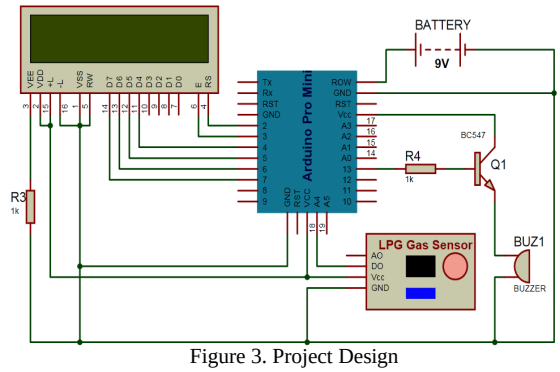

Figure 3. Project Design

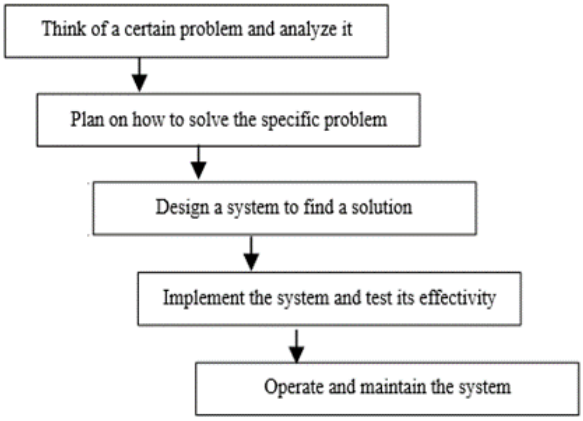

Figure 4. Project Development

The first step in the process is identifying a community issue that needs to be solved. The next step involves coming up with a strategy and a design for a solution. After the system is designed, it will be tested and operated to ensure its effectiveness.

D. Project Implementation

The use of combustible gas such as LPG has a negative effect on people's lives. This issue can also be solved through the design of an examining system that will detect and prevent gas leaks[14]. The system works by using sensors to detect a gas leak and turn on an alarm. The GSM then sends an alert to the person in charge of the gas.

E. Project Evaluation

The project developed was evaluated as to functionality, workability, and device safety based on the design and purpose.

TABLE 1. Participants of the Study

Respondents	Frequency
Household	41
Employee	24
Total	**65**

The respondents of the conducted survey are household and employees, as shown in table 1. The household represents 63.08% of the entire 100%, whereas the employee represents 36.92% of the whole 100%.

Jerlou B. Sal, Arvin E. Mag-Usara, Michael P. Yujoco, and Donald C. Salvador, "Microcontroller Based Automated Gas Leakage Detector," *International Research Journal of Advanced Engineering and Science*, Volume 7, Issue 2, pp. 146-149, 2022.

International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

V. Results and Discussions

Functionality

TABLE 2. Characteristics of the Microcontroller Based Automated Gas Leakage Detector in terms of Functionality:

Items No.	Functionality	M	R	Verbal Interpretation
1	Ease of operation.	3.98	5	Very Good
2	Device alarm system	4.07	4	Very Good
3	Sensor effectivity	4.43	1	Very Good
4	Sensor accuracy	4.30	2	Very Good
5	Measurement as to frequency	4.11	3	Very Good
	Average	**4.18**		Very Good

It illustrates that the rating of respondents on Microcontroller Based Automated Gas Leakage on the aspect of functionality is Very Good and got the mean of 4.18.

Among the five items, the highest item is "sensor effectivity" which obtained a mean of 4.43. It is followed by "sensor accuracy" with a mean of 4.30. Measurement as to frequency and Device alarm system is the third and fourth item with the mean of 4.11 and 4.07. The lowest item having a mean of 3.98 is "ease of operation". All items are rated very good.

Workability

TABLE 3. Characteristics of the Microcontroller Based Automated Gas Leakage Detector in terms of Workability:

Item No.	Workability	M	R	Verbal Interpretation
1	Easy to perform by doing experiments.	3.92	4	Very Good
2	Nature of assembly work is achievable.	4.10	3	Very Good
3	Process involved is simple and operational.	4.15	2	Very Good
4	Output of the experiment can be recognized immediately.	4.42	1	Very Good
5	The work can be done individually.	3.87	5	Very Good
	Average	**4.09**		Very Good

The results showed that the respondents rated the aspect on Workability of the Microcontroller Based Automated Gas Leakage Detector as Very Good with an average mean of 4.09. The highest item is "Output of the experiment can be recognized immediately" got the mean of 4.42. This is followed by "Process involved is simple operational", "Nature of assembly work is achievable", "Easy to perform by doing experiments" garnered the mean of 4.15, 4.10 and 3.92 respectively. The lowest is "The work can be done individually", with a 3.87 mean. All the items are rated Very Good.

Device Safety

It is reflected in the table below that the highest mean item is the "Absence of toxic materials" which garnered 4.96. It follows with "Safety from any combustible materials" with a mean of 4.93. The third and fourth items are "Absence of sharp edges" and "The device is tightly connected without any loss connections" with 4.92 and 4.72 mean respectively. The last item with the lowest rank is "The device can be installed on the targeted location" with a mean of 4.68. All the items are rated Very Good.

TABLE 4. Characteristics of the Microcontroller Based Automated Gas Leakage Detector in terms of Device Safety:

Item No.	Device Safety	M	R	Verbal Interpretation
1	Absence of sharp edges	4.92	3	Very Good
2	Absence of toxic materials	4.96	1	Very Good
3	Safety from any combustible materials	4.93	2	Very Good
4	The device can be easily installed on the targeted location	4.68	5	Very Good
5	The device is tightly connected without any loss connections	4.72	4	Very Good
	Average	**4.84**		Very Good

VI. Conclusions

The results of tests indicate that a tool designed to detect the presence of gas leaks in a home will appear on the LCD screen. The sensor, which is an MQ-6 based device, is tested by measuring its output. When the gas level in the home is detected at 2000 ppm, the gas level will be written on the screen and the buzzer will sound. The objective of the test was to determine the contribution of the MQ-6 sensor to the protection of the home.

References

[1] L. Raslavičius, A. Keršys, S. Mockus, N. Keršiene, and M. Starevičius, "Liquefied petroleum gas (LPG) as a medium-term option in the transition to sustainable fuels and transport," *Renew. Sustain. Energy Rev.*, vol. 32, pp. 513–525, 2014, doi: 10.1016/J.RSER.2014.01.052.

[2] M. A. Ghadikolaei *et al.*, "Why is the world not yet ready to use alternative fuel vehicles?," *Heliyon*, vol. 7, no. 7, Jul. 2021, doi: 10.1016/J.HELIYON.2021.E07527.

[3] Q. Jia, G. Fu, X. Xie, S. Hu, Y. Wu, and J. Li, "LPG leakage and explosion accident analysis based on a new SAA method," *J. Loss Prev. Process Ind.*, vol. 71, Jul. 2021, doi: 10.1016/J.JLP.2021.104467.

[4] N. Evalina and H. A Azis, "Implementation and design gas leakage detection system using ATMega8 microcontroller," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 821, no. 1, May 2020, doi: 10.1088/1757-899X/821/1/012049.

[5] K. Guo, P. Yang, D. H. Guo, and Y. Liu, "Gas Leakage Monitoring with Mobile Wireless Sensor Networks," *Procedia Comput. Sci.*, vol. 154, pp. 430–438, Jan. 2019, doi: 10.1016/J.PROCS.2019.06.061.

[6] M. Hasibuan, I. I.-J. of P. C. Series, and undefined 2019, "Intelligent LPG gas leak detection tool with SMS notification," *iopscience.iop.org*, doi: 10.1088/1742-6596/1424/1/012020.

[7] G. Shingan, S. Sambhare, … V. B.-, D. A. and, and undefined 2017, "Smart gas cylinder: Leakage alert and automatic booking," *ieeexplore.ieee.org*, Accessed: Apr. 06, 2022. [Online]. Available: https://ieeexplore.ieee.org/abstract/document/8389616/.

[8] S. Nahid, N. Anjum, … N. C.-2021 I. 12th, and undefined 2021, "Development of a Smart Automatic Gas Leakage Detector and Alarming System," *ieeexplore.ieee.org*, Accessed: Apr. 06, 2022. [Online]. Available: https://ieeexplore.ieee.org/abstract/document/9623207/.

[9] V. Tamizharasan, T. R.-… S. (ICACCS), and undefined 2019, "Gas level detection and automatic booking using IoT," *ieeexplore.ieee.org*, Accessed: Apr. 06, 2022. [Online]. Available: https://ieeexplore.ieee.org/abstract/document/8728532/.

[10] J. R.-C. Journal and undefined 1992, "What is software design," *user.it.uu.se*, Accessed: Apr. 06, 2022. [Online]. Available: http://user.it.uu.se/~carle/softcraft/notes/Reeve_SourceCodeIsTheDesign.pdf.

[11] M. K.-E. Proceedings and undefined 2020, "Sensor-based gas leakage detector system," *mdpi.com*, vol. 2, p. 28, 2020, doi: 10.3390/ecsa-7-08278.

[12] M. Burry and J. Burry, "Prototyping for architects," p. 272.

[13] J. Chaudhary and A. Mishra, "Detection of Gas Leakage and Automatic Alert System using Arduino," *SSRN Electron. J.*, Apr. 2019, doi: 10.2139/SSRN.3350271.

[14] Syeda Bushra Shahewaz and Ch. Rajendra Prasad, "Gas leakage

detection and alerting system using Arduino Uno," *Glob. J. Eng. Technol. Adv.*, vol. 5, no. 3, pp. 029–035, Dec. 2020, doi: 10.30574/GJETA.2020.5.3.0109.