LPG COOKING GAS WARNING SYSTEM VIA THE IOT SYSTEM

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This report is submitted in partial fulfilment of the requirements for the degree of Bachelor of Electronic Engineering with Honours

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DECLARATION

I declare that this report entitled “LPG COOKING GAS WARNING SYSTEM VIA THE IOT SYSTEM” is the result of my own work except for quotes as cited in the references.

Signature : ……

Author : SATHIA A/L THAUTHU

Date : 25 JUNE 2021

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Bachelor of Electronic Engineering with Honours.

Signature : .....

Supervisor Name : DR. KHAIRUDDI BIN OSMAN

Date : 25 JUNE 2021

DEDICATION

I dedicate my research to my loving father and mother, who have always encouraged and supported me throughout my educational career. My favourite lecturers, who never stop giving guidance and information throughout my studies, have always been helpful and helped me to overcome obstacles. Not to mention my fellow classmates who assisted me throughout my studies and research.

ABSTRACT

The flammable mixture of hydrocarbon gases used as fuel in heating appliances, cooking equipment, and automobiles are liquefied petroleum gas (LPG or LP gas). By refining petroleum or 'wet' natural gas, LPG is prepared and almost entirely derived from fossil fuels sources, formed during the refining of petroleum (crude oil), or extracted from streams of oil or natural gas emerge from the earth. In households and to some degree in some industries. LPG or Liquid Petroleum Gas cylinders are widely used. This project is designed to send LPG cooking gas warning signs to the telephone via the IoT system. This is because there are two unfavourable of this LPG cylinders. First, without any warning, the LPG stops. Often the LPG cooking gas, though still cooking, it may run out of gas. Results in an unfinished meal. Secondly, the LPG Cylinder blast. It occurs due to gas supply leakages. Injuries from the explosion are divided into serval things because of the direct "blast overpressure" effect which can cause injuries. This scope provides LPG leakage reports, or any other gaseous substance based on petroleum and also LPG cooking gas cylinder load/pressure. Modern resuscitation helps to save many lives across the world.

ABSTRAK

Campuran gas hidrokarbon mudah terbakar yang digunakan sebagai bahan api dalam peralatan pemanasan, peralatan memasak, dan kereta adalah gas petroleum cecair (LPG atau gas LP).Dengan memperhalusi gas asli petroleum atau 'basah', LPG disediakan dan hampir sepenuhnya berasal dari sumber bahan api fosil, yang terbentuk semasa penapisan petroleum (minyak mentah), atau diekstrak dari aliran minyak atau gas asli muncul dari bumi.Dalam isi rumah dan beberapa ijazah dalam beberapa industri. Silinder LPG atau Gas Petroleum Cecair digunakan secara meluas.Projek ini direka untuk menghantar tanda-tanda amaran gas memasak LPG ke telefon melalui sistem IoT.Ini kerana terdapat dua silinder LPG ini tidak memberangsangkan.Pertama, tanpa sebarang amaran, LPG berhenti. Selalunya gas memasak LPG, walaupun masih memasak, ia mungkin kehabisan gas.Keputusan dalam hidangan yang belum dilupakan. Kedua, letupan Silinder LPG.Ia berlaku disebabkan kebocoran bekalan gas. Kecederaan daripada letupan dibahagikan kepada perkara-perkara yang serval kerana kesan "letupan overpressure" langsung yang boleh menyebabkan kecederaan. Skop ini menyediakan laporan kebocoran LPG, atau apa-apa bahan gas lain berdasarkan petroleum dan juga beban silinder gas memasak LPG / tekanan. Resusitasi moden membantu menyelamatkan banyak nyawa di seluruh dunia.

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The satisfaction that accompanies the successful completion of any task would be incomplete without mentioning the people who made it possible and whose constant guidance and encouragement crown all the effort success.

I'm heartily thankful to the Supervisor's DR. KHAIRUDDI BIN OSMAN, who provided continuous encouragement, guidance, and support from the initial to the final level enabled us to develop an understanding of the subject.

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LIST OF SYMBOLS AND ABBREVIATIONS

3D :	Three Dimensional
DC :	Direct Current
IDE :	Integrated Development Environment
IEEE :	Institute of Electrical and Electronics Engineering
IoT :	Internet of Things
NodeMCU:	Node Microcontroller
WiFi :	Wireless Fidelity
LPG :	Liquefied petroleum gas

LIST OF APPENDICES

1

INTRODUCTION

1.0 INTRODUCTION

This chapter will overview the project, including an explanation of the project objectives and problem statement. In addition, this chapter includes the project's scope statement, which specifies the scope of work that the project will and will not cover. Finally, at the end of this chapter, a thesis statement provides an overview of each chapter.

1.1 Background of Project

Approximately 30% of LPG users in the world, which 40% are ordinary people. Several guidelines apply to gas contamination detection systems. The modern frame is discrete, mainly used to distinguish the overflowing gas in the living room and office space [1]. Liquefied petroleum gas (LPG), widely known as propane or butane, is typically stored as a liquid in a pressure cylinder and evaporates at atmospheric pressure. This may result in a leakage, which will ignite and produce an explosion. As a result, gas leak detection has grown in popularity in recent years, particularly in safety, industry, the environment, and emission control. Traditional gas leak systems use alarms as warnings to indicate that the leak detection system. Triggering the alarms will be more effective when there is no one on-site [2].

Due to the introduction of home electronic gas detectors in the 1980s and 1990s, the presence of gas detected using chemically impregnated paper. When the paper is exposed to the gas, it changes colour. Since that time, many detections have been created, such as monitoring, alerting technologies and equipment to detect significant amounts of gas escapes [3]. An MQ-2 gas sensor is used in this design to detect gas leakage. It can withstand concentrations ranging from 200 to 10,000 parts per million smoke, alcohol, propane, hydrogen, methane, and carbon monoxide, as well as liquefied petroleum gas [4]. The Internet of Things (IoT) seems to be the most current technology that people are utilising these days. This innovation brings things within the real world to life. The Internet of Things connects in relation to Internet through the things such as doors, cars, refrigerators, or houses. In this way, users can access and collect connected devices anytime and anywhere [5].

A wireless LPG leakage monitoring system proposed for family safety. This system detects LPG leakages and alerts the users about the leakage by a notification Furthermore, as a precautionary step, the system cuts off the gas supply. It employs a load cell to keep track of the LPG level in the cylinder and alerts the user when the gas level falls below a certain threshold, allowing the user to replace the old cylinder with a new one. The equipment can provide safety and prevent suffocation and explosion caused by gas leakages [6]. For various purposes, many research and electronic designs based on discrete components have proposed. Within the same point of discrete components plan, the work in this paper suggests a complete electronic plan with a simulation of discrete components based on an accurate analogue framework. The system will monitor, alert, and determine appropriate protective measures for LPG leaks in domestic and industrial applications [7].

1.2 PROBLEM STATEMENT

Cylinders LPG or Liquid Petroleum Gas are widely used in households and some factories to some degree. These are the reasons why LPG bursts or finishes. As per the numerous investigations conducted by the Oil Industry Safety Directorate (OISD), it is found that overfilled / liquid full cylinders, which are highly hazardous, are the common causes of LPG-related accidents. In addition, failing to turn the controller off while not in use. Furthermore, Damaged the PR knob's ring. The fourth LPG leakage is from damaged rubber lube. Finally, the incorrect way of fixing the regulator on LPG cylinder causes leakage.

1.3 OBJECTIVE

1. To develop the safety measurement of LPG Cooking Gas cylinder
2. To design the LPG Cooking Gas IoT System Updates
3. To analyze the gas leakage detection and response towards preventing LPG.

1.4 AIM

Modern resuscitation helps to save many lives across the world from explosive of LPG cylinder through IoT System.

1.5 PROJECT OF SCOPE

Using the IoT framework, this project is focusing on software analysis. The scope provides LPG cylinder leakage reports of any other gaseous substance based on petroleum and LPG cooking gas cylinder load/pressure. It generates an alarm sound when detecting gas leakage. At the same time, the valve will automatically close and transmit a warning message to the phone via the IoT system.

1.6 THESIS OUTLINE

This thesis outline is organized into five chapters to cover the research work that is related. The techniques of the thesis are described as follows: -

1. Chapter 1

This chapter is about a section of the introduction. Typically, in this chapter, the context of the LPG Cylinder disadvantage will be addressed. Besides, the content of the statement of issues, goals, project scope, and project report structure for a summary of the whole chapter will be clearly outlined in this chapter.

2.Chapter 2

This section reflects the literature review of Case Study History, Gas Leakage Detection, Load Calculation, and Valve Prevention. All the data regarding LPG cylinder prevention will be explained in this chapter.

3. Chapter 3

This chapter is the research methodology for the LPG cylinder warning system. This section will describe the project's management, including the overall flow chart and the Gantt chart for the project.

4. Chapter 4

This chapter focuses mainly on the analysis and discussion of the LPG Alert outcome that will be produced. In this chapter, we can see the outcome of the method obtained from the laboratory experiment.

5. Chapter 5

This chapter sets out the ultimate conclusion of the project and the potential work of the project. In this chapter, we can infer what we are going to get and what we want in the future.

2

BACKGROUND STUDY

In this chapter, the project background study and literature analysis are being clarified for a deeper understanding of this work. Few similar past research are discussed to gain relevant and useful knowledge.

2.0 History Case study

On November 15, 2020 in Tiruvannamalai, Tamil Nadu, three humans were killed, including an 8-yr-old boy and his mother. Four were injured when the wall collapsed after a domestic LPG cylinder exploded said by the police state.

The wounded were hospitalized. “The LPG cylinder might have been spilling driving to collection of gas within the kitchen. When they attempted to light the stove, it activated the impact and the resultant house collapse,” a police officer said.

The police group driven by Arni DSP N Kotteeswaran and Examiner D Subramai and the staff of Tamil Nadu Fire and Protect Administrations (TNFRS) hurried to the spot. The figure 2.1 below shows a scenario of Fireman rescuing People form fire accident.

Figure 2.1: Fireman rescuing People form fire accident.

On August 2020, in Pune one individual was murdered, and seven others were harmed when an LPG cylinder detonated in a level. It driven to the collapse of a common wall isolating two flats in Pimpri Chinchwad township of Maharashtra's Pune area on Sunday morning.

As per preparatory data, it appears the Liquefied petroleum gas (LPG) spilled from the cylinder and caused a blast the minute the gas stove was turned on. The figure 2.2 beneath shows cause of explosion due to LGP cylinder.

Figure 2.2: Shows cause of explosion due to LGP cylinder.

2.1 Liquefied Petroleum Gas

Liquefied petroleum gas (LPG) is a light hydrocarbon molecular combination. It is composed of butane (C4H10), propane (C3H8), or a mixture of the two. At room temperature, these gases are colourless and odourless. Butane has a boiling point of -0.5°C, whereas propane has a boiling temperature of -42°C. LPG becomes a fluid when exposed to natural weight or low temperatures. LPG cylinders for cooking in the house and major components contains more butane than propane. Butane has a higher fuel value per kilogram than propane. It liquefies at a far lower weight than propane, making it more secure to deal with. National and universal guidelines indicate the minor substance of butane and the most excellent LPG vapour pressure. When butane and propane melted under pressure, their volume decreased to about 1/260 of their vaporous total level. Thus, depending on the LPG composition, the specific calorific value is around 46 MJ/kg or 12.78 kWh/kg.

Wood has a vitality content of 14-18 MJ/kg or 3.89 - 5 kWh/kg (depending on the kind of wood and moisture level), but charcoal has a vitality value of 27 - 33 MJ/kg or 7.5 - 8.34 kWh/kg (depending on the sort of charcoal). In oil and gas refineries, LPG is maintained distinct from other businesses. As a consequence, 4 to 5% of total crude oil can be recovered as LPG. However, depending on the crude oil quality, a refinery's technological level, and current advertising expenditures for propane and butane in comparison to other oil items, this might be as low as 1%.

Due to the fact that liquefied gas is heavier than air, it can build on the ground. This might lead to LPG-'lakes.' It is common practice to add a foul-smelling odorant to the Gas in order to detect leaks and limit the chance of explosions. LPG is not toxic, although it is extremely flammable. As a result, LPG must be handled with extreme caution, and all gear and equipment used to store or transport the Gas must comply to stringent security regulations. They must be maintained current and examined on a regular basis. Exchanging for LPG is often subject to government security criteria and a comparison of criteria in order to minimize fire and blast disasters.

2.1.1 LPG physical and chemical properties

The table 2.1 below shows the physical and chemical properties of LPG. It explains more details about the LPG.

LPG	**Properties**
Form	Gas. May be liquefied by pressurization
Color	Colorless
Odor	Very faint petroleum odor 22,000 to 36,000 mg/m^3
Specific gravity	0.5 @ 20ºC
Vapor density	1.55 (air = 1)
Vapor Pressure at ambient	500 kPa
Boiling point	-40ºC to 80 ºC (-40 to 176ºF)
Freezing point	-190ºC (-310ºF) (propane)
Coefficient of water/oil	2.36 [log P]

Table 2.1: physical and chemical properties

2.2 Detecting of Gas Leakage

The Gas Sensor is used to find LPG gasoline spillage (Methane & Propane). It transforms from one form to the other to detect the aroma of booze, cooking exhaust, and cigarette smoke. MQ-4 may also detect levels of indigenous gas ranging from 200 to 10000 ppm. Intemperate affectability to CH4, regular gas. MQ four sensor incorporates a quick, solid, and long-lifestyles reaction. Author research M Anusha, V Nagesh, B Venkata Sai, k Srikanth, and Rupalin Nanda [8].

The sensor is proposed in the paper from Vasudev Yadav, Akhilesh Shukla, Sofiya Bandra, Vipin Kumar, Ubaid Ansari, and Suraj Khanna is MQ 9. It has the advantage of having solid CO/combustible fuel affectability, over the top methane, propane, CO affectability, long life, and incidental expense, fast weight circuit. There are six pins interior that encompassed MQ-9, four of which can utilize to get alarms, and the other two to supply warming modern-day. The framework is created to distinguish and evaluate methane gas inflammable gas capacity space. The framework tests the gas and water consistency, counting any parameters deviated due to gas spillage within the water or gas [9].

The MQ 2 gasoline sensor was used to detect gas leaks. The MQ 2 gas sensor's sensitive layer is SnO2. The conductivity of SnO2 is destitute beneath ordinary working conditions when the environment is free from gas contamination. When the concentration of target gasses such as methane happens within the environment, the conductivity of SnO2 increases, and the resistance of the sensor changes. The sensor is power up by a 5V control supply: author Alan Macker, Anil Kumar Shukla, Sagarika Dey, and Jyoti Agarwal [1].

The MQ4 used as a component of the gas leakage that characterises the part. It is perfect for recognizing CH4, homegrown gas, and keeping far away from the alcohol and cooking debilitate and tobacco smoke. The sensitive material of the MQ 6 gas sensor is SnO2, which has decreased conductivity in clean air and makes strides in its affectability with gas concentration, subsequently stopping gasses incorporating cooking exhaust. It needs a voltage of zero-5 volts that is energizing supply [3]. The figure 2.3 below shows a sample circuit of MQ 6 sensor using buzzer and LED.

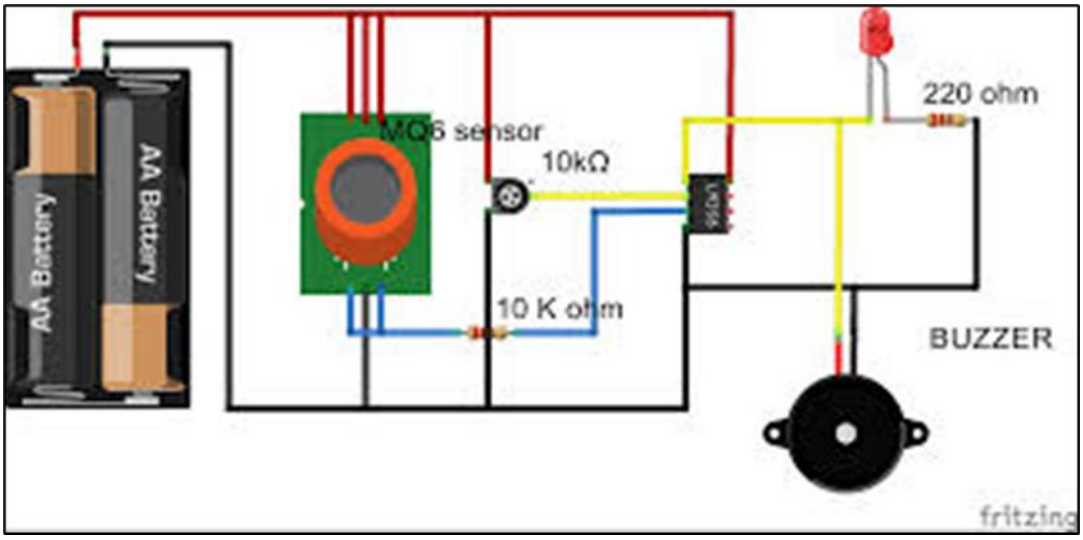

Figure 2.3: Circuit of MQ 6 sensor using buzzer and LED.

2.2.1 Compression between MQ 5 and MQ 6

The table 2.2 beneath shows the compression between MQ 5 and MQ 6. It explains the advantage and disadvantage of the sensors.

Type of Sensor	Advantage	Disadvantage
MQ 5 LPG 200 ~ 10000 ppm	Strong sensitivity to LPG Isobutane	Small susceptibility to alcohol and smoke
MQ 6 LPG 500 ~ 10000 ppm	Strong sensitivity to LPG Isobutane, propane, natural gas	Unable to detect natural gas

Table 2.2: Compression between MQ 5 and MQ 6

2.3 Measurements of Load

A load cell is a transducer that transforms force into an electrical signal that is used to calculate the weight of an LPG gas cylinder in order to estimate and notify the customer how many days the cylinder will be empty. Load cells with varying weight calculating capabilities are available on the market by Suma V, Ramya R Shekar, Akshay Kumar A [4].

The strain gauge load cell is the load cell type employed in this research. The other fundamental portion that utilized as a portion of the undertaking is using a load cell. The load cell calculates the cylinder's weight to educate the client when the weight surpasses the lower limit esteem. Author research by M Anusha, V Nagesh, B Venkata Sai, K Srikanth and Rupalin Nanda [8].

The load cell with the fundamental weighing capacity for the residential cylinder utilized. The weight sensor module utilized at the side of the load cell for calibration purposes. The L6D weight sensor module is built within the machine. The load cell's output drives a hand-off circuit, which generates two constant beats (=10 kg and =0.5 kg). Which, in combination with the microcontroller port pins, are utilised to determine the gas level [3].

A load cell is a transducer that interprets the sum of constraining signals that are connected to electrical signals. The force sensor load cell is the most often used load cell, and it is normally inflexible with high reverberation values. These load cells are long-lasting and long-lived in the application. An amplifier—HX711—is employed to extract perceptible information values from the load cell and strain gauge [5]. The figure 2.4 below shows Donut/Through Hole Load Cell.

Figure 2.4: Donut/Through Hole Load Cell

2.3.1 Types Of Load Cell

The table 2.3 below explain the types of load sensor. It explains the function of the load sensors and its application.

Type Of Load Sensor	Application
Single Point Load Cells	As one of the most complicated load cells, a single point has a variety of applications, including scales, weights, sack fillers, basic supplies, therapeutic weighing, shipping, cost scales, and mechanical weighing.
S-Type Load Cells	Container and truck scales, tank level scales, mechanical to electrical scale changeover, level and stock checking are all applications for S-Type load cells.
Tension/Compression Load Cells	Compression load cells frequently found in stage scales, container scales, vehicle analyzers, track scales, and electronic weighing devices.
Shear Beam and Bending Beam Load Cells	Bending beam load cells are widely used in OEM applications and various cell applications such as tank weighing and mechanical preparation control.

Table 2.3: Types of Load Sensor

2.4 Preventing of Valve

Creates a gas detection and reaction device that faculties Gas leakage is detected, and the gas solenoid valve is automatically shut off and a warning is sent. It centers on keeping up the gas supply of cylinder utilized in family cooking to minimize gas leakage mischances. A valve is a mechanical device regulating fluid flow and pressure within a system or operation, said by Geeta Loshali, Rohit Basera, Lalit Darmwal1, and Sachin Varma [6].

The valve controls the gas system's movement and pressure. For an example the mechanism works by stopping and starting the gas flow changing the volume of gas flow. The valve also controls the flow path of the gas and regulates the downstream mechanism or process pressure. Besides, it relieves the part or pipe over the force. The figure 2.5 beneath shows the flow of the valve.

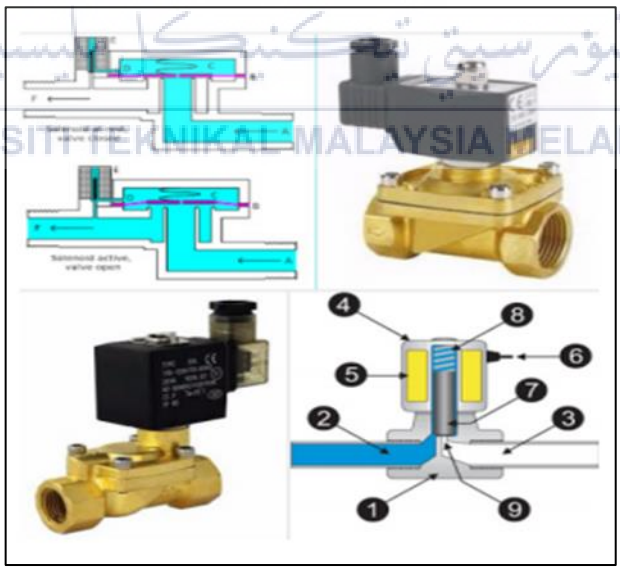

Figure 2.5: Flow of Valve

2.4.1 Compression of Solenoid Valve

Based on the table 2.4 below shows the compression of solenoid valve. It explains the difference between manual reset solenoid valve and automatic solenoid valve.

Type of Solenoid Valve	MANUAL RESET SOLENOID VALVE	AUTOMATIC SOLENOID VALVE
	• A solenoid valve is a type of electromechanically controlled valve powered by an electrical current flowing through a solenoid. • These solenoid valves are designed to be combined with any gas detection device. • The gas supply at the gas pipe is cut off when an emergency is identified, and the signal is sent to the solenoid valve. • To reset the solenoid valve, simply pull the reset button.	• Automatic gas solenoid valves are utilized for the security and direction of gas shut-off in gas nourish channels. • Suitable for a variety of gases such as natural gas, propane, and LPG. The solenoid, which opens automatically when the coil is driven and closes automatically when there is no voltage, usually closes the gas solenoid valve.

Table 2.4: Compression of Solenoid Valve

2.5 Programming Language and Microcontroller

The Arduino IDE is a Java-based cross-program system that begins with the programming language's IDE and advances to the wiring project. It suggested developing programming for engineering and other potential clients who were unfamiliar with computer programme updates. It includes a code editor with features like syntax value, programmable space, and brace coordinating. It is also capable of compiling and transferring a bundle to the board with a specific press. Research is done by Rhonnel S. Paculanan, Israel Carino [10].

Arduino compiled with the Arduino IDE program. This program is the one that announces the machine language to be the rationale language utilized to execute the assignments that we arrange. In this analysis, the Arduino we utilize could be a frame of Arduino Uno R3. With Arduino, analysts can gather devices that have frameworks competent in recognizing gas.

A single cycle run-time microcontroller is like ATMega16A. The microcontroller is within the center of the device. It includes 16Kb of internal RAM, making it necessary to store whole code within the microcontroller itself, as well as a 1 MIPS per MHz instruction cycle execution rate for advanced by and considerable device performance [3].

Atmega8 may be a common control 8-bit CMOS microcontroller that empowers device architects to optimize control utilization versus preparing speed. ATmega8 contains a few instructions sets of 32 registers. All registers with a value of 32 are straightforwardly associated with the rationale number juggling unit. Empowering two isolated registers to be gotten to in one instruction and executed in one loop [11].

Figure 2.6: Coding Form the Research Paper

2.5.1 Comparison between IoT and Bluetooth

The table 2.5 below shows the differences between IoT system and Bluetooth system.

Aspects	Internet of Things	Bluetooth
Range	Wider range	Short range
Data transfer rate	100M Dependent on the modem used for WIFI bit/sec to 1Gbit/sec	Can pass data at the speed of the 3Mbit/second up to 24Mbit/second
Frequency of Bandwidth	2.4 GHz for 2G 5 GHz for 5G	2.45 GHz
Price	The speed that is required can be expensive	Cheap
Future Market	Continuous Upgrade is done	Might stop upgrading

Table 2.5: Comparison between IoT and Bluetooth

2.6 Buzzer

The buzzer is a framework that can transmit a boisterous noise when it is running. Regularly, buzzers utilized to send signals to mean certain conditions. In this test, Bel utilized to appear the detector's state where the LPG spillage has recognized that the buzzer will sound on this circuit if the gas spillage occurs [11].

Piezoelectric buzzers are utilized as a good, dependable framework to deliver an alert tone in electronic circuits. Piezo Buzzers utilized to render beeps, tones, and notices. (Abid Khan, Neju K. Prince, Shailendra Kumar Dewangan, Praveen Singh Rathore) [12]. The figure 2.7 and 2.8 shows the magnesium of the buzzers.

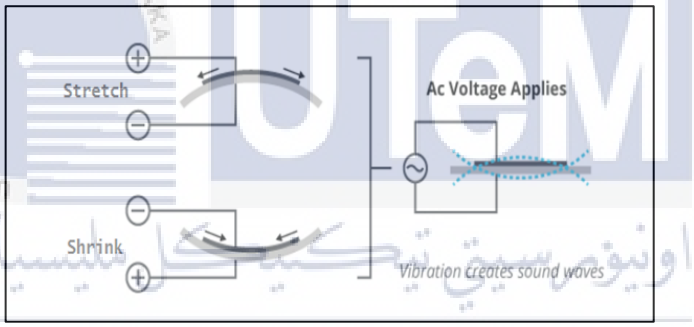

Figure 2.7: Piezoelectric buzzers

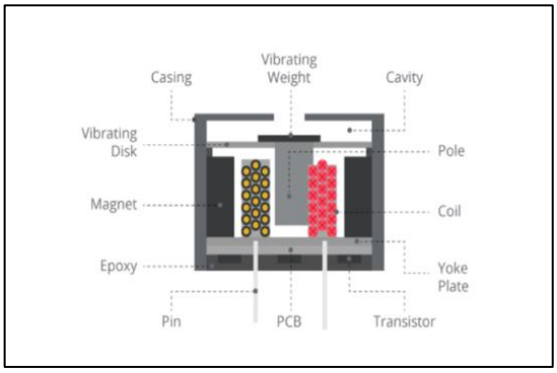

Figure 2.8: Magnetic buzzers

2.6.1 Comparison Of Buzzer

Piezoelectric and magnetic buzzers are most widely used for electrical applications. Buzzers are designed to be used as transducers or indicators in any circuit. The table 2.6 shows the comparison of Buzzers.

Piezoelectric Buzzer	Magnetic buzzer
The piezoelectric buzzer based on the theory of piezoelectric effect. The key component of the piezoelectric buzz is the piezoelectric part. The part consists of a piezoelectric ceramic and a metal layer. Both the piezoelectric disk and the metal plate are held together with the adhesive. The piezoceramic disk has electrodes attached to it. The piezoelectric disk stretches and contracts diametrically as the alternating current applied to it. This induces vibrations in the piezoelectric factor and creates the sound of a specific frequency or frequency spectrum.	There is a ferromagnetic disk attached to a pole in a magnetic buzzer. There are magnets around the pole that hold the disk in a sitting place. There is a coil underneath the ferromagnetic disk that functions as an electromagnet. As the current supplied to the coil, the disk drawn to the coil. If there is no current in the coil, the disk will return to its rest location. The weight above it controls the movements of the disk. As an oscillating pulse applied to the coil, the electromagnetic field produced by the coil often fluctuates, creating fluctuations in the ferromagnetic disk. This way, the frequency sound is the same as the frequency of the oscillating signal applied.

Table 2.6: Comparison of Buzzer

2.7 Summary

The history of cases that have occurred in victims over the years has increased due to the LPG cylinder explosion. However, based on the previous invention in order to overcome this problem, it could be seen that each step and method used to ensure that the problem does not persist. This invention created in the mind of overcoming this problem by combining the knowledge of electronics and science of each system. It ensures that the above factors are the reason for being a victim of an LPG cylinder explosion. On the other hand, based on the previous invention, weaknesses and deficiencies are identified. Therefore, methods are in place to ensure that the problem can further be addressed.

3

METHODOLOGY

This chapter clarifies the strategy for this research. The block chart and organize diagram of the project will be clarified. The parameter of the extend moreover will be appeared in this chapter.

3.0 Introduction

This chapter is about building an LPG Cooking Gas Warning System Through the IoT System based on the literature review of Chapter 2 and what strategy to apply to get the expected result that gives the user a warning or alarm.

3.1 Process of Flow Chart

The flow chart below in figure 3.1 shows the overall flowchart of the project. The design system is composed of hardware and software modules. The hardware modules consist of components and devices—meanwhile, the software modules designed in C language. If a gas leak occurs, the gas sensor will detect the gas leak, and it automatically activates the valve and buzzer. A buzzer warns the people near the gas cylinder, and the valve will avoid the gas flow. The load sensor function estimates the heaviness of the LPG cylinder with plus without gas. It will then inform the user when it finished. This document introduces the way of using the MQ-2 gas sensor, solenoid valve and load cell with NodeMCU 8266 to detect and protect LPG cylinders.

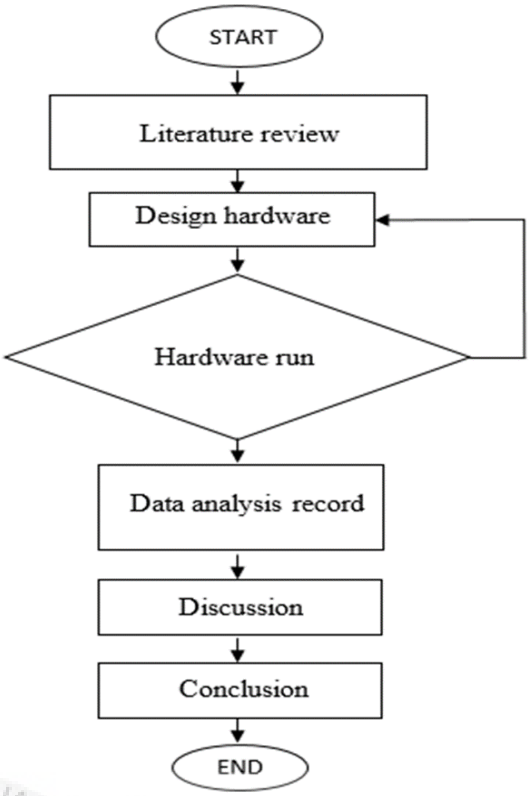

Figure 3.1: Flow Chart

3.2 Block Diagram

This project involves LP Gas cylinders or the cooking gas cylinder. The hardware specifications used in the project have addressed at this point. The open-source (IDE) Arduino Program simplifies to build code and transfer and upload it to the NodeMCU 8266. A Wi-Fi module, buzzer or speaker, load sensor, the MQ-2 gas sensor and Solenoid Valve are also required. When we put the LPG Cylinder on the tray, the flowchart clarifies that the NodeMCU 8266 will trigger and send the LPG cylinder's details to the phone through the Blynk application using the load sensor and gas sensor.

For the load sensor part there is a four-stage weight scale: 70%, 50%, 25% and 0% percent. This percentage means the weight in the LPG cylinder. It indicates the weight and sends value reading to the user through the Blynk application.

The MQ2 gas sensor can identify an LPG Cylinder leakage, then the buzzer and valve will be triggered simultaneously with a message sent to the phone. This is a highly restricted model, and only after the previous step ends, the next stage will begin.

The sequential, step-by-step process of this project is shown in the figure 3.2. Finally, it has reached all the prototypes specifically designed to establish LPG Safety and warning system. In the Result and Discussion section of Chapter 4, further explanations given.

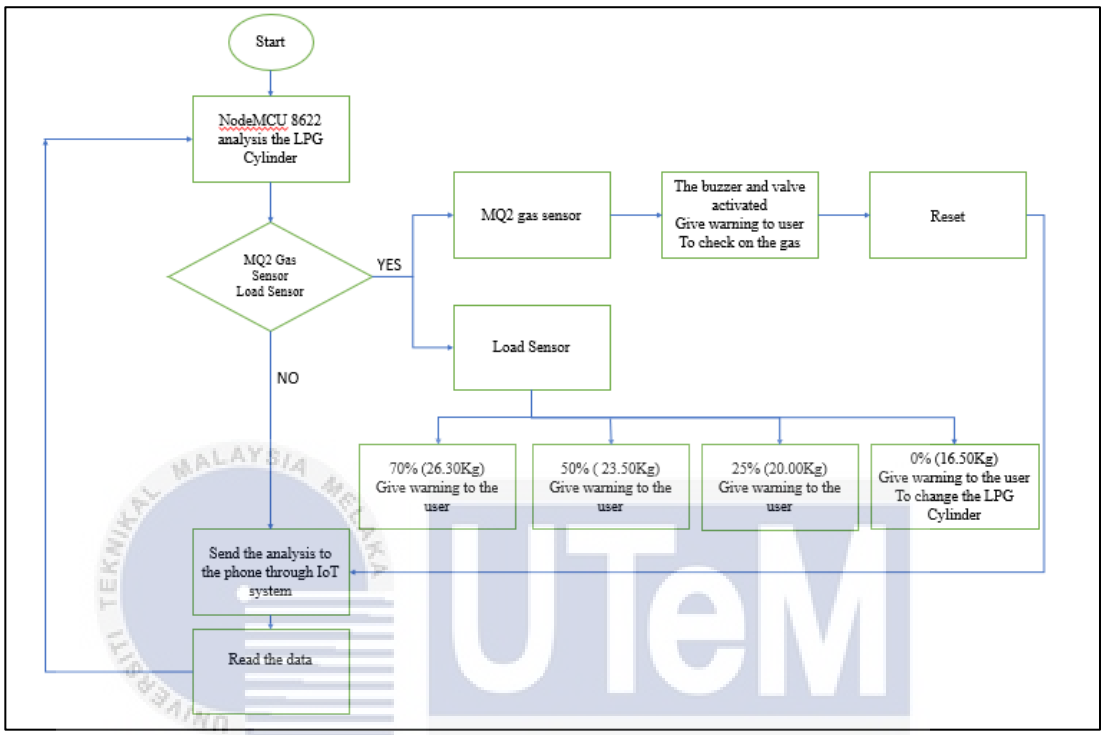

Figure 3.2: LPG Safety System Block Diagram

3.3 Hardware

3.3.1 NodeMCU 8266

The title "NodeMCU" merge "node" and "MCU" (micro-controller unit). The word "NodeMCU" entirely talking alludes the microcode instead of the related improvement units. Two of the microcode and prototyping board plans are open source. The microcode employments the Lua scripting language. The microcode is depending on the eLua extend and built on the Espressif Non-OS SDK for ESP8266.

Because it is simple to use, the NodeMCU Improvement Board may be effectively modified using the Arduino IDE. NodeMCU programming using the Arduino IDE will take only 5-10 minutes. The Arduino IDE, a USB cable, plus the NodeMCU board are all needed. To plan Arduino IDE for NodeMCU, it will review this Getting Started Instructional activity for NodeMCU. The ESP-12 module of the ESP8266 have a Wi-Fi shield built in it and broadly used in IoT applications. The figure 3.3 below shows the NodeMCU ESP 8266 pinout.

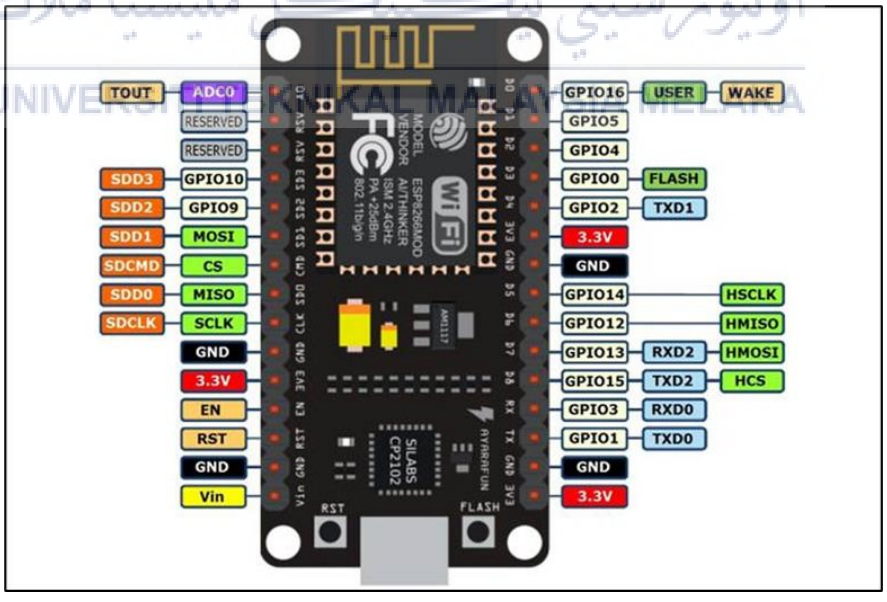

Figure 3.3: NodeMCU ESP8266 Pinout

3.3.2 Nodemcu Esp8266 Expansion Baseboard

This baseboard designed to facilitate prototyping with the NodeMCU V3 board (Lolin). It will extend the NodeMCU's GPIO to header pins, including the Vin, VUSB, 5V, 3.3V, and GND. It can now control the NodeMCU and the complete framework with a DC jack and voltages ranging from 6V to 24VDC using the integrated voltage controller. The board includes a control pointer. It can now power up the MQ2 Gas Sensor, Load Sensor, and Solenoid Valve without any addition power supply or circuits. The figure 3.4 below shows Base Board for NodeMCU V3.

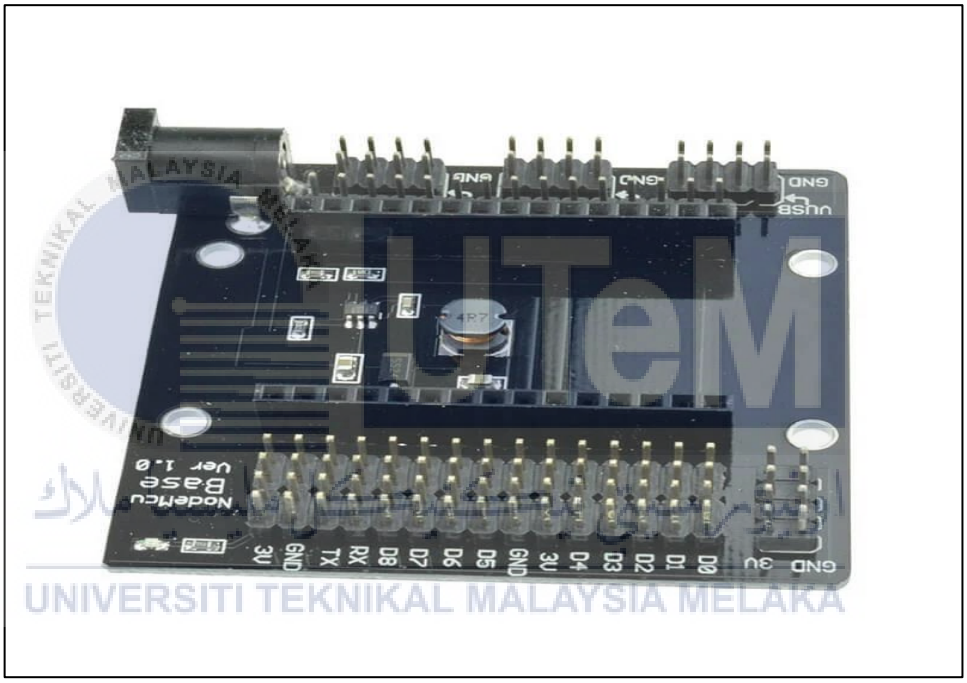

Figure 3.4: Base Board for NodeMCU V3

3.3.3 MQ 2 Gas Sensor

MQ2 will be one of the most often utilized gas sensors in the MQ sensor array. The MQ2 gas sensor operates in this method. When tin dioxide (semiconductor particles) heated in air, oxygen adsorption occurred on the surface. Giver electrons in tin dioxide are attracted toward oxygen adsorbed on the surface of the detecting material in clean air. This avoids the flow of electric current. Because it responds to decreasing gases, the surface thickness of adsorbed oxygen reduces when it is close to lowering gases. Electrons will be then discharged into the tin dioxide, permitting current to stream freely from the sensor.

The sensor changes the analogue output voltage in response to the convergence of smoke/gas. The higher the gas concentration, it is higher the result voltage, and the when the gas concentration decreases, the output of the voltage decreases too. To digitise the signal, the analogue signs from the MQ2 Gas sensor is advanced sent to the LM393 High Exactness Comparator. Moreover, the comparator has potentiometer that can twist to adjust the sensor's affectability. It is suitable to use for LPG detection. The figure 3.5 beneath shows the MQ 2 Gas Sensor.

Figure 3.5: MQ 2 Gas Sensor

3.3.4 Load Sensor

A load sensor (also known as a "load cell") is an electronic device which converts overpressure and pressure powers into a relating electrical sign. Load sensors typically utilized for identifying the weight of a subject (mechanical scales), yet it has also been used to measure pressure (such as in pulley cables and ropes).

Meanwhile the designs plus capacities of load sensors range, all action obstruction and bending inside the sensor to decide the magnitude of pressure and pressure qualities. Load sensor technology benefits the manufacturing, therapeutic, primary supply, and automobile industries.

It detects compression strengths by measuring capacitance. Capacitive load sensors made up of both conducting plates that move nearer or farther apart as the load changes. This type of load sensor used because it will be determining the mass of the LPG cylinder. The figure 3.6 beneath shows the load sensor of weight scale.

Figure 3.6: Load Sensor of Weight Scale

3.3.5 HX711 Module

This method has made use of 24 high-precision A/D converters. This chip intended for a high-precision electronic scale and program, and it features two analogue input channels and a programmable pick up of 128 coordinate tenses. Furthermore, the input circuit can offer a bridge voltage electrical bridge (such as weight, load) sensor display, making it an absolute high accuracy, less cost checking front-end module.

HX711 is an IC that permits effortlessly coordinated load cell to any extend. Furthermore, no amplifiers or double power supply fair require any amplifiers to utilize this board, and it will effectively interface it to any micro-controller to degree weight.

This could be useful in developing a mechanical scale, preparation management, or fundamental nearness finding. The HX711 Weighting Sensor communicates via a two-wire interface (Clock and Data). Therefore, any microcontroller's GPIO pins must be functional, allowing the user to inspect data from the HX711.

At last, it is one of the most excellent choices for electronic devotees. The chip brings down the cost of the electronic scale, at the same time, moving forward execution and unwavering quality. The figure 3.7 and 3.8 beneath shows the hx711 module and arrangement of Load Sensor.

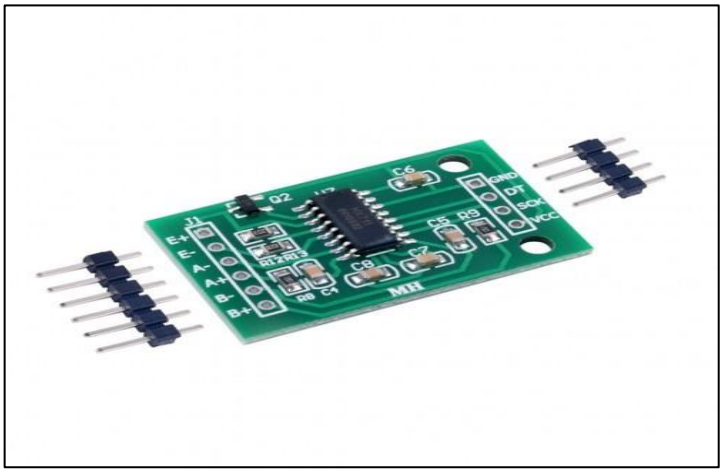

Figure 3.7: HX711

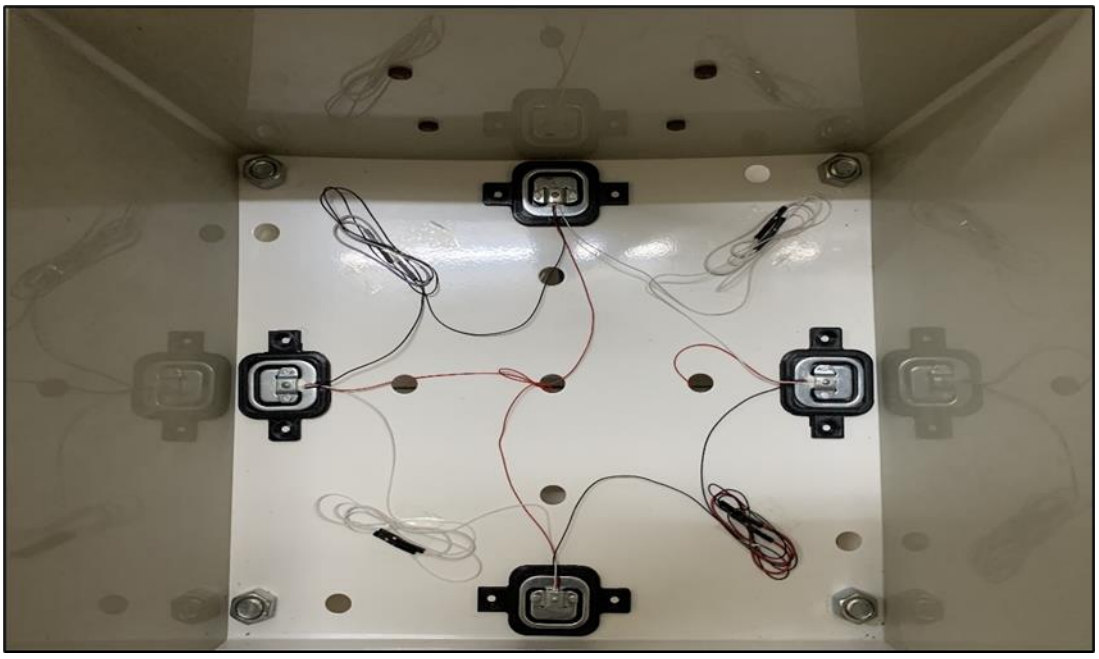

Figure 3.8: Arrangement of Load Sensor

3.3.6 Gas Solenoid Valves

Gas Solenoid Valves are as flexible as they are valuable. Deciphering electrical impulses to open and close the valve controls gas flow in a broad. In this way controlling the flow of gas into a chamber or even through a line. Thus, a gas solenoid valve can utilize in numerous applications.

The valves are accessible in brass, aluminum, and stainless steel. It natural highlights incorporate intersection box, pipe taps; visual sign; verification of closure, driving office endorsements, and pipe associations from 1/8" to 3". This valve appraised for -40ºF benefit for open-air establishment in bone-chilling climates. The run of gas solenoid valves is accessible in a broad extend of body and seal materials. This is a perfect solenoid valve to use to control LPG gas flow. Based on the table 3.1 below shows features and working principle of gas solenoid valve. Furthermore, figure 3.9 and 3.10 shows DN15 solenoid valve and the way solenoid valve fix to LPG regulator.

Features	Working Principle
• It used to manage the fluid and gas within the pipeline organically. • Excellent copper material, smash resistance, break leak-proof, safe, non-toxic, and long life. • Appropriate for mediums containing gas, water, oil, and gas.	• Normally closed: When the coil is activated, the spool closes, the gap opens, the upper chamber of the valve shrinks, the lower chamber's medium weight pushes the cylinder, and the solenoid valve opens. • When the coil is de-energized, the spring resets the spool, the gap closes, the upper chamber of the valve pressured by the cylinder opening and the pushing of the return spring, and the solenoid valve closes.

Table 3.1: Features and working principle of Gas Solenoid Valve

Figure 3.9: DN15 Solenoid Valve

Figure 3.10: The Solenoid Valve fix to LPG regulator

3.3.7 Relay

A relay is a switch which will be activated by electricity. It has a bunch of info terminals for a single or numerous control signals and many of working contact terminals. Relays utilizes when an autonomous low-power signal is required to operate a circuit or when a single signal should control multiple circuits. Transfers were initially utilized as signal repeaters in significant distance send circuits. It resuscitates the signal from one channel by transmitting or sending it on another. Transfers generally utilized to direct coherent operations in early computers and phone transactions.

Because the relay has a 12V trigger voltage, it switches to connect a +12V DC supply to one end of the coil and ground to the another. Plus, making use of the transistor as a switching device for swapping. The diode used to shield the switch from a high voltage spike brought about by the relay coil. In this project, one end of the solenoid valve is linked to the Common pin, while the other end is either attached to NO or NC. If the solenoid valve linked to NO, it stays disconnected sometime after the trigger. If it connected to NC, it remains attached sometime after the trigger. The figure 3.11 and table 3.2 below shows the relay diagram and description of 12V DC relay.

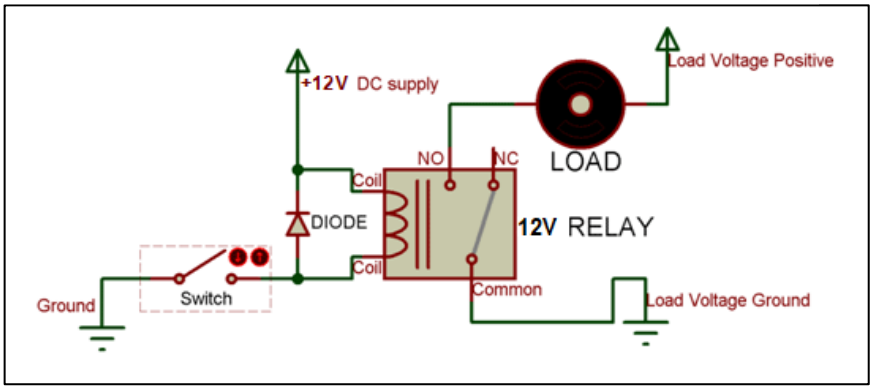

Figure 3.11: Relay Diagram

Pin Number	Pin Name	Description
1	Coil 1	To activate (turn on/off) the relay, one end is typically connected to 12V and the other to the ground.
2	Coil 2	To activate (turn on/off) the relay, one end is typically connected to 12V and the other to the ground.
3	(COM)	The term "common" refers to one of the ends of the load that must be regulated.
4	(NC)	The load's other end is either related to NO or NC. If the load is associated with NC, it will remain attached until the load is disconnected.
5	(NO)	The load's other end is either related to NO or NC. If the load remains disconnected after a recent trigger and is associated with NO, the load will be disconnected.

Table 3.2: Description of 12V DC Relay

3.4 Software

3.4.1 Arduino IDE Application

The Arduino Integrated Development Environment (IDE) is known as cross-platform application (for Windows, macOS, and Linux) written in C and C++. The Arduino (IDE) - includes a code editor, a message area, a content comfort, a toolbar with buttons for standard functions, and a menu layout. It connects with the NodeMCU 8266 boards to transfer and communicate with them.

Sketches are programmes written with the Arduino Computer programme (IDE). These sketches are created in the content editor and saved with the file expansion. The editor has highlighted information for cutting/pasting and searching/replacing. The message area comments while storing and sending out both display errors. The terminal displays the Arduino Computer programme (IDE) content, such as total error messages and other data. The designed board and serial port are displayed in the bottom right corner of the window. The toolbar buttons permit you to confirm and transfer programmes, create, open, save drawings, and access the serial screen.

Libraries provide additional usefulness for applying in outlines, for example, interacting with equipment or controlling data. The Arduino computer programme includes a few libraries. Others can obtain from a variety of sources or the Library Director. The Figure 3.12 shows the content editor arduino computer programme (IDE) with the project code on it.

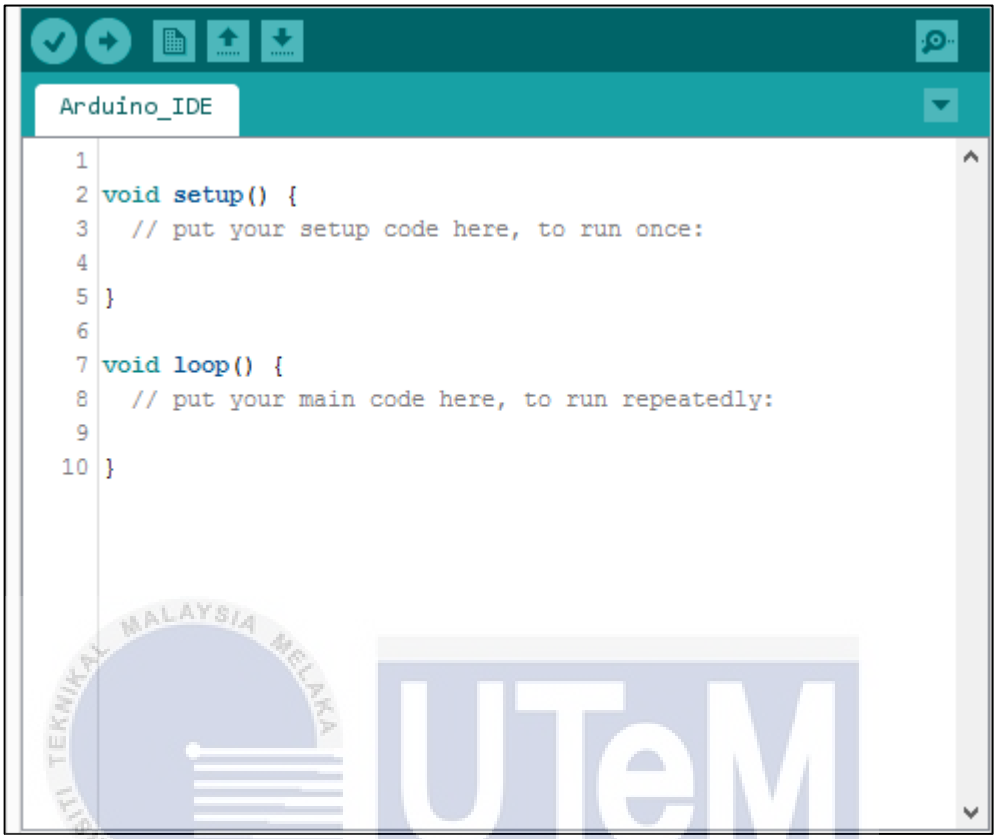

Figure 3.12: Content Editor Arduino Computer Programme (IDE).

3.4.2 Ultimaker Cura

Cura is an open-source 3D printer cutting application. Ultimaker Cura works by partitioning the demo record into layers and producing printer-explicit g-code. Once completed, the g-code will be conveyed to the printer for actual item development or construction. The open-source computer programme, which is compatible with most desktop 3D printers, can deal with many files from the most prevalent 3D groups, for instance STL, OBJ, X3D, 3MF, and image file formats such as BMP, GIF, JPG, and PNG. Furthermore, it has designed the Load Sensor casing using this Ultimaker Cura application with PLA 1.75mm Filament. The figure 3.13, 3.14 and 3.15 beneath show the design for load sensor, the setup for 3d printing and PLA 1.75mm filament.

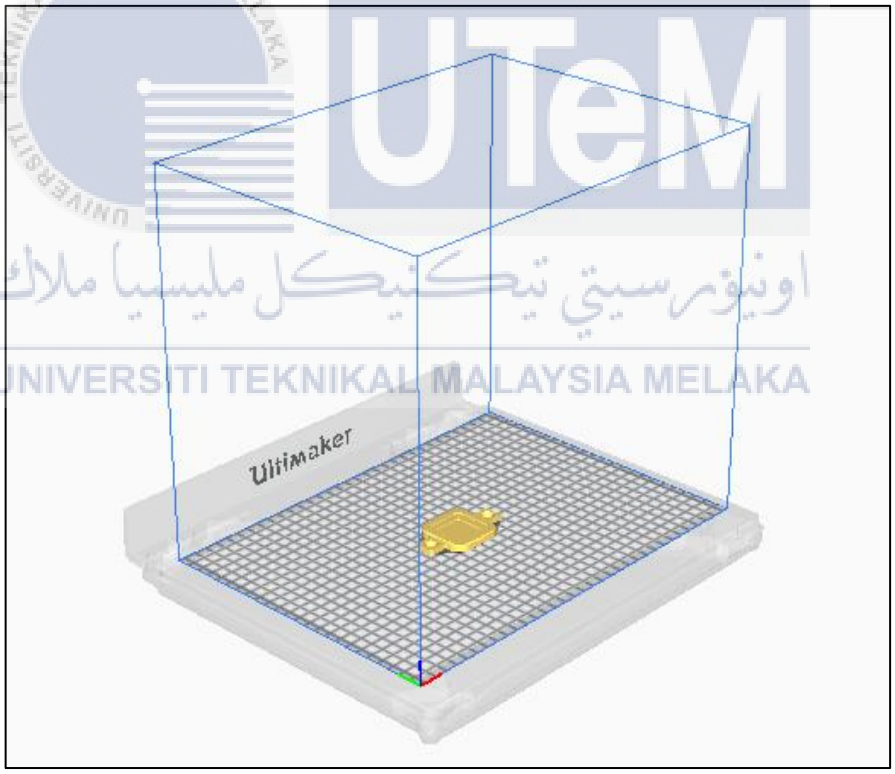

Figure 3.13: The Design for Load Sensor

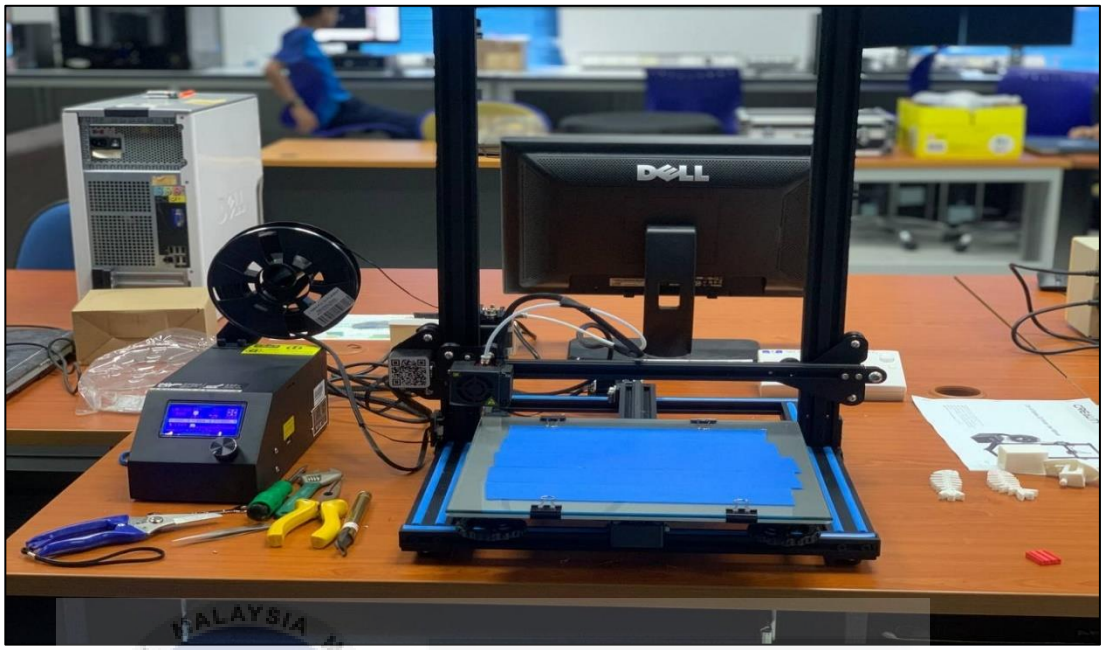

Figure 3.14: The Setup for 3D Printing

Figure 3.15: PLA 1.75mm Filament

3.4.3 Blynk Application

The Blynk platform used by small-batch manufacturers of innovative domestic products, complex HVAC systems, agricultural equipment, and everything in between. Blynk is a new platform that quickly builds the interface for managing and monitoring equipment ventures from Android and iOS devices. After installing the Blynk software, generate a new dashboard and arrange two-gauge (Smoke and Weight), Super Chart and Notification on the screen to monitor. Last but not least, adjust the gauge to specific value to obtain the reading from the NodeMCU. The figure 3.16 below shows the blynk application.

Figure 3.16: The Blynk application

3.5 Working Method

3.5.1 Welding

Welding is a metalworking procedure in which two or more parts joined together using heat, pressure, or both, forming a connection when the components cool. Welding commonly used on metals and thermoplastics. The finished welded junction referred to as a weldment. The purpose of welding is to hold on the solenoid valve on the LPG cylinder. As shown in figure 3.17 is the outcome solenoid valve hook.

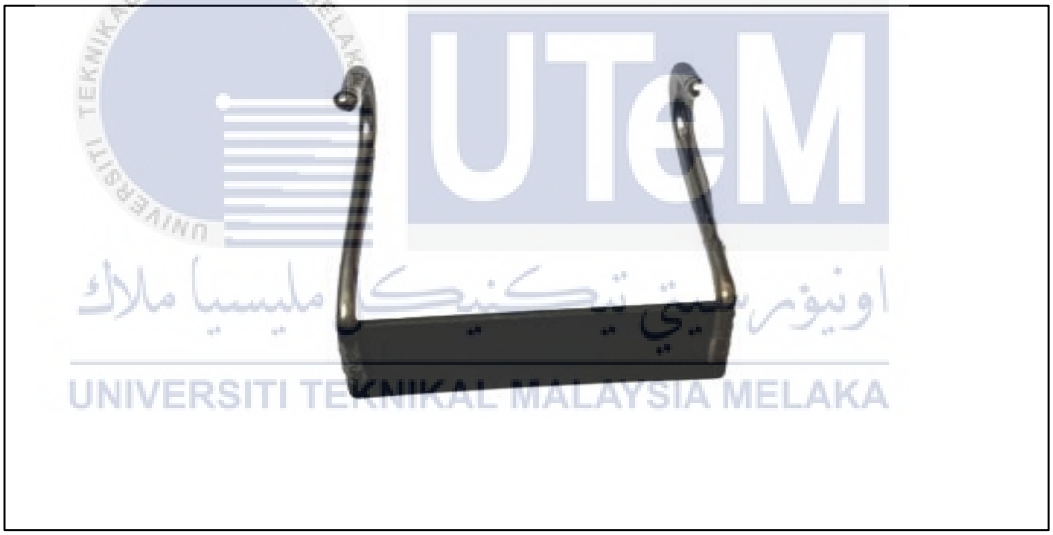

Figure 3.17: The Outcome Solenoid Valve Hook

3.5.2 Coding

When I use the NodeMCU with the Arduino IDE, it writes directly to the firmware of the NodeMCU, wiping the original firmware. If I want to re-install the firmware, I utilize the “flasher.” I obtained the flasher from their Github page, which located at https://github.com/nodemcu/nodemcu-flasher.

Step 1: Using a MicroUSB cable, connect the NodeMCU to the laptop.

Step 2: Obtain and instal the drivers. I used the link to download the driver.

Step 3: Open and paste my code into the IDE.

Step 4: Pick and board the NodeMCU and Port, then upload the application; that's all there is to it; the coding went smoothly.

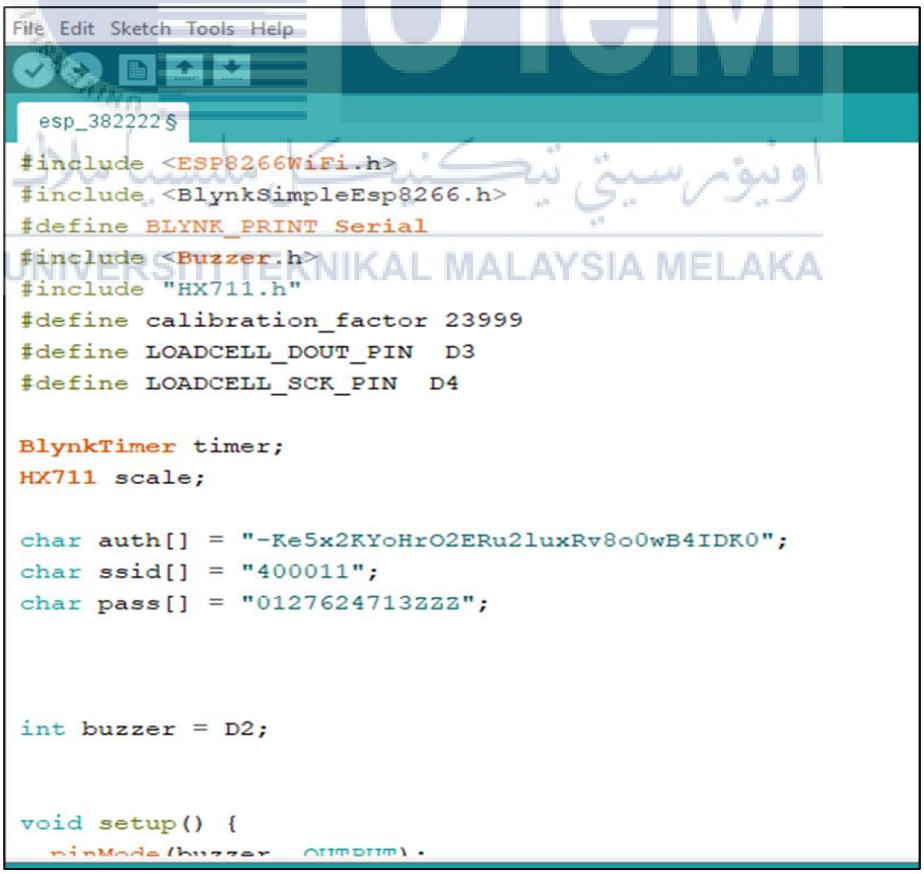

Figure 3.18: The Sample of Coding Use In The Project

3.5.3 Designing

3.5.3.1 3D Printing

3D printing is regularly performed in three steps. The primary step includes planning the object demonstrate in a CAD bundle. The moment the step includes building the object with a 3D printer. The third step consists of wrapping up where the ultimate touches are made. This is the outcome from the Ulitimaker Cura for the load sensor casing. As shown below figure 3.19, the load sensor casing from 3D printer.

Figure 3.19: Load Sensor Casing From 3D Printer

3.5.3.2 Casing and Full Design

A physical prototype for the LPG Cooking Gas Warning System Via The IoT System built. All the components functioned as expected. The functioning system consists of the NodeMCU 8266 with an expansion board, a 200kg load cell, an HX711 Load cell Amplifier Module, an MQ 2 gas sensor, a solenoid valve, and a buzzer. The schematic of the built functional prototype presented below. The figures 3.20, 3.21, 3.22, and 3.23 shows the outcome casing of the project.

Figure 3.20: Top View for LPG Cylinder Casing

Figure 3.21: Back View For LPG Cylinder Casing

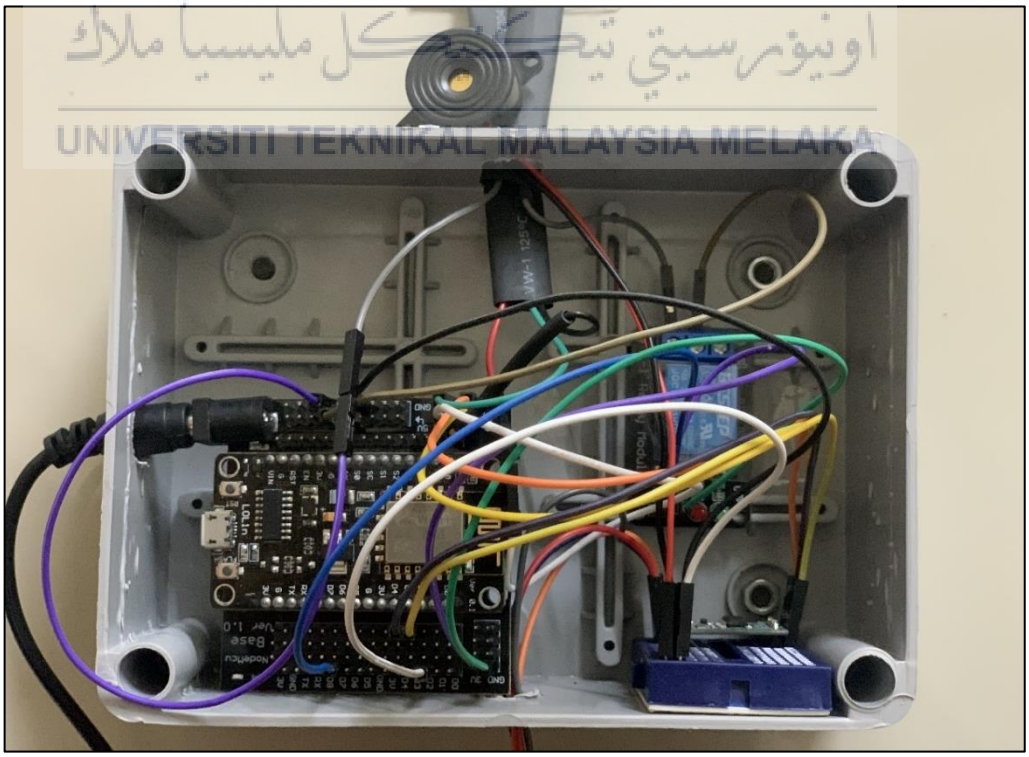

Figure 3.22: Components Arrangement

Figure 3.23: Complete Casing with LPG Cylinder

3.6 Summary

The block diagram and flow chart provided a visual representation of the project's overall structure. The hardware has been described above and chosen in keeping with the project's essential purpose. This project uses software such as the Arduino IDE platform for coding, the Blynk Application for notification sending, and the Ultimaker Cura 3D printer to create the load sensor enclosure. Following the assembly of the circuit and its components, troubleshooting carried out to evaluate the project's results.

4

RESULT AND DISCUSSION

4.0 Introduction

This chapter will examine the methodology that was employed to achieve the project's objective, as well as give some in analysis of the process through which the project was successfully completed. Detailed explanations of each achievement and choice made throughout the design of this project will be provided at each stage until the project is done, with the assistance of illustrations illustrating the progress of hardware and software.

4.1 Analysis of System Performance

4.1.1 Gas sensor

This LPG gas sensor, monitors the surrounding concentration of LPG gas. Because the project focused on LPG detection, the MQ2 gas sensor was selected. To find out whether the gas had leaked, a lighter used. Liquefied Petroleum Gas is the liquid within the lighter. The serial monitor and the Blynk show the LPG gas leak if the gas sensor has triggered.

The test results performed on the device for concentration of gas in the air surrounding the sensor at various locations. The open field tests were performed close to the stove cabinet. Depending on the specified distance of the gas sensor. The lighter was activated to release the surrounding LPG gas. The display read was captured on the serial monitor. The test was conducted three times in order to generate an average data. The device positioned within 5 cm, according to the data observed, with a threshold value of 100 as the maximum quantity of leakage. Based on the table 4.1 and figure 4.1 below shows the result and graph of MQ 2 Gas Sensor according to distance.

	Outside The Cabinet				Inside The Cabinet			
	1 ST	**2 ND**	**3 RD**	**AVG**	**1 ST**	**2 ND**	**3 RD**	**AVG**
1 cm	312	298	297	302.33	319	313	298	310
2 cm	256	238	194	229.33	226	248	228	234
3 cm	139	182	150	157	160	175	166	167
4 cm	162	117	93	124	169	145	124	146
5 cm	127	141	115	127.66	142	147	141	143.33

Table 4.1: Result of MQ 2 Gas Sensor according to distance

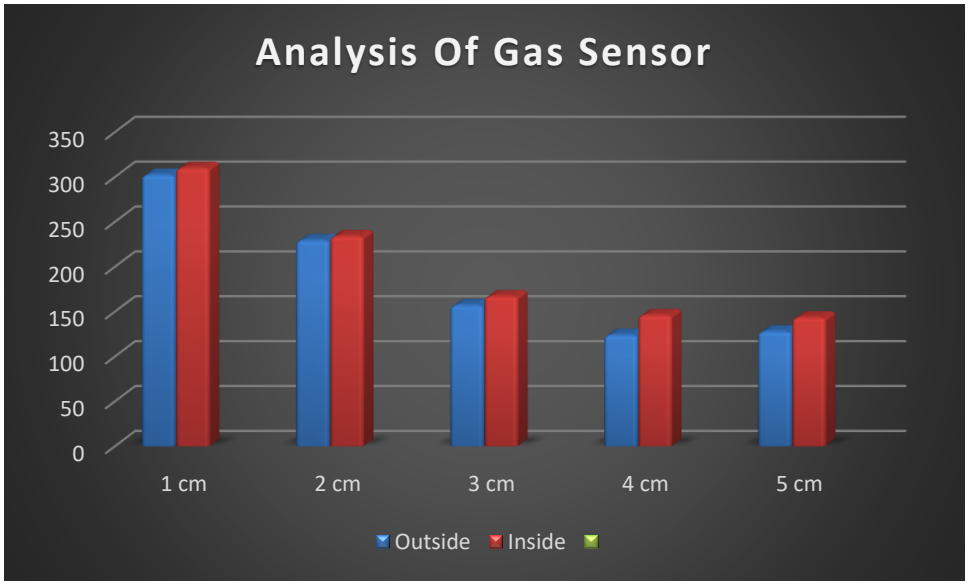

Figure 4.1: Analysis of Gas Sensor

4.1.2 Load Sensor

The load sensor measures the weight of the gas cylinder. A 200kg load sensor selected since the LPG gas cylinder with gas weighs between 30kg and 30.5kg, whereas the empty tank weighs between 16kg and 16.5kg. Depending on their height, the weight of empty tanks varies. The gas filling quantity is nonetheless 14 kg standard in every tank.

The digital weight scale is used for weighting the LPG gas cylinder. This ensures that the reading of load cells matched the reading of the reference weighing scale after calibration. The value of the calibration factor set to 23999 after only a few tries. The tests displayed in Fig. 4.2 and Fig. 4.3 using the application of Blynk.

Figure 4.2: Weight of LPG Cylinder On Digital Weighing Scale

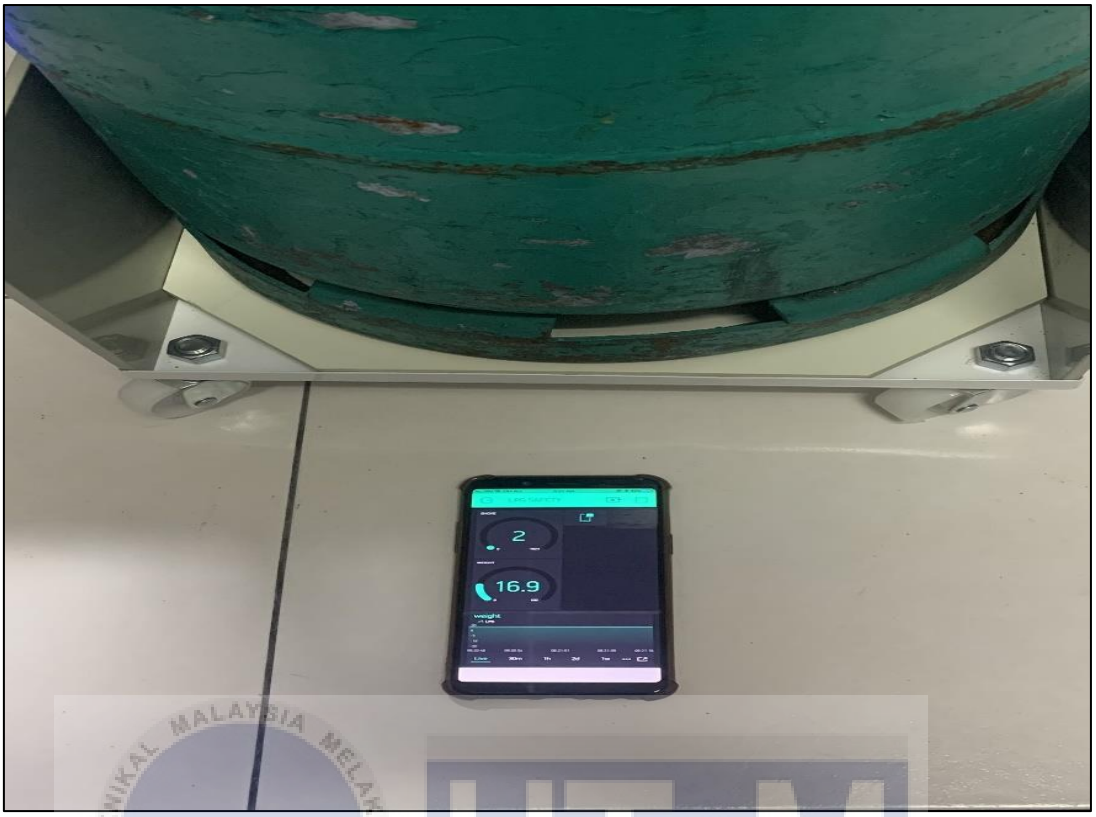

Figure 4.3: Weight of LPG Cylinder on Load Sensor

This Load sensor tested with an LPG cylinder for 23 minutes. However, the differences in the weight of LPG cylinders could only be seen after a considerable period. This result can be seen below in Fig. 4.4 and Fig. 4.5, where Blynk Super Chart extracts weight details.

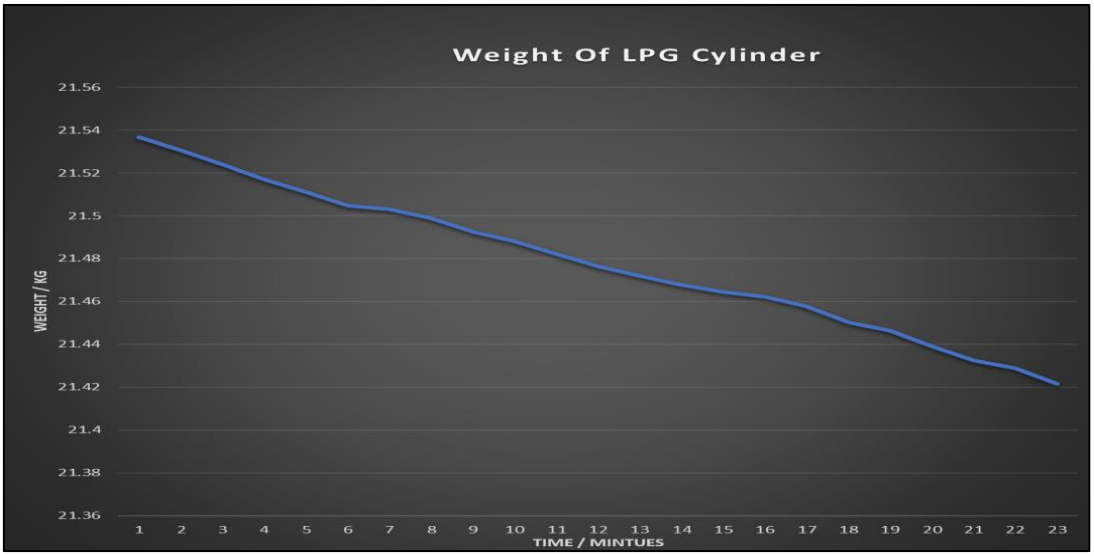

Figure 4.4: Weight of LPG Cylinder Result on Blynk

Figure 4.5: Testing the LPG Cylinder Weight For 23mins (In Use)

The alternative way was to test the load sensor by using the water dispenser to see the drastic changes in a shorter period. The graph result of water dispenser weight changes can be seen below in Fig. 4.6 and Fig. 4.7.

Figure 4.6: Testing Load Sensor with Water Dispenser

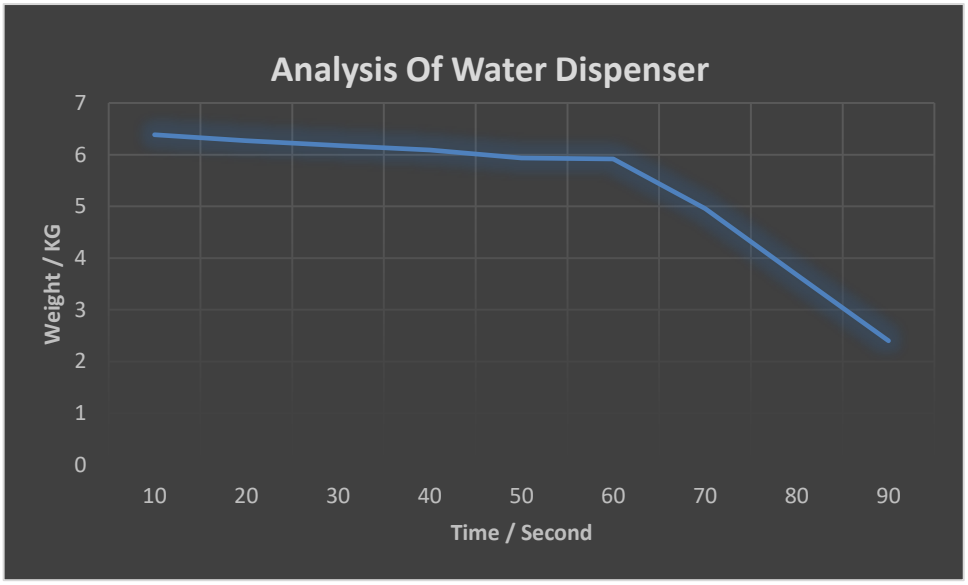

Figure 4.7: Water Dispenser Weight Result

4.1.3 Blynk Application

Compared to other developments, this one has the benefit of having an online monitoring system based on the most up-to-date Internet of Things technology (IoT). It monitors the gas leakage and the changes in weight of LPG cylinder.

In the first incident, the alarm system was deactivated. This is due to the fact that there is no gas leak, and the cylinder weighs more than 28kg. Because both sensors indicate that the status is normal, the user will not get any warning or alarm signal.

In the second situation, the alarm condition is triggered by the gas sensor, indicating that LPG gas is escaping into the surrounding area. Both alarm alerts are enabled in this situation. As seen in Fig. 4.8, the buzzer will begin to ring, the solenoid valve will activate, and Blynk will send a notice to the user stating, "GAS DETECTED."

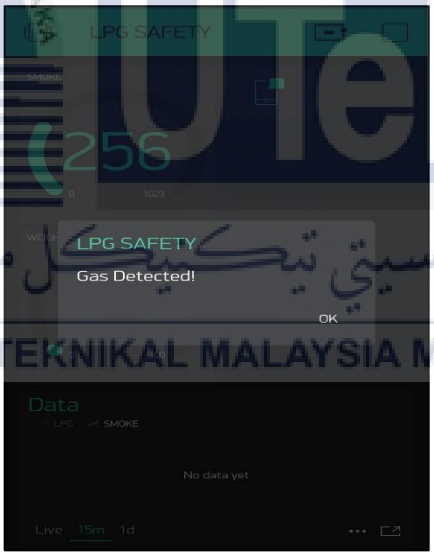

Figure 4.8: Notification of Gas Leakages

Third scenario, a load cell sensor is activated and an alert is sent. Due to the fact that the load sensor alerts are divided into four phases. As a result, Blynk notified the user at each level, as seen in Figure 4.9. In this situation, the buzzer will stay quite due to the absence of a gas leak. The buzzer alarm designed to notify users of gas leakages.

Figure 4.9: Shows the Notification of Each Level

4.2 Summary

The results are shown by the prototype, which demonstrates the system's hardware and software. Following that, the software displays the notification that the user will get through the smartphone. Moreover, the system's performance determined using sensors and the internet. Finally, the project's objective accomplished.

5

CONCLUSION AND FUTURE WORKS

This chapter will summarize all of the project's accomplishments. Additionally, some ideas and comments will be made on prospective project work.

5.1 Conclusion

In a nutshell, a Liquefied gas (LPG) detection and monitoring system have successfully developed. The discovery unit has effectively observed the weight of the gas barrel and recognized the gas leak within the specific zone. Moreover, physical and non-physical caution, such as the alert, is being worked appropriately concurring to the required command. In expansion, the online observing framework using the IoT Blynk platform was also effectively created. Subsequently, the client can screen gas leakage and the weight of the gas cylinder in Blynk from their smartphone at whatever point and wherever they need.

5.2 Future Work

Recommendations and suggestions might be implied for future improvements to this project. The opinions and ideas are specifically aimed at the LPG Regulator. The solenoid valve should be combined with the LPG regulator to make it more user-friendly. It will be very simple to plug in and repair it.

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

APPENDICES

APPENDIX A: Function Of NodeMCU 8266

Lolin NodeMCU Features

- Arduino-Like Hardware IO
- Code like Arduino, but interactively in Lua script
- Event-driven API for network applications, which facilitates developers writing code
- Integrates GPIO, PWM, IIC, 1-Wire and ADC all in one board
- 10 GPIO, every GPIO can be PWM, I2C, 1-wire
- 4M Flash Memory
- Built-in WiFi Antenna

APPENDIX B: Coding of NodeMCU 8266

Final_Coding

```
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#define BLYNK_PRINT Serial
#include <Buzzer.h>
#include "HX711.h"
#define calibration_factor 23999
#define LOADCELL_DOUT_PIN  D3
#define LOADCELL_SCK_PIN  D4

BlynkTimer timer;
HX711 scale;

char auth[] = "-Ke5x2KYoHrO2ERu2luxRv8o0wB4IDK0";
char ssid[] = "KALAIPULUT";
char pass[] = "viva1299";


int Gas_analog = A0;
int Buzzer = D2;
int relay = D7;
int data = 0;
```

Final_Coding

```
void setup() {
  Serial.begin(9600);
  Blynk.begin(auth, ssid, pass);
  pinMode(Gas_analog, INPUT);
  pinMode(Buzzer, OUTPUT);
  pinMode(relay, OUTPUT);
  Serial.println("Gas sensor warming up!");
  Serial.println("HX711 Scale");
  scale.begin(LOADCELL_DOUT_PIN, LOADCELL_SCK_PIN);
  scale.set_scale(calibration_factor);
  scale.tare();
  Serial.println("Readings:");
  timer.setInterval(1000L, sensorDataSend);
  delay(10000);
}

void loop() {
 timer.run();
 Blynk.run();
}
```

Final_Coding

```
void sensorDataSend(){

  int gassensorAnalog = analogRead(Gas_analog);
  data = analogRead(Gas_analog);
  Blynk.virtualWrite(V2, data);
  Serial.print("Gas Sensor: ");
  Serial.print(gassensorAnalog);
  Serial.print("\t");

  Blynk.virtualWrite(V3, scale.get_units());
  Serial.print("Reading: ");
  Serial.print(scale.get_units(), 1);
  Serial.print(" kg");
  Serial.println();

  if (gassensorAnalog > 100) {
    Blynk.notify("Gas Detected!");
    Serial.println("Gas");
    digitalWrite (Buzzer, HIGH) ;
    digitalWrite(relay, LOW);
    Serial.println("Current not Flowing");
    delay(10000);
```

Final_Coding

```
    delay(10000);
    }
  if ((scale.get_units() >= 0.90 )&& (scale.get_units() <= 1.50 )){
    Blynk.notify("CHANGE THE LPG");

  }
  if ((scale.get_units() >= 1.50 )&& (scale.get_units() <= 2.50 )){
    Blynk.notify("LPG 25%!");

   }
  if ((scale.get_units() >= 2.50 )&& (scale.get_units() <= 3.50 )){
    Blynk.notify("LPG 50%!");

     }
  if ((scale.get_units() >= 3.50 )&& (scale.get_units() <= 5.50 )){
    Blynk.notify("LPG 70%!");

  }

else
 {
   Serial.println("No Gas");
```

```
    }

  else
    {
      Serial.println("No Gas");
      digitalWrite (Buzzer, LOW) ;
      digitalWrite(relay, HIGH);
      Serial.println("Current Flowing");
    }
  delay(100);
}
```

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