



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

AUTOMATIC WATERING THE PLANT WITHOUT HUMAN INTERFERENCE

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Automation and Robotics) With Honours

by
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MUHAMMAD ALLIF IZZAT BIN MD SUHAIMI

B071310878

FACULTY OF ENGINEERING TECHNOLOGY

2016

DECLARATION

I hereby, declared this report entitled “Automatic Watering the Plant without Human Interference” is the result of my own research except as cited in reference.

Signature :

Author's Name :

Date :

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Muhammad Allif Izzat Bin Md Suhaimi

اونيورسيتي تيكنيكل مليسيا ملاك

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Automation and Robotics) with Honours. The member of the supervisory is as follow:



ABSTRAK

Penyiraman adalah menjadi tugas harian yang penting bagi pekebun di rumah hijau. Seperti yang diketahui kebanyakan pekebun menggunakan sistem manual untuk menyiram pokok, tetapi sistem ini tidak sesuai digunakan. Tumbuhan akan mati jika tidak mendapat air yang mencukupi atau ia akan menggunakan air secara berlebihan dan membuang masa jika menyiram secara berlebihan. Untuk mengatasi masalah ini, “Automatic Watering the Plant without Human Interference” dicipta. Projek ini menggunakan sistem penyiraman tiub kerana ia menyiram pokok didalam pasu. Selain itu, projek ini juga menggunakan Arduino Uno sebagai pengawal sistem. Ia di programkan untuk mengesan tahap kelembapan tanah dan membekalkan air kepada tumbuhan. Kebiasaanya sesi penyiraman akan dilakukan sebanyak tiga kali sehari. Apabila kelembapan tanah bawah 70%, pam air akan menyedut air dari tangki dan akan memulakan sesi penyiraman. Ia akan berhenti menyiram apabila tahap kelembapan tanah mencapai 70%. Sensor yang digunakan untuk projek ini adalah “Moisture Soil Sensor”. Sensor ini akan membaca tahap kelembapan di dalam tanah. Skrin LCD akan menunjukkan data apabila tanah dalam keadaan kering dan basah. Projek ini tidak menggunakan pekerja untuk menyiram dan memerhati tumbuhan, semua sesi akan dijalankan secara automatik. Kesimpulanya, menggunakan penyiraman tumbuhan akan lebih senang jika menggunakan sistem automatik

ABSTRACT

Watering is the most important cultural practice and most labour intensive task in daily greenhouse operation. As we all know, most of the gardener use the manual system to irrigate their plant but this system is not efficient. The plants die if there is not enough water supplies to the plant or it waste water and time if over watering. To overcome this problem, the “Automatic Plant Watering without Human Interference” is created. For this project, it is used watering tube system because it can water the plants located in the pots. Besides, this project uses Arduino UNO board. It is programmed in such a way that it will sense the moisture level of the plants and supply the water if required. Normally, the plants need to be watered three times daily. So, the microcontroller has to be coded to water the plants when the content of moist in soil dries. When the content of water in the soil below than 70%, a pump will automatic suck the water from the tank and spray to the plant. It will stop when the content of the water above 70%. The sensor will be used in this project are moisture sensor. This moisture sensor can read the amount of moisture present in the soil surrounding it. The monitor will show the data when the soil in wet, dry or dampness. This project does not use human effort to watering and monitoring the plant, all operation will be automatic. Conclusion, watering the plant make easier when the operation automatic. When the soil reaches dry condition the motor will trigger the pump to watering the plant, and it will make the plant growth. In agricultural lands with the severe shortage of rainfall, this model can be successfully applied to achieve great results with most types of soil.

DEDICATION

Special dedicated to my beloved parents, family, friends and lecturers, who had strongly encouraged, inspired and supported me in my entire journey of learning



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LIST OF ABBREVIATIONS SYMBOL AND NOMENCLATURE

LCD	-	Liquid Crystal Display
°C	-	Celcius
Cb	-	Centibar
GSM	-	Global System for Mobile Communications
PH	-	Potential Hydrogen
I/O	-	Input/Output
PWM	-	Pulse Width Modulation
SRAM	-	Static random-access memory
EEPROM	-	Electrically Erasable Programmable Read-Only Memory
FDR	-	Frequency Division Reflectometry

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CHAPTER 1

INTRODUCTION

1.0 Introduction

The purpose of this project is automatic watering the plant without human interference. In this chapter will explain about project briefing, the problem statement for this project, objective for this project and work scope.

1.1 Project Briefing

Most of the gardener uses a manual system for watering the plant, but this system is not efficient to use now (BIN 2007). When the gardener watering manually, the possibility of planting overwatering is high and can cause plant drown, also it will waste the water and time for the gardener.

According to Clay, J. (2004), water consumption for agriculture over than 70%, compare to water consumption industry (28%) and municipal (8%) use less than twice from agriculture. Below is water consumption in sector:

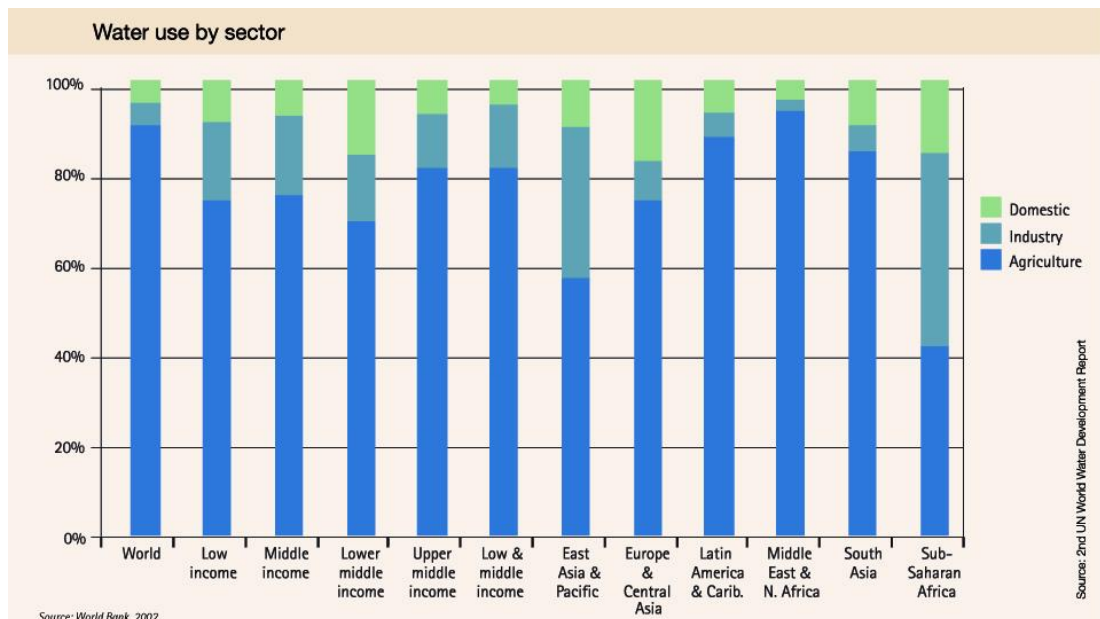


Figure 1.1: Water Consumption by Sector

From the figure 1.1 graph, water consumption for agriculture at Asian more than 50%, the main reason wasteful water are leaky irrigation system, overwatering the plant, cultivation of thirsty crops not suited to the environment. By using this project, automatic system will reduce the consumption water in agriculture and save the time for worker. The effect of using this system will make the plant grow up healthy the plant no died overwatering, saving the water consumption, and reduce the cost and time as compared to manual system.

In this project, automatic watering the plant without human interference are using moisture soil sensor type capacitance to measure water content in soil, Arduino UNO R3 to control sensor and water pump for watering operation, LCD to display the moisture level, water pump to inhale the water and DC servo motor for adjust the position of pipe to where the soil need water.

1.2 Problem Statement

Water is most importance in our life without it, the plant cannot survive. When the gardener using a manual system, the probability to over watering is high and it will waste water and time.

In the earlier, it was proposed (BIN 2007) most of the gardener use the manual system to irrigate their plant but this system is not efficient. The plants will either die if there is not enough water supplies to the plant or vice versa. This will reduce the time if using automatic rather than the manual way of watering.

The best humidity for soil is 70% - 80% (Leonard Perry 2003). To overcome this problem, automatic watering the plant without human interference is created. To get the almost perfect humidity, the content of the humidity soil must 70% or more.

1.3 Objective

These were the objective of this project:

1. To design plant watering device by using moisture soil sensor.
2. Auto watering the plant when humidity less than 70%.
3. To reduce cost and time of plant watering

1.4 Scope

To achieve the objectives, collected data watering the plants eight hours per day and take the data for 21days continuous. The data collected are value of water content in soil using moisture soil sensor, watering the plant when the value more or

equal to 70%, the cost of water in 21days, costing for the material of the system, and how often happen overwatering.

For the final year project, using moisture soil sensor type capacitance connect to Arduino Uno R3 board for the main component in this project, water pump also connect to Arduino Uno R3 board for watering the plant, DC servo motor for controlling the position of pipe outlet and Arduino UNO R3 is the main controller for operating the automatic system.

After finished collect data for 21days, then it will compare the results. The temperature of the surrounding will be monitored in order to understand the impact of temperature on the evaporation of water from the soil.

1.5 Summary

In this chapter was discuss about the background project, overcome the problem statement, objective for this project and limitation of this project.



CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter discusses the types of sensors and monitor there around the world, a further study will be conducted to determine how it can be related with this system.

2.1 Moisture Sensor

The moisture sensor is a device to measure water content in the soil(S. V. Devika, Sk. Khamuruddeen, Sk. Khamurunnisa, Jayanth Thota 2014). Methods used to measure soil water are classified as direct and indirect. The direct method is soil sample by volume and indirect method is any method(Prichard n.d.) which relates a reading to soil sampling moisture sensor. Moisture sensor suitable to use in the agriculture sector. This sensor is passive type cause gather the data through detection.

2.1.1 Moisture Sensor Type Capacitance

Moisture sensor type capacitances have two plates of conductor material and between of both plate have the electromagnetic field to calculate dielectric material. When the material between the plates is air, the capacitor measures 1 (the dielectric constant of air). Most materials in soil, such as sand, clay and organic matter, have a

dielectric constant from 2 to 4. Water has a higher dielectric constant of 78. (Enciso et al. 2007)

If the water has higher value dielectric, than the other dielectric constant higher too. Volumetric water in soil or water content in soil is measured indirectly. This sensor is passive type.

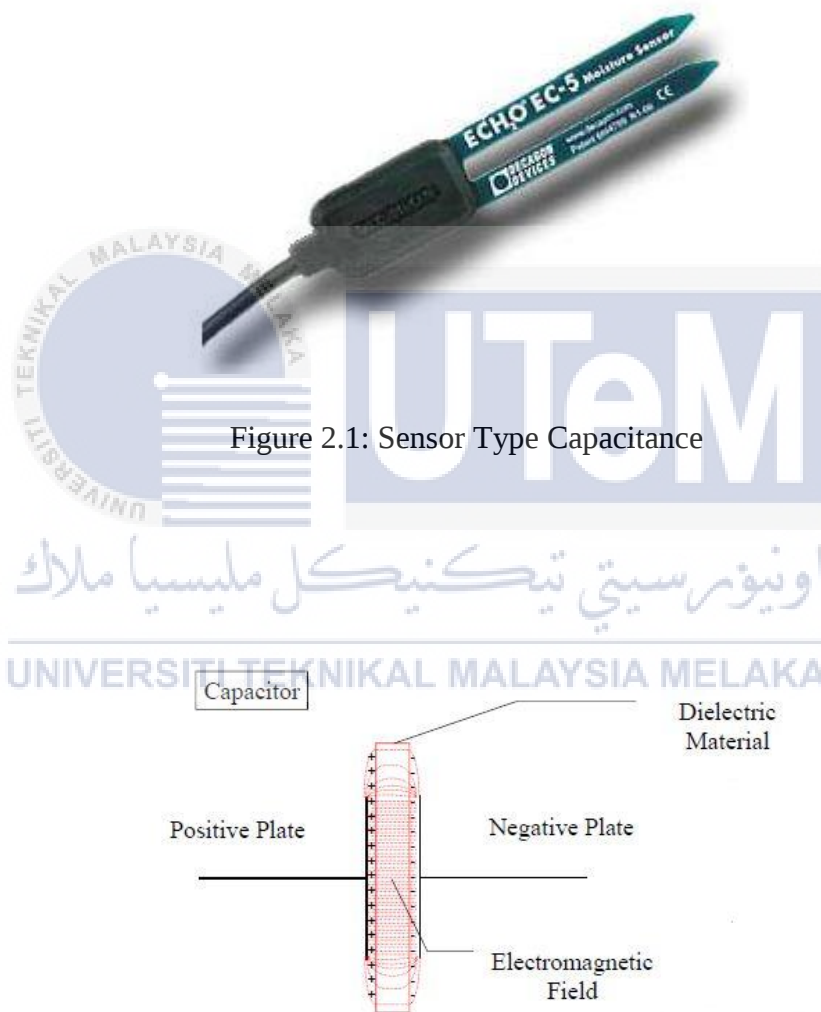


Figure 2.1: Sensor Type Capacitance

Figure 2.2: Typical Capacitor

Method is using in moisture sensor type capacitance gives a reading of volumetric soil water content. Put the sensor in the soil at a few profundities in a

region of the field so as to evaluate soil water development and exhaustion in the root zone. This is observed after some time and with crop water use.

Since sensors measure the water content near their surface, it is important to avoid air gaps and excessive soil compaction around them. This enables readings to be most representative of undisturbed soil.(Enciso et al. 2007). Table 2.1 shown below is advantage using moisture soil sensor type capacitance.

Table 2.1: Advantage Moisture Sensor Type Capacitance

Moisture Sensor Type Capacitance	Ability to read soil volumetric water content directly
	No special maintenance necessary
	Highly accurate when sensors are installed properly in good contact with soil
	Large range of operating environment (0 to 50°C) and range of measurement (0% to saturated water content)
	Continuous measurements at same location

2.1.2 Moisture Sensor Type Resistance

Moisture sensors type resistance sort resistance react to soil water conditions at the profundity they are put by measuring electrical resistance between two circles of wire work that are associated with a permeable material.



Figure 2.3: Moisture Sensor Type Resistance

Method by using this type is in spite of the fact that the electrical resistance is measured in ohms, the handheld meter changes over the reading consequently to centibars (1 bar = 100 centibars) (Getu & Attia 2015). Electrical resistance increase as soil water suction increase, or as soil moisture decrease.

The sensors set at different profundities, contingent upon the crop developed (and effective root zone profundity). This is to evaluate moisture development and depletion inside the root zone over time and with crop water use.

The placement of the sensors will vary slightly according the irrigation technique. In addition, they must be placed in a representative area, such as within the plant row for row crops, in the bed for vegetable crops or in wetted areas under drip irrigation. Depth of placement should also be representative of the effective root zone. Table 2.2 shown below is advantages and disadvantages using this sensor.

Table 2.2: Advantage and Disadvantage for Moisture Sensor Type Resistance

Moisture Sensor Type Resistance	Good accuracy in medium to fine soils due to their fine-sized particle similar to its inner granular matrix	Slow response to changes in soil water content, rainfall or irrigation (minimum 24 hours)
	Easy handling (light weight, pocket-size, easy installation and direct reading)	Lack of accuracy in sandy soils due to their large particle
	Continuous measurements at same location	Need for each soil type to be calibrated

2.1.3 Tensionmeter

A tensiometer measures the tension of the soil water or soil suction. This instrument consists of a sealed water-filled tube equipped with a vacuum gauge on the upper end and a porous ceramic cup on the lower end (Figures 5 and 6).

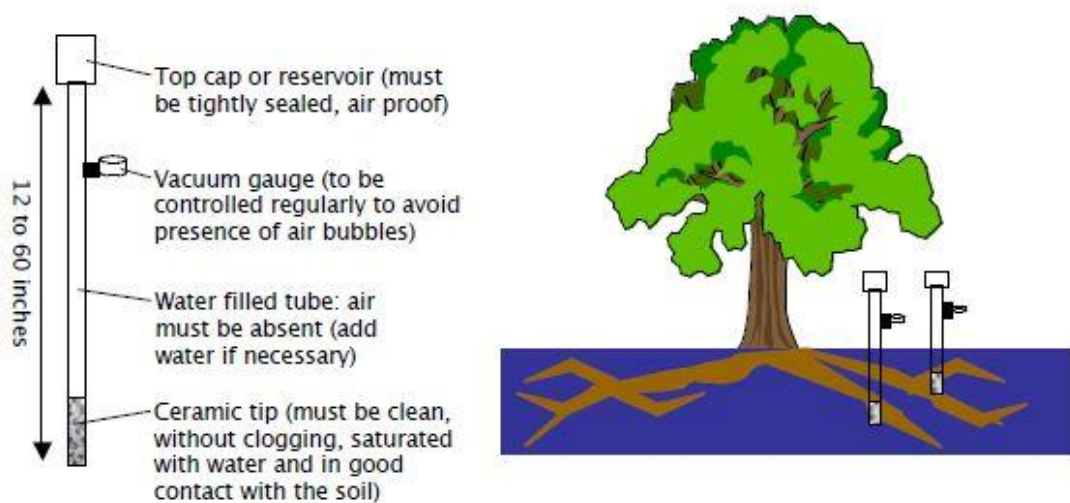


Figure 2.4: Diagram Of A Tensionmeter And A Station Of Two Tensiometers Installed At Different Soil Depths.



Figure 2.5: Station of Three Tensiometers

Method by using tensionmeter is water flow from the tube tensionmeter to soil in response to soil water section. Water also can flow from the soil to the tube tensionmeter during irrigation. Vacuum measure limitation is 100centibar (cb). When the meter at value 0, it means a saturated soil and if the value of measure increases the condition soil increase too.

This sensor limit about 80centibar (cb), if this sensor measure above 80cb possibility to damage the sensor. This sensor most helpful on sandy soils and sensitive crop, because the range soil is narrower.(Enciso et al. 2007). Table 2.3 shown below is advantages and disadvantages using tensionmeter.

Table 2.3: Advantage and Disadvantage for Tensionmeter

Tensionmeter	Direct water potential reading for irrigation scheduling	Requiring periodic service
	Continuous measurements at same location	Operating only to 80 cb soil moisture suction (not useful in drier soil conditions)

2.2 Monitoring using GSM (Global System for Mobile Communications)

GSM module is way of communication with electronic device, this device higher data transmission rate. It is two way communication device. It will collect the data from controller and update the information in web server of data base by using internet.



Figure 2.6: GSM module

2.2.1 Method using GSM

Moisture sensor will give information signal from the soil through the microcontroller. At the point when microcontroller gets the input signal, it will generate an output signal that drives a relay for operating the water pump. At whatever point the water pump switches ON/OFF, an SMS is sent to the concerned individual with respect to the status of the pump. The client needs to send SMS back to GSM to turn ON the water pump to begin the working(Krishna 2016).

2.3 Monitoring With Automatic Irrigation System

The system gives a constant input control system which monitors and controls every one of the exercises of trickle watering system framework proficiently. The system valves are turned ON or OFF naturally relying on the moisture content. The framework additionally gives the productive data with respect to the soil pH and soil supplements. In this manner the system monitor, and control. Utilising this system, one can spare labour, water to enhance generation and eventually expand benefit(Gainwar & Rojatkar 2015).

2.3.1 Method

The system is used to turn the valve ON and OFF automatically as per the water requirement of the plant. All sensor will record the value and give it to microcontroller Then display the value on a LCD screen the value will be displayed on the screen one by one at an interval of 10 seconds. Below is flow chart for monitoring:

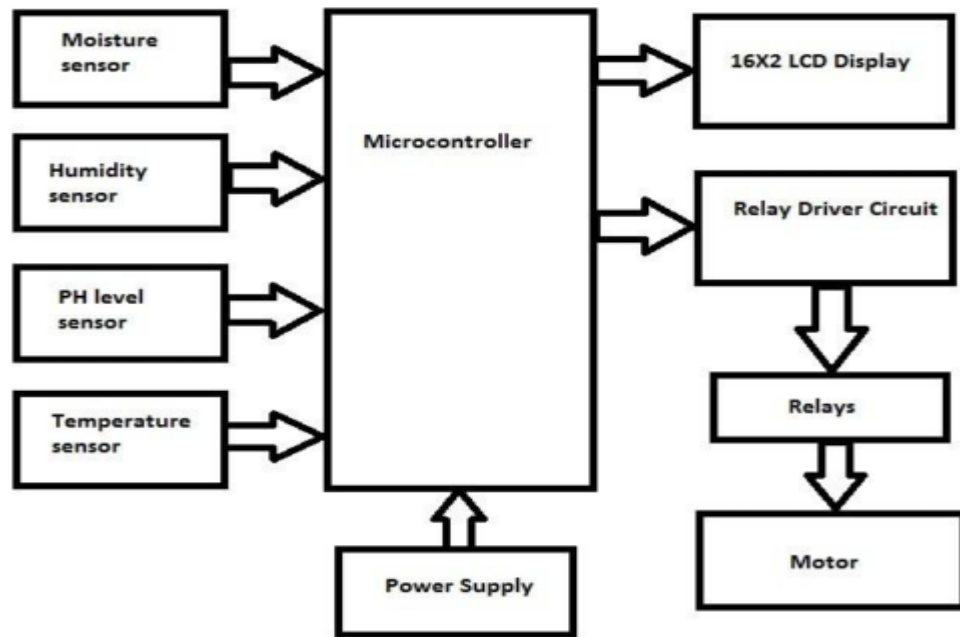


Figure 2.7: Flow Chart Monitoring

2.4 Summary

In this chapter was explaining what component related to the final project. Divide by two sections, moisture sensor and monitoring. In Section moisture sensor was list several types of moisture sensor and in section monitoring also list the method monitoring the system.

CHAPTER 3

METHODOLOGY

3.0 Introduction

This chapter will be discussing on the hardware and software part of the project such as the method, process needed. Beside that project flow also being discuss in this chapter 3.

3.1 Hardware Development

All the hardware being used in this project will show to the table 3.1 also the description about the hardware.

Table 3.1: Hardware and Description

Hardware	Description
Arduino Uno R3	Microcontroller
Moisture soil sensor	To measure moisture
LCD	Display for humidity level
Water pump	Watering the plant
Pipe	To flow the water
DC servo motor	Position watering water
Relay	Operate switch

3.2 Arduino Uno R3 board

The reason why using the Arduino Uno R3 board because this microcontroller have power consumption, portable, the price economical, and programmable. Using Arduino Uno R3 board to make this project automated. Below is the table 3.2: technical specifications and the figure9&10: Arduino Uno R3 board.

Table 3.2: Technical specifications

Microcontroller	ATmega328
Operating System	5V
Input Voltage(recommended)	7-12V
Input Voltage(limit)	6-20V
Digital I/O Pins	14(of which 6 provide PWM output)
Analog Input Pin	6
DC Current per I/O Pin	40mA
DC Current for 3.3V Pin	50mA
Flash Memory	32KB of which 0.5KB used by bootloader
SRAM	2KB
EEPROM	1KB
Clock Speed	16MHz

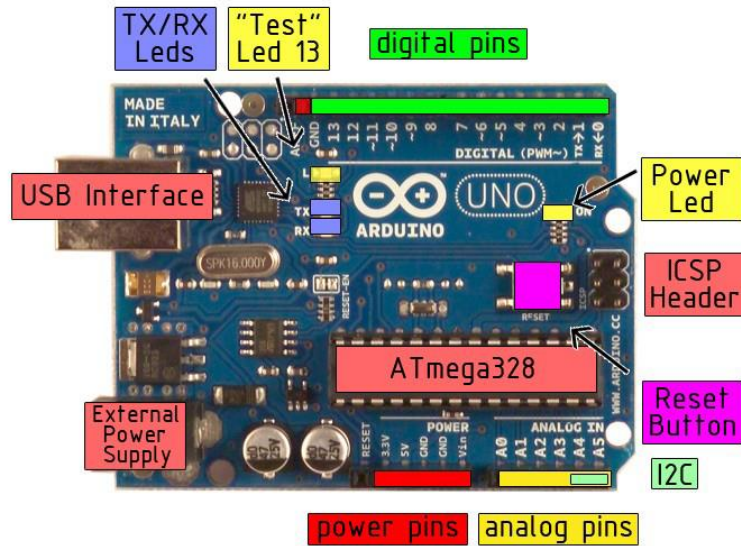


Figure 3.1: Arduino Uno R3 Board

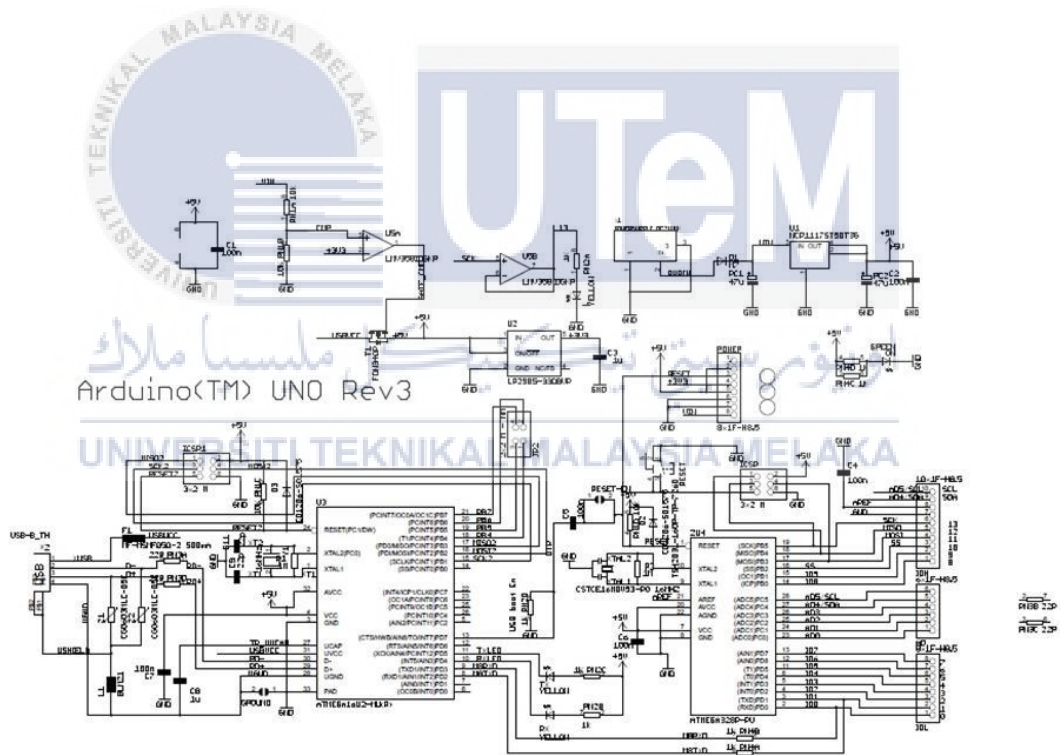


Figure 3.2: Arduino Uno R3 Board

3.2.1 Working Principle

Arduino Uno R3 board is main controller to control all the operating in this system. It will get the input signal from moisture sensor and give the output signal to LCD and water pump.

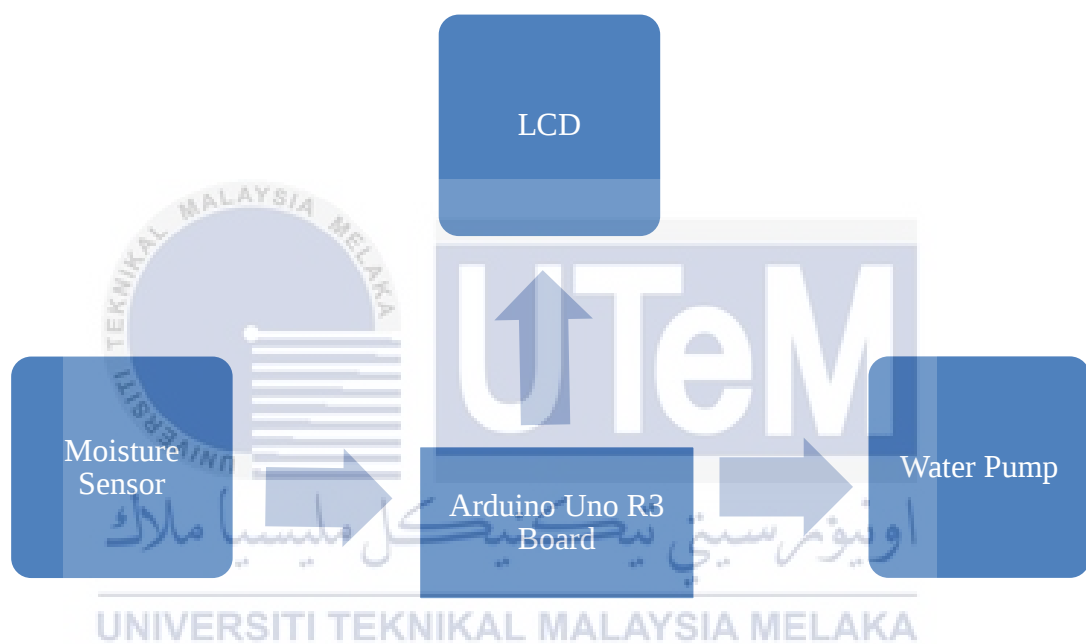


Figure 3.3: Working Principle

3.3 Moisture Soil Sensor

Sensor be using in this project is moisture soil sensor capacitance type and main component. These sensor give readings of volumetric soil water content at the depth they are placed (Enciso et al. 2007)

It's a low tech sensor but easy to use, economical, no need to calibrate for each type soil and monitoring. Below is the working principle for moisture soil sensor type capacitance.

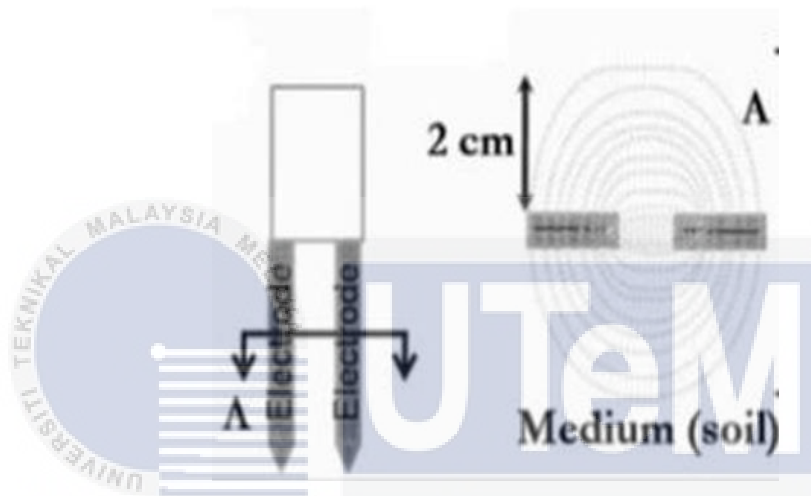


Figure 3.4: Working Principle Moisture Soil Sensor Type Capacitance

The Soil Moisture Sensor uses capacitance to measure dielectric permittivity of the surrounding medium. In soil, dielectric permittivity is a function of water content. The sensor creates a voltage proportional to the dielectric permittivity, and therefore the water content of the soil. The sensor averages the water content over the entire length of the sensor. There is a 2 cm zone of influence with respect to the flat surface of the sensor, but it has little or no sensitivity at the extreme edges. (Manoj & Udupa 2015)

3.3.1 Concept Capacitance Soil Moisture Sensor

Capacitance soil moisture sensor or it called Frequency Division Reflectometry (FDR). The concept of FDR is explained below:

1. The electrical capacitance of a capacitor that uses the soil as a dielectric depends on the soil water content
2. In Capacitance sensors the dielectric permittivity of a medium is determined by measuring the charge time of a capacitor made with that medium.

So, any changes in the dielectric constant of the soil will bring about changes in the oscillating frequency and thus will help in determining the soil moisture content. Dielectric constant of water is approximately 81 Dielectric constant of soil is approximately 3-5. (Tripathy et al. 2015)



Figure 3.5: Moisture Soil Sensor

3.3.2 Method

Method be using in this project by using moisture soil sensor are the sensor measure the volumetric water content in soil, then it will send the signal to Arduino Uno R3 board.

Soil moisture sensors measure the volumetric water content in soil .Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. (Archana 2016)

3.3.3 Volumetric Soil Water Content Formula

Moisture sensor soil can measure the volumetric soil water content, below is the formula to calculate volumetric soil water content.

$$GRAVIMETRIC\ WATER\ \% = \left[\frac{WET\ WEIGHT(g) - DRY\ WEIGHT(g)}{DRY\ WEIGHT(g)} \right] \times 100 \quad \dots\dots (1)$$

$$BULK\ DENSITY = \frac{MASS\ OF\ DRY\ SOIL}{VOLUME\ OF\ SOIL} \quad \dots\dots\dots (2)$$

Then,

$$VOLUMETRIC\ WATER\ \% = GRAVIMETRIC\ WATER\ \% \times BULK\ DENSITY \left(\frac{g}{cm^3} \right)$$

3.3.4 Datasheet Moisture Soil Sensor

Table 3.3 : Specification

PCB size	71.65mm X 24.00mm X 1.6mm
Working voltage	3.3 or 5v DC
Operating voltage	3.3 or 5v DC
Compatible interfaces	2.54 3pin interface and 4-pin Grove interface

Table 3.4 : Electrical characteristic

Parameter	Min.	Typical	Max.	Unit
Working voltage	2.1	5	5.5	VDC
Analog output voltage (VCC=5V)	0	Vout	5	V
Digital output voltage (VCC=5V)	0	-	5	V
Working current (VCC=5V)	-	5	-	mA
Threshold hysteresis Uth	-	VCC*0.09	-	V

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3.4 Liquid Crystal Display (LCD)

Liquid crystal display (LCD) 16 x 2 will be used for this project. Content on LCD will be level humidity and watering session. LCD will display when moisture soil sensor measure volumetric soil water content, then send the data to Arduino Uno R3 board. After that, Arduino board will send the data to LCD. Below is specification for LCD:

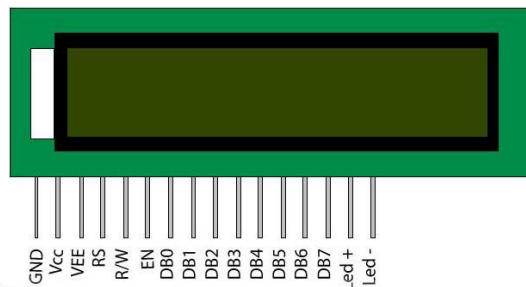


Figure 3.6: LCD Pin Diagram

Table 3.5: LCD Pin Descriptions

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	V _{CC}
3	Contrast adjustment; through a variable resistor	V _{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V _{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

3.4.1 Circuit schematic LCD

From LCD pin will connect to Arduino Uno R3 board. To wire your LCD screen to your board, connect the following pins:

Table 3.6 : LCD Connention

LCD RS pin	to digital pin 12
LCD Enable pin	to digital pin 11
LCD D4 pin	to digital pin 5
LCD D5 pin	to digital pin 4
LCD D6 pin	to digital pin 3
LCD D7 pin	to digital pin 2

Additionally, wire a 10k pot to +5V and GND, with it's wiper (output) to LCD screens VO pin (pin3). A 220 ohm resistor is used to power the backlight of the display, usually on pin 15 and 16 of the LCD connector All the pin connection will be shown figure below:

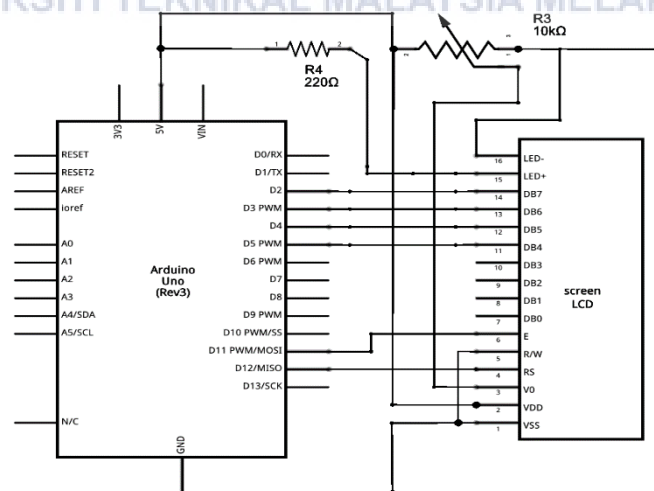


Figure 3.7: LCD Connection to ArduinoUno R3

3.5 Water Pump

The water pump will be using for this project to control watering session. The water pump operation is to inhale water from the tank and flowing to the soil. Below is working principle for the water pump.

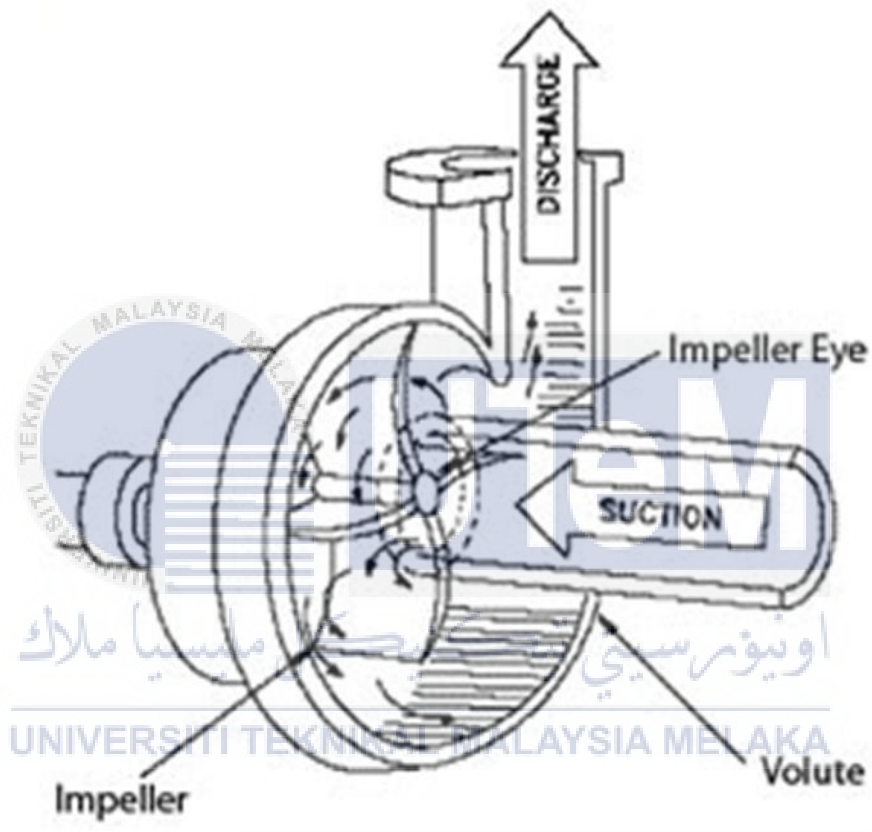


Figure 3.8: Water Pump Working Principle

3.5.1 Method

Water pump will get the output signal from Arduino Uno R3 board. When the data measure level humidity below than 70%, relay will energize and trigger the

water pump to turn on but if the data measure level humidity reach 70%, the relay will not energize and the pump will turn off.

3.5.2 Schematic Circuit

If higher current loads are to be driven a PNP transistor can be added to the module's digital output. Here the addition of 2N3906 transistor controls an electro-magnetic relay (RL1) for driving high-current/high voltage loads like water pump motors through its N/C contacts (when soil is wet, relay remains in energized state).

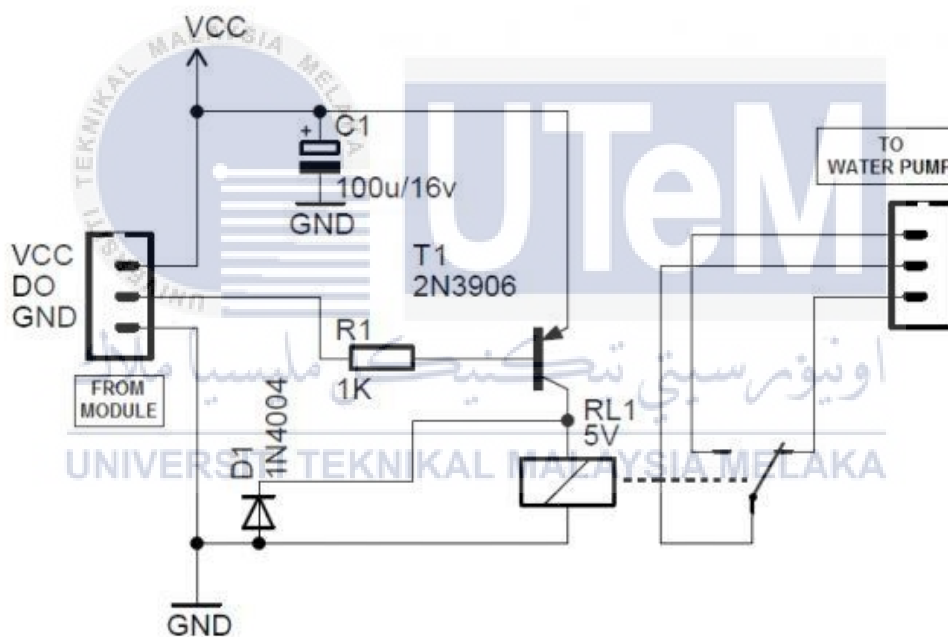


Figure 3.9: Circuit Design

3.6 DC Servo Motor

The type of servo motor using in this project is S3003 Futaba Servo. Function for this servo motor is to move the pipe where the soil moisture dries. This motor can move 360 degree. Below is working principle for S3003 Futaba Servo Motor

3.6.1 Working Principle

DC motor servo has four important components, DC motor, sensing position device, gear assembly, and control circuit. Below is disassembling part of servo motor.



Figure 3.10 : Servo Motor

DC servo motor get supply from Arduino Uno R3 to run the motor and the torque is low. The gear and shaft connected to the DC servo motor for reduce the speed into suitable speed and torque will increase. Control circuit will get the information from position sensor.

3.6.2 Connection DC Servo Motor

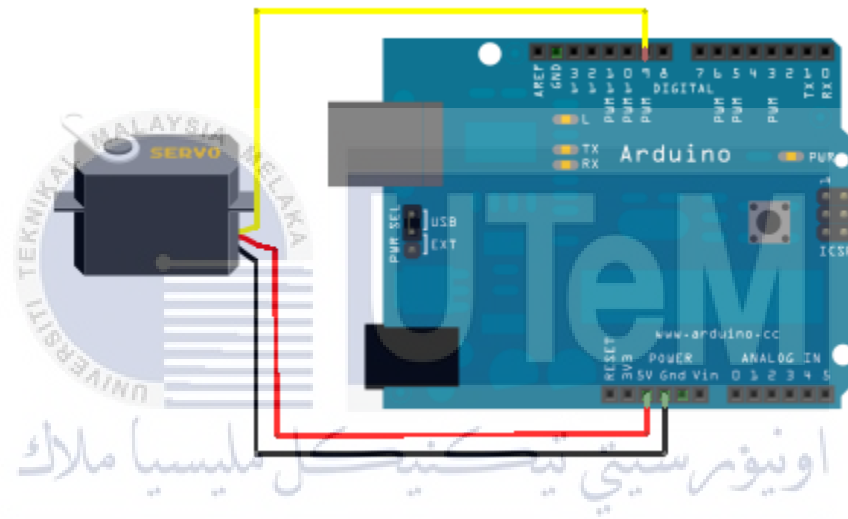


Figure 3.11 : Connection DC Servo Motor to Arduino Uno R3

Table 3.7 : Specification

Pin	Explanation
Any digital pin	Signal
VCC	VCC
GND	GND

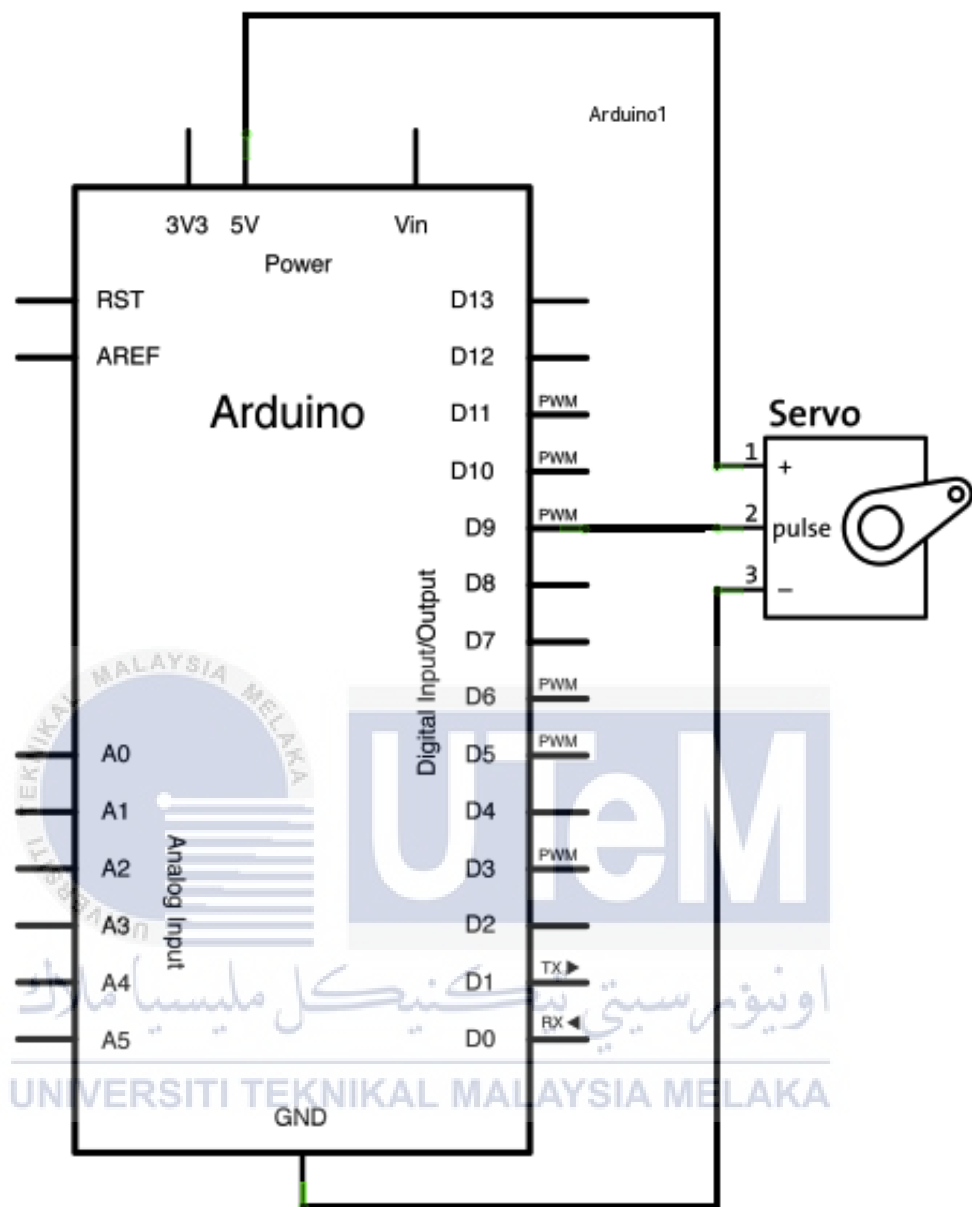


Figure 3.12 Schematic circuit for DC servo motor

3.6.3 Specification

Below is specification for DC servo motor S3003 Futaba.

Table 3.8 : Detail Specification

Control System:	+Pulse Width Control 1520usec Neutral	Current Drain (4.8V):	7.2mA/idle
Required Pulse:	3-5 Volt Peak to Peak Square Wave	Current Drain (6.0V):	8mA/idle
Operating Voltage:	4.8-6.0 Volts	Direction:	Counter Clockwise/Pulse Traveling 1520- 1900usec
Operating Temperature Range:	-20 to +60 Degree C	Motor Type:	3 Pole Ferrite
Operating Speed (4.8V):	0.23sec/60 degrees at no load	Potentiometer Drive:	Indirect Drive
Operating Speed (6.0V):	0.19sec/60 degrees at no load	Bearing Type:	Plastic Bearing
Stall Torque (4.8V):	44 oz/in.(3.2kg.cm)	Gear Type:	All Nylon Gears
Stall Torque (6.0V):	56.8 oz/in. (4.1kg.cm)	Connector Wire	Length: 12"
Operating Angle:	45 Deg. one side pulse traveling 400usec	Dimensions:	1.6" x 0.8"x 1.4" (41 x 20 x 36mm)
360 Modifiable:	Yes	Weight:	1.3oz. (37.2g)

3.7 Process Control

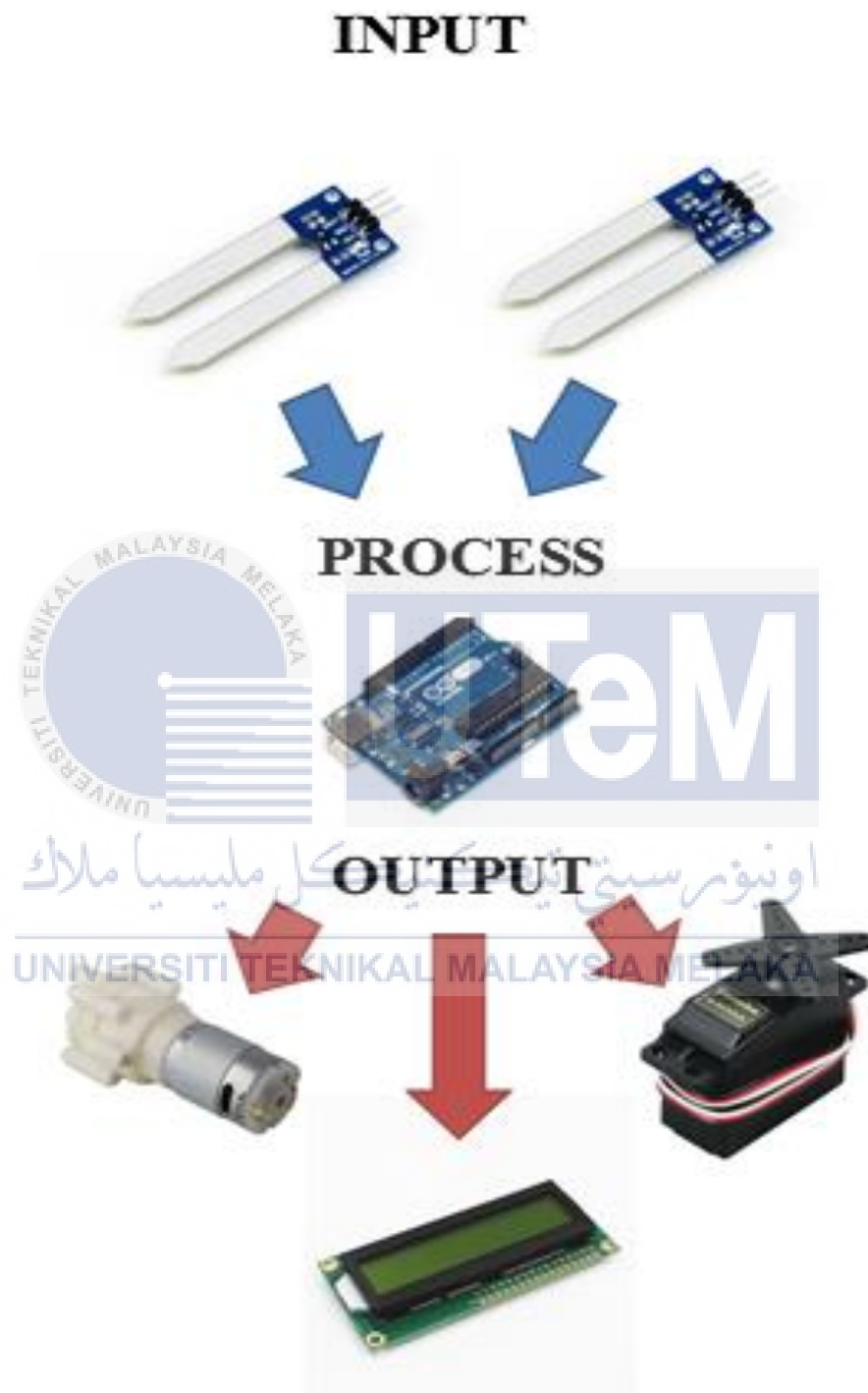


Figure 3.13 : Process Control

3.8 Project Flow

In this section will show overall operating automatic watering the plant without human interference. Below is the flow chart for whole automatic system:

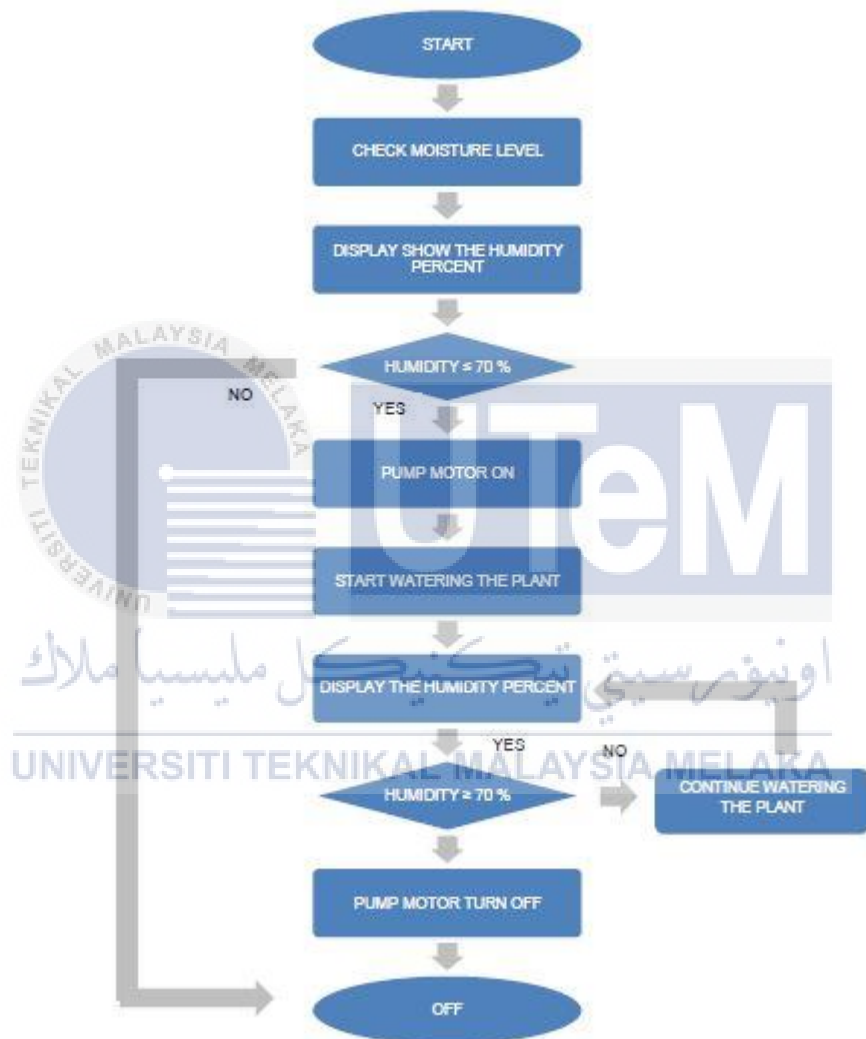


Figure 3.14: Flow Chart

3.9 Schematic Circuit Project

Below is the schematic circuit for automatic watering the plant without human interference. Using software Proteus 8.1 and software Fritzing for design the schematic circuit

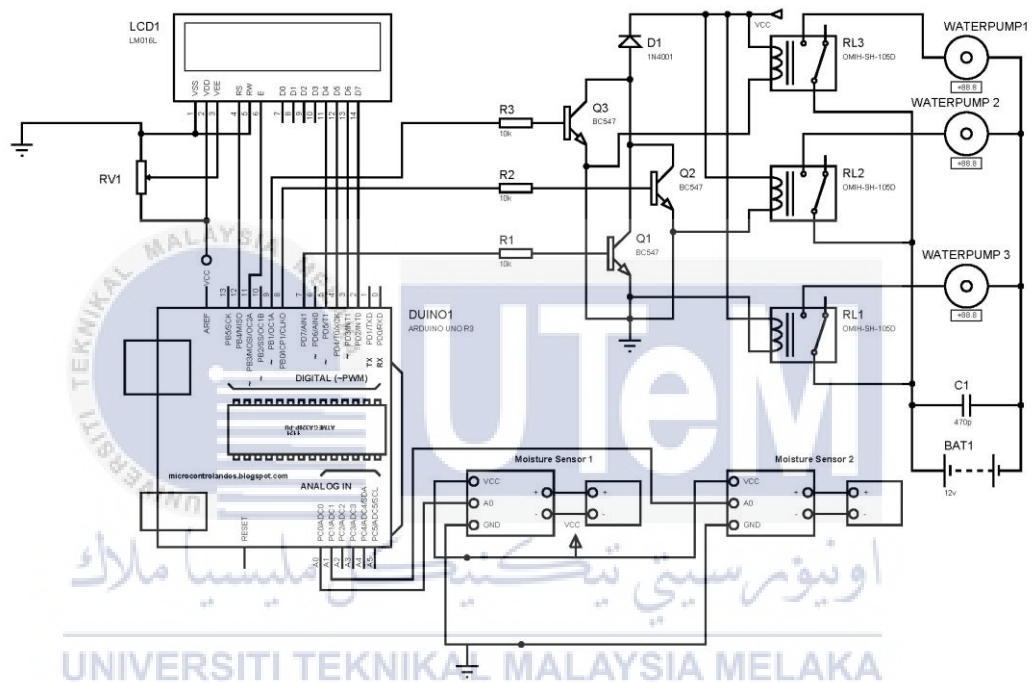


Figure 3.15 : Schematic Circuit

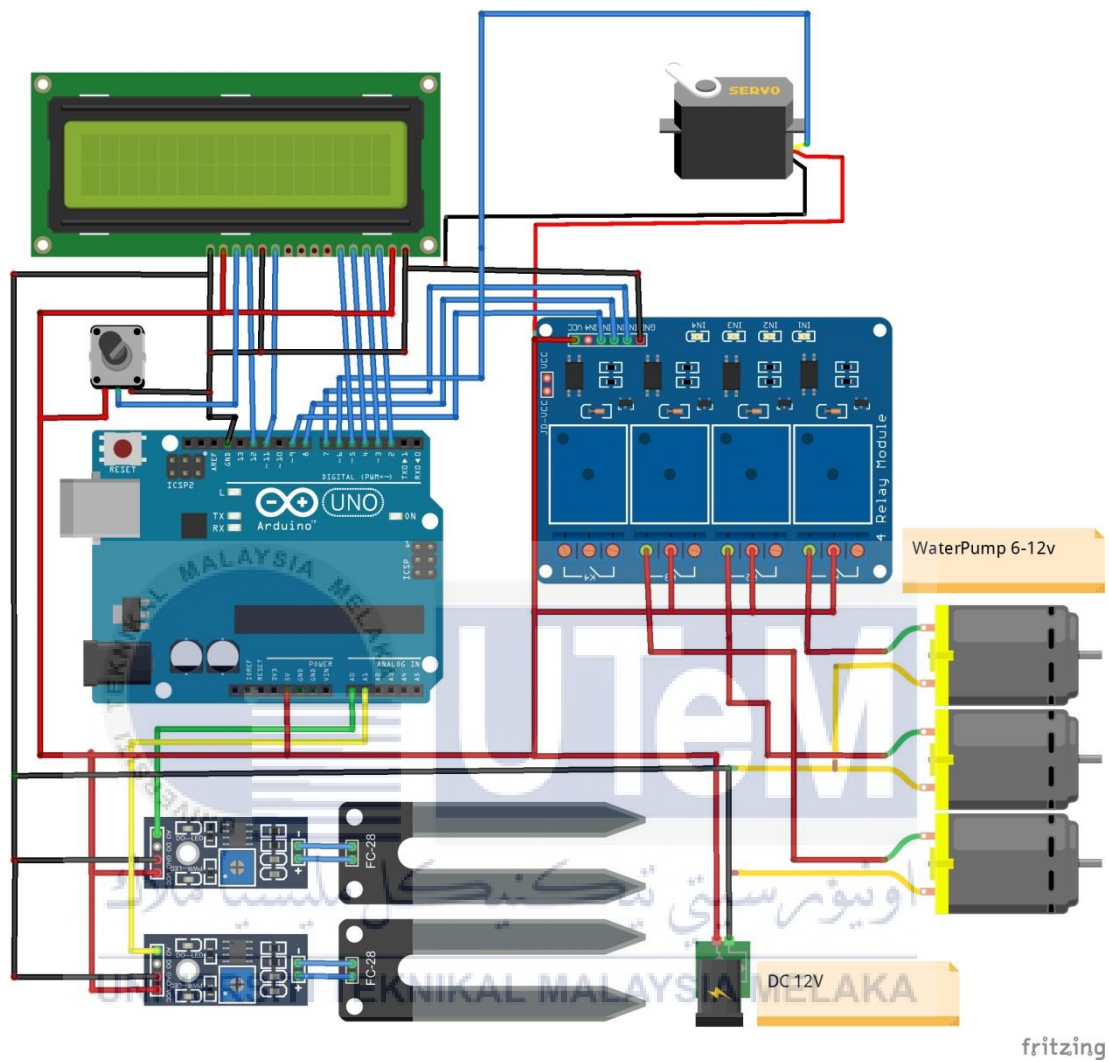


Figure 3.16 : Schematic circuit project using fritzing

3.10 Project Program

In this section will explain more detail about project program. Using software Arduino IDE to upload the program to Arduino Uno R3 board.

```
#include <LiquidCrystal.h>
#include <Servo.h>

Servo myservo; // create servo object to control a servo
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

#define RELAY1 7 // Connect Digital Pin 7 on Arduino to CH1 on Relay Module
#define RELAY2 8 // Connect Digital Pin 8 on Arduino to CH1 on Relay Module
#define RELAY3 9 // Connect Digital Pin 9 on Arduino to CH1 on Relay Module

const int moisturePin = A0; // Moisture sensor connected to A0
const int moisturePin1 = A1; // Moisture sensor connected to A1
int moistureValue = 0;
int moistureValue1 = 0;
int watering = 0;
int vitamin = 50;
int counter = 0;
int pos = 0; // variable to store the servo position
```

Figure 3.17 : Declaration program

Declaration program is section to declare the data type in this program project. Include the library *liquidcrystal.h* and *servo.h* to provide extra functionality for use in sketches. Define the digital pin DC servo motor and relay on Arduino Uno R3. The main data for this project will be declared as int and const int.

```

void setup() {
  Serial.begin(9600);

  myservo1.attach(6); // attaches the servo on pin 6 to the servo object

  pinMode(RELAY1, OUTPUT);
  digitalWrite(RELAY1, LOW);
  pinMode(RELAY2, OUTPUT);
  digitalWrite(RELAY2, LOW);
  pinMode(RELAY3, OUTPUT);
  digitalWrite(RELAY3, LOW);

  lcd.begin(16, 2); // set up the LCD's number of columns and rows:
}

```

Figure 3.18 : Void Setup

The void setup() function is called when a sketch starts. Use it to initialize variables, pin modes, start using libraries. The setup function will only run once, after each power up or reset of the Arduino board. Set the DC servo motor to digital pin 6, set the relay as output and condition low (off).

```

void loop()
{
  delay(500);

  moistureValue = analogRead(moisturePin); //read moisture 1
  moistureValue1 = analogRead(moisturePin1); //read moisture 2

  lcd.print("Moisture1 = ");
  lcd.print(moistureValue);

  lcd.setCursor(0,1);

  lcd.print("Moisture2 = ");
  lcd.print(moistureValue1);

  delay(1000);

  lcd.clear();

  delay(1000);
}

```

Figure 3.19 : Void loop

In void loop, function does precisely what its name suggests, and loops consecutively, allowing your program to change and respond. Use it to actively

control the Arduino board. Declare `analogRead(moisturePin)` as `moisturevalue` for read value moisture soil sensor 1 and `analogRead(moisturePin1)` as `moisturevalue1` for read value moisture soil sensor 2. LCD will show the value both moisture value.

```

if(moistureValue > 450) {

    delay(1000);

    lcd.print("WATERING NOW!!");
    lcd.setCursor(0,1);
    lcd.print("PLANT 1");
    myservo1.write(0);          // tell servo to go to position 0

    delay(1000);
    digitalWrite(RELAY1, HIGH); //motor on
    delay(1000);
    lcd.clear();
    watering = 1;
}

else if(moistureValue1 > 450) {

    delay(1000);

    lcd.print("WATERING NOW!!");
    lcd.setCursor(0,1);
    lcd.print("PLANT 2");
    myservo1.write(180);       // tell servo to go to position 180

    delay(1000);
    digitalWrite(RELAY1, HIGH); //motor on
    delay(1000);
    lcd.clear();
    watering = 0;
}

else {

    myservo1.write(90);        // tell servo to go to position 90
    delay(1000);
    digitalWrite(RELAY1, LOW); //motor off
    delay(500);
    lcd.clear();
    delay(1000);
}

if(watering != vitamin){
    if(watering == 1){
        counter = counter + 1;
        Serial.println(counter);
    }
}

```

Figure 3.20 : IF else statement condition

If/else allows greater control over the flow of code than the basic if statement, by allowing multiple tests to be grouped together. If moisture value 1 more than 450 is true then it will do work, if moisture value 1 more than 450 is false then it will go to second statement condition. If first and second statement condition is false it will go to else condition.

```

if(watering == vitamin){
    delay(250);
    lcd.print("FERTILIZER");
    lcd.setCursor(0,1);
    lcd.print("VITAMIN");
    myservo1.write(180); // tell servo to go to position 180
    delay(1000);
    digitalWrite(RELAY2, HIGH); //motor on
    delay(10000);
    digitalWrite(RELAY2, LOW); //motor on
    delay(1000);
    myservo1.write(0);
    digitalWrite(RELAY3, HIGH); //motor on
    delay(10000);
    digitalWrite(RELAY3, LOW); //motor on
    delay(1000);
    lcd.clear();
}

```

Figure 3.21 : Counter condition

In this section when the counter equal or same to 50 times, if statement condition watering equal or same vitamin will works. It needs to equal to 50times to true condition.

3.11 Automatic Watering the Plant Method

This section will explain about how automatic watering the plant without human interference work and also the method to collect data.



Figure 3.22 : Setting the controller

Connect water pump to battery 12V, put the moisture sensor 1 and 2 into soil, setting the DC servo motor and turn on the Arduino Uno R3.



Figure 3.23 : Moisture sensor into the soil



Figure 3.24 : Setting the DC servo motor

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Figure 3.25 : After setting all the component

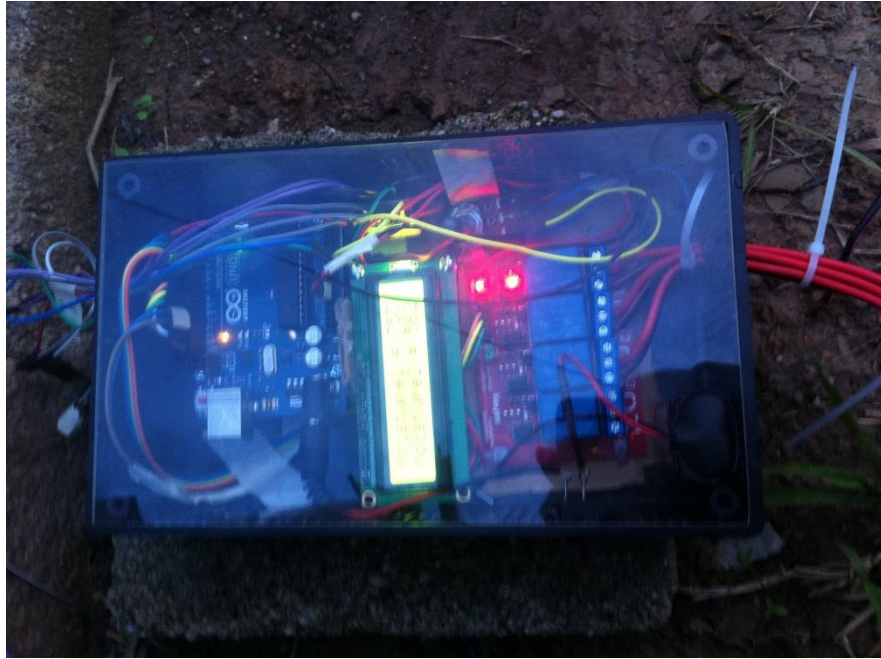


Figure 3.26 : Check the moisture value on LCD screen

The sequence for this project is if the value moisture soil sensor 1 or 2 below than 450, the relay will trigger and water pump will turn on also the DC servo motor will move 0° or 180° . Position plant 2 is 180° and position for plant 1 is 0° .

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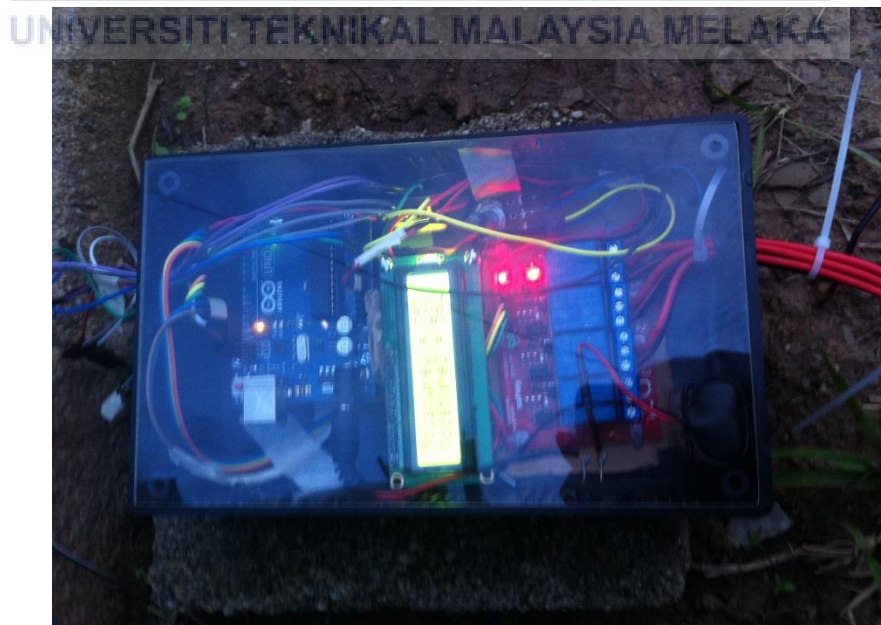


Figure 3.27 : LCD show value moisture soil sensor 1 and 2



Figure 3.28 : Position DC servo motor 180° for plant 2



Figure 3.29 : Position DC servo motor 0 for plant 1°

The data will collect per hours every day and then it collected for make a graph.

3.12 Summary

The entire component has been show in this chapter, the method and description has been explaining more detail. Working principle for each type component also schematic diagram has been shown. The flow chart explains the operation for automatic watering the plant without human interference. Schematic circuit project, project program and project method also been explained in this chapter.



CHAPTER 4

RESULT & DICUSSION

4.0 Introduction

In this chapter will discuss about result data analysis, development of vegetable growing also discussion about automatic watering the plant without human interference.

4.1 Result

The result and analysis of automatic watering the plant without human interference have been done and finalize the part used in this project. The data and result more focus in design the project using moisture soil sensor, value of moisture soil, to reduce amount of water usage and time. It will show development plant 1 and 2 from week one until week three.

4.1.1 Data Plant 1

The data was collected continuous per days for 21days. The data was collected is value of moister soil in plant 1. Figure 4.1 is data plant 1 was collected in first week.

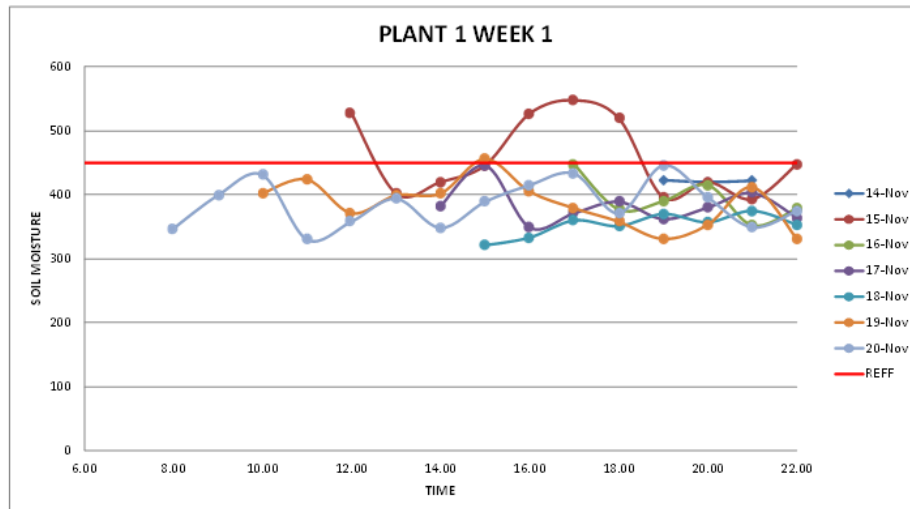


Figure 4.1 : Data plant 1 week 1

Figure 4.1 is the data for plant 1 week 1, the limitation for soil moisture is 450. When the value of soil moisture above the reference point, watering session will start and when the value is below than reference point watering idle.

Data on 15th November 2016, it increase to highest point because watering session is idle due to the water pump was not connected with relay and the process not exist. For the following days, the data goes to normal condition, it show value below than reference point.

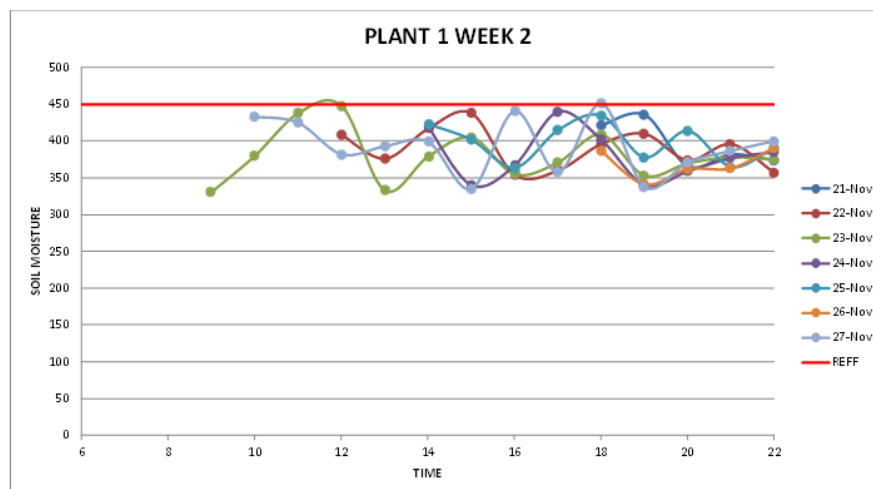


Figure 4.2 : Data plant 1 week 2

Figure 4.2 is the data for plant 1 week 2, limitation for soil moisture is same value like data plant 1 week 1 450. The data week 2 is more stable because no more problems on water pump or vice versa. Figure 4.2 show for one week data below than limitation, no overwatering and the sequence work normal condition.

After 7.00pm to 10pm the data show value soil moisture below 400 because surrounding temperature moist condition, rainy season and it make soil always wet condition. On 23th November 2016, 11:00pm and 12:00pm the data show value soil moisture approaching limitation reference because that day weather so hot and it make the soil dry condition.

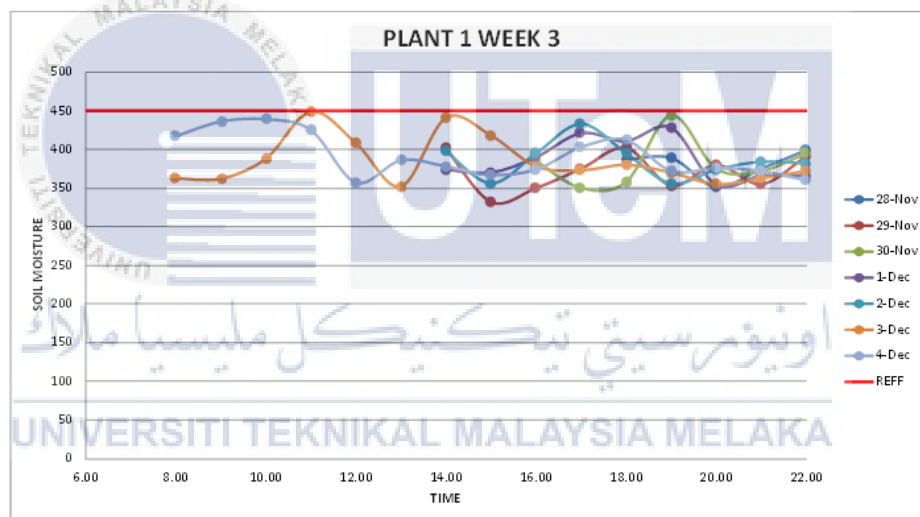


Figure 4.3 : Data plant 1 week 3

Figure 4.3 show the data for plant 1 week 3, limitation for week 3 also same like plant 1 week 1 and 2. In week 3, data plant 1 is same like data plant week 2 because it does not have any problem with hardware also no overwatering.

The data show from 8:00pm to 10:00pm, soil moisture value below than 400 because the soil in moist condition and watering session idle. It happen because week 3 in rainy season and because rainy season condition soil always wet.

On 3rd November 2016, it shows two time data soil moisture approaching 450. It happens because that day the weather so hot and it make watering session often done. After 2:00pm the data show average value 370, because condition soil is wet.

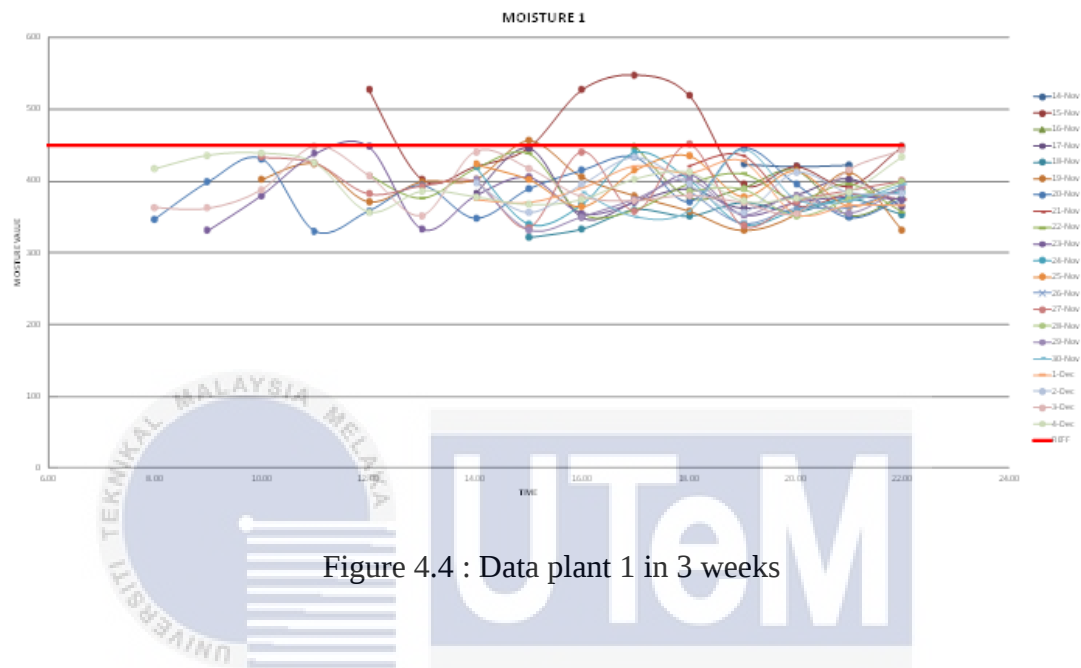


Figure 4.4 : Data plant 1 in 3 weeks

21days data was collected for plant 1, only one day on 15th November 2016 the system have a problem because the motor not connected with Arduino Uno R3. Figure 4.4 show no overwatering the plant, automatic watering the plant when value moisture soil sensor more than 450, reduce the water usage and time.

4.1.2 Data Plant 2

The data was collected continuous per days for 21days. The data was collected is value of moister soil in plant 2. Figure 4.5 is data plant 2 was collected in first week.

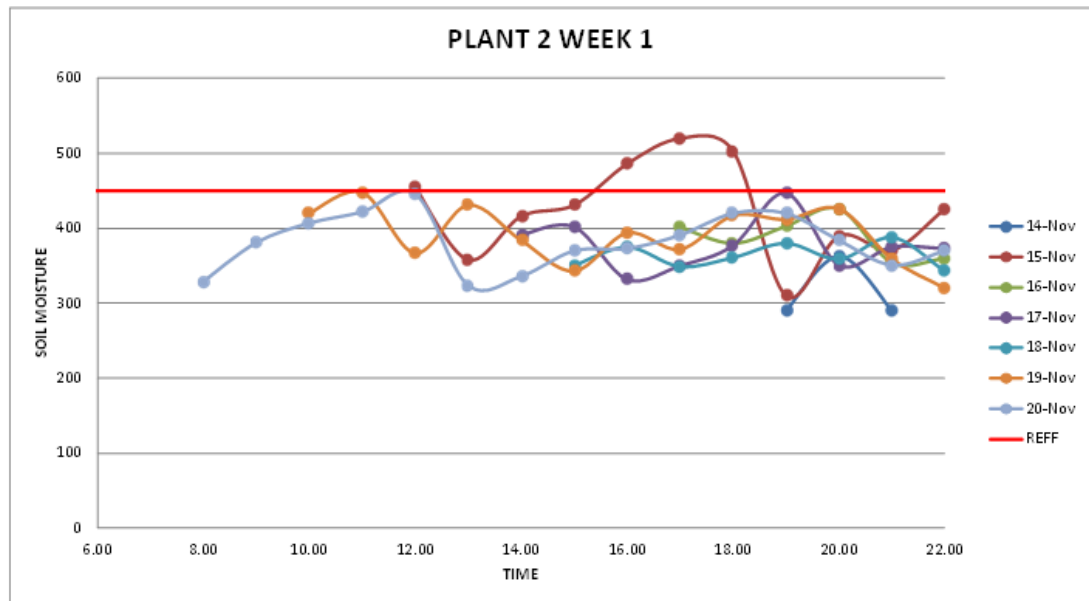


Figure 4.5 : Data plant 2 week 1

Figure 4.5 show the data collected for one week continuous, it show on 15th November 2016 value moisture soil sensor past limitation reference because water pump not connected with Arduino Uno R3. The problem same with data plant in week 1 but for next day it back to normal condition.

From 8:00pm until 10:00pm the data value show below than 400, it happen because surrounding temperature at this time is moist. Condition for soil moisture always wet. On 19th November 2016 the data show value soil moisture past 400 two time because that day the weather hot and it make the soil condition dry.

On 20th November 2016 the value soil moisture show after 2:00pm until 6:00pm below than 400 because that day is rainy so condition soil always wet. The value soil moisture increase slowly compare to another day.

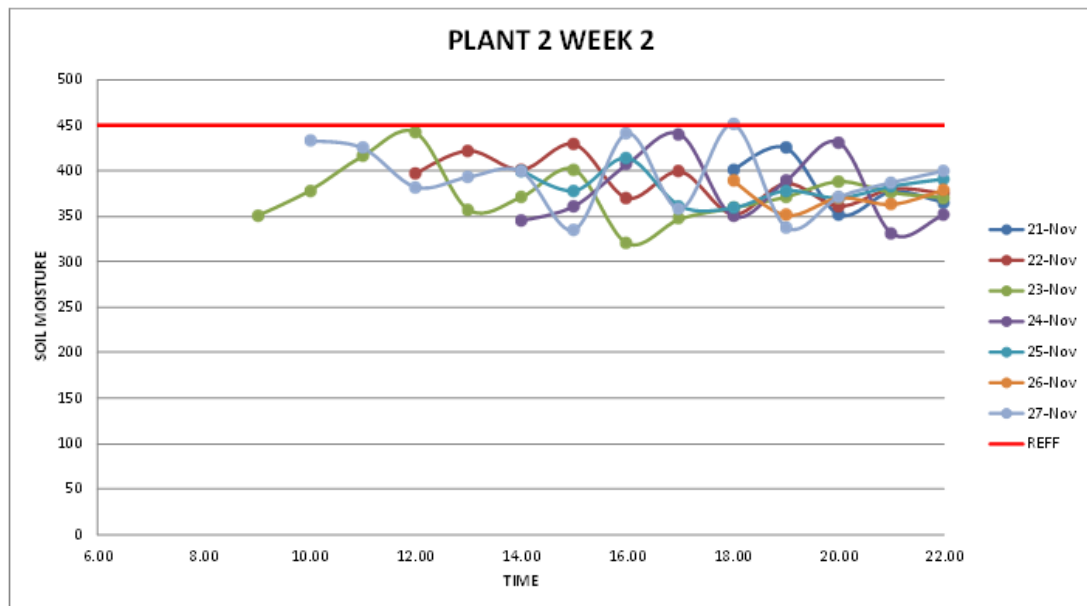


Figure 4.6 : Data plant 2 week 2

Figure 4.6 show the data plant 2 in week 2, it show the data more stable compare data plant 2 week 1. The system for this week 2 doesn't any problem. It shows no data past the limitation reference, its mean no overwatering for this week.

From 8:00pm until 10:00pm the data value soil moisture shows below than 400 because surrounding temperature moist and it make condition soil always wet. On 27th November 2016 the data show two time value soil moisture reach the limitation reference because condition soil at the time dry also condition weather hot.

On 22th November 2016 the data show value soil moisture is stable because that day surrounding temperature not to hot and moist also condition soil not to wet and dry. The process is often done on that day.

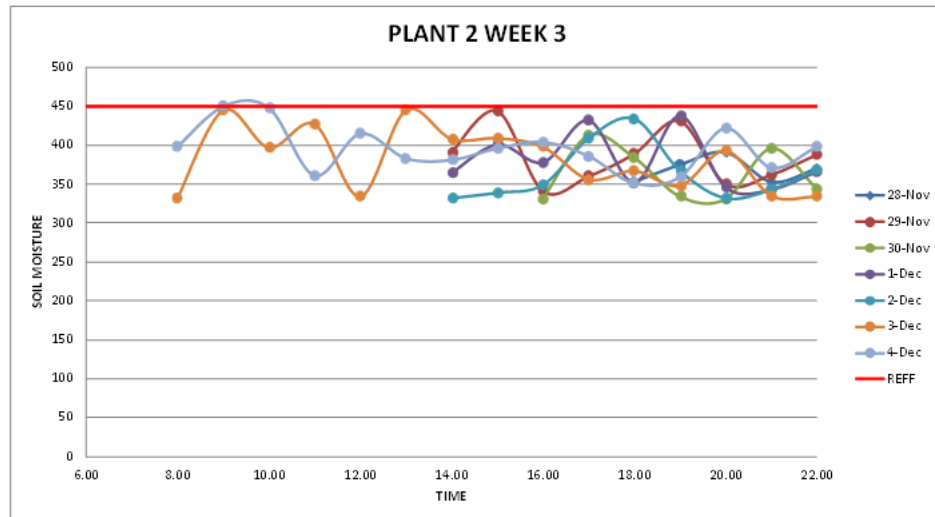


Figure 4.7 : Data plant 2 week 3

Figure 4.7 show data plant 2 week 3, it show the data stable like data plant 2 week 2 because it show not any past limitation reference 450. On 3rd and 4th December 2016 the data show at 9:00am, value soil moisture reach at limitation reference 450 because condition weather hot and it makes the condition of soil dry quickly. The data show from 8:00pm until 10:00pm, value soil moisture not past 400 because the surrounding temperature moist and condition soil always wet. No overwatering in this week also the process work in normal condition.

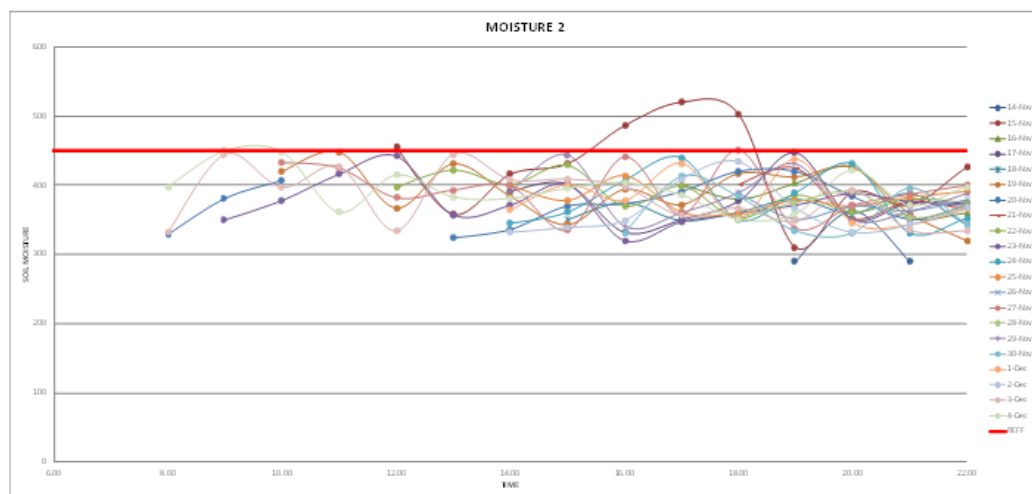


Figure 4.8 : Data plant 2 in 3 weeks

Figure 4.8 show the full data plant 2 in three weeks, it show on 15th November 2016 value soil moisture past the limitation reference 450 because the water pump motor have problem not connected with Arduino Uno R3. Automatic watering systems not turn on because of that problem. After overcome the problem, the data back to normal again. No overwatering plant in three weeks and it reduce the usage water and time.

4.2 Growth Plant 1 and 2

In this section it will show growth plant 1 and 2 in three weeks.



Figure 4.9 : Plant week 1



Figure 4.10 : Plant week 2



Figure 4.11 : Plant week 3

4.3 Calculation of Water Usage and Time Watering the Plant

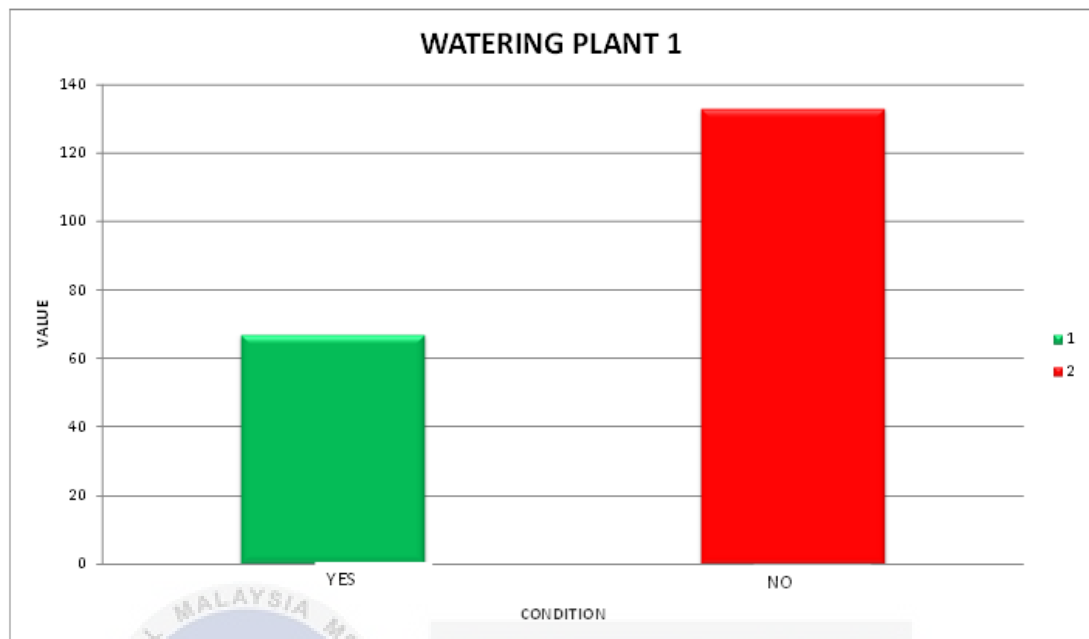


Figure 4.12 : Watering plant 1

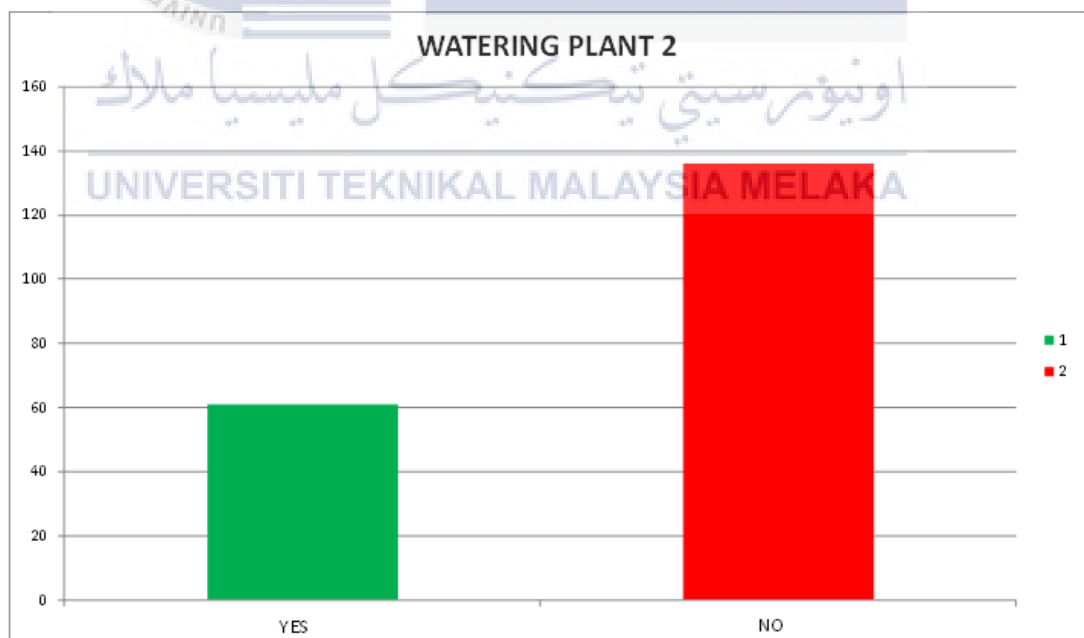
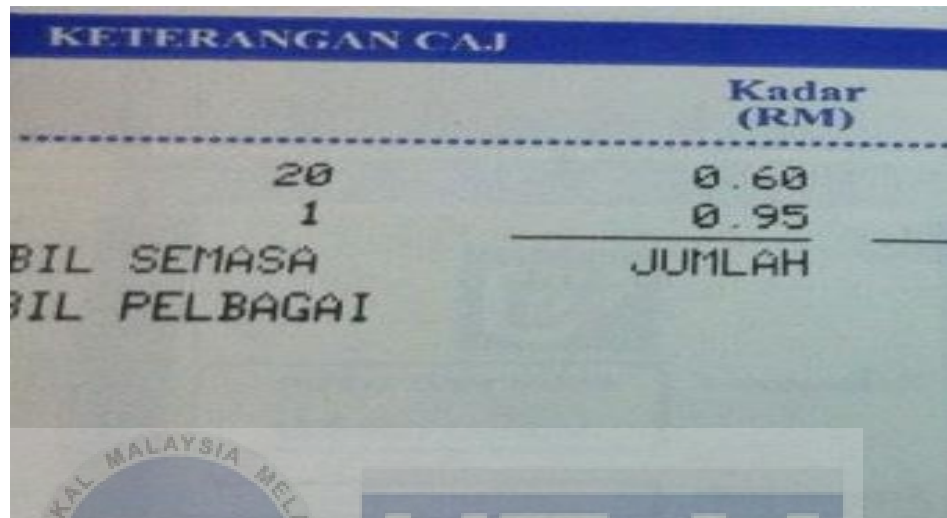


Figure 4.13 : Watering plant 2

Figure 4.11 graph for watering plant 1 and figure 4.12 graph for watering plant 2. This section will show the calculation of cost usage water and time taken for watering the plant.



	Kadar (RM)
20	0.60
1	0.95
JUMLAH	0.95

Figure 4.14 : SAMB bill

Figure 4.13 explain about water usage 20m^3 rate RM0.60 and more than 20m^3 It rate RM0.95. 1m^3 convert to litre will be 1000 litre, Rate for 1000 litre is RM0.03.

Table 4.1 : Cost for water usage in three weeks

Plant	Watering Time	Convert to Litre	Cost
1	67 (one session using 250mililiter)	16.75 litre	RM 0.00050
2	61 (one session using 250mililiter)	15.25 litre	RM 0.00045

4.4 Summary

Result and analysis already discuss on this chapter, the data was collected 21day continuous. Analysis for this project about value in soil moisture not past limitation reference 450, no overwatering and reduce the usage water and time plant watering. Graph for data plant 1 and 2 in three weeks, plant 1 and 2 growth in three weeks, Data watering the plant, and calculation for cost of water usage been show in this chapter.



CHAPTER 5

CONCLUSION

5.0 Conclusion

From the problem statement, using a manual system will burden the user and worker for watering the plant. To achieve the objective, automatic watering the plant without human interference already built. By using automatic system will make easier for user or worker. The studies prove that water usage can reduce by using automatic system and not need human interference for watering operation. The automatic system also can cut cost and time.

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