Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF AUTOMATED RECYCLE BIN COMPRESSOR USING ARDUINO FOR SMART CITY

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Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

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DEVELOPMENT OF AUTOMATED RECYCLE BIN COMPRESSOR USING ARDUINO FOR SMART CITY

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A project report submitted
in partial fulfilment of the requirements for the degree of
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DECLARATION

I declare that this project report entitled “DEVELOPMENT OF AUTOMATED RECYCLE BIN COMPRESSOR USING ARDUINO FOR SMART CITY” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

Student Name : MOHAMMAD ASYRAF BIN ZULKARNAIN

Date : 11/1/2023

APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electronics Engineering Technology (Telecommunications) with Honours.

Signature : 

Supervisor Name : MADAM TS ELIYANA BINTI RUSLAN

Date : 24 Februari 2023

DEDICATION

To my beloved mother, Che Su Binti Kamis, and my father, Zulkarnain Bin Mohd Saad,

Thank you for supporting me when I continue my studies

for bachelor's degree in UTeM.

To my friend, Ezzat Muhammad Syahmy Bin Asri

Thank you for providing your creativity expertise and suggestion

for completing this project.

ABSTRACT

The rate of urbanisation has increased rapidly over the last several decades, necessitating the establishment of sustainable urban development plans around the world. The concept of smart cities is gaining popularity throughout the world because of today 's technology and a deliberate approach. A smart city is incomplete without a smart waste management system, since they play an important part in keeping cities clean and hygienic, as well as providing a better public image for tourists from all over the world. Development of Automated Recycle Bin Compressor using Arduino for Smart city is designed to automatically compress when the wastes inside the bin reached a specific level and before the wastes are collected. This bin is suitable to be placed in crowded area to ensure the objectives were achieved. Normally, the wastes will be collected without any compression and that will be a waste of space. The bin is equipped with a sensor to detect the level of wastes in the bin to make the DC motor to start working and compresses the wastes. The sensor is called infrared sensor (IR sensor). When the led light emits and it reflect to the infrared receiver, the sensor starts to detect wastes. The sensor is located by the side of the bin and can be removed manually. By doing this, it can reduce the problem of excessive wastes and overflowing bin that are not managed well. A high torque and low rpm DC motor is used to make sure the wastes are compressed perfectly. This DC motor is working under battery. To support the battery, the bin used 3 Watt of solar panel to recharge the battery using a solar charger circuit to avoid the charging is interrupt. For example, when the battery is full, the circuit will cut off the charging process. The switch off button is located behind the bin and can be turn off manually if anything happens. Then the ESP8266 Wi-Fi module is placed to collect the data from the recycle bin. It is expected the result will improve the waste collection, reducing pollution, reducing the carbon that emitted by the vehicle and maximum utilization of the internal space of the bin.

ABSTRAK

Kadar pembandaran telah meningkat dengan pesat sejak beberapa dekad yang lalu, memerlukan penubuhan rancangan pembangunan bandar yang mampan di seluruh dunia. Konsep bandar pintar semakin popular di seluruh dunia kerana teknologi masa kini dan pendekatan yang disengajakan. Bandar pintar tidak lengkap tanpa sistem pengurusan sisa pintar, kerana ia memainkan peranan penting dalam memastikan bandar bersih dan bersih, serta menyediakan imej awam yang lebih baik untuk pelancong dari seluruh dunia. "Development of Automated Recycle Bin Compressor using Arduino for Smart city" direka untuk memampatkan secara automatik apabila sisa di dalam tong mencapai tahap tertentu dan sebelum sisa dikumpul. Tong sampah ini sesuai diletakkan di kawasan sesak bagi memastikan objektif tercapai. Biasanya, bahan buangan akan dikumpul tanpa sebarang pemampatan dan itu akan membazir ruang. Tong ini dilengkapi dengan sensor untuk mengesan tahap sisa dalam tong untuk membuat motor DC mula berfungsi dan memampatkan sisa. Sensor itu dipanggil sensor inframerah (sensor IR). Apabila cahaya yang dipancarkan dan ia memantul ke penerima inframerah, sensor mula mengesan bahan buangan. Penderia terletak di tepi tong sampah dan boleh dikeluarkan secara manual. Dengan berbuat demikian, ia dapat mengurangkan masalah sampah berlebihan dan tong melimpah yang tidak diuruskan dengan baik. Tork tinggi dan motor DC rpm rendah digunakan untuk memastikan bahan buangan dimampatkan dengan sempurna. Motor DC ini berfungsi di bawah bateri. Untuk menyokong bateri, tong menggunakan panel solar 3 Watt untuk mengecas semula bateri menggunakan litar pengecas solar untuk mengelakkan pengecasan terganggu. Sebagai contoh, apabila bateri penuh, litar akan memutuskan proses pengecasan. Butang matikan terletak di belakang tong sampah dan boleh dimatikan secara manual jika apa-apa berlaku. Kemudian modul Wi-Fi ESP8266 diletakkan untuk mengumpul data daripada tong kitar semula. Keputusan ini akan meningkatkan kutipan sisa, mengurangkan pencemaran, mengurangkan karbon yang dikeluarkan oleh kenderaan dan penggunaan maksimum ruang dalaman tong sampah.

ACKNOWLEDGEMENTS

To complete this project, many people had helped and inspired me. I have received a lot of support from each of them.

First and foremost, I would like to express my gratitude to my supervisor, TS. ELIYANA BINTI RUSLAN for their precious guidance, words of wisdom and patient throughout this project.

I am also my fellow colleague and housemates for the willingness of assisting me regarding the project. They are never relentless to share their knowledge, information, and experience with me.

My highest appreciation goes to my parents, and family members for their love and prayer during the period of my study.

An honourable mention also goes to both of my long-time friends for brainstorming together to form this project idea.

Table of Contents PAGE

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

A waste bin (or recycle bin) is a container used to hold recyclables before they are taken to recycling centers. Recycling bins exist in various sizes for use inside and outside homes, offices, and large public facilities. Separate containers are often provided for paper, tin or aluminum cans, and glass or plastic bottles, or may be commingled. Recycling bins began to be known around 1965. Recycling bins were labeled to facilitate people to remove recyclable materials.

Many recycling bins are designed to be easily recognizable and are marked with slogans promoting recycling on a blue or green background along with the universal recycling symbol. Others are intentionally unobtrusive. Bins are sometimes in different colors so that user may differentiate between the types of materials to be placed in them. While there is no universal standard, the color blue is commonly used to indicate a bin is for recycling in public settings.

1.2 Problem Statement

Based on our observations, the existing garbage bins are often full before the collection day is made especially in the recreational area. A waste collection timetable has been issued by SWM Environment Sdn. Bhd. on Figure 1, recycling waste collection is collected once a week. This causes the waste bin to overflow causing the surrounding area to be dirty. In addition, there is a waste of space when the waste is less compressed because by compressing the garbage, it can increase the space of a recycle bin equivalent to 5 to 8 times based on a survey conducted on the internet. Subsequently, the increase in cost to collect recyclable waste since the collection of recyclable materials and raw materials are collected in different time. More often the waste is compressed, the collection time will be reduced. For example, from once a week to fortnightly collection. Therefore, this project is suggested to over the problem by proposed Development of Automated Recycle Bin Compressor using Arduino for Smart City. The idea of this project aims to analyze the system designed in terms of its functionality. There will Internet of Things (IoT) installed to monitor the level waste in the bin.

Figure 1: Schedule collecting recycle item

1.3 Project Objective

The main aim of this project is to Development of Automated Recycle Bin Compressor, the objectives are as follows:

a) To develop automated recycle bin compressor using arduino for smart city.

b) To compress the recyclables when the level is reached.

c) To analyze the system designed in terms of its functionality.

1.4 Scope of Project

To avoid any uncertainty of this project due to some limitations and constraints, the scope of the project are defined as follows. Development of Automated Recycle Bin Compressor using Arduino for Smart city is designed to reduce waste collection work in all areas such as recreational areas and indoor recycle item. This project can be devoted to municipalities in every state where the municipalities can reduce the cost and time of waste collection at the certain places. It uses infrared sensor to detect excess waste in the recycle bin. The programming of the project will be using Arduino Uno software in C language. A ESP 8266 wifi module will be used in this project to interact with user. The wifi module model being used in the project act as Internet of Things (Iot) to monitor the level of the waste in bin. So from here we can develop the project.

1.5 Summary of Chapter

The proposed research is carried out by covering the project background, problem statement, objective, and project scope. The project background is explained to initiate the project, what prerequisites are, and what results are supposed to be obtained at the successful completion. Problem statements is a concise description of waste issues that are addressed so our project will help to overcome the problems and achieve our objective.

1.6 Thesis organization

The first chapter in this thesis is chapter 1, the introduction for this project. The project background, problem statement, objectives, and project scope are all written in this chapter. This chapter helps the reader to understand the reason for the development of this project.

The next chapter will be chapter 2 which is literature review. In the chapter it shows related research done by the other researchers will be observed and studied one by one. Comparison and review of the studied papers will be done to recognize each project advantages and disadvantages.

Next, chapter 3 is discussed about the methodology which is the method and technique is applied to the project. Therefore, the design of the procedure used on the project that represents the process of the hardware also will be included.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, I have been comparing others research project related with the own project. It is related to the function and operation of each research project. All the comparison process during the literature review were made to complete the Development of Automated Recycle Bin Compressor Using Arduino for Smart City.

2.1.1 A cloud based smart recycling bin for in-house waste classification

The main of the development of the smart bin that proposed in [1] is to classify each of the waste that will be going into the bin by using the camera inside the Raspberry Pi Zero. Raspberry Pi Zero comes with camera module that enable the users to program it to detect present of plastic, paper, glass, metal and trash. Its also equipped with Wi-Fi to store the result of the waste in the bin. The smart recycling bin also equipped with ultrasonic sensor in order to measure the fullness percentage. The proposed project also conducted experiment in city of Kozani. The result they gathered is successfull to detemined the effiency of the proposed system. In the future, they will improve the project by doing custom microcontroller instead of Raspberry Pie Zero. The weakness of the system is on the software side which is execution time of the data received need to be improved.

2.1.2 Design a smart waste bin for smart waste management

A trash bin that is proposed in the project [2] basically a general waste-bin equipped with sensing units. The purpose of the system is to monitor all the waste in the city with the concept of smart waste management. System is equiped with ultra sonic sensor to monitor the level of waste. Load cell sensor device is used to measure load in the waste bin either directly or indirectly. This help gather information more effective to monitor the waste bin level. Mobile application also help to the system proposed to help it maintain the project as smart waste management. The system that have been proposed successfully collect real time accurate data so that this project is suit using in any kind of regular waste management.

2.1.3 Design and Assembly of A Smart Recycling Bin

This system is introduced in [3] named as Enviro-Bin. The system consist of microcontroll by Arduino Uno that control sensor such as inductive sensor and colour sensor to seperate the recycle waste that goes in the bin. IR sensor is placed to detect whether the object has been placed inside the bin. Stepper motor is being used in the system to seperate the waste. It consist of 4 compartments for plastic, metal, glass and etc. The system is design multipurpose and suitable for all type of homes. Futhermore, the mobile application will notify the user to empty which compartment.

2.1.4 Design Of Smart Bin For Smarter Cities

According to [4] , the system of smart bin proposed is not like other ordinary bin. The system is equipped with network of sensor that capable of providing various of information to monitor waste in real time. Each of the sensor is controll by Arduino Uno. The workflow of the [4] is when the waste is full, the system should close the lid and notify the user. The design is made to protect the waste from animals and unnatural weather condition that can cause the waste all over the place. The ultra-sonic sensor is important role here to close or open the lid of the smart bin. The bin has an LCD monitor that shows the fill percentage, date, and time in real time. The result shown as graph have been carried out to show the fill vs time.

2.1.5 Waste Management using Solar Smart Bin

A smart waste management system that presented in [5] is a project that offer the compressed waste to reduce the volume of the waste bin. Not only reducing the volume of the bin its also can reduce pollution caused by the garbage vehicle by reducing the number of time its collection. The project that proposed also design consist of two bin. One container is for biodegradable garbage alone, while the other is for non-biodegradable waste. This distinction is formed because the recycling process for biodegradable garbage is essentially identical, however the recycling procedure for non-biodegradable waste is different for plastic, glass, and metal. Furthermore, non-biodegradable garbage should not be pulverised. The biodegradable materials are crushed by a motor attached to crushers. All of this action are triggered by the ultra-sonic sensor that had been placed in the bin and monitored by GSM module in mobile application.

2.2 Journal Comparison for Relevant Previous Research

Table 2.1 show the comparision table for 5 different research related to this proposed project so that we can improve or avoid the drawback for this project after analyzing it.

Between the research had been made, most of the project used microcontroller Arduino Uno which is easy to use and program. It also user friendly because it a open source program. The program also easy to learn from the internet source. Then, most of the author are using mobile application as monitoring system because of its mobility. We can monitor our project data in any places. The idea can be implented to our project for a good result.

Next, most of this research are using GSM module because of easy to use and very common. The idea of our project will be using ESP8266 arduino module because it easy to interact with our Arduino Uno that will be using in this project.

Moreover, most of the researcher are not using solar panel as maintaining the green technology. But for our project, we will implement the solar panel to maintain the power of the battery that recharge the power for our system. Thus, we can apply the green technology to our project. Futhermore, I will use latest technology for example Arduino Uno, Infrared Sensor module, Ultrasonic sensor module, ESP8266 wifi module because of the source can be found on internet easily as reference.

Table 2.1 : Journal comparison

Title	Microcontroller	Monitoring system	Type of sensor	Communication system	Function	Advantage	Disadvantages
A cloud based smart recycling bin for in-house waste classification	Raspberry Pi Zero	Computer	a Raspberry Pi Zero W camera module version 2.1. , ultra-sonic sensor	The Raspberry Pi Zero W board has integrated Wi-Fi (802.11n wireless LAN) and Bluetooth 4.0.	utilizes the power of cloud to assist with waste classification for personal in-house usage. A centralized Information System (IS) collects measurements from smart bins that can be deployed virtually anywhere and classifies the waste of each bin using Artificial Intelligence and neural networks.	it has very low cost, it is very energy efficient it has a very small form factor (Dimensions: 65mm ˜A 30mm ˜A 5mm)	Wi-Fi can't reach far distance and slow.
Design a Smart Waste Bin for Smart Waste Management	Microcontroller	Mobile application, Computer	ultrasonic sensors	GSM Module	The system consists of sensors to measure the weight of waste and the level of waste inside the bin. The system also adapts with network environment, to manage all information from waste management	quick response to monitor the condition of waste-bin.	Ultrasonic sensor bad Change in nature for example temperature, airborne particles, weight, air turbulence, influence ultrasonic reaction.
Design and Assembly of a Smart Recycling Bin	Arduino Uno	Mobile application	IR sensor, inductive sensor, Capacitive	Bluetooth Sensor	The proposed prototype is an automated waste material filtering system that contains infrared	simple design attracts users and suits all	Capacitive & inductive sensor not too accurate

			sensor, Colour sensor		sensors and two proximity sensors, an inductive sensor and a capacitive one, to determine the presence and type of material. Moreover, each compartment includes an IR sensor to detect the level of the waste in the container.	types of homes.	choosing type of recycle item
Design Of Smart Bin for Smarter Cities	Arduino Uno	Computer	PIR Sensor, Ultrasound range Sensor, Temperature Sensor, Proximity Sensor	Ethernet shield/Wi-Fi shield	smart bins are equipped with a network of sensors, and they transmit real time data indicating the fill percentage of the bin	Efficient with complete sensor	Complicated to build with too many sensors, Expensive
Waste Management using Solar Smart Bin	ARM-7 CONTROLLER	Mobile Application	Ultra-sonic sensor, IR Sensor	GSM Module	Module consists of two bins, one for crushing the biodegradable waste such as plastic/ paper cups and glasses, and various other materials and the other bin is used for storing the bottles, tins etc.	Energy Efficient because of solar	Microcontroller is hard to program because of not compatible with latest version of window

2.3 Summary

At the end of this chapter, various project advantages and disadvantages are discussed. It is simpler to put the approaches that earlier researchers utilised in this project into practise. Furthermore, the disadvantages can be minimised to the greatest extent feasible. The outcome of examining previous researchers' study has a positive impact on this project since the right and appropriate approach will be used while keeping the weak point in mind. After reading their reseach, I want to utilise more green technology in this project since using alternative energy prevents the depletion of fossil resources, reduces greenhouse gas emissions, and slows global warming.

CHAPTER 3

PROJECT METHODOLOGY

3.1 Overview

Project methodology contain guiding processes for project compressed recycle bin. In this chapter, process of making will be explained and dividing project step into multiple stages such as designing a project, creating a block diagram, draw the schematic circuit and lastly create the flowchart of the project. The methodology defines inputs and outputs for every stage of a project so that nothing is left to change.

3.2 Ideas of Project Design

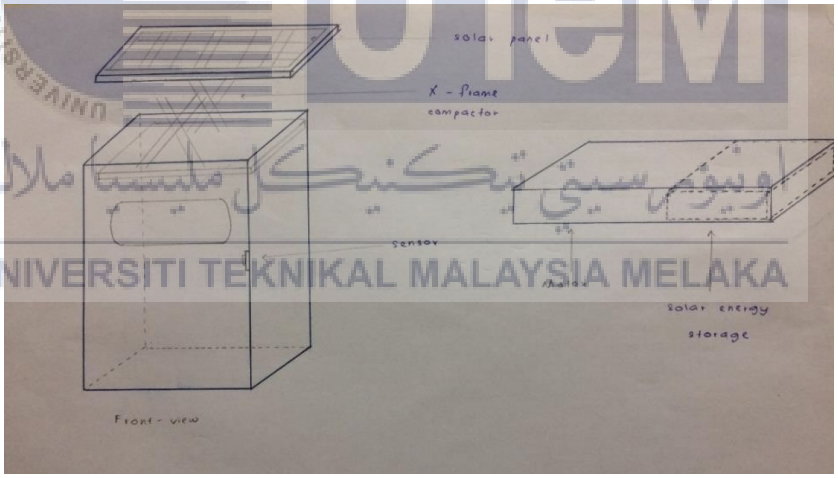

Figure 3.1: Schematic Drawing

The idea of design is to design the project concept before the expected result is been made. The model of the project is to design it as a normal rectangular bin. This bin will be equipped with X frame compactor. The X frame is designed to facilitate the compression process. Then, the solar panel is placed on top of the project to ensure it get direct sunlight to ensure the solar panel is charging the battery. The motor as well as the circuit compartment box is located behind the bin to make it well ordered.

3.3 Concept/Theory

In this section, the component for the project will be elaborated in detail. To achieve the project development, each of the component will be studied. All the explanations process during the project were made to complete the Development of Automated Recycle Bin Compressor Using Arduino For Smart City

3.3.1 Arduino Uno

Arduino is an open-source electrical kit that was created to make it easier for people to create products or construct electronic devices that can interface with various sensors and controllers. [6]

The Arduino UNO is a micro bodyguard board that is completely protected by the ATmega328. As seen in Figure 3.2, the Arduino UNO has 14 digital input/output pins (6 of which may be used as PWM outputs), 6 analogue inputs, a 16 MHz crystal oscillator, a USB connection, a power connector, an ICSP header, and a reset button. The Arduino UNO has everything needed to run a micro bodyguard; alternatively, it is simple to connect it to a computer by USB or power it is using a shuttle adapter to energy or batteries.

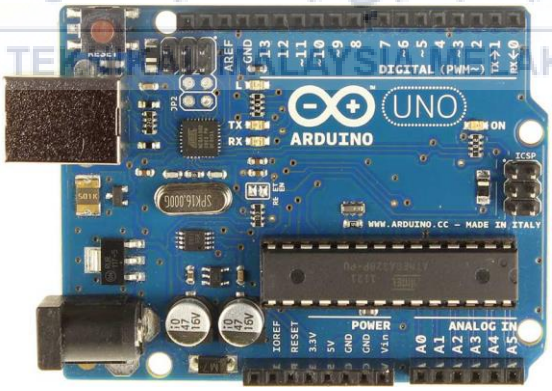

Figure 3.2: Microcontroller Arduino Uno

3.3.2 Relay Module

A relay is a switch that responds to an electric signal. Most relays use an electromagnet to change the switch or contact relay. As shown in figure 3.3, contact relays are categorised into two types: usually open (NO) and normally closed (NC). Relays are used to control direct current motors so that they can rotate clockwise and counterclockwise. Relay modules come in a variety of voltage acceptance configurations [7]. Because the current motor continues to operate at 12 volts, the relay module is used for this project.

Figure 3.3: Relay Module

3.3.3 Infra Red Object Detector Module

An infrared object detection module is one that identifies barriers or things in front of it. This detector may be used for a variety of reasons, such as alerting the robot as it approaches the wall or adjusting the robot's trajectory as it approaches the wall [8] . In our project, the detector will function as a trace level detector in project bin for moving motors.

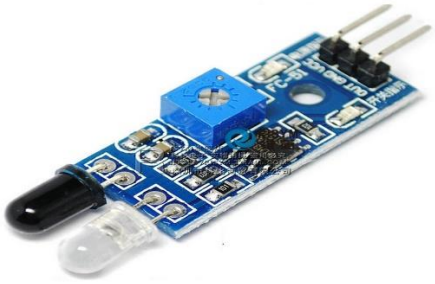

Figure 3.4: Infrared Object Detector

3.3.4 Direct Current Motor

As a waste compressor project, the project used direct current motors. A direct current motor is a motor that converts electrical energy to mechanical energy. Electricity is required for the motor to work in the form of rotational motion (such as a fan or power wheel). There are other types of direct current motors, but for this project, we will use a straight current motor. Constant current currents have the ability to adjust their speed, have a high torque, and have a velocity proportional to the load. The current motor, for example, stays parallel in Figure 3.5.

Figure 3.5: Direct Current Motor

3.3.5 Solar Panels

A solar panel is a material that converts direct light energy into electrical energy through the photovoltaic effect. Solar modules, which catch sunlight and are known as solar panels, are made from cells [9]. Solar energy is the energy produced by solar panels. This being used to this project to maintain the power of battery.

Figure 3.6: Solar Panel

Table 3.1: Advantages and Disadvantages of solar panel

Advantages	Disadvantages
Solar energy is renewable energy	Expensive
Long term use	Only rely on sunlight
Low maintenance costs	

3.3.6 Battery

All electronic drives in the project are powered by the batteries to utilised in this project. The present 12 Volt battery can supply 10 Ampere current for 12.5 hours [10]. To increase the voltage to 24 volts, connect the 12 volt battery in parallel or series. It will also store energy from a solar panel.

Figure 3.7: Example battery Cell

3.3.7 Ultrasonic Sensor

An ultrasonic sensor as figure 3.8 is an electronic device that detects the distance between two objects by producing ultrasonic sound waves and converting the reflected sound into an electrical signal [11]. The material is used to measure the level of waste in the bin to transmit into blynk application to interact with.

Figure 3.8: Ultrasonic sensor module

3.3.8 ESP8266 Module

The module is used in the project to collect real time data from the project to analyze the real time data monitoring. From figure 3.9, the ESP8266 Wi-Fi module is a self-contained SOC with an inbuilt TCP/IP protocol stack that can provide access to your Wi-Fi network to any microcontroller [12].

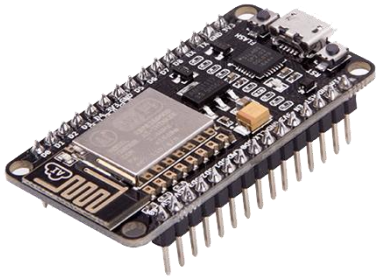

Figure 3.9: ESP8266 Wi-Fi module.

3.4 Block Diagram

A block diagram is a diagram of a system in which the principal parts or functions are represented by blocks connected by lines that show the relationships of the blocks. Block diagrams are typically used for higher level, less detailed descriptions that are intended to clarify overall concepts without conern for the details of implementation. Contrast this with the schematic diagrams and layout diagrams used in electrical engineering, which show the implementation details of electrical components and physical construction [13].

The Figure 3.10 shown a block diagram for the project. The block diagram is starting from solar panel that is collecting the power from the sun and stored through the battery. A circuit is used to prevent the battery not charging and will damaged the battery because of reverse current. Then when the arduino get supplied from the battery, component such as DC motor and IR sensor will be working. From arduino, when the IR sensor is triggered, arduino will transmit data to the relay to make the DC motor to run clockwise. After that, the relay will triggered the DC motor to run anticlockwise. Last but not least, the ultrasonic sensor will measure the bin waste level and send to cloud server to monitor the real time data.

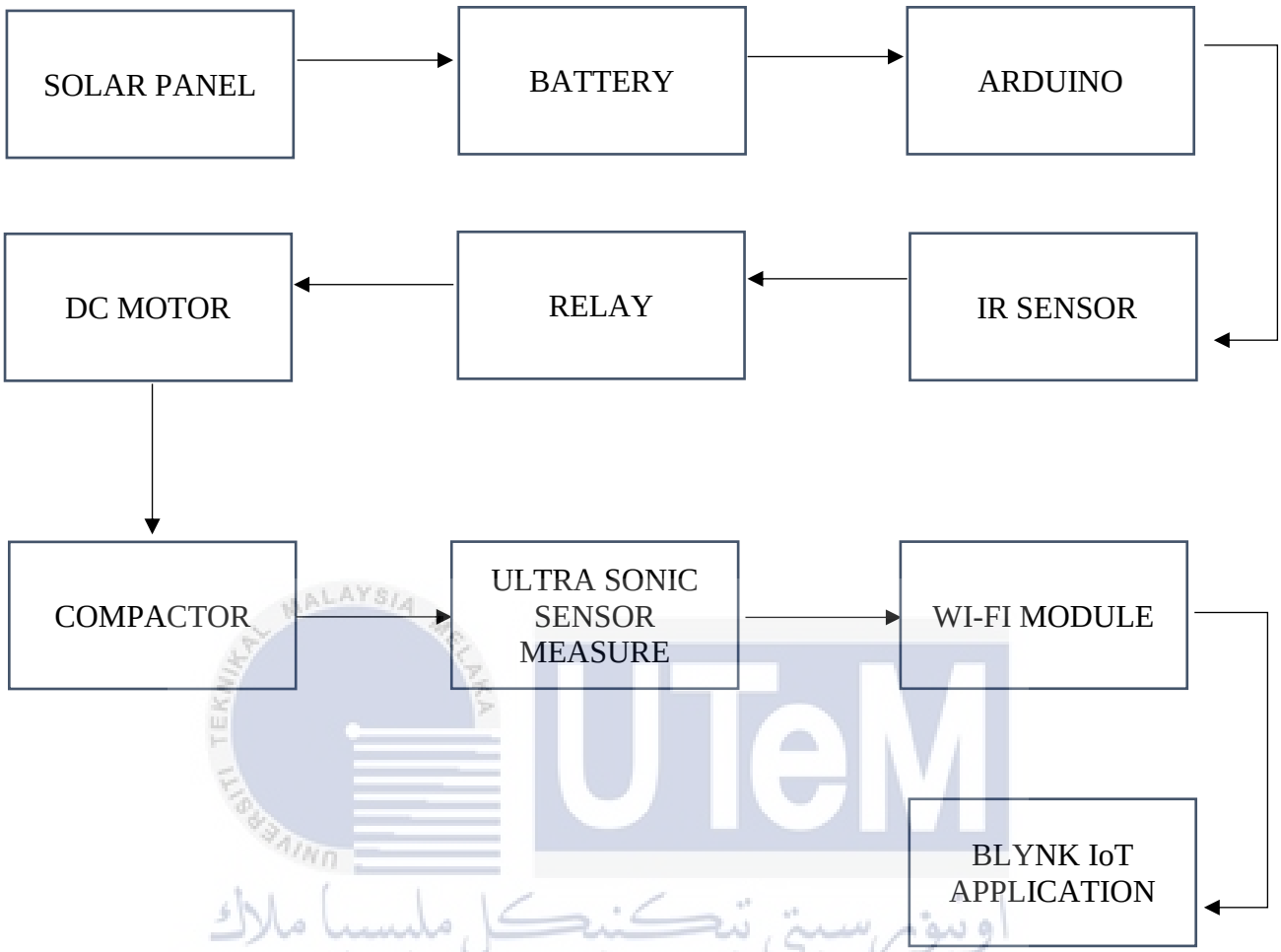

Figure 3.10: Block Diagram

3.5 Flowchart Project

A flowchart project is used to represent an algorithm, workflow or process. The flowchart shows the steps as boxes of various kinds, and their order by connecting the boxes with arrows. The diagrammatic representation illustrates a solution model to a given problem. The project is designed to compress the recycle item. Firstly, the start is elongated circle, which signify the start or end of a process. Then a diamond is used to highlight where it makes a decision. In this case, the IR sensor will transmit data to the Arduino if it senses the level of trash. If yes it will more to the next step. For the next step, rectangle is used to shows instructions. When the Arduino receive the data from IR sensor, it will more to the next step which is triggering the relay to make the DC motor move clockwise and anti-clockwise. Then, when the recycle item is compressed, the process is done for compressing the waste. Lastly, the ultrasonic sensor will measure the level of the bin and transmit the data into the user application for analyze the real time data.

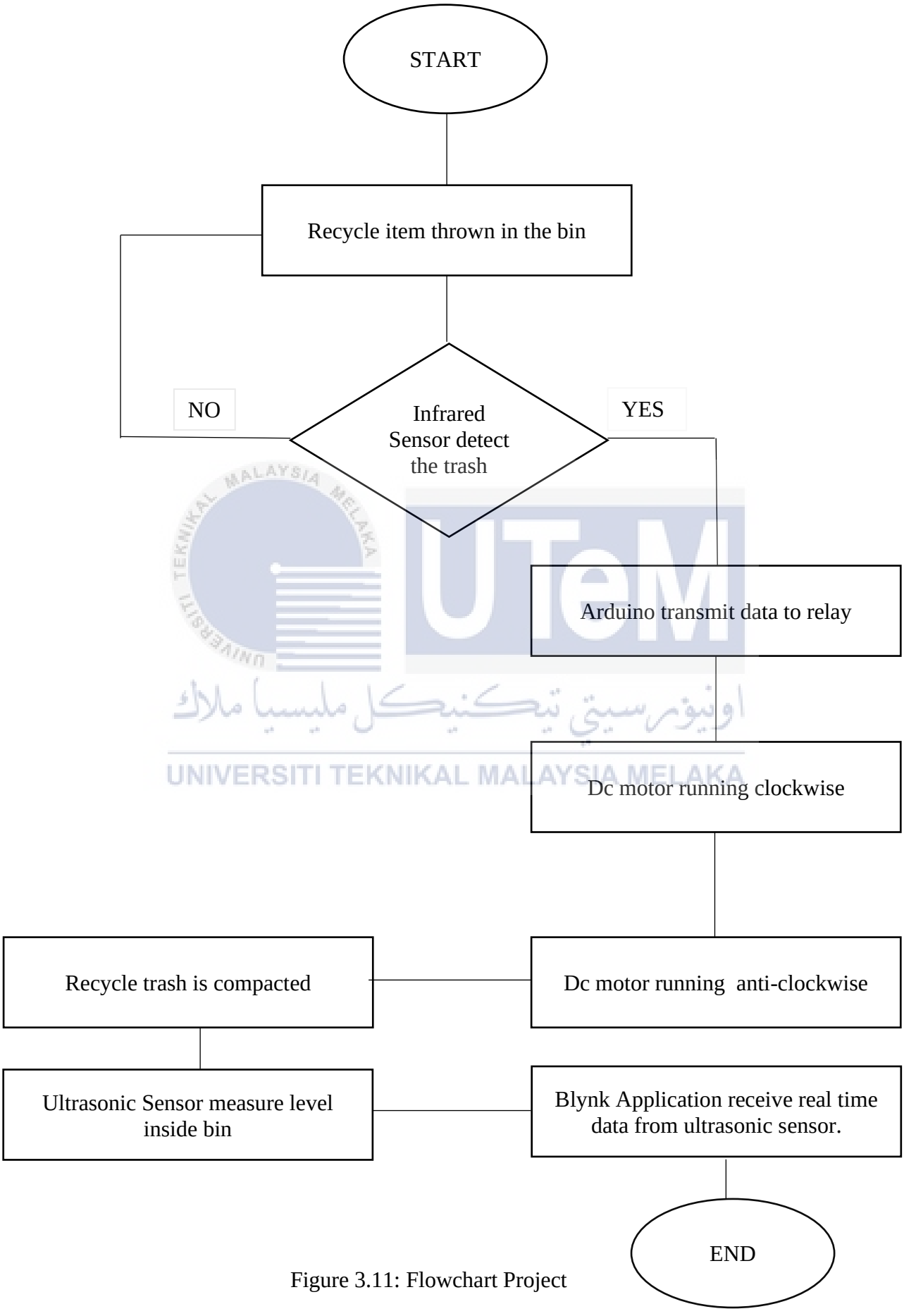

Figure 3.11: Flowchart Project

3.6 Preliminary results

Figure 3.12 shows the circuit when no object is passing through the Infrared Sensor. Shape that has been highlighted in figure 3.12 show in trigger pin value is 1. When the trigger pin show 1, its mean there is no object reflect with the infrared sensor. On figure 3.13, trigger pin for the infrared sensor value has been changed to 0. The value changed to shows that object has reflected into the sensor and trigger the DC motor as figure 3.14. The DC motor will run in clockwise and then anti-clockwise and return to its original position as shown in figure 3.14 and figure 3.15

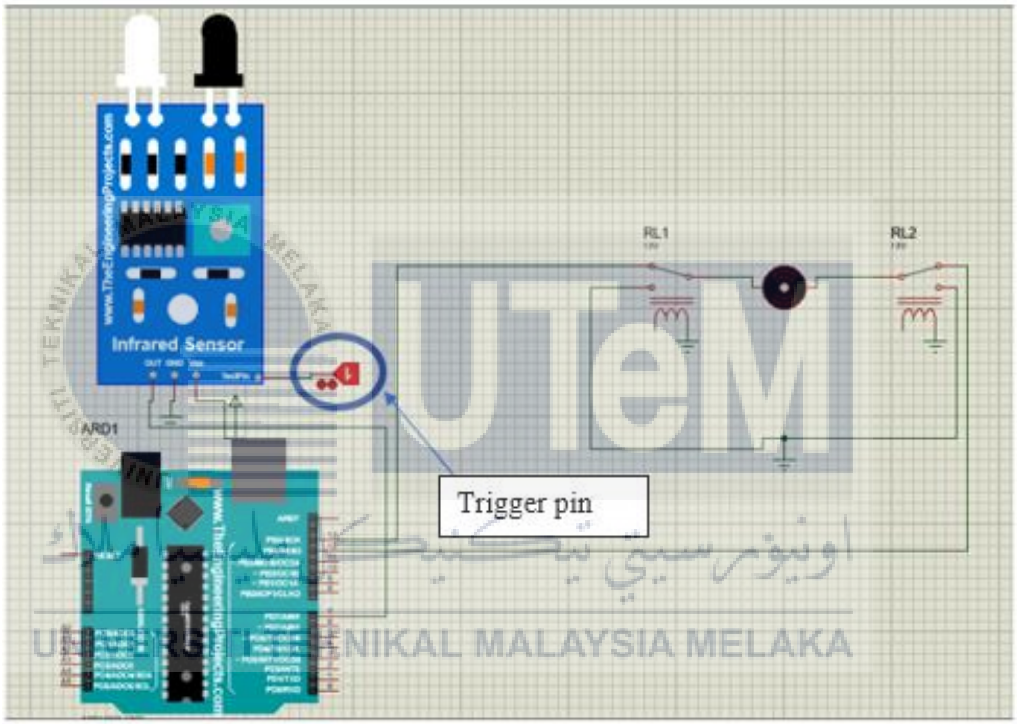

Figure 3.12: Circuit Simulation on standby mode. Trigger pin is on 1

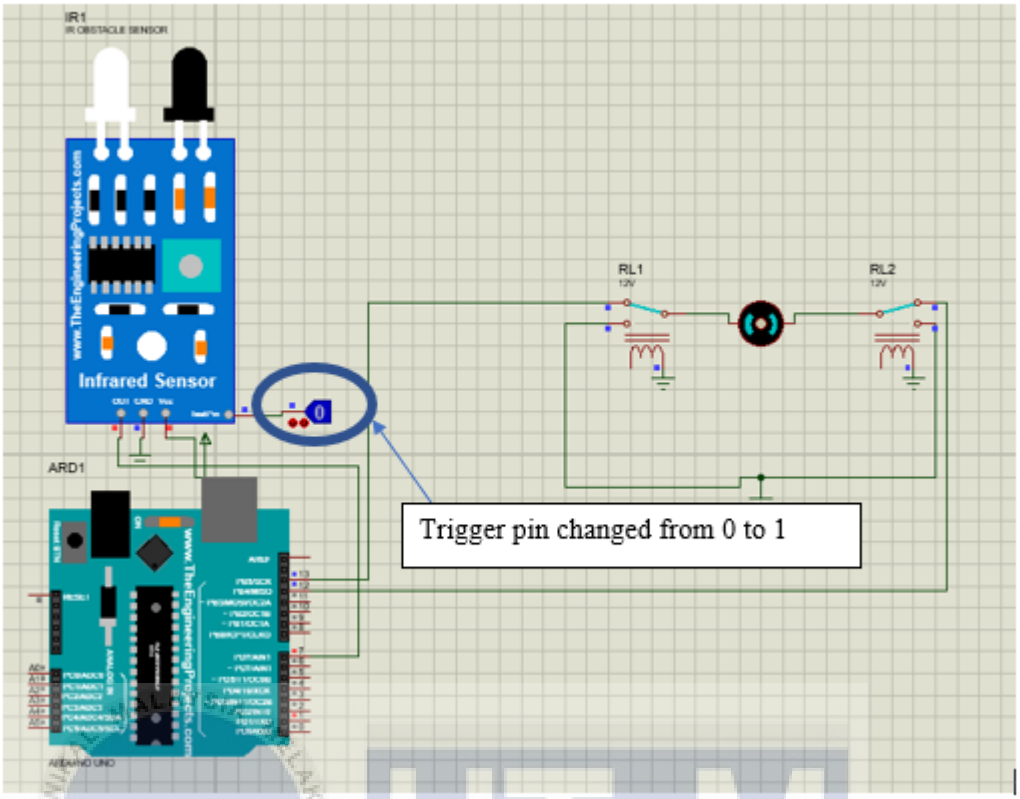

Figure 3.13: Infrared sensor trigger pin changed from 1 to 0.

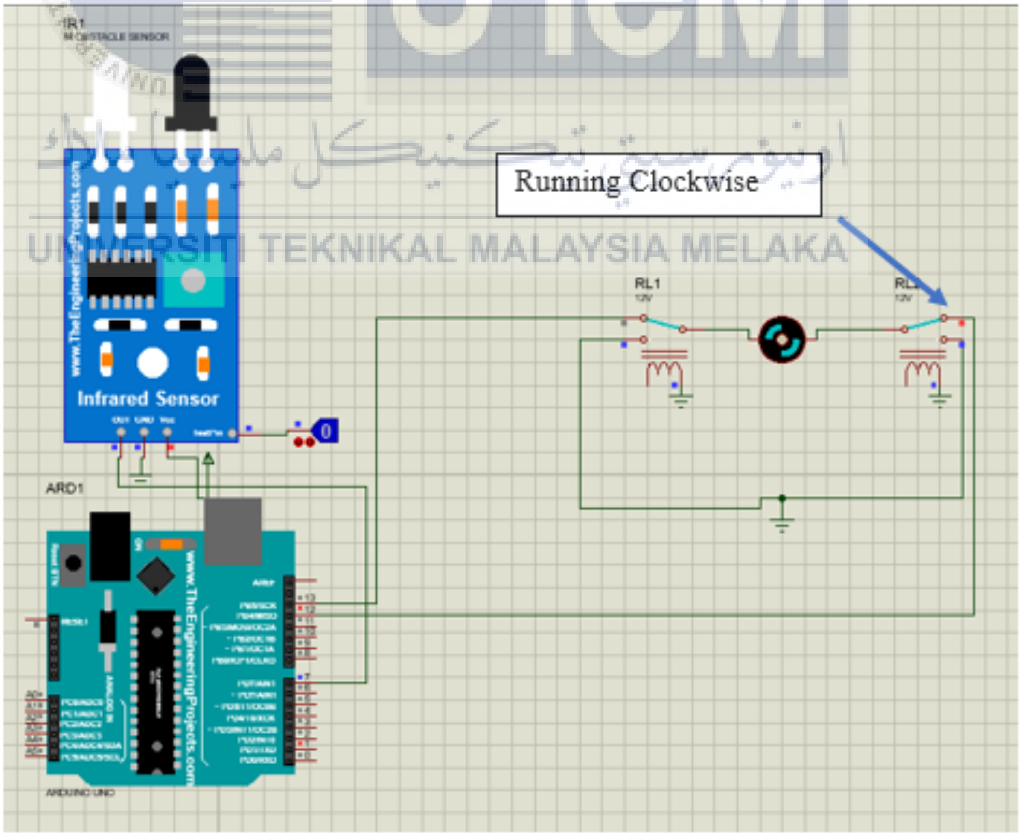

Figure 3.14: The DC motor running clockwise

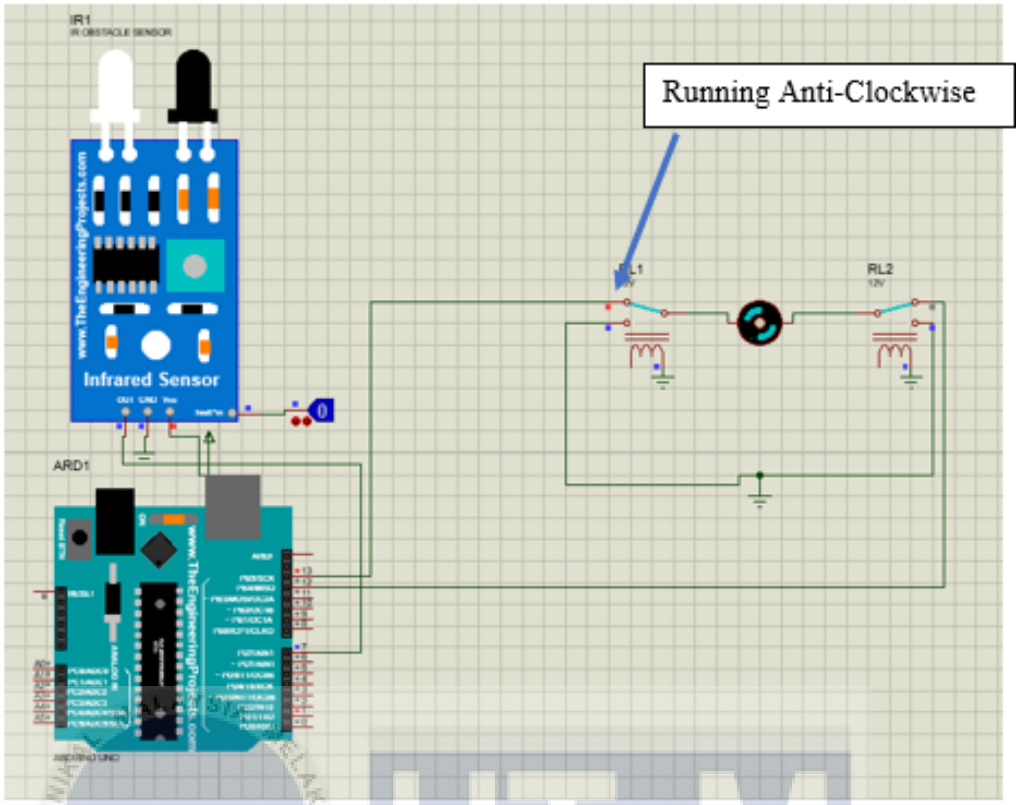

Figure 3.15: The DC motor running anti-clockwise and return to original position

3.7 Gantt Chart

Table 3.2: Gantt Chart for PSM 1

PROJECT ACTIVITIES	STATUS	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10	WEEK 11	WEEK 12	WEEK 13	WEEK 14	WEEK 15	WEEK 16
BDP Briefing	E									M							S
	A																
Meeting with Supervisor	E									I							T
	A																
Finding information and research	E									D							U
	A																
PSM 1 Rubrics Explanation	E									B							D
	A																
Project planning	E									R							Y
	A																
Chapter 1 Preparation	E									E							
	A																
Chapter 2 Preparation	E									A							W
	A																
Chapter 3 Preparation	E									K							E
	A																
Construct the simulation	E																E
	A																
Preparation for present	E									M							
	A																
Report draft submission	E																
	A																
PSM 1 Present	E																
	A																

Notes: E- Expected A-Actual

Table 3.3: Gantt Chart for PSM 2

PROJECT ACTIVITIES	STATUS	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10	WEEK 11	WEEK 12	WEEK 13	WEEK 14	WEEK 15	WEEK 16
Draft Material List	E									M							S
	A																
Meeting with Supervisor	E									I							T
	A																
Test Hardware	E									D							U
	A																
Analyse Result	E									B							D
	A																
Complete Chapter 4:Result and Discussion	E									R							Y
	A																
Complete Chapter 5:Conclusion	E									E							
	A																
Submit draft report	E									A							W
	A																
Prepare Project Poster	E									K							E
	A																
Preparation for presentation	E																E
	A																
Presentation	E									S							K
	A									E							
Submit Final Report	E									M							
	A																

3.8 Summary

In this chapter, the method that going to be used in this project and the development process had been explained. The reasons for the hardware and software used in this project are also explained one by one. This will help the reader to understand the development of this project more clearly.

To complete the project and achieve the project's objective, a plan will be needed. A plan will consist of planning the working flow and the project development schedule. This is to make sure each element in this project can be done on time and successfully. The plan can be carried out by creating a flow chart that shows all the processes and makes a Gantt chart to schedule the needed time for completing each task every week.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

In this chapter will be describing about the expected findings that obtained during the project development, testing and troubleshooting. The result and analysis of projects are a theoretical or written project in relation to the functions of the circuit and the operation of the circuit in the project field. In addition, it should be explaining the results obtained after the project is running in a period of time is functioning properly or not.

4.2 Solar Panel Charging Testing

Solar panel absorb sun lights a source of energy to generate electricity. It will convert light energy to electrical energy. After that, the energy will be stored in the battery. Battery capacity is measured in Amp Hours.

7.2 (battery size in AH) x 12 (battery voltage) = 86.4 WH (power available in Watt hour)

Figure 4.1: Battery capacity used in the project.

This means the battery could supply 86.4 Watt for 1 hour, 43.2 Watt for 2 hours. The more energy you take, the faster the battery discharges. However, lead acid battery that we used will give around 50% of their rated power. This means 7.2 Ah battery has 3.6 Ah of usable power as show in Figure 4.1. In Malaysia, an average of sunshine is 8 hours. Therefore, a 3 Watt solar panel will provide and generate 24 Watt worth of energy back into battery. 3-Watt x 8 = 24 Watt

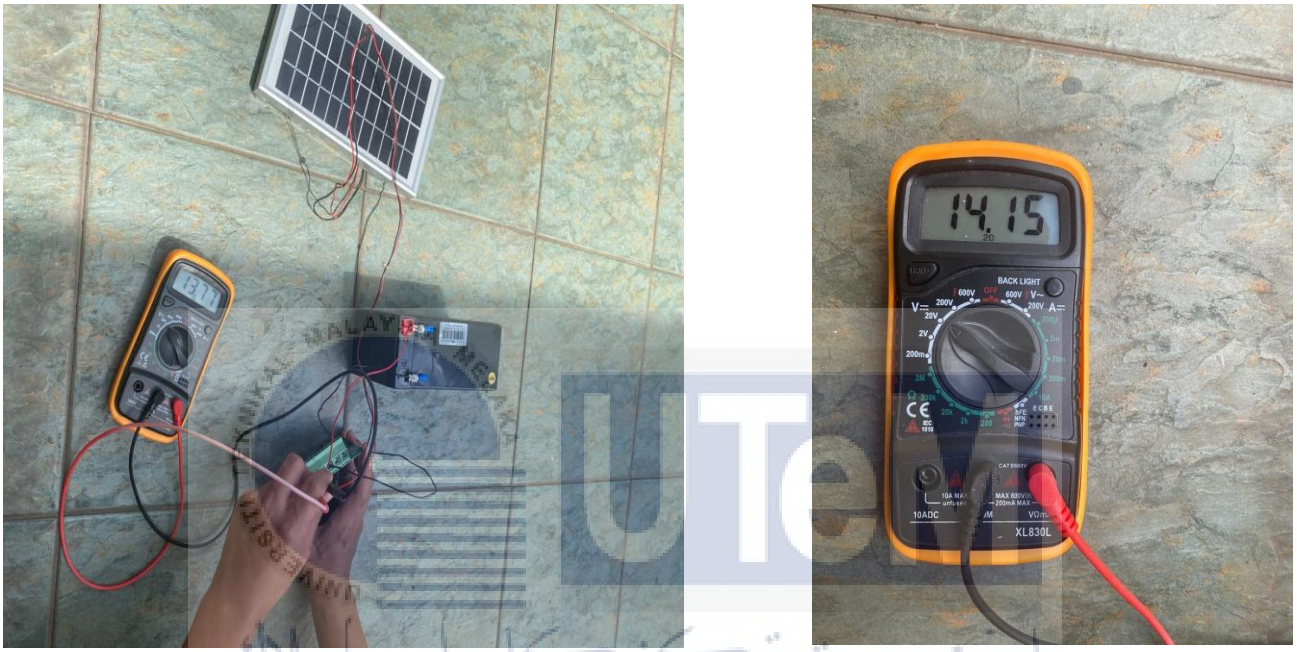

Figure 4.2: Measurement voltage from solar panel into solar panel charger controller

Figure 4.2 it shows the solar panel able to provide enough voltage to supply the solar charger controller to charge into the battery. The solar panel and the solar charger controller only for backup power if the battery voltage low and if the battery voltage low, the 12 DC motor may move slower to compress the reycle trash. The system still working, but it will takes time to compressed it. From Figure 4.3, it shows parameter used in this project. Table 4.1 show calculation for solar panel.

Table 4.1: Solar panel calculation

• **Calculation**		**Value**
Estimated Watt demand		
3	Total Watts Per Hour (DC) DC Amps x System Voltage	3 Watts
Hours per day		
6	Hours Equip is expected to run (24hr) as per application	2 Hrs d^{-1}
Watt-Hours per day		
9	Total daily usage Watts x Hours	6.00 Watt-Hrs d^{-1}
Amp-hour calculation		
10	Total watts Daily requirements	6.00 Watt-Hrs d^{-1}
11	Corrected for battery losses Assumes static average loss	6.120 Watt-Hrs d^{-1}
12	System voltage DC voltage only	12 Volts
13	Amp-hours per day Watts divided by Volts	0.510 Amp-Hrs d^{-1}
Battery bank calculation		
14	# of days backup power required Average 24 hour periods	3 days
15	Amp-hour storage Raw capacity you need	3.5700 Amp-Hrs
16	Depth of discharge Assumes 50%	0.5 fraction (enter decimal)
17	Required amp backup Prevents excessive discharge	7.1400 Amp-Hrs
18	Battery Amp Rating (20 hr) Battery Capacity in Amps	7.2 fraction
19	Actual # batteries wired in parallel Raw number	0.99
20	Batteries wired in series Relates to system voltage	1.00
21	Rounded number of Batteries Always rounded up	1

Solar Panel Array calculation		
22	Sun hours per day (Direct only)	9 Hrs
23	Worst-weather multiplier* 1.55 default	1.55 fraction
24	Total sun hours per day	5.161 Amp-Hrs
25	Select panel size (Watt rating) Watt hour rating	12 Watts
26	Nominal Panel Voltage Approximate Solar output	16 Volts
27	Amps required from solar panels Total daily consumption	1 Amps
28	Peak amperage of solar panel Watts divided by Volts	0.750 Amps
29	Number of solar panels in parallel Raw Number	0.132
30	Number of panels in series (12 V) it is 1 for 12v, 2 for 24v, etc	1
31	Rounded number of solar panels Always rounded up	1

Figure 4.3: Solar panel parameter.

4.3 Hardware setup

In this section, the implementation or design of the hardware will be discussed. For this project, two parts of hardware had been set up which are system to move the direct current motor and Internet of Things (IoT) to monitor levels of the bin. From Figure 4.4 shows the Arduino powered with 9V battery is transmit data to relay move the direct current moto clockwise and anti-clockwise. The Arduino will trigger the relay after it receive data from infrared sensor. The placement infrared sensor is approximately place between 20 cm as shown in Figure 4.5. In Figure 4.6 shows how ultrasonic sensor measure the level of bin and ESP8266 act as Internet of Things (IoT) for monitoring using Blynk applications.

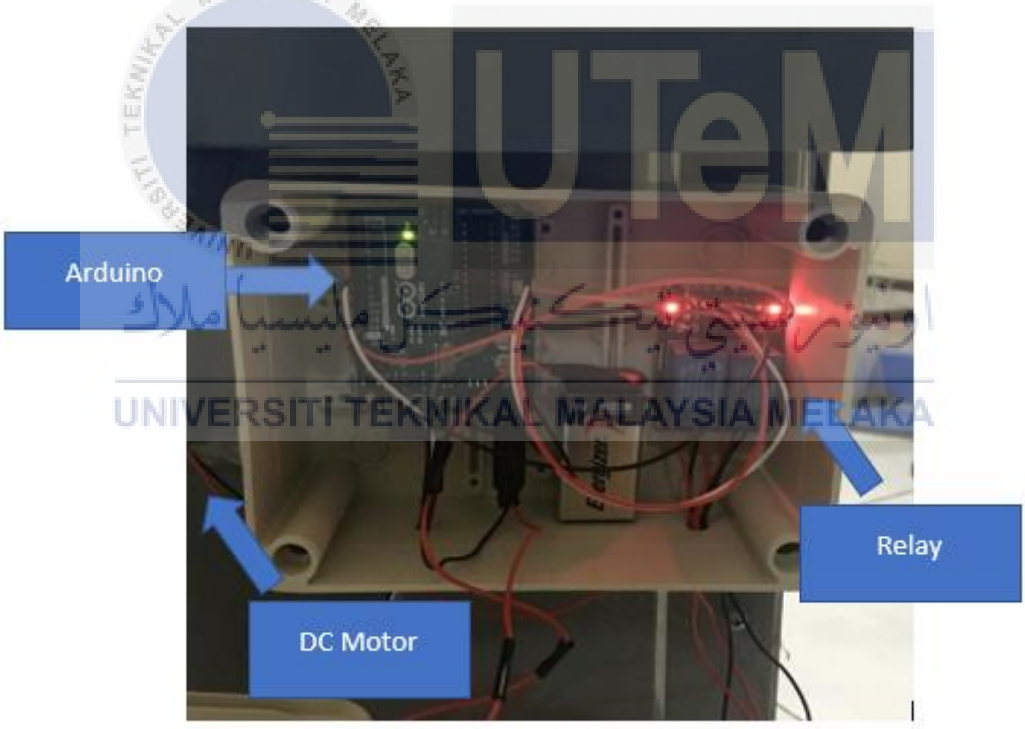

Figure 4.4: System circuit

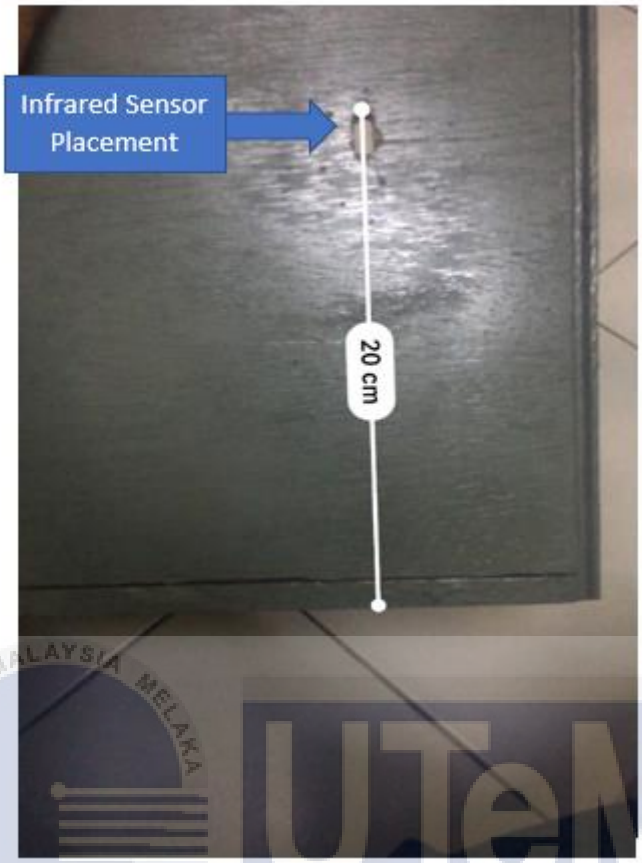

Figure 4.5: Infrared sensor placement.

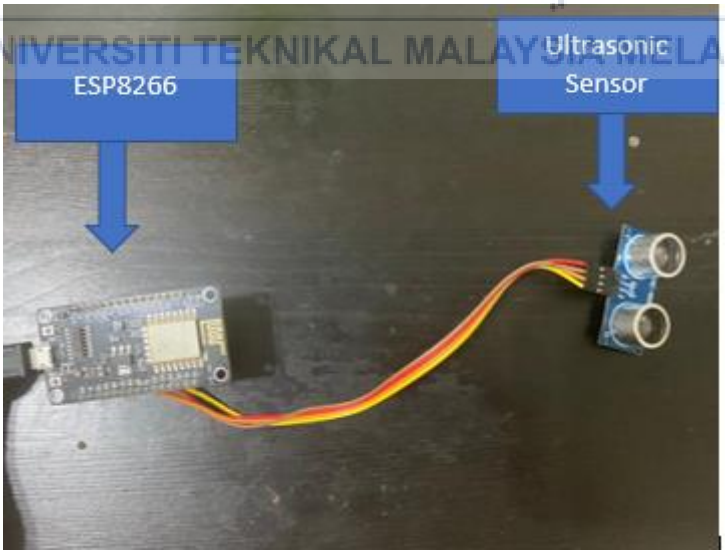

Figure 4.6: Internet of Things (IoT) setup.

Figure 4.7: Hardware setup.

4.4 Working Principle for Infrared (IR) Sensor

An electronic device called an infrared sensor emits light in order to sense something about the surrounding. This type of sensor will not emit infrared radiation, but it will detect infrared radiation, allowing it to detect the motion of an object. Most objects emit some infrared radiation, which is invisible to the human eye but may be seen by an infrared sensor. Any item or object moment can be detected with it. Infrared Astronomy, Infrared Tracking, and Night Vision Devices all use IR sensors with increased capabilities. In this case, the infrared sensor is used only detecting recycle item. From Figure 4.7 shows the only 1 LED only light up when there is no object detect. Then, Figure 4.8 shows the infrared sensor detect object near. The range of detection approximately 4 cm.

Figure 4.7: 1 LED light up when there no object near

Figure 4.8: Range of object to the infrared sensor

4.5 Result of Compressed recycle item

In this section, the result of compressed recycle testing obtained will be shown. First things are compaction will start after the relay trigger the direct current motor to run clockwise and anti-clockwise. The compaction can be done about 2 until 3 times after the trash was reach to the infrared sensor. This project is a prototype concept where it only can compress 2 until 3 times due to the size of bin only 28 cm. Figure 4.9 shows the diameter of the bin. The compressed item depends on what recycle item will be compressed such as paper, can or plastic bottle. For this testing, recycle paper and recycle can will be recorded in the report. As can be seen in Figure 4.10, first attempt is by filling up the recycle paper. Then Figure 4.11 shows the result after first compression of the recycle paper. After that, the bin is refilled with recycle paper for second attempt of compression. The result shown in Figure 4.12 the recycle paper almost reach the infrared sensor. This mean the recycle item should be removed from the bin to avoid too much compression. Third attempt shouldn't be done because the paper will reach the infrared sensor and it may cause infrared sensor to keep transmit data into relay to move the direct current (DC) motor.

Next, recycle tin can will be used for the testing. Figure 4.13 shows the bin is filled with tin can. Then, result recorded in Figure 4.14 after the compression done. The result came out slightly different before the tin can compressed. This is because tin can material harder than paper. So, the result from compressing tin can only be compressed only once when it full.

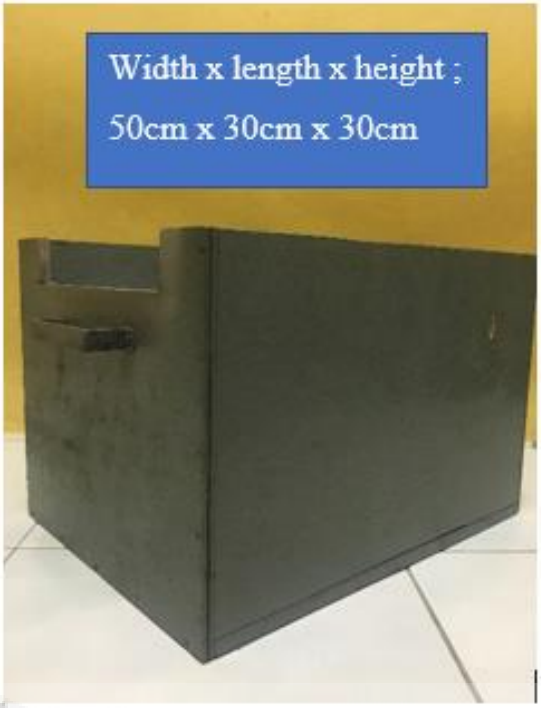

Figure 4.9: Compartment of the Compressed recycle bin

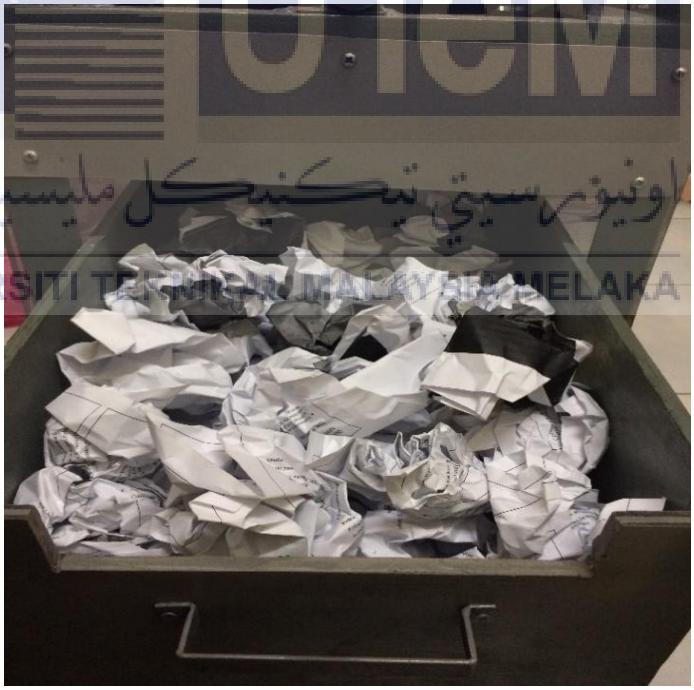

Figure 4.10: The paper is fill up inside the bin.

Figure 4.11: The paper is compressed.

Figure 4.12: Second attempt of compression after refilled.

Figure 4.13: Tin can filled up in the bin

Figure 4.14: Tin can after compressed.

Then, recycle plastic bottle will be used for the testing. Figure 4.15 shows the bin is filled with plastic bottle. Then, result recorded in Figure 4.16 after the compression done. The result came out slightly different before the tin can compressed. This is because plastic bottle can expand and filled up with air.

Figure 4.15: Plastic Bottle filled up.

Figure 4.16: Plastic bottle after compress.

4.6 Measurement level inside the bin

In this section, the hardware of ultrasonic sensor that connected to ESP8266 Wi-Fi module to observe the level in the bin will be discuss. Figure 4.17 shows the ultrasonic sensor is place in the compressed recycle bin. The level measured as shown in Figure 4.18. Then in Blynk application user will be get alert if the level of recycle item in the compartment is full as shown in Figure 4.19 and Figure 4.20. This can be usefull to user to monitor the automated recycle bin compressor from far away as long as user and the ESP8266 is connected to the internet. From this prototype after getting two notification from the Blynk, user should empty the recycle bin.

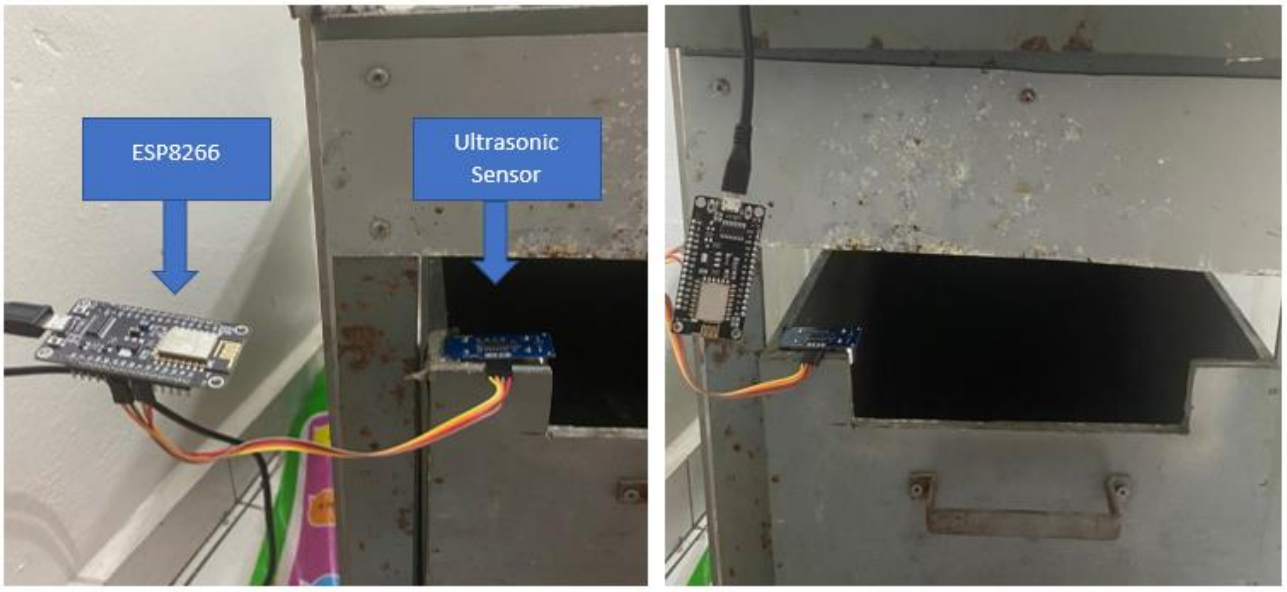

Figure 4.17: Ultrasonic sensor placement.

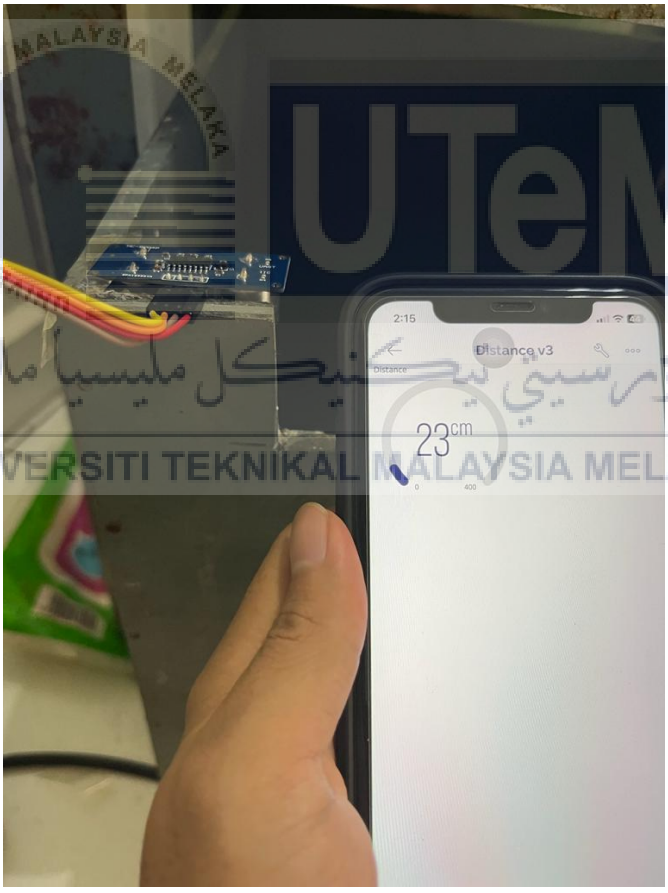

Figure 4.18: Ultrasonic measure using Blynk application.

Figure 4.19: Alert notice mobile Blynk application.

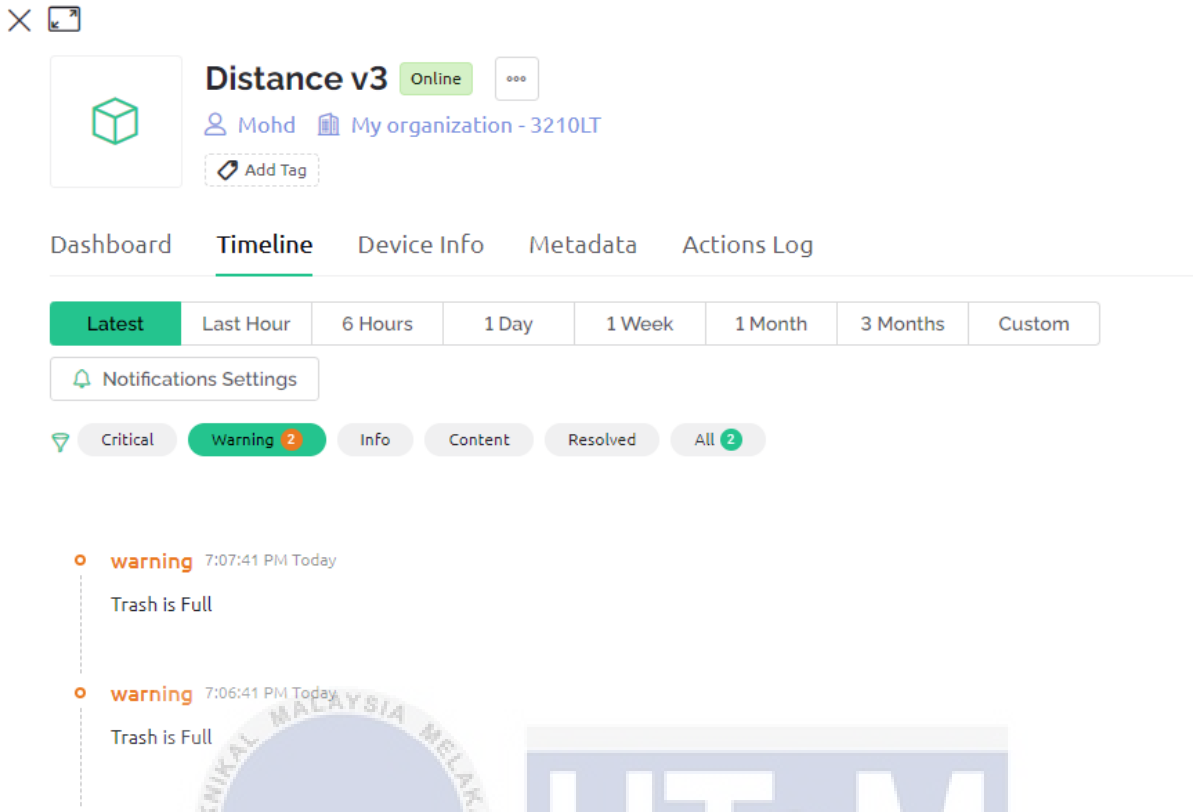

Figure 4.20: Alert notice on web dashboard.

4.7 Summary

In this chapter, several data had been collected and shown for the result and discussion. There is several error and limitation because this is just prototype. The limitation from compressing the recycle item should be overcome by making the bin more bigger. From the data collected, it should able to compressed a recycle trash to fill up more trash. Beside that, result shown in the chapter hopefully can solve the objective that come out to create the project.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Introduction

In this chapter will conclude the overall aspects of the project that have been discussed in every chapters. Through the completion of the "Development of Automated Recycle Bin Compressor Using Arduino for Smart City" project, student has embodied all the knowledge learnt, able to think critically and creatively, have strong leadership skills and able to communicate effectively by the implementation of this projects. There are many creations and ideas that researchers can explore in the field of electrical and electronic as the potential work for the adaptation of the future idea design.

5.2 Conclusion

Around the world, urbanization is expanding quickly as more people choose to live in urban areas where there are more prospects for success and advancement. All cities are growing fast than ever and a result, the idea of smart cities was introduced. This project is innovated and implemented to address the problems faced by the community based on the study. The problem of garbage is really not to be trivial because hygiene symbolizes the image of a person or country. With this project, the problem of overflowing trash can be overcome by compressing the recycling item in the bin can save more space. Recyclable items such as paper bottles of drinking water, beverage cans or recycling papers placed in this trash can be compressed when it reaches a prescribed height. Once compressed, space in the trash can be reduced. Smart cities concept using modern technology to collect specific data. Due to the circumstances, this project will utilize IoT to fulfil its goals. However, this project might not be perfect. It does not have the reset button to reset the direct current motor to its origin place. Beside the monitoring function, many improvements can be done to this project to make it perform better and do other things. In conclusion, this prototype able to achieve the project objective.

5.3 Future Work

For this project, the monitoring system only for monitor level and alert user when its full. But, it will be great if the user can control the project by mobile application. User can turn it off when it already reach max volume and unable to compress anymore. To do that, blynk application not suitable for this because there is many limitation using the application. Next, placement of each sensor should be design more efficient to ensure no error when measuring and monitoring the level of recyclable item in the bin. Then, due to prototype limitation, the size of this project should be matter. In this prototype, the bin unable to compress too much recycable item. To meet the demand for using it in the area, the ideal design must be researched. Lastly, duty cycle each compression for this prototype should be improve. Each compression took more than ten minutes for its compressing recycable item. Suitable DC motor should be apply in future development to improve the time taken to compress the recycle item.

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APPENDICES

Appendix A: Arduino Uno Coding

```
#define CW 12
#define CCW 13
int obstaclePin = 7;
int hasObstacle = HIGH;



void setup() {
pinMode(CW, OUTPUT);
pinMode(CCW, OUTPUT);
pinMode(obstaclePin, INPUT);
Serial.begin(9600);

                }
void loop() {
hasObstacle = digitalRead(obstaclePin);
if (hasObstacle == LOW)
{
digitalWrite(CW,HIGH);
delay(1000);
digitalWrite(CW, LOW);
digitalWrite(CCW, HIGH);
delay(1000);
digitalWrite(CCW, LOW);

                }
                else
                {
// do nothing
                }
}#define CW 12
#define CCW 13
```

```
int obstaclePin = 7;
int hasObstacle = HIGH;



void setup() {

pinMode(CW, OUTPUT);
pinMode(CCW, OUTPUT);
pinMode(obstaclePin, INPUT);
Serial.begin(9600);

                }

void loop() { //Loop runs forever//
hasObstacle = digitalRead(obstaclePin);
if (hasObstacle == LOW)
{
digitalWrite(CW,HIGH);
delay(1000);
digitalWrite(CW, LOW);
digitalWrite(CCW, HIGH);
delay(1000);
digitalWrite(CCW, LOW);

                }
                else
                {
// do nothing
                }
}
```

Appendix B: Node MCU coding

```
#define BLYNK_TEMPLATE_ID "TMPLhx1K70hy"
#define BLYNK_DEVICE_NAME "Distance"
#define BLYNK_AUTH_TOKEN "QXrn-pXqtdZ20w4hDNqRgD3t9j0KP8Vj"
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
char auth[] = BLYNK_AUTH_TOKEN;



#define echoPin D7
#define trigPin D6
#define BLYNK_PRINT Serial

char ssid[] = "MariaOzana-2.4GHz@unifi";
char pass[] = "Beetoz_130";

long duration;
int distance;

void setup()
        {
          Serial.begin(9600);
           pinMode(34, INPUT);
           pinMode(trigPin, OUTPUT);
           pinMode(echoPin, INPUT);
           Blynk.begin(auth, ssid, pass);
           delay(2000);
          }

void ultrasonic()
          {
            digitalWrite(trigPin, LOW);
            delayMicroseconds(2);
```

```
                digitalWrite(trigPin, HIGH);
                delayMicroseconds(10);
                digitalWrite(trigPin, LOW);
                duration = pulseIn(echoPin, HIGH);
                distance = duration * 0.034 / 2; //formula to calculate the distance for
        ultrasonic sensor
                Serial.print("Distance: ");
                Serial.println(distance);
                Blynk.virtualWrite(V0, distance);
                delay(500);
                if (distance <= 10)
               {
              Blynk.logEvent("warning","trash is full");
               }
              }

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