POLITEKNIK SHAH ALAM

DESIGN A FREEZER/REFRIGERATOR TEMPERATURE MONITORING SYSTEM USING IOT

NAME	REGISTRATION NO
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JABATAN KEJURUTERAAN ELEKTRIK

DECEMBER 2019

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This report submitted to the Electrical Engineering Department in fulfillment of the requirement for a Diploma in Electrical Engineering

JABATAN KEJURUTERAAN ELEKTRIK

DECEMBER 2019

CONFIRMATION OF THE PROJECT

The project report titled " Design a freezer/refrigerator temperature monitoring system using IoT" has been submitted, reviewed and verified as a fulfills the conditions and requirements of the Project Writing as stipulated

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Verified by:

Project Coordinator name :

Signature of Coordinator :

Date :

"I acknowledge this work is my own work except the excerpts I have already explained to our source"

1. Signature :

Name : **Mohammad Amirul Hairie Bin Omar**

Registration Number : **08DJK17F2011**

Date :

DECLARATION OF ORIGINALITY AND OWNERSHIP

TITLE : DESIGN A FREEZER/REFRIGERATOR TEMPERATURE MONITORING SYSTEM USING IOT

SESSION: DECEMBER 2019

1. I, **1. MOHAMMAD AMIRUL HAIRIE BIN OMAR (08DJK17F2011)**

   is a final year student of **Diploma in Electrical Engineering, Department of Electrical, Politeknik Shah Alam**, which is located at **40150, Shah Alam, Selangor**. (Hereinafter referred to as 'the Polytechnic').

2. I acknowledge that 'The Project above' and the intellectual property therein is the result of our original creation /creations without taking or impersonating any intellectual property from the other parties.

3. I agree to release the 'Project' intellectual property to 'The Polytechnics' to meet the requirements for awarding the **Diploma in Electrical Engineering** to me.

Made and in truth that is recognized by;

a) **Mohammad Amirul Hairie Bin Omar**) .
(Identification card No: - 980512035693)) .....
) **MOHAMMAD AMIRUL HAIRIE BIN OMAR**

In front of me, **PUAN FA`IZAH BINTI YA`ACOB** (Click here to enter text.)) .....
As a project supervisor, on the date:) Click here to enter text.

ACKNOWLEDGEMENTS

I have taken efforts in this project. However, it would not have been possible without the kind support and help of many individuals and organizations. I would like to extend my sincere thanks to all of them. I am highly indebted to (Name of your Organization Guide) for their guidance and constant supervision as well as for providing necessary information regarding the project & also for their support in completing the project.

I would like to express my gratitude towards my parents & member of (Organization Name) for their kind co-operation and encouragement which help me in completion of this project. I would like to express my special gratitude and thanks to industry persons for giving me such attention and time.

My thanks and appreciations also go to my colleague in developing the project and people who have willingly helped me out with their abilities.

ABSTRACT

A refrigerator is a common machine used as a part of families, commercial ventures, or industries and hospitals. It`s consists of a thermal insulator and a heat pump that exchanges heat from the inner part of the fridge to its outside environment. The commercial refrigerator is used to store food while medical refrigerator stores medical samples such as urine test, and blood human tissue that need to be refrigerated. When the power supply fails, the refrigerator will not be working properly, which may lead to the food or medical sample getting spoilt over time to time and also may further prompt the loss of cost. The strength of this project is to develop a commercial or medical refrigerator alert system. The refrigerator temperature monitoring system will inform with a notification whenever the temperature is out of range. The temperature monitoring system will notify the person in charge to monitor the temperature of the refrigerator easily. The project relates to the concept of the Internet of things (IoT) system. The main controller used is Arduino. Arduino Uno is a microcontroller unit (MCU), it will fetch data of humidity and temperature from the DHT22 sensor, process it and then send it to an ESP8266 module. ESP8266 is a wifi module, it is one of the leading platforms of IoT. The refrigerator temperatures vary throughout the world, but are below 7°C (Terpstra and others 2005), with many countries recommending below 5°C. Refrigerator temperature also plays a key role in minimizing food spoilage and waste. The project is highly recommended for everyone, especially in the healthcare industry, frozen food supplier and also for the household. This recommendation will lead to a healthier and higher quality of food, long-lasting medicine, and the most important thing is to avoid any losses.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

A refrigerator is a machine for keeping things cold. It is sometimes called a fridge or an icebox. People put food and drinks in it, to keep those items cold or good (unspoiled) for a longer time. There are also ice boxes available that do not use electricity because they are filled with ice to provide the colder temperature. The ice can keep things cold until the ice melts. These ice boxes can be taken on camping trips. Sometimes they are called coolers. Refrigerator-sized iceboxes were used before electricity was available. Most modern refrigerators are available in a variety of colours, although normally fridges are white. Smaller versions of the popular refrigerator are also used. These are mainly used in hotels and college dorm rooms.

1.2 Background Research

A refrigerator (colloquially fridge) consists of a thermally insulated compartment and a heat pump (mechanical, electronic or chemical) that transfers heat from the inside of the fridge to its external environment so that the inside of the fridge is cooled to a temperature below the room temperature. Refrigeration is an essential food storage technique in developed countries. The lower temperature lowers the reproduction rate of bacteria, so the refrigerator reduces the rate of spoilage. A refrigerator maintains a temperature a few degrees above the freezing point of water. Optimum temperature range for perishable food storage is 3 to 5 °C. [1] A similar device that maintains a temperature below the freezing point of water is called a freezer. The refrigerator replaced the icebox, which had been a common household appliance for almost a century and a half.

1.3 Problem Statement

The problem related to the current issue when it comes to a refrigerator machine is the machine will possible to suffers failure. As we know that the refrigerator is running 24 hours non-stop to keep cooling our stuff in it, so the chance of the machine getting failed is very high.. If the temperature of the refrigerator is out from the range of 3 to 5 °C and keep getting higher, the risk of the food getting spoil in the refrigerator will be very much higher.

If you're the owner of a food or beverage retail or manufacturing business, you should already be aware of the importance of having your refrigerators running 24/7. But, do you have a process in place for when issues occur? What happens if your refrigerator breaks down over the weekend and you're not there to take action? This, in turn, can lead to food wastage, financial loss and potential reputational damage. So the solution for this problem is to keep monitor the temperature of the refrigerator.

1.4 Research Objectives

The main objective of this project is to monitor the temperature of the refrigerator at your household or supermarket at all time, especially at night and weekends when nobody is around.

More specifically the principle objective of this research are:

1. To design a refrigerator temperature monitoring system IoT using Arduino.
2. To implement the solution of the refrigerator that probably will spoil the food if the machine is suffers failure that cause increasing of the temperature.
3. To develop a good condition of refrigerator temperature that will prevent any lost, food wastage or reputational damage.

1.5 Scope of Research

1. This project is focusing on monitoring the temperature of the refrigerator using gadget with internet connection such as smartphone. So it is possible to monitor temperatures and humidity of the refrigerator anywhere at anytime, especially during night and weekends when nobody is around.
2. The emphasis is to always monitor the temperature and humidity of refrigerator even nobody is not around.
3. The main controller is using the Arduino Uno. The microcontroller will connect with the other component such as sensor and buzzer to make the component work as desired.

1.6 Project Significance

This project already done by several people before, so what we can see the difference between this project and theirs is this project based on IoT. The data that will get from the microcontroller will be sent through our gadget such as a smartphone. Using the Blynk Apps, the refrigerator will possible to be monitored even at night time or weekends.

1.7 Chapter Summary

So to summerize, A refrigerator is a machine for keeping things cold. It is very important to keep maintaining the temperature of the refrigerator, it is because the lower temperature will lowers the reproduction rate of bacteria, so the working refrigerator will reduces the rate of spoilage. If the temperature of the refrigerator is out from the range of 3 to 5 °C due to machine failure, the risk of the food getting spoil is increase. The emphasis is to always monitor the temperature of refrigerator even nobody is not around. Using the Blynk Apps (an IoT based application), the refrigerator will possible to be monitored even at night time or weekends.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

The domestic refrigerator is a common, if not ubiquitous, household device throughout much of the world. There are very few households in the developed world that do not possess one for the storage of chilled foods. Refrigerators are reported to be one of the first assets, after a television, that a typical low-income household acquires as its wealth increases (Wolfram and others 2012). Take-up of refrigerators in developing countries has been related to urbanization, with ownership in China (an increasingly urbanized country) leaping from 24% in 1994 to 88% in 2014, whereas ownership in less urbanized countries, such as Peru and India, was only 45% and 25%, respectively, in 2014 (Anon 2014). The annual worldwide production of these appliances in 2009 was approximately 80 million units (Sim and Ha 2011), and there were estimated to be around 1 billion refrigerators in use worldwide in 2008, double the number 12 y earlier (Coulomb 2008).

2.2 Recommended Refrigerator Temperatures

Autism The official standards of the Codex Alimentarius Commission (2003) declare that insufficient food temperature control is one of the most common causes of foodborne illness. The World Health Organization (WHO) also states in its 5 keys to safer food that cooked food should not be left at room temperature for more than 2 h (in total), and that all cooked and perishable food should be quickly refrigerated below 5 °C (World Health Organization 2001). Recommended refrigerator temperatures vary throughout the world, but are below 7 °C (Terpstra and others 2005), with many countries recommending below 5 °C. In the United Kingdom, it is recommended that temperatures should be ≤5 °C (FSA 2015a), while in the U.S.A., a temperature ≤4.4 °C (40.0 °F) is recommended (USA FDA 2014). In 2007, IEC 62552:2007 “Household Refrigerating appliances – characteristics and test methods” was published (this has since been withdrawn): this included temperature performance standards including those for chilled compartments. Refrigerator temperatures also play a key role in minimizing food spoilage and waste.

2.3 Control System

Control System theory has played an important role in formulating the theoretical basis for understanding how a system work. A control system is an interconnection of components forming a system configuration that will provide a desired system response. The basis for analysis of a system is the foundation provided by linear system theory, which assumes a cause-effect relationship for the components of a system. Therefore a component or process to be controlled can be represented by a block, as shown in Figure 2.1. The input-output relationship represents the cause-and-effect relationship of the process, which in turn represents a processing of the input signal to provide an output signal variable, often with a power amplification. An open-loop control system utilizes a controller or control actuator to obtain the desired response, as shown in Figure 2.1. An open-loop system is a system without feedback.

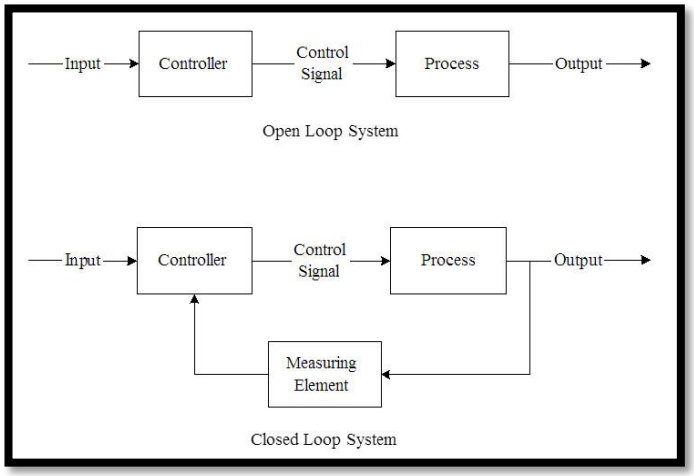

Figure 2. 1: Block diagram of open loop and closed loop system

In contrast to an open-loop control system, a closed-loop control system utilizes an additional measure of the actual output to compare the actual output with the desired output response. The measure of the output is called the feedback signal. A simple closed-loop feedback control system is shown in Figure 2.1. A feedback control system is a control system that tends to maintain a prescribed relationship of one system variable to another by comparing functions of these variables and using the difference as a means of control. A feedback control system often uses a function of a prescribed relationship between the output and reference input to control the

process. Often the difference between the output of the process under control and the reference input is amplified and used to control the process so that the difference is continually reduced. The feedback concept has been the foundation for control system analysis and design.

2.3.1 Microcontroller

A microcontroller is a computer present in a single integrated circuit which is dedicated to perform one task and execute one specific application. It contains memory, programmable input/output peripherals as well a processor. Microcontrollers are mostly designed for embedded applications and are heavily used in automatically controlled electronic devices such as cellphones, cameras, microwave ovens, washing machines, etc.

2.3.2 Arduino

Arduino refers to an open-source electronics platform or board and the software used to program it. Arduino is designed to make electronics more accessible to artists, designers, hobbyists and ayone interested in creating interactive objects or environments. An Arduino board can be purchased pre-assembled or, because the hardware design is open source, built by hand. Either way, users can adapt the boards to their needs, as well as update and distribute their own versions.

2.4 Chapter Summary

This section focusing on two different section, the first is regarding the effect of the equipment if temperature of the refrigerator is not monitored. The second section is discovered about the technical part including the selection the type of controller.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

In order to realize this project as a product that ready to use with safety characteristic, a very comprehensive plan is undertaking. A step by step procedure is done so that the project can be completed in time.

3.2 Project Design and Overview.

As As mention in previous chapter, the main controller is using Arduino. The design of the controller circuit using Arduino is realize using Proteus Software to make sure the circuit is run as we desired. Here, we can read temperature and humidity data from DHT11/DHT22 sensor and upload it to a Blynk Android App using Arduino Uno and ESP8266-01 module.

Arduino Uno is Micro Controller Unit (MCU), it fetch data of humidity and temperature from DHT11/DHT22 sensor, process it and then send it to a ESP8266 Module. ESP8266 is a WiFi module, it is one of the leading platform for Internet of Things. It can transfer data to IOT cloud. The Arduino will only use 5 volts to power up its board, so it will only feed maximum 5 volts to the other component for example sensor, LED and buzzer.

3.2.1 Block Diagram of the Project

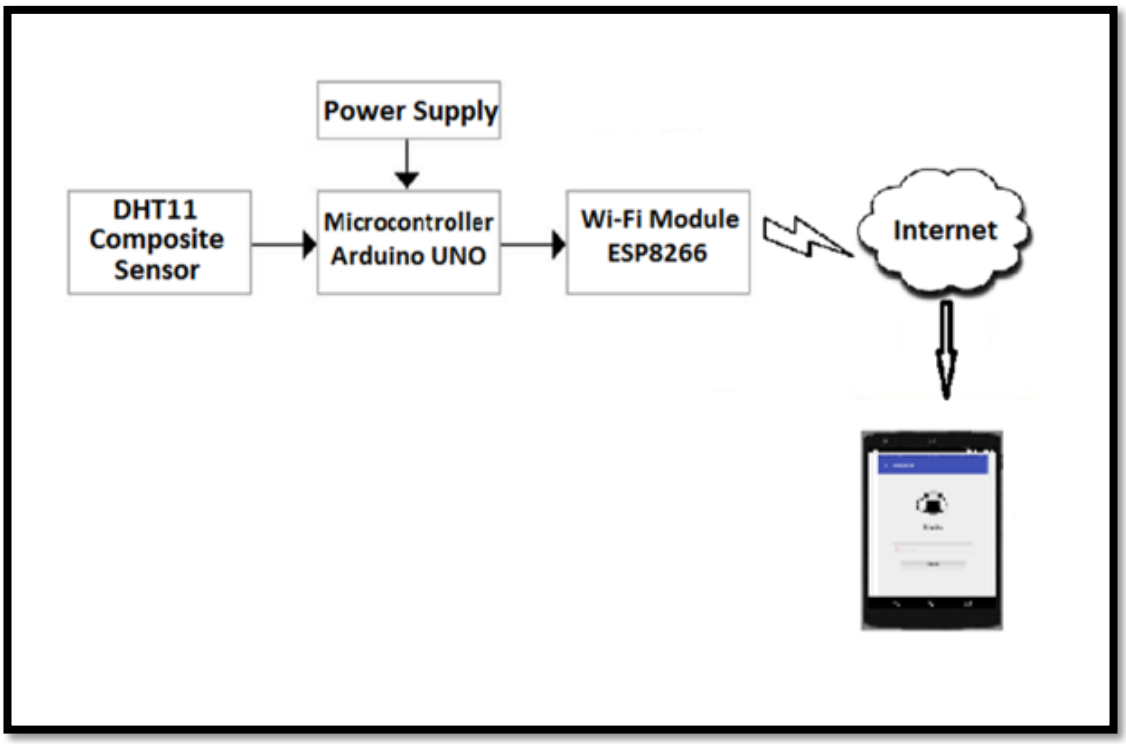

Figure 3. 2: Block diagram of the Project

3.2.2 Flowchart of the Project

Figure 3. shows the circuit diagram of the whole system. It is shows that the Microcontroller will connect with the required sensors. Then, the microcontroller will process the data from sensor. Next, the data will be sent to the cloud using Wi-Fi module. Develop an application to read the data means we have to use the IoT platform such as Blynk Android Apps to read the data in the smartphone. The data will plot the graph and display the value of the parameters reading in the Blynk Android Apps. In addition, if the parameter reading is above the setpoint, it will alert the user using Blynk Apps.

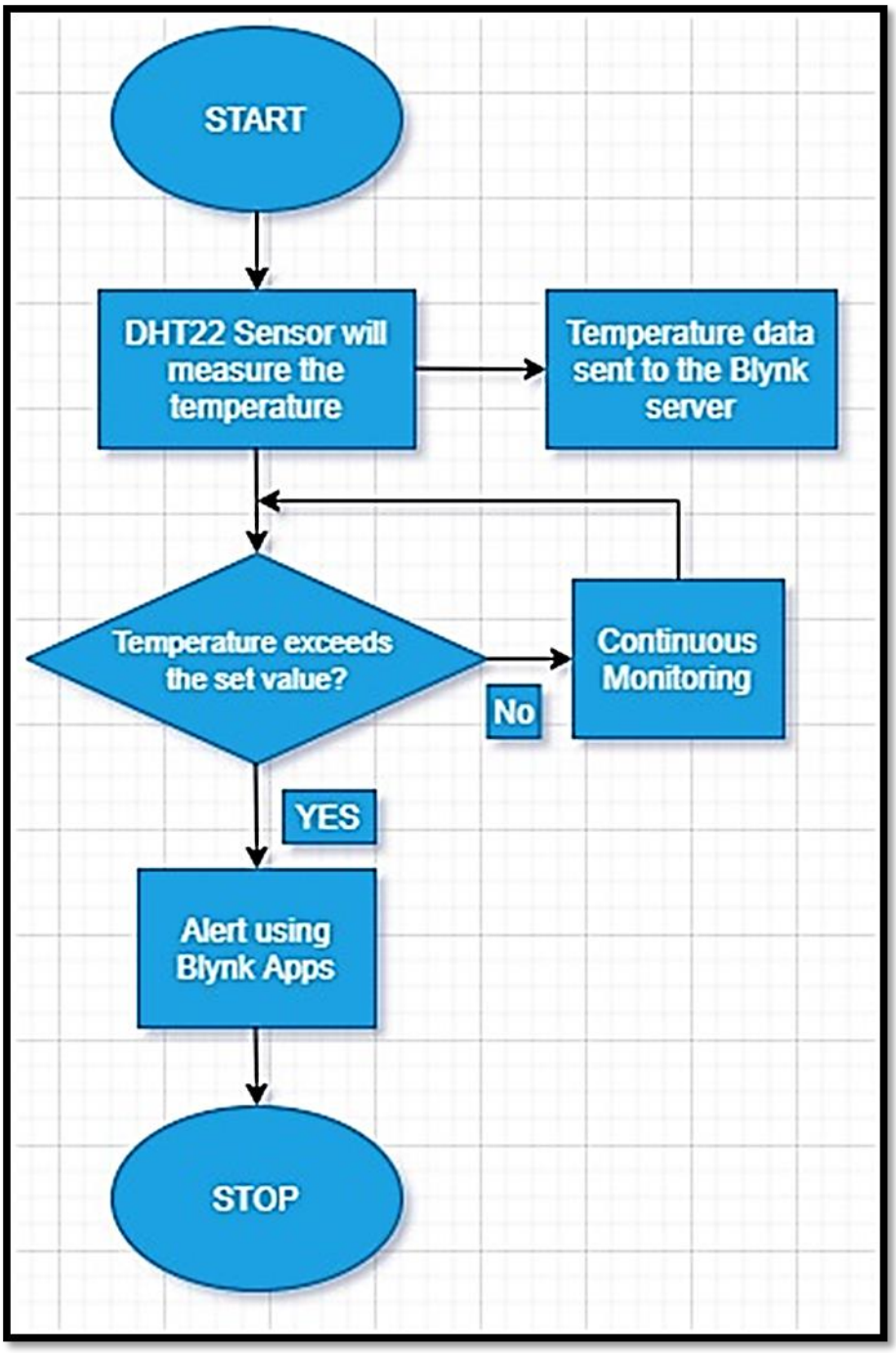

Figure 3. 2: Flow chart of operation of the system

3.3 Project Hardware

As As mention in previous chapter, the main controller is Arduino. The temperature sensor that is going to be use is DHT11/DHT22. The Arduino will process data from the sensor and after that the data will give it to a ESP8266 module. ESP8266 is a WiFi module, it is one of the leading platform for Internet of Things. It can transfer a data to IOT cloud.

3.3.1 Schematic Circuit

Figure 3. 3 shows the overall circuit diagram of this project

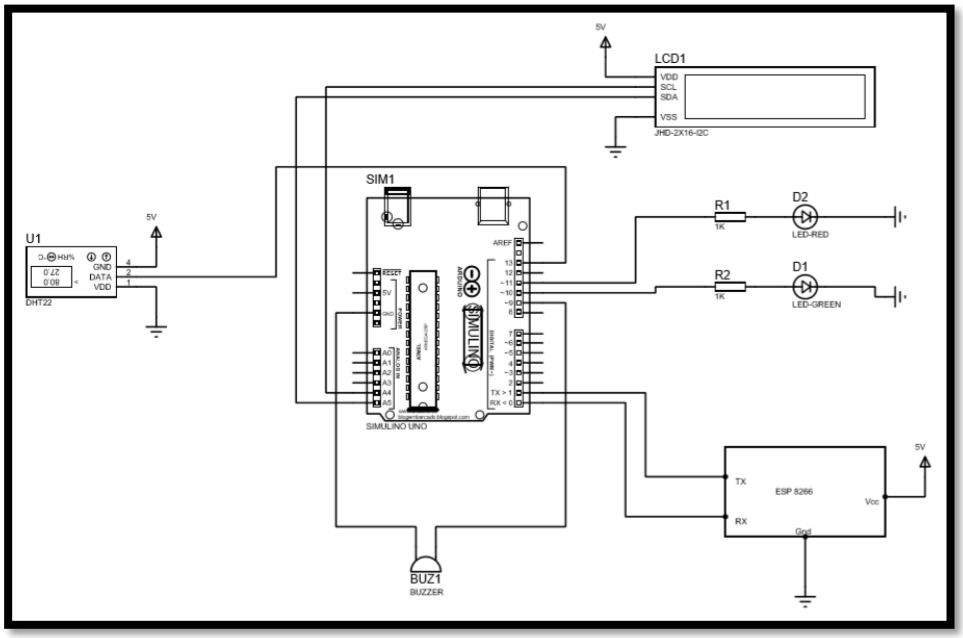

Figure 3. 3: Circuit Diagram

3.3.2 Description of Main Component

The main component is DHT11/22. This DHT11 Temperature and Humidity Sensor features a calibrated digital signal output with the temperature and humidity sensor capability. It is integrated with a high-performance 8-bit microcontroller. Its technology ensures the high reliability and excellent long-term stability. This sensor includes a resistive element and a sensor for wet NTC temperature measuring devices. It has excellent quality, fast response, anti-interference ability and high performance.

Each DHT11 sensors features extremely accurate calibration of humidity calibration chamber. The calibration coefficients stored in the OTP program memory, internal sensors detect signals in the process, we should call these calibration coefficients. The single-wire serial interface system is integrated to become quick and easy. Small size, low power, signal transmission distance up to 20 meters, enabling a variety of applications and even the most demanding ones. The product is 4-pin single row pin package. Convenient connection, special packages can be provided according to users need.

3.3.2.1 Component 1 : ESP8266 WiFi Module

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.

3.3.2.2 Component 2 : AMS1117 3.3V Regulator

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.

3.3.2.3 Component 3 : LCD

We come across LCD displays everywhere around us. Computers, calculators, television sets, mobile phones, digital watches use some kind of display to display the time. An LCD is an electronic display module which uses liquid crystal to produce a visible image. The 16×2 LCD display is a very basic module commonly used in DIYs and circuits. The 16×2 translates o a display 16 characters per line in 2 such lines. In this LCD each character is displayed in a 5×7 pixel matrix.

3.3.3 Circuit Operation

When the power supply is feed to the Arduino, the other component also will be power up. The Arduino will process the data from the DHT sensor and then the WiFi module will sent the data through the cloud using internet connection. The voltage regulator is been use because to make sure the voltage is fixed at 3.3 volts since the battery that is use is above 5 volts.

3.4 Project Software

Software that is used during this project is Blynk Apps for Smartphone. Blynk is a Platform with IOS and Android apps to control Arduino, Raspberry Pi and the likes over the Internet. It's a digital dashboard where you can build a graphic interface for your project by simply dragging and dropping widgets. The UI of the Apps is shown below :

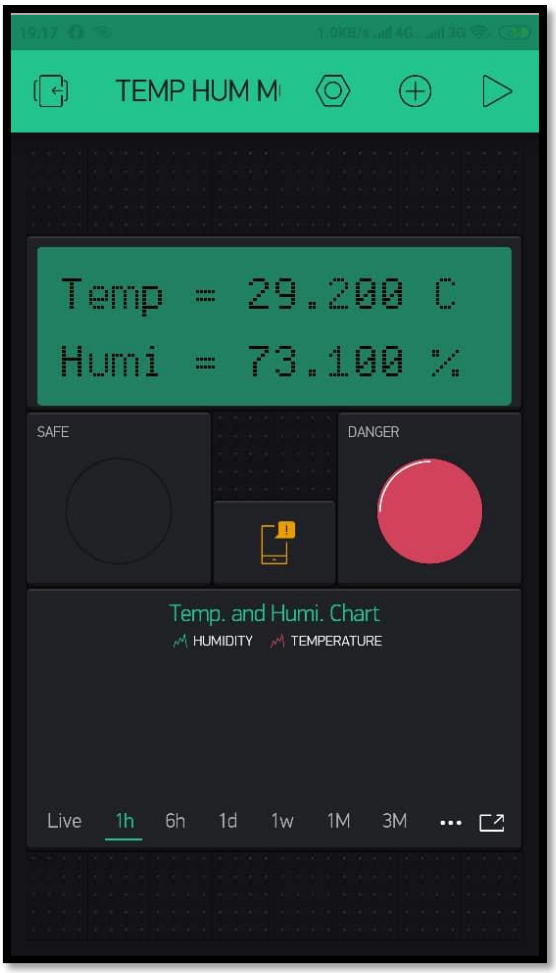

Figure 3. 4: UI of the Blynk Apps

3.5 Prototype Development

For prototype development, we have completed some of these projects by doing a mini-project. The mini-project includes Arduino, LCD and DHT11 sensor. The prototype development of the project is shown below :

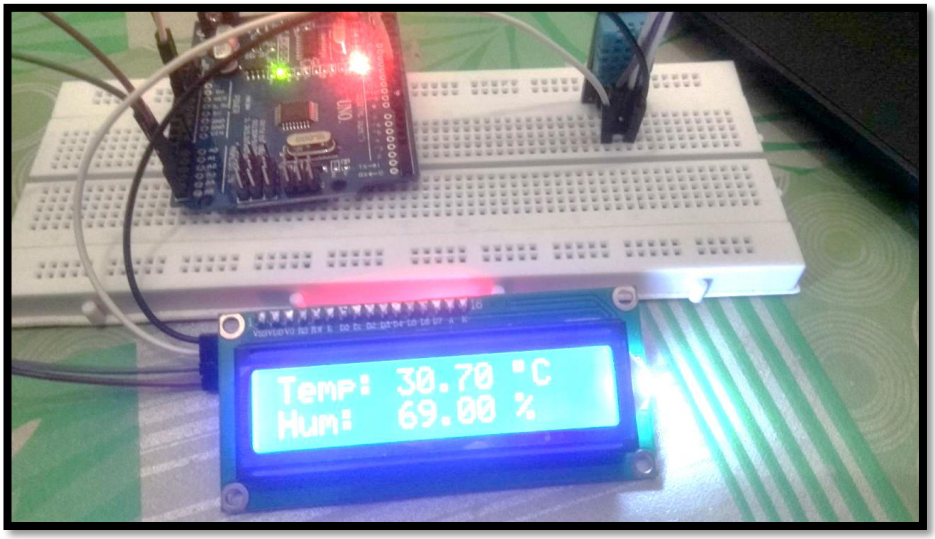

Figure 3. 5: Prototype Development

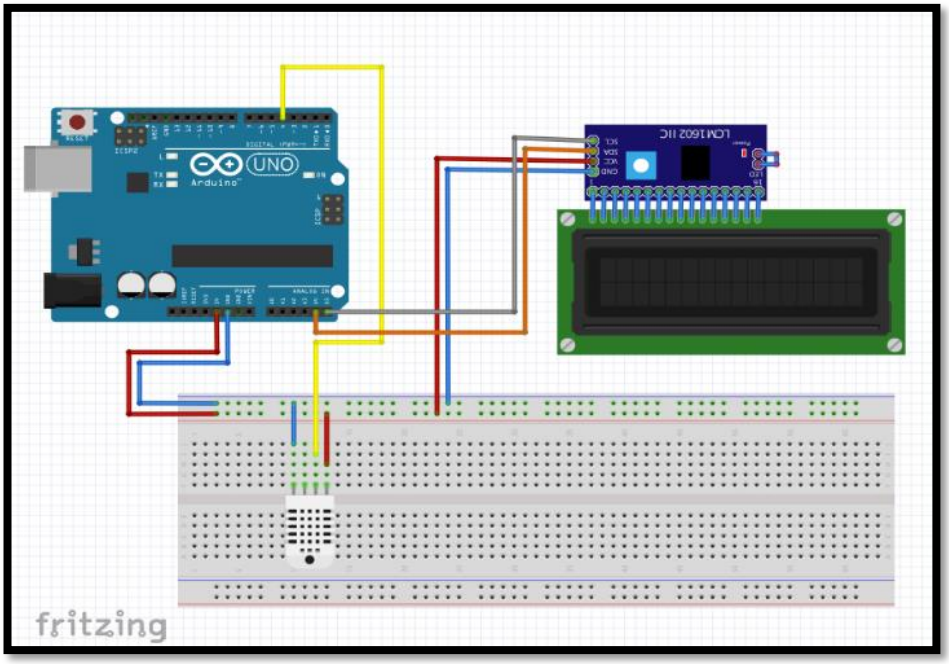

Figure 3. 6: Circuit of Prototype Development

3.5.1 Mechanical Design/Product Layout

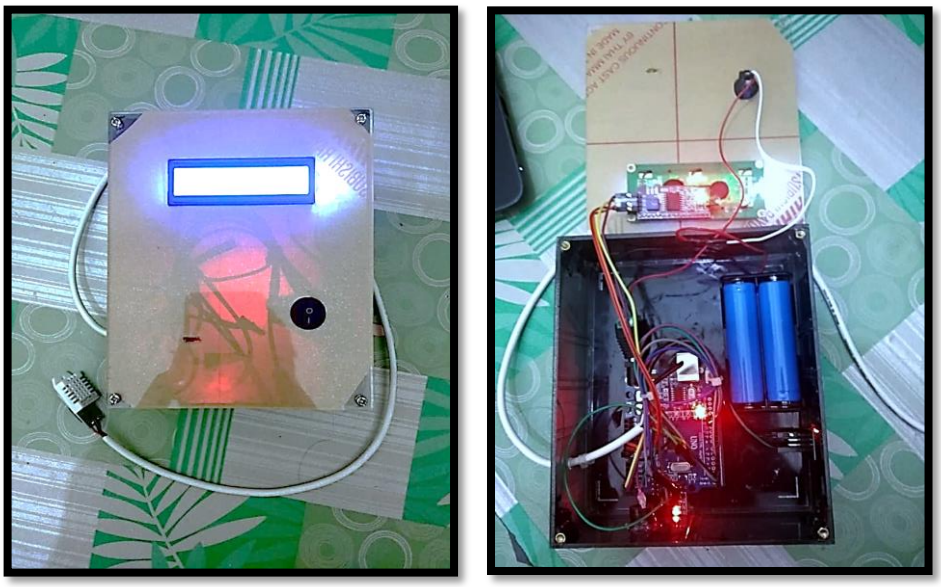

Figure 3. 7: Front view of the project

3.6 Sustainability Element in The Design Concept

The design show that the component is in the small box, so it is easy to place it everywhere such as beside or top of the refrigerator.

3.7 Chapter Summary

So this chapter is discuss about the project design and overview such as flowchart of the project and also the block diagram of the project. Besides, this chapter also discuss about the component that is used in this project.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

To find out more about the results, testing and running the whole process of the project have been made. The purpose is also to observe the performance and how well the project works.

4.2 Results and Analysis

There are several type of refrigerator that have been used to test the project.

1. Mini Fridge

Figure 4. 1: Mini Fridge

2. Domestic Refrigerator

Figure 4. 2: Domestic Refrigerator

3. Freezer

Figure 4. 3: Freezer

Data of the temperature of refrigerator that have been tested as below :

DATA TEMPERATURE OF DIFFERENT REFRIGERATOR

TYPE OF REFRIGERATOR	RANGE OF TEMPERATURE
MINI FRIDGE	18°C to 21°C
DOMESTIC REFRIGERATOR	-4°C to 5°C
FREEZER	Below -20°C

Table 4. 1: Data Temperature of Different Refrigerator

4.3 Discussion

Three types of refrigerator/freezer had been tested to observe the real temperature and also to test the function of the project. The first one is a mini-fridge, the second one is a domestic refrigerator and the last one is a freezer. When the DHT22 (temperature sensor) detects the temperature surrounding, the LCD will display the temperature readings. The ESP8266 that was connected with the smartphone will send the data of the temperature of the refrigerator to the Blynk server and the Blynk Application in the smartphone will display the same readings of a refrigerator as the LCD. Since the project is using a mini-fridge (temperature from 18°C to 21°C) to represent the other type of refrigerator, the code program in Arduino has to set the value to 20°C to notify the user if the temperature is safe or in a dangerous state. So if the readings of temperature are below 20°C, the Blynk Apps will continuously monitor the situation, but if the readings exceed to above 20°C, the Blynk Apps will start to alert and notify the user. The example of Blynk Apps is shown below :

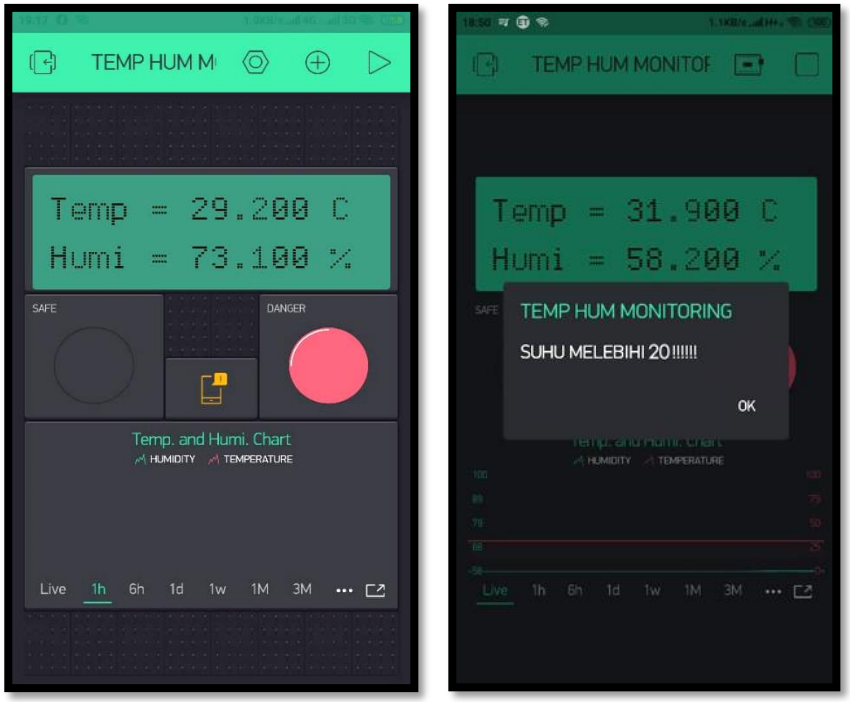

Figure 4. 4: Blynk with the Alert Notification

The Blynk Apps that sent a notification to a user acts as an alert in the software. For the alert in the hardware part, the buzzer that is in the box will continuously make a noisy sound until the temperature drops to a safe reading, then it will stop.

4.4 Chapter Summary

There are two sections in this chapter, the first section is discuss about the type of refrigerator that has been used to test the project. The second section discuss about testing and running the whole process of the project and also observing what happens to the software and the hardware part if the temperature exceeds the set value in the code program.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

To summarize the overall results, the conclusion must be drawn in order to see the benefits of the project and also to improve the project to its fullest potential.

5.2 Conclusion

This project is highly recommended for everyone, especially in the healthcare industry, frozen food supplier and also for the household. This recommendation will lead to a healthier and higher quality of food, long-lasting medicine, and the most important thing is to avoid any losses. With the proposed system, users are capable to store their food or medical samples securely, and make a suitable move quickly at whatever an unwanted situation happen.

5.3 Suggestion for Future Work

The project is expected to perform extensive testing and also suggested to upgrade the temperature sensor to the wireless mode without using any connection of a cable. This project also will improve its functionality for widely usage other than monitoring the refrigerators such as monitor the server room temperature or monitor the home appliances.

5.4 Chapter Summary

This chapter discuss about the significance of the project and also discuss about the future work suggestion to increase its functionality for widely usage.

CHAPTER 6

PROJECT MANAGEMENT AND COSTING

6.1 Introduction

As we all know, every project needs to spend money and make a better plan to make sure the project is possible. So this chapter will discuss about the project planning and the budget that is used.

6.2 Gant Chart and Activities of the Project

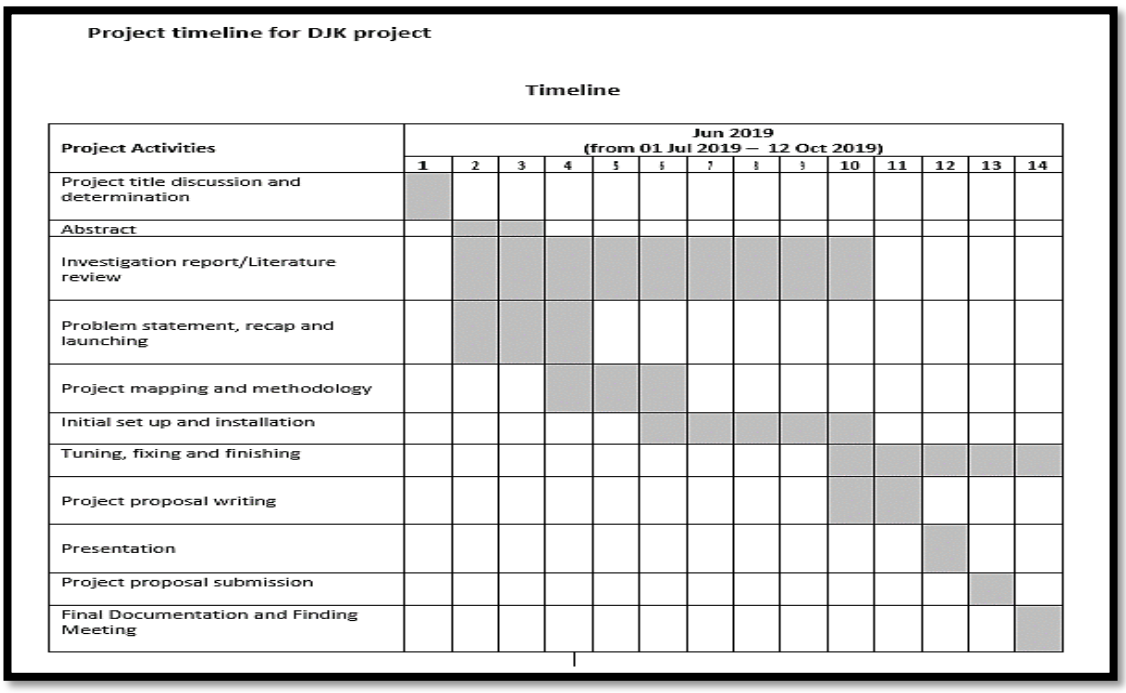

Table 6. 1: Gant Chart for Project 1 in Semester 4

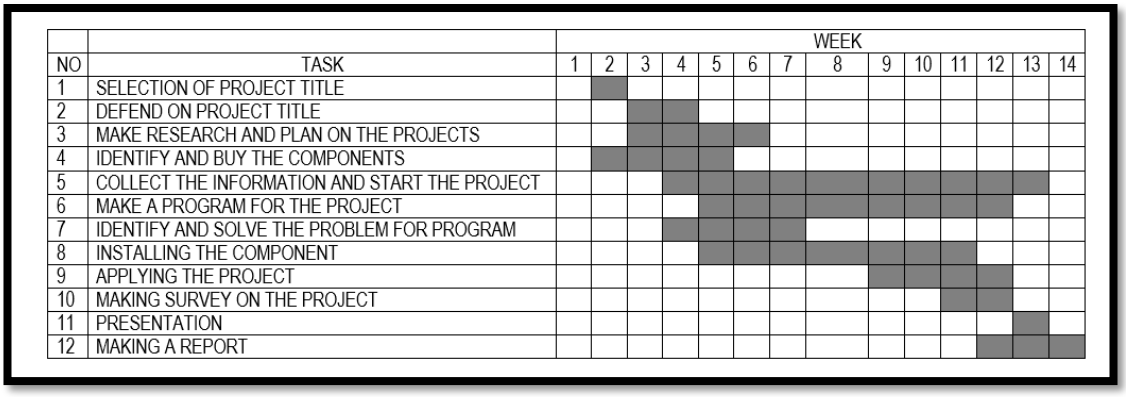

Table 6. 2: Gant Chart for Project 2 in Semester 5

6.3 Milestone

Course	No	Task Name	Implementatic	Duration (Days)	Cost (RM)
DEE40082 PROJECT 1	1	**FREEZER / REFRIGERATOR MONITORING SYSTEM USING IOT**	**Plan**	**98**	**50.00**
			Actual		**73.00**
	2	START	**Plan**	0 days	0.00
			Actual		
	3	**INVESTIGATION REPORT**	**Plan**	**49**	**0.00**
			Actual	**56**	**0.00**
	4	FIND INFORMATION ABOUT A PROJECT THAT RELATED TO INDUSTRY AND IR 4.0	**Plan**	7	0.00
			Actual	14	0.00
	5	PRESENT 3 SELECTED PROJECTS TO LECTURE	**Plan**	21	0.00
			Actual	28	0.00
	6	SEARCH ONLINE THE LITERATURE REVIEW	**Plan**	28	0.00
			Actual	35	0.00
	7	DRAW A FLOWCHART OF PROJECT FLOW	**Plan**	42	0.00
			Actual	42	0.00
	8	DRAW THE SCHEMATIC CIRCUIT OF THE PROJECT	**Plan**	7	0.00
			Actual	14	0.00
	9	PREPARE AND SUBMIT THE INVESTIGATION REPORT	**Plan**	7	0.00
			Actual	14	0.00
	10	**PROJECT PROGRESS(DESIGN,FABRICATE,INSTALL,TESTING)**	**Plan**	**49**	**50.00**
			Actual	**49**	**73.00**
	11	PURCHASE COMPONENTS AND MATERIALS	**Plan**	14	50.00
			Actual	14	73.00
	12	CONSTRUCT GRAPHICS/ TABLES/ DIAGRAM FLOWCHART/ALGORITHM/PROGRAMMING/C	**Plan**	14	0.00
			Actual	21	0.00
	13	PRODUCE CIRCUIT SCHEMATIC AND CIRCUIT SEMULATION	**Plan**	14	0.00
			Actual	21	0.00
	14	PRODUCE PCB DESIGN LAYOUT	**Plan**	7	0.00
			Actual	14	0.00
	15	PRODUCE PCB USING ETCHING OR CNC MILING	**Plan**	7	0.00
			Actual	7	0.00
	16	SOLDERING TOOLS AND TECHNIQUE	**Plan**	7	0.00
			Actual	14	0.00
	17	COMPONENT AND CIRCUIT TESTING	**Plan**	21	0.00
			Actual	21	0.00
	18	**DOCUMENT WRITING REPORT(FINAL PROPOSAL& LOGBOOK)**	**Plan**	**91**	**0.00**
			Actual	**91**	**0.00**
	19	WRITING THE FINAL PROPOSAL	**Plan**	42	0.00
			Actual	42	0.00
	20	WRITING THE LOGBOOK	**Plan**	70	0.00
			Actual	77	0.00

Table 6. 3: Milestone for Project 1 in Semester 4

Course	21	Task Name	Implementation	Duration (Days)	Cost (RM)
		FREEZER / REFRIGERATOR MONITORING SYSTEM USING IOT	**Plan**	**98**	**100.00**
			Actual		**105.00**
DEE50102 PROJECT 2	22	**INSTALLATION**	**Plan**	**84**	**80.00**
			Actual	**84**	**85.00**
	23	INSTALLATION OF COMPONENTS ON PCB	**Plan**	35	0.00
			Actual	42	0.00
	24	INSTALLATION OF WIRING	**Plan**	28	50.00
			Actual	35	60.00
	25	INSTALLATION OF SOFTWARE	**Plan**	35	0.00
			Actual	48	0.00
	26	INSTALLATION OF CONTROL CIRCUIT / SYSTEM	**Plan**	42	0.00
			Actual	42	0.00
	27	INSTALLATION OF PROJECT CASING	**Plan**	28	30.00
			Actual	35	25.00
	28	**TESTING**	**Plan**	**91**	**20.00**
			Actual	**91**	**20.00**
	29	TEST THE ELECTRONIC PART	**Plan**	35	20.00
			Actual	42	20.00
	30	TEST THE MECHANICAL PART	**Plan**	28	0.00
			Actual	35	0.00
	31	TEST THE OVERALL PROCESS / PROJECT	**Plan**	28	0.00
			Actual	35	0.00
	32	**DOCUMENTS**	**Plan**	**98**	**0.00**
			Actual	**98**	**0.00**
	33	PREPARATION OF SLIDE PRESENTATION	**Plan**	28	0.00
			Actual	35	0.00
	34	PREPARATION OF LOGBOOK	**Plan**	98	0.00
			Actual	105	0.00
	35	PREPARATION OF PROJECT 2 FINAL REPORT	**Plan**	98	0.00
			Actual	98	0.00
	36	PREPARATION OF INSTRUCTION MANUAL	**Plan**	42	0.00
			Actual	49	0.00
	37	END	**Plan**	7	
			Actual	7	

Table 6. 4: Milestone for Project 2 in Semester 5

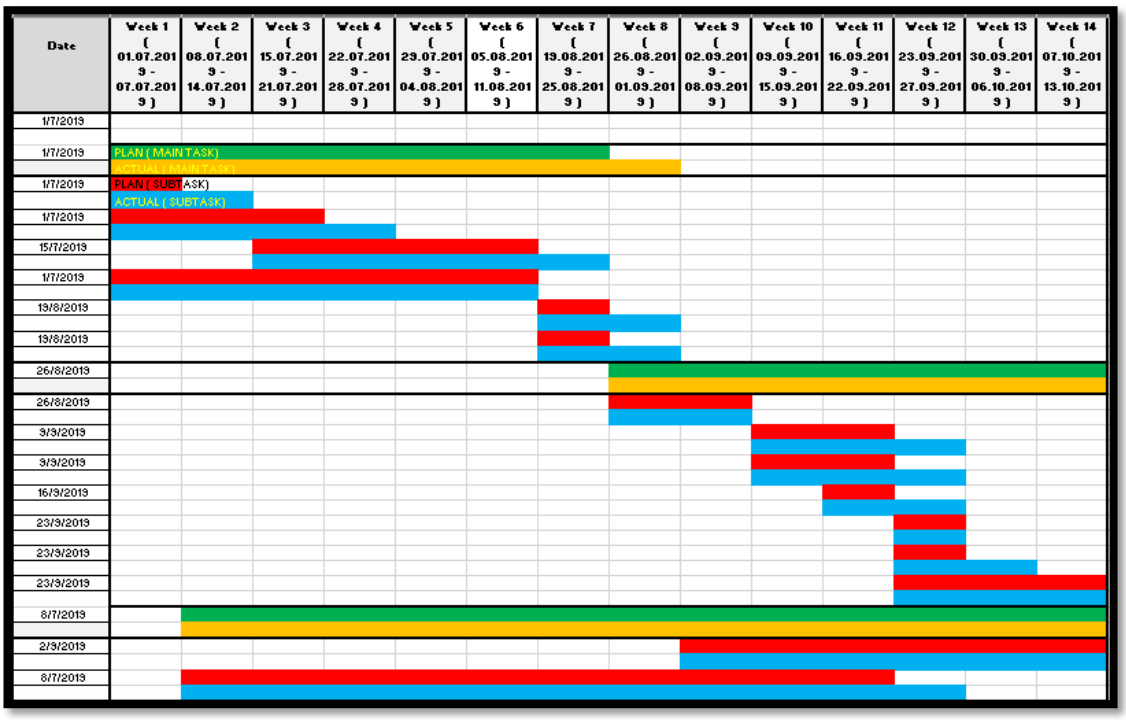

Table 6. 5: Milestone Bar for Project 1 in Semester 4

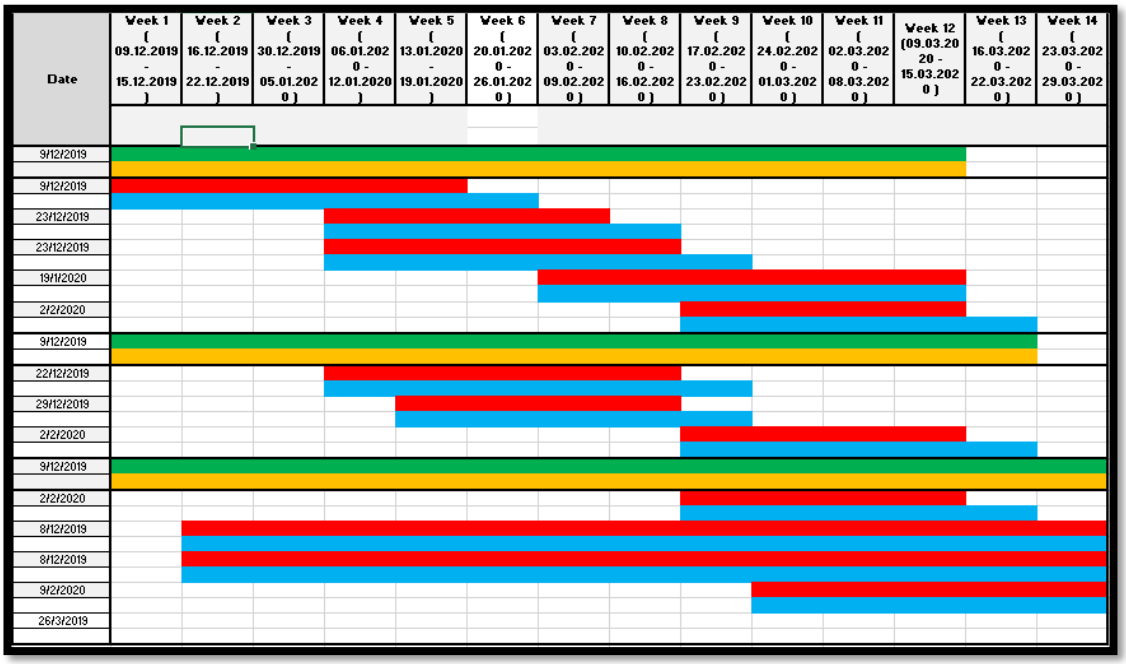

Table 6. 6: Milestone Bar for Project 2 in Semester 5

6.4 Cost and Budgeting

Cost Estimation Project

No.	Component	Cost	Quantity	Total
1	Arduino UNO	RM30	1	RM30
2	Wire Jumper – 3 Types	RM3	3	RM9
3	Breadboard	RM12	1	RM12
4	Wifi Module ESP8266	RM15	1	RM15
5	Battery 9V	RM4	2	RM8
6	AMS1117 Voltage regulator	RM10	1	RM10
7	DHT22	RM21	1	RM21
8	Resistor 3.3KΩ	RM1	1	RM1
9	Stripboard	RM1 x 3 = RM3	3	RM3
10	Battery holder	RM1	1	RM1
11	Solder	RM25	1	RM25
12	Sucker	RM10	1	RM10
			TOTAL	RM145

Table 6. 7: Cost Estimation Project

6.5 Chapter Summary

So this chapter shows about the budget that is used, and the activities that had been done since week 1 to week 14 for Semester 4 and Semester 5.

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APPENDICES

APPENDIX A- DATA SHEET

APPENDIX B- PROGRAMMING

APPENDIX C- PROJECT MANUAL/PRODUCT CATALOGUE