DEVELOPMENT OF COMMUNICATION SYSTEM FOR IOT BASED SOLAR IRRIGATION SYSTEM

AIMAN SAFWAN BIN AHMAD SUFFIAN

BACHELOR OF ENGINEERING TECHNOLOGY
(ELECTRICAL) WITH HONS

UNIVERSITI MALAYSIA PAHANG

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Full Name : TS DR. ROSHAHLIZA BINTI M. RAMLI

Position : SENIOR LECTURER / HEAD OF PROGRAM FACULTY OF ELECTRICAL & ELECTRONICS ENGINEERING TECHNOLOGY, UNIVERSITI MALAYSIA PAHANG

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Date :

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AIMAN SAFWAN BIN AHMAD SUFFIAN

Thesis submitted in fulfillment of the requirements
for the award of Bachelor's Degree Bachelor's Degree in Engineering Technology Electrical

Faculty of Engineering Technology Electrical & Electronics

UNIVERSITI MALAYSIA PAHANG

JANUARY 2021

ACKNOWLEDGEMENTS

Alhamdulillah. First and foremost, my deepest thanks and praises to Allah SWT for His showers of blessings throughout this project and giving me patience, assistance in completing this project and thesis successfully.

I owed my deepest gratitude to my supervisor, TS Dr. Roshahliza binti M Ramli, whose encouragement, assistance and guidance from the start to this stage which help me to understand and complete this project. Without her guidance and assistance this thesis would not be done completely and successfully. I am extending my heartfelt thanks and sincere appreciation to my group partner for the cooperation, hard work during the completion of this project.

I also would like to thank Universiti Malaysia Pahang especially the Faculty of Engineering Technology Electrical & Electronic (FTKEE) for allowing me and my partner to use the facilities provided with full of cautions and care to handle and complete this project. I would also like to express my gratitude to all the lecturers who teach me in this 4 years studying in UMP. Not to forget i take this oppoturnity to thank all my friends here for giving me advice and motivate me during my study.

Lastly, my utmost gratitude goes to my parents, my family members for their support, patience, love and advices during my study. Not to forget all the people who have supported me to complete this project and thesis directly or indirectly.

ABSTRAK

Pertanian telah menjadi amalan yang paling penting dari awal tamadun manusia. Ini kerana pertanian adalah sumber makanan untuk tamadun manusia dan sangat penting untuk mempunyai tanaman yang baik dan berkualiti. Untuk mempunyai tanaman berkualiti petani perlu sentiasa memantau dan menyiram tanaman mereka atau menggunakan sistem pengairan. Pada permulaan industri pertanian, mereka menggunakan kaedah tradisional untuk sistem pengairan, seperti perenjis overhed dan jenis banjir (flooding). Sistem ini tidak begitu efisien untuk digunakan dan mengakibatkan banyak pembaziran air dan juga boleh mewujudkan penyakit seperti pembentukan kulat kerana lebihan air di dalam tanah. Kekurangan air juga merupakan salah satu masalah akibat perubahan iklim global. Kekurangan air terutamanya buatan manusia kerana pertumbuhan penduduk yang berlebihan dan penggunaan air yang tidak betul. Untuk tujuan pengairan, petani memerlukan banyak air. Dan untuk itu ia adalah sangat penting dan mereka memerlukan cara yang betul dan mampan untuk menggunakan air untuk pengairan tanpa sebarang kekurangan air dan pembaziran. Salah satu cara untuk mengatasi kerugian air ini dan pembaziran adalah dengan menggunakan sistem pengairan yang betul. Perenjis atau sistem pengairan titisan boleh dilaksanakan untuk mengurangkan kehilangan air. Dan berdasarkan kajian, sistem titisan adalah lebih efisien daripada perenjis. Pada zaman moden ini, sistem ini boleh dibangunkan menggunakan teknologi baru dan boleh diautomatikkan. Sistem pengairan automatik merujuk kepada operasi sistem dengan tidak atau hanya sekurang-kurangnya campur tangan secara manual. Hampir setiap sistem (titisan, perenjis, permukaan) boleh dijadikan automatik. Setiap sistem (titisan, perenjis, permukaan) boleh dijadikan automatik dengan bantuan pemasa, sensor atau komputer atau peralatan mekanikal. Dengan menggunakan mana-mana mikrokontroller seperti Arduino, Raspbery Pi, NodeMCU ia dapat menghubungkan bilangan sensor yang berbeza, pada masa yang sama dan di dalam pasaran menawarkan pelbagai jenis dan saiz sensor. Sensor, pemasa yang digunakan adalah sempurna dalam mengesan dan menghantar isyarat kepada Arduino, untuk mengawal pam secara automatik. Ini akan membuatkan sistem pengairan akan lebih efisien dan pekerja dapat memberi fokus kepada tugas yang lebih penting. Walaubagaimanapun, sistem ini adalah mahal dan agak mempunyai sistem yang kompleks dan memerlukan pakar untuk melaksanakannya. Tujuan sistem ini dibangunkan adalah untuk memudahkan operasi di tapak semaian.

ABSTRACT

Agriculture has been the most important practice from the very beginning of the human civilization. This is because agriculture are source of food for human civilization and it is very important to have a good and quality crop. To have the quality crop the farmers have to keep monitor and watering their crop or call as irrigation. In the beginning of agricultural industry, they use the traditional methods for irrigation, such as overhead sprinkler and flood type. This system is not that much efficient. They results in a lot of wastage of water and can also create a disease such as fungus formation due to the over moisture in the soil. Water scarcity is also one of the problems due to the global climatic changes. Water scarcity is mainly man-made due to excess population growth and improper use of water. For the irrigation purposes, farmers will need a lot of water. And for that it is very important and they will need a proper and sustainable way to use water for irrigation without any water loss and wastage. One of the ways to counter this water losses and wastage is by using a proper irrigation system. A sprinkler or drip irrigation system can be implemented to reduce the loss of water. And based on research drip sytem is more efficient than sprinkler. In this modern day, this system can be develop using new technology and can be automated. An automated irrigation system refers to the operation of the system with no or just a minimum of manual intervention beside the surveillance. Almost every system (drip, sprinkler, surface) can be automated with help of timers, sensors or computers or mechanical appliances. By using any microcontroller such as Arduino, Raspbery Pi, NodeMCU it is able to serve numbers of different sensors, at the same time and the markets offer various type and sizes of sensors. The sensor, the timer used was perfect in detecting and sending signal to Arduino, to control the water pump and to open the solenoid valve. It makes the irrigation process more efficient and workers can concentrate on other important farming tasks. On the other hand, such a system can be expensive and very complex in its design and may needs experts to plan and implement it. The aim of this automated irrigation system is to provide a technology that can help ease the operation to the farmer and also in agricultural industry. With this technology, it can be operated anywhere and not worrying about the electricity supply because it is powered by solar. Thus, the main objective of this project is to develop a system that can optimize water, to develop a system that can optimize electricity consumption by using solar, to have fully automated irrigation system and also to have a system that can be monitored by using mobile application.

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LIST OF SYMBOLS

A Current

V Voltage

W Watt

LIST OF ABBREVIATIONS

DC Direct Current

YPPH Yayasan Pahang Plantation Holding

CHAPTER 1

INTRODUCTION

1.1 Project Background

Nowadays, there are many technology that have been developed to be used by us in our daily life. With this development of technology, people had created amazing tools that can be use in various way and it make the work become easier. All the access to industry, medicine, transportation, agriculture and many more has been simplified due to the current technology.

Now with the advancement of technology, the system use in agriculture has transform from traditional method to modern machinery or automation system. There is been a development in plant operation in agriculture section, which require a high accuracy in processes to optimize output and also the quality of the product or crops. Furthermore, it is also a need to reduce the running cost of the plantation. To achieve the required, we need to have automation system.

Water is an essential and very important element for survival. Around seventy per cent of the human body consists of water while plants will contain about almost 90 per cent of water. Therefore water is really an essential element to us and also plant. To fulfil the water requirements of our body we have to depend on some outside sources. Same goes to the crops, crops require water for their growth and development. For that the process of supplying water to the crops is known as irrigation. Irrigation is the process of applying water to the crops to fulfil their water requirements daily. Nutrients and fertilizer can also be provided to the crops through the irrigation system. The various sources of water for irrigation can be from wells, ponds, lakes, canals, tube-wells and even dams. Irrigation will offers moisture required for growth and development, germination and other related functions.

There are different types of irrigation system that can be used for improving crop yield. These types of irrigation systems are used based on the different types of soils, climates, crops and resources. The main types of irrigation followed by farmers include:

- **Surface Irrigation**

In this system, no irrigation pump is involved. Here, water is distributed across the land.

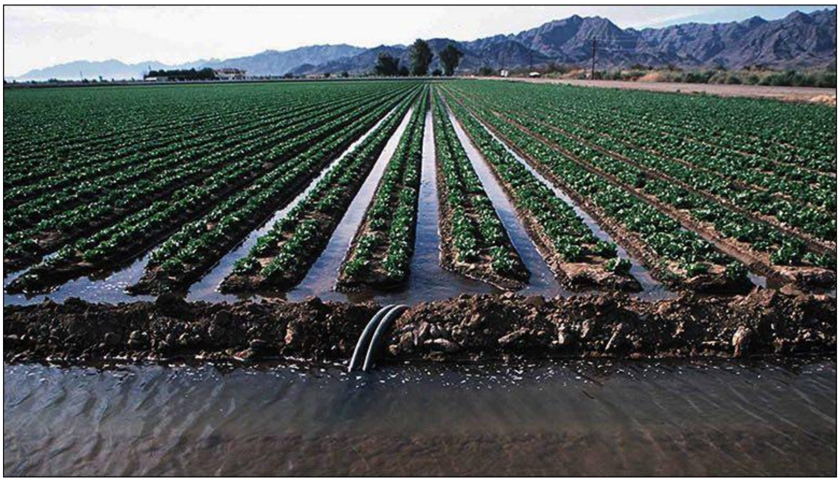

Figure 1.1 Surface Irrigation

- **Sprinkler Irrigation**

Water is distributed from a central location by overhead high-pressure sprinklers or from sprinklers from the moving platform.

Figure 1.2 Sprinkler Irrigation

- **Drip Irrigation**

In this type, drops of water are delivered near the roots of the plants. This type of irrigation is rarely used.

Figure 1.3 Drip Irrigation

- **Centre Pivot Irrigation**

In this, the water is distributed by a sprinkler system moving in a circular pattern.

Figure 1.4 Centre Pivot Irrigation

- **Sub Irrigation**

Water is distributed through a system of pumping stations gates, ditches and canals by raising the water table. Subirrigation is the distribution of water to soil below the surface; it provides moisture to crops by upward capillary action. Trickle irrigation involves the slow release of water to each plant through small plastic tubes. This technique is adapted both to field and to greenhouse.

Figure 1.5 Sub Irrigation

- **<u>Manual Irrigation</u>**

This a labour intensive and time-consuming system of irrigation. Here, the water is distributed through watering cans by manual labour.

Figure 1.6 Manual Irrigation

Traditional Methods of Irrigation

In this method, the irrigation is done manually where a farmer will pulls out water from ponds or water tank by himself or using cattle and carries to the farming fields or nursery area. This method can vary in different regions. The main advantage of this method is that it is cheap. But for the efficiency it is poor because of the uneven distribution of water. And the chances of water loss will be very high.

Modern Methods of Irrigation

The modern method will counter the disadvantages and problem of traditional methods and thus it will helps in the proper way of water usage.

The modern method involves two systems:

- Sprinkler system

Figure 1.7 Sprinkler Irrigation

- Drip system

Figure 1.8 Drip Irrigation

Sprinkler System

A sprinkler system, will sprinkles water over the crop and helps in distribution of water. This method is much advisable in areas facing water scarcity. But the problem is this system will have an uneven water distribution.

Drip System

In the drip system, water supply is done drop by drop exactly at roots using a hose or pipe. This method can also be used in regions where water availability is less.

With this project, we try to make and automated irrigation system. This system will help to solve the problems of irrigation in plantation such as the consumption of large quantities of water. So that, the error will not affect the crops that has been plant. It will also can help in reducing the production cost for the farmers. The system will be controlled automatically, so it will reduce manpower needed and reduce the management cost for plantation.

In drip irrigation method, pipes are laid across the whole field, wherever essential. Certain fixed diameter holes are made at regular intervals throughout the length of the pipe, so that, when the pump is switched on, water through the holes of the pipes reaches the crops for irrigation. This method proves to be a little expensive as it increases the cost of irrigation due to requirement of additional pipes but at the same time wastage of water in this irrigation method as compared to the other two methods i.e. mud digging method and sprinkler method is much reduced. Besides, the pipes once purchased, have long durability and hence there is no requirement of replacing them for a very long time. The labour work requirement in this technique is the installation of additional pipes, which is the least amount of labour work to be done as compared to other two methods of irrigation. Among these three irrigation methods, i.e. mud digging or traditional method, sprinkler method and drip method, drip irrigation method seems to be a superior method as it provides advantages over the other two methods. Drip irrigation has the minimum amount of water wastage as compared to other two methods and also the labour work requirement in this method is also very less. Although drip irrigation has the drawback of high cost due to requirement of additional pipes but, as explained earlier, the pipes have long durability, so they do not require to be replaced till a very long time. So, this drawback of drip irrigation can be neglected. Table I below shows the comparison of pros and cons of mud digging, drip and sprinkler irrigation methods.

This project also will have a collaboration with Yayasan Pahang Plantation Holding Sdn Bhd (YPPH). YPPH was establish in 1985 as a subsidiary of Yayasan Pahang. Formerly YPPH was known as Sumber Perindu Sdn Bhd. On 24 January 2003, the name Sumber Perindu Sdn Bhd was changed to YP Plantation Holding Sdn Bhd (YPPH) where the selection of this new name was on recommendation of YAB Menteri Besar of Pahang, Dato’ Sri DiRaja Haji Adnan bin Haji Yaakob, as the chairman of the company.

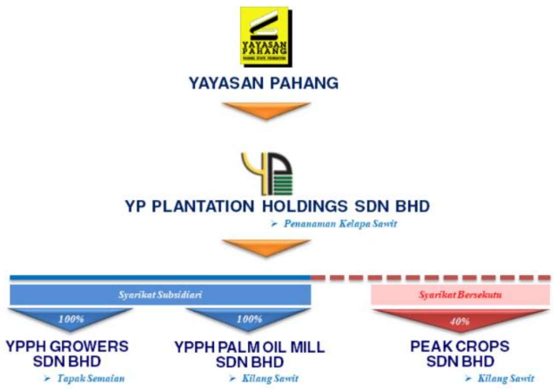

Figure 1.9 YPPH Structure

YPPH had started the operation of palm oil plantation in 1994 at Pulau Manis, Pekan, Pahang with an area covered of 1,171 acres. In 1996 YPPH increase their plantation area with 10,000 acres in Endau Rompin, and had opened up about 32,000 acres in Rompin on 2002. Then in 2004 they take over Ladang Gambang, Kuantan with an area covered 12,000 acres. YPPH continue to expand their plantation area by opening a new nursery at Pekan in 2009 with an area 27,000 acres. Now they are developing 10,000 acres of new farm located at Pekan, Pahang.

FARM	AREA (ACRES)
Kuantan	7,149
Rompin	21,080
Pekan	21,995
(In Development) Pekan	30,021
Total Area	80,205

Table 1.1YPPH Farm Area

YPPH also have a nursery plant in Bukit Payong with an area 80 hectare. The capacity for this nursery is 1 million seeding and have water source from the lake nearby. The objective of this nursery is to prepare a high quality seedling for replanting program at Ladang Tanjung Gemok (LTG) AND Ladang Endau Rompin (LER). This is where we are planning to use the automated irrigation system to get the quality output with efficient monitoring.

1.2 Problem Statement

Agriculture is one of important sector of economy in Malaysia, such as rubber and palm oil. Therefore, it is very important to have a good quality of the crops. To do that farmers has to focus on some important matter such as the appropriate amount of water supply for irrigation of crops, as well as the usage of electricity for water pump. Furthermore, farmers also want to cut the cost of production by reducing manpower. This way of irrigation requires high water pressure. Therefore, diesel fuel water pump will be used to provide high pressure of water.

By using pump power by fuel it may create harmful emissions when it is turned on and this this will cause or lead to air pollution, such as ground-level ozone and particulate matter (U.S. Energy Information Administration, 2020). Meanwhile, if this diesel engine pump is being replaced by using electric water pump the farmers will have to bare the cost of electricity consumption. This will increase the cost of farming for the farmers and will be a big problem for them to continue the plantation. Although most of the time the main electricity is produced by renewable resources, but when the peak period of using electricity, boost electricity is supply through combustion of nonrenewable resources.

Hence, farmers have to focus on some important matter such as the appropriate amount of water supply for irrigation of crops, as well as the usage of electricity for the irrigation system. Furthermore, farmers also want to cut the cost of production by reducing manpower. Manual way of irrigation requires manpower and this lead to the increasement of cost. Different type of irrigation system has different consumption of water. A suitable irrigation system may reduce the amount of water usage. This project will be an automated irrigation system controlled using mobile application. With this system, farmers can reduce the manpower in plantation, control the irrigation wirelessly, save water and electricity, and monitor the surrounding conditions of crops or plants.

1.3 Objectives

This project has objectives as below:

1. To develop a mobile apps to monitor and control the system.
2. To develop a web based monitoring system.
3. To have an automated irrigation system.

1.4 Project Scope

The scope of this project is to focus on designing an automated irrigation system with monitoring and is powered by solar which is to transform the process from manual to automated.

The objectives is to develop an IoT-based solar irrigation system with monitoring features. This innovation is used the developed solar water pump to attach into the irrigation system. Hence, the solar water pump not only portable use to irrigate the plant but also be a controlling system to this project.

The water pump powered by solar is portable and it has 2 sensors which are soil moisture sensor and temperature & humidity sensor. This water pump can be controlled and monitor using mobile application. This solar water pump will make the irrigation process easier to control and monitor. But in our project, we improve this solar water pump to be used to control the solenoid valve. Water pump had been replaced with solenoid valve as we do not need high water pressure to irrigate the plants as we use the drip system that using low pressure of water. And this problem we had solve by using the tank that placed above ground with 3 metres that will produce gravity force and provide low water pressure.

Furthermore, we improve the monitor features with raindrop sensor which able to detect overflow water to the plants. The previous project is only can be monitored in mobile application and we upgrade this feature to be displayed in web through browser. It can be displayed in any device as long as it has internet.

This IoT-based solar irrigation system can be used at any plantation or nursery. The main component needed for this system consist of Arduino Uno, NodeMCU, Raspberry Pi, solenoid valve and sensors. Lastly, the scope for this project is to create a programming code for NodeMCU ESP8266 and Arduino Uno microcontroller to enhance the system as it provides remote function towards the user.

1.5 Organization of thesis

In this paper there will be 5 chapters including introduction, literature review, methodology, result and discussion, and conclusion. Introduction would briefly explain the project in general such as the project background, project statement, objectives and also the scope of the project. For Chapter 2, it contains all the past research from related field researcher which give an idea and reference for this project. These past research act as guidance and improvisation that combining the benefit of few past project can be seen in this project. In Chapter 3, the information of design, electrical part, and component sizing. Result and discussion contain of the changes and process of uncompleted project until the finished project which contain the finding of the project process. Finally, Chapter 5 is the part of summarize all the important feature of this project and the suitable recommendation that can be modify in future.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, we will discuss about the automated irrigation system concepts, the details of automated irrigation system and also type of system use in irrigation sytem. Drip irrigation system makes the efficient use of water and fertilizer. Water is slowly dripped to the roots of the plants through narrow tubes and valves. Water is fed directly to the base of the plants which is a perfect way to water plants. There should be proper drainage in the fields or pot plants to avoid any water logging which in case may affect the productivity. (R.Hussain, J.Sehgal, A.Gangwar, M.Riyag, 2013)

2.2 Comparison of manual and automatic irrigation systems

In Switzerland, the major part of the 500 ha strawberry production area is cultivated with drip irrigation. Traditionally, the irrigation management is based on the monitoring of the soil moisture combined with a manually operated irrigation system, which is quite time consuming. In Switzerland, salaries are high and are a major production cost. The use of fully automatic irrigation systems might help to reduce production costs and eventually reduce the amount of water used for irrigation. From 2013 to 2015, a field experiment was carried out to compare two manual irrigation systems (traditional producer manual approach and optimised) and two automatic irrigation system (Watermark and PlantCare) on yield and fruit quality (fruit size, acidity, sugar, firmness) of strawberries. During the irrigation period, the average daily water volume was 1.1 - 1.2 L m-2 for the optimised irrigation systems (manual or automatic) and 1.6 L m-2 for the traditional manual producer irrigation system. This important reduction of the irrigation water volume had no impact on yield and fruit quality. The optimised manual irrigation system could save as much water as the automatic irrigation systems, but increased the workload. **(**A. Ançay, V. Michel and C.A. Baroffio, 2017)

Manual producer system

The irrigation system was based on the reading of three tensiometers twice a week. When the median of three tensiometer values reached the threshold value, irrigation was activated manually to dispense a predefined water volume.

Manual optimised system

The irrigation system was also based on tensiometer measurements, which occurred at a higher frequency than in the Manual producer system. When the threshold was reached (median of three tensiometers), the irrigation was manually started to dispense a predefined water volume, which was different from the Manual producer system.

Automatic Watermark (WEM) system

The automatic WEM system was based on measurements taken from three Watermark sensors connected to a electronic control module. The sensors measured the soil moisture four times per day (9 am, 11 am, 1 pm, 3 pm). When the threshold value of 20 kPa was reached at one of the four measuring moments, irrigation started automatically to dispense 0.75 L m-2.

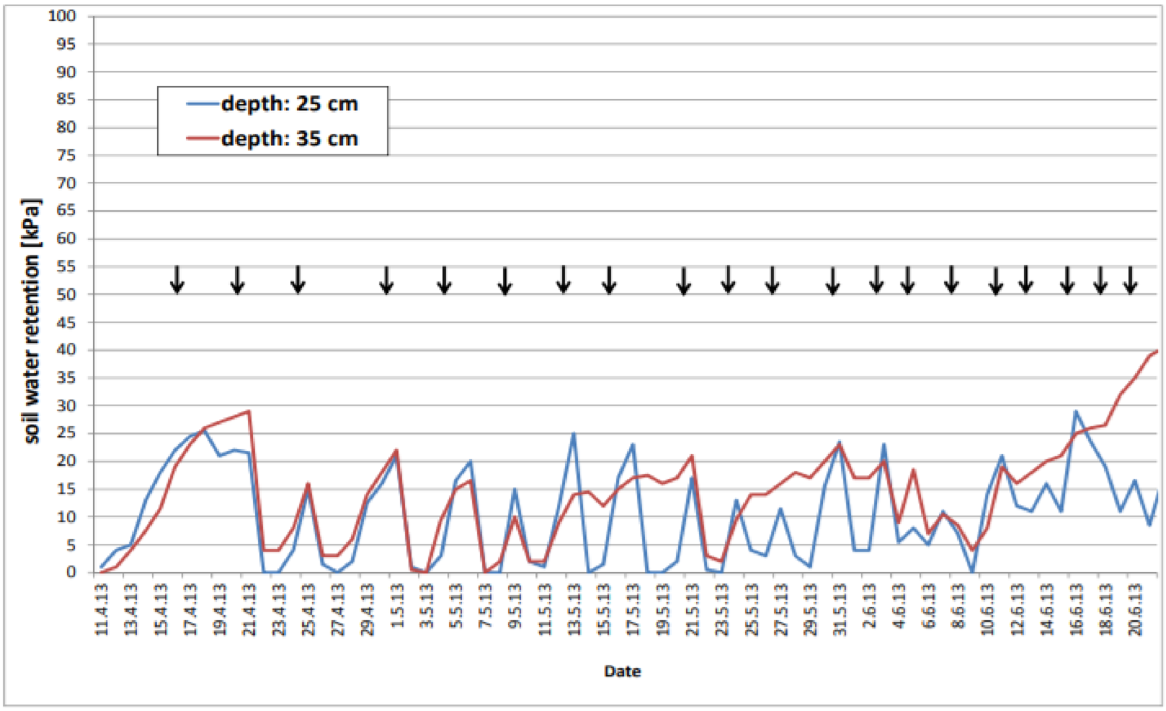

Figure 2.1 Soil moisture of the manual producer system (median of 3 Watermark sensors for each depth). Each arrow indicates an irrigation cycle.

In the manual producer system, a continuous change of soil moisture between 0 and 20 kPa, was measured at a depth of 25 and 35 cm (Figure 2.1), which indicates an excessive volume of water applied for irrigation.

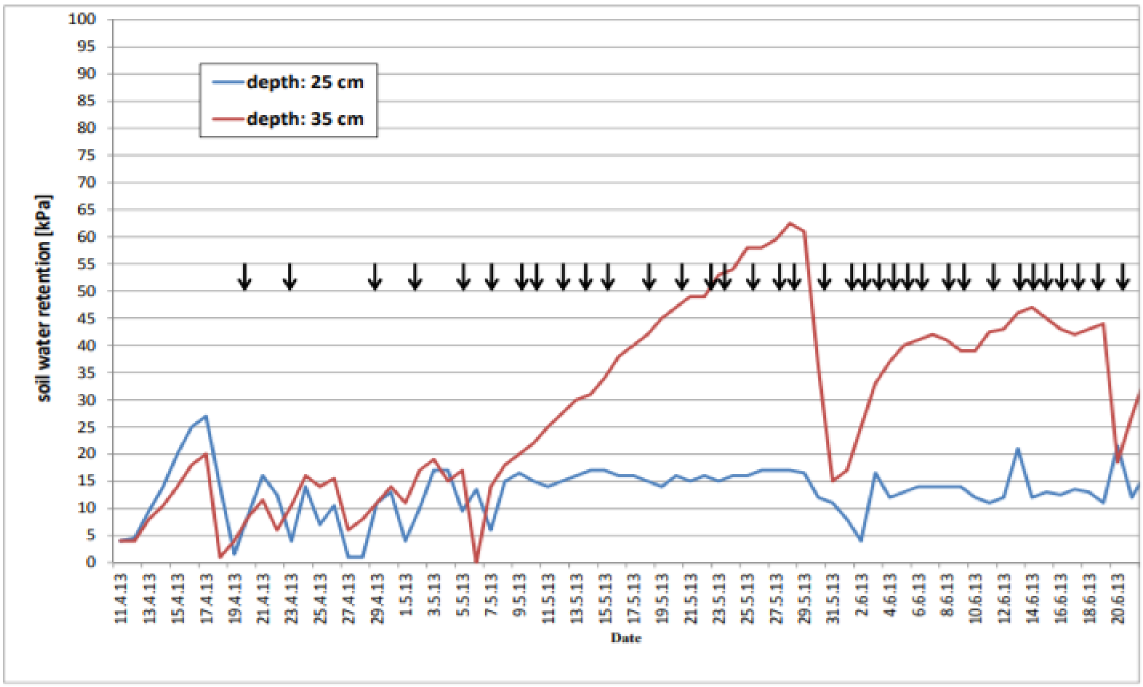

Figure 2.2 Soil moisture of the manual optimised system (median of 3 Watermark sensors for each depth). Each arrow indicates an irrigation cycle.

In the manual optimised system, a similar soil moisture pattern was measured until mid-May (Figure 2.2). Starting from this moment, the soil moisture level at 25 cm depth did no more climb higher than 15 kPa, this was caused by the rising temperatures. This effect was even stronger at a depth of 35 cm. There was no visible loss of water, the water was consumed in the top 25 cm soil layer. The WEM system showed a continuous change in soil moisture at 25 cm depth, where it varied between 0 and 15-20 kPa. At 35 cm depth, in contrast, the soil moisture decreases from the beginning of the irrigation period. This could be the result of the higher irrigation frequency (max. 4 times per day), but a quite lower water volume per irrigation.

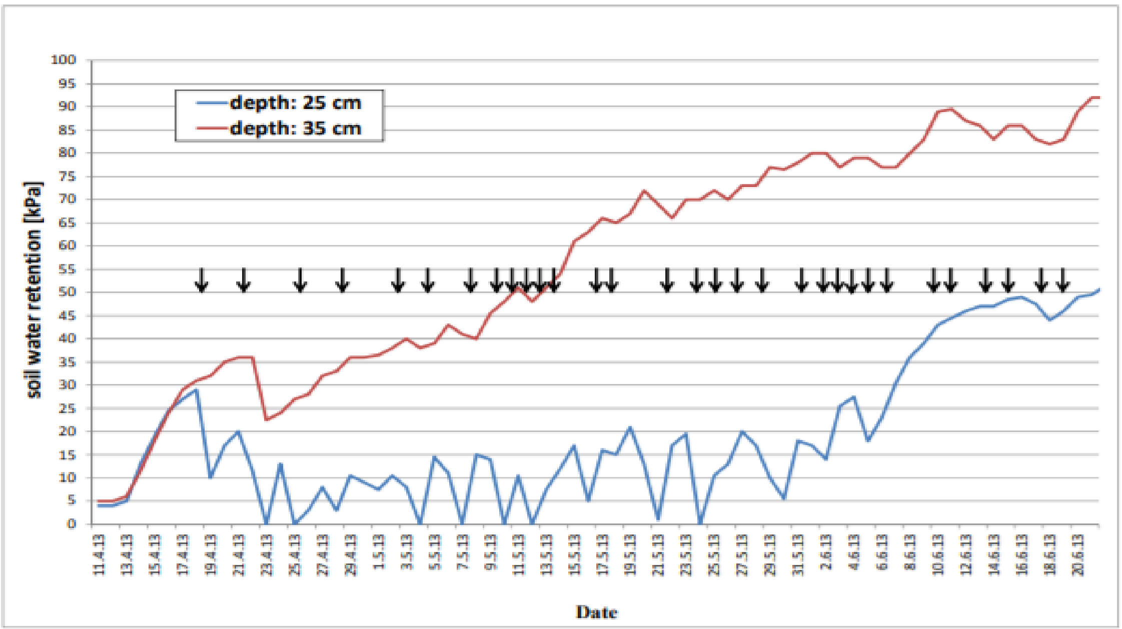

Figure 2.3. Soil moisture of the WEM system (median of 3 Watermark sensors for each depth). Each arrow indicates an irrigation cycle.

The investigation carried out on different irrigation systems in strawberries showed that with higher workload in a manual or with an automatic irrigation system, an important volume of irrigation water can be saved. The automatic systems have a potential to reduce labour and water in the same time. There were no statistically significant differences in yield, fruit size and fruit quality of the different irrigation systems.

2.3 Smart Irrigation System using Arduino and Microcontroller Based Automatic Plant Irrigation System

Water plays an important part in a human's daily life. In India for example many agricultural land and industries already are facing the problems of drought, so this issue can be solved with the help of current technology. Today's technology requires an easy to use device which is economical and effective such as Arduino. The system have two different part. For the first part is setting up an Arduino and interface it with a few sensors. For the second part is the integration with the IoT platform which is using ESP 8266 Wi-Fi moduled. It is used for transmission to becomes simpler and faster. It will help the farmers to monitor the system easily. (S. Thakare, P. H. Bhagat 2018)

This paper presents the smart irrigation system using Internet of Things (IoT) via the Arduino Mega 2560. In tis paper the objectives are to investigate the concept of smart irrigation system using IoT and also to develop a system using an Arduino Mega 2560 that will processes the data from the soil sensor which automatically water the plant and to analyse the real time condition of soil of the plants via the smart phone that is connected to the internet. In this project, it will used the blynk application software on the smartphone and hardware implementation which can detect the condition of the plant by using the temperature & humidity sensor and soil moisture sensor. (N. A. M. Leh, M. S. A. M. Kamaldin, Z. Muhammad and N. A. Kamarzaman 2019)

In this system the sensor of soil moisture is placed in the plant. The sensor will send an information to the microcontroller and passes the data on. An algorithm was developed for measuring the threshold value of the soil moisture sensor, which was programmed into a microcontroller to monitor the soil moisture content. This system is based on microcontroller ATMEGA328. Farmer will get the information through GSM module without going to the nursery. (BD Kumar, P Srivastava, R Agrawal, 2017)

2.4 Precision water saving Irrigation Automatic System

There are some studies show that moisture and temperature are two main enviromental factor for plants growing. The impact on different soil water handling on stem weight, and root weight, total biomass is notable, plant leaves relative moisture content and water consumption volume per plant decrease with the reduction of soil water. When soil water content is higher than a certain value, the plants could survive. However, when soil water content is too high, it will not only cause the root to decay, but also a waste of water at the same time, and as a result of too much irrigation, water infiltration will take away large fertilizer, which causes a waste of fertilizer, pollution of groundwater resources. Therefore, controlling soil water content near root of plants in a certain range between plant survival threshold value and plant water requirement with the largest biomass could ensure a large number of water saving and plant's appreciation. (Y. Zhao, J. Zhang, J. Guan and W. Yin, 2009)

2.5 Control and Automation in Citrus Microirrigation Systems

Microirrigation (drip and microsprinklers) is the predominant method of irrigation for citrus in Florida. With chemigation, microirrigation systems it can also provide an economical method of applying fertilizer and other agricultural chemicals on a time basis. Microirrigation systems require a high level of management expertise compare to other irrigation methods. Microirrigation systems are more complex, which it require greater filtration and water treatment, and have high maintenance costs compared to other types of irrigation. Irrigations generally must be scheduled more frequently with microirrigation systems, since they reach only a fraction of the root zone as compared to other types of systems. (Brian Boman, Steve Smith, and Bill Tullos, 2006)

There is a way to manage the higher demands of microirrigation is by using of automation and central control systems. With these technologies, it allow efficient control of water flows to various zones; injection of water conditioners, fertilizers, and agricultural chemicals; allow remote checks of system performance; control filter backflushing; and provide extensive records of water use. More sophisticated systems allow irrigations to be scheduled based on evapotranspiration (ET) calculations from nearby weather stations. In many citrus microirrigation systems, a controller is an important and integral part of the irrigation system.

Controllers can help to achieve labor savings in addition to applying water in the necessary quantity and at the right time to achieve high efficiency in water, energy and chemical uses. Irrigation controllers have been available for many years in the form of mechanical and electromechanical irrigation timers. These devices have evolved into complex computer-based systems that allow accurate control of water, energy and chemicals while responding to environmental changes and crop demands.

There are two control strategies in this project, which is by using two general types of controllers to control irrigation systems: open control loop systems and closed control loop systems. Open control loop systems apply a preset action, such as is done with simple irrigation timers. Closed control loops receive feedback from sensors, make decisions and apply the results of these decisions to the irrigation system.

2.5.1 Open Loop System

In an open loop system, the operator makes the decision on the amount of water to be applied and the timing of the irrigation event. The controller is programmed correspondingly and the water is applied according to the desired schedule. Open loop control systems use either the irrigation duration or a specified applied volume for control purposes. Open loop controllers normally come with a clock that is used to start irrigation. Termination of the irrigation can be based on a pre-set time or may be based on a specified volume of water passing through a flow meter.

2.5.2 Closed Loop System

In closed loop systems, the operator develops a general control strategy. Once the general strategy is defined, the control system takes over and makes detailed decisions on when to apply water and how much water to apply. This type of system requires feedback from one or more sensors. Irrigation decisions are made and actions are carried out based on data from sensors. In this type of system, the feedback and control of the system are done continuously. Closed loop controllers require data acquisition of environmental parameters (such as soil moisture, temperature, radiation, wind-speed, etc) as well as system parameters (pressure, flow, etc.).

Figure 2.4 A simple version of a closed loop control system is that of an irrigation controller.

A moisture sensor interrupts the irrigation process. When soil-moisture drops below a certain threshold, the sensing device closes the circuit, allowing the controller to power the electrical valve and the irrigation starts.

2.5.3 Controllers

In the simplest form, irrigation controllers are devices which combine an electronic calendar and clock and are housed in suitable enclosure for protection from the elements. The controller provides a low-voltage output (typically 12 or 24 volts DC or 24 volts AC) to the valves and control devices for specific zones. As long as the voltage is applied, valves stay open and irrigation water is applied. Most remote control valves are “normally closed” meaning that the valve is closed until the solenoid is actuated by the controller. A “normally open” control valve remains open until such time as the solenoid is actuated. Normally open valves are sometimes used as master valves in systems when it is desirable to have a continuously pressurized mainline but still have a primary valve that can be closed in the event of excessive flow or other alarm conditions.

2.5.4 Sensors

A sensor is a device placed in the system that produces an electrical signal directly related to the parameter that is to be measured. In general, there are two types of sensors: continuous and discrete. Continuous sensors produce a continuous electrical signal, such as a voltage, current, conductivity, capacitance, or any other measurable electrical property. Continuous sensors are used when just knowing the on/off state of a sensor is not sufficient. For example, to measure pressure drop across a filter (Fig. 7) or determe tension in the soil with a tensiometer fitted with a pressure transducer (Fig. 8) requires continuous-type sensors.

Figure 2.5 Control panel for automatically backflushing filters based on pressure differential between inlet and outlet of filter.

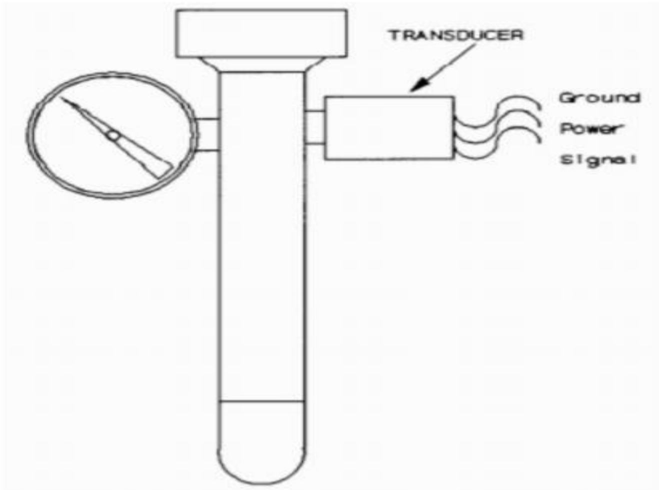

Figure 2.6 Tensiometer fitted with pressure transducer to provide continuous feedback of soil tension status.

CHAPTER 3
METHODOLOGY

3.1 Introduction

Methodology is a system of broad principles or rules from which specific methods or procedures may be derived to interpret or solve. This chapter explained in detail on the procedures of the implementation of communication system in Solar Automated Irrigation system. The methods used in this chapter are aimed to achieve the objectives of the project which will give satisfying results on the performance of control system and monitoring system in Solar Automated Irrigation system.

3.2 Proposed System

In our proposed system, the system of IoT-based solar irrigation system is divided into two parts which acontrol part and communication part. Control part is the part which include the methods or operations of the solenoid valve to close or on the irrigation. Meanwhile, for the communication part, this is where the explanation of mobile application feature and also web based monitoring..

Figure 3.1 is the system flow diagram of the IoT-based solar irrigation system. This flow diagram shows the solar energy harvesting process where the solar panel is used to collecting the solar energy and convert into electric energy. Next, the electric energy is stored into the rechargeable battery and it is a source of power to control the solenoid valve. Solenoid valve in this system is a controlling component to allow or cut down the water supply from the water tank to the irrigation of crops or plants. This solenoid valve is commanded by a microcontroller which is NodeMCU. Sensors are attached to the surrounding of the plants or crops to gain information and display to the user with the help of microcontroller. The microcontroller can be coding to customise the interface of the information provide by sensors.

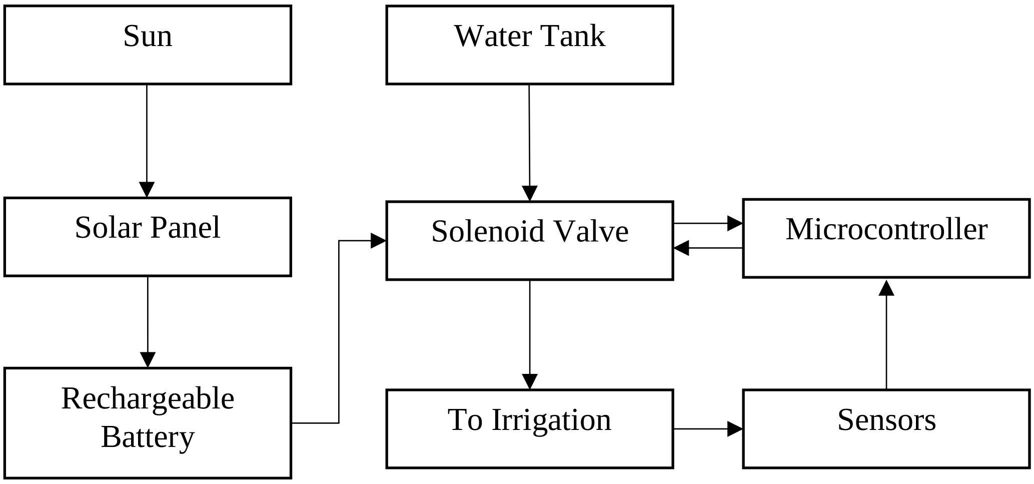

Figure 3.1 System Flow Diagram of Valve Control

3.3 Communication System

This solar automated irrigation system is made up of communication system using NodeMCU and sensor while electrical components are solenoid valve, solar panel, inverter and battery.

After research, we decided to develop a system with NodeMCU and sensors that can observed surrounding condition and can be control by buttons or remotely using mobile application. The sensors used are light sensor (LDR), soil humidity sensor, temperature and humidity sensor (DHT11). The function of light sensor is to detect the light intensity while the temperature and humidity sensor (DHT11) is to sense the condition of temperature and humidity of surrounding area. The soil moisture sensor used to sense the moisture of soil and it will stop the system to irrigate once the soil moisture meets desirable value. These sensors will give a feedback value to the system show by the LCD Display and help the users to monitor the surrounding conditions of the plants more efficiently.

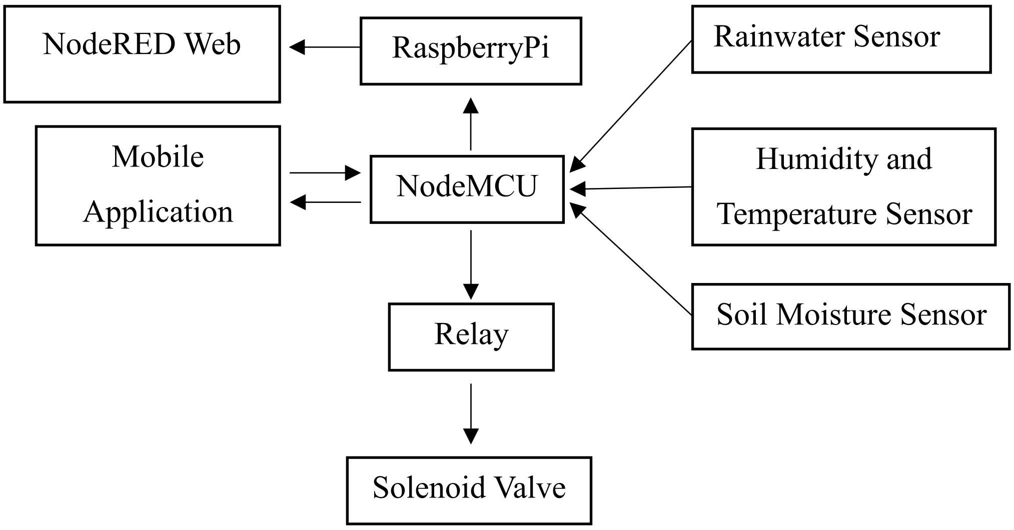

Figure 3.2 Block Diagram of Communication System

3.3.1 WI-FI AND MQTT

```
const char* ssid = "A1601";
const char* password = "ftdyvuyz";
const char* mqtt_broker = "192.168.43.52";

WiFiClient espClient1;
PubSubClient client(espClient1);
```

Figure 3.3 WiFi and MQTT setup

The Figure 3.3 shows the coding for the Wi-Fi and MQTT setup. The IP address of the Raspberry-Pi can be obtained through the terminal of the raspberry pi by running the code “if-config”. The Wi-Fi set up requires an SSID and password that is declared in the constant character data type and is applied to all the NodeMCU. The text in orange in Figure 3.3 is the declaration of the client. When naming the client, it has to be unique to differentiate itself from other clients to prevent overlapping of messages when publishing readings to MQTT broker.

The connection to a Wi-Fi uses "*WiFi.begin*" and shows the status of connection through "*WiFi.status()*" in Figure 3.4. In case of disconnection, a reconnect function is added so that it reconnects whenever the Wi-Fi is running again. However, the serial monitor reading of the NodeMCU will not display readings from the sensor until it is connected to the MQTT broker even though it is connected to the Wi-Fi as explained in system description in 3.5.

```
void wifi_connection() {
  // Connecting to a WiFi network
  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("WiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
}
```

Figure 3.4 Wifi Connection

```
void reconnect() {
  // Loop until we're reconnected
  Serial.println("In reconnect...");
  while (!client.connected()) {
    Serial.print("Attempting MQTT connection...");
    // Attempt to connect
    if (client.connect("Arduino_Moisture")) {
      Serial.println("connected");
    } else {
      Serial.print("failed, rc=");
      Serial.print(client.state());
      Serial.println(" try again in 5 seconds");
      delay(5000);
    }
  }
}
```

Figure 3.5 Wifi Reconnect

3.3.2 PUBLISH AND SUBSCRIBE

The system solely uses the publishing model of the MQTT protocol. Whenever the NodeMCU receives reading from the sensor or the input pin, it first needs to be converted to string or character. This is because of the data Node-Red is only able to read is in string in which we set the input of the MQTT as string or character data type.

```
sprintf(msg1,"%i",sensor1);
```

Figure 3.6 Data Conversion

```
client.publish("ppm1", msg1);
```

Figure 3.7 Publish

The Figure 3.6 shows the coding for the conversion of readings obtained from sensor into string and is published into topic "*ppm1*" as shown in Figure 3.7. The topic has to match with the input MQTT node in Node-Red to enable connection.

3.4 Sensor Technology

Light dependent resistors (LDR) is a light sensitive device use to indicate the presence or absence of light and measure the light intensity. The resistance of LDR will be high up to 1MΩ when in the dark, but when the LDR sensor is exposed to light, the resistance drops dramatically to a few ohms depends on the light intensity. LDRs are made from semiconductors with light sensitive material mounted on isolating base. The most common semiconductors used in this system are cadmium sulphide, lead sulphide, germanium, silicon and gallium arsenide (Bauman, 1962), Figure 3.8 show the symbol and corresponding reaction of LDR sensor.

ORP12 Cadmium Sulphide photoconductive cell is a commonly used photo resistive light sensor. This photo resistive light sensor has a spectral response around 610nm in the region of yellow to orange light. The resistance of the cell is very high at about 10MΩ's when unilluminated (dark resistance) and falls to about 100Ω's when fully illuminated (lit resistance). To increase the dark resistance and reduce the dark current, the resistive path will form a zigzag pattern across the ceramic substrate. Cadmium Sulphide photocell is a cheap device often used camera light meters, clock radios, alarm devices (as the detector for a light beam), nightlights, outdoor clocks, solar streetlamps, and solar road studs.

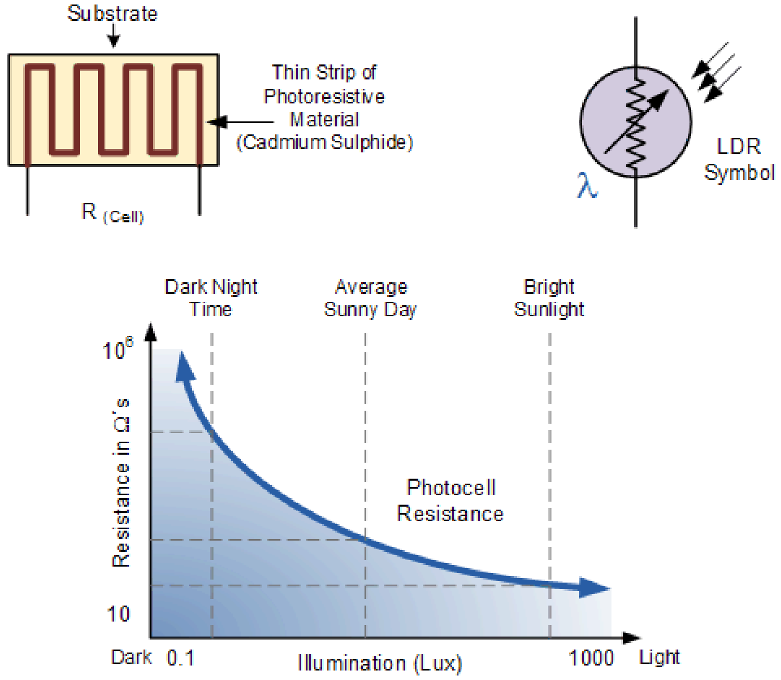

Figure 3.8 Symbol and corresponding reaction of LDR sensor

Figure 3.9 shows the Temperature & Humidity Sensor (DHT11) and it is functioning as a sensor which can detect the temperature and humidity complex with a calibrated digital signal output. This sensor provides a high reliability and excellent long-term stability by using the exclusive digital-signal acquisition technique and temperature & humidity sensing technology. This sensor includes resistive-type humidity and NTC temperature measurement component and connects to high performance of 8-bit microcontroller which allow it offering excellent quality, fast response, anti-interference ability and cost-effectiveness.

DHT11 changes from the low-power-consumption mode to the running-mode when MCU sends a start signal and waiting for MCU completing the start signal. Once the MCU completing the start signal, a response signal of 40-bit data that include the relative humidity and temperature data will send by DHT11 to MCU. DHT11 will not give the response signal to MCU without the start signal from MCU. After the data is collected, DHT11 will turn to the low power-consumption mode until the next start signal is receives from MCU again (Mouser Electronics, 2011).

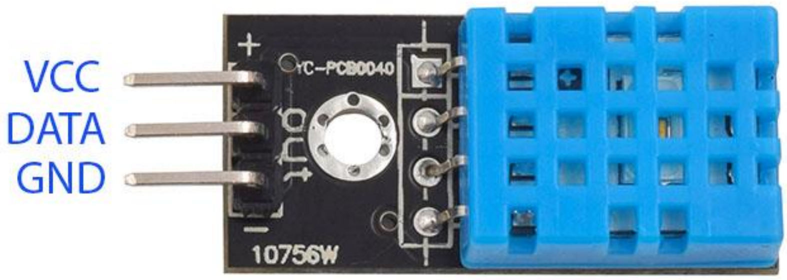

Figure 3.9 Temperature & Humidity Sensor (DHT11)

Figure 3.10 shows the Soil Moisture Sensor is used to measure the water content(moisture) of soil. The module output is at high level when the soil is having water shortage, else the output is at low level. This sensor is functioning to remind the user to water their plants and monitors the water content of soil. It has been widely used in agriculture, botanical gardening and land irrigation.

This sensor uses capacitance to measure dielectric permittivity of the surrounding medium. Dielectric permittivity is a function of the water content in soil. Voltage is created by the sensor 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. A 2 cm zone of influence is respected to the flat surface of the sensor with little or no sensitivity at the extreme edges. The Soil Moisture Sensor is functioning to measure the loss moisture of soil over time due to plant uptake and evaporation, evaluate optimum soil moisture for various type of plants and monitor soil moisture content to control irrigation (eProLabs, 2016).

Figure 3.10 Soil Moisture Sensor

Figure 3.11 Raindrop Sensor is a tool used for sensing rain. It consists of two modules, a **rain board** that detects the rain and a **control module**, which compares the analog value, and converts it to a digital value. The raindrop sensors can be used in the automobile sector to control the windshield wipers automatically, in the agriculture sector to sense rain and it is also used in home automation systems. The control module of the raindrop sensor has 4 outputs. VCC is connected to a 5V supply. The GND pin of the module is connected to the ground. The D0 pin is connected to the digital pin of the microcontroller for digital output or the analog pin can be used. To use the analog output, the A0 pin can be connected to the ADC pin of a microcontroller. In the case of Arduino, it has 6 ADC pins, so we can use any of the 6 pins directly without using an ADC converter. The sensor module consists of a potentiometer, LN393 comparator, LEDs, capacitors and resistors. The pinout image above shows the components of the control module. The rainboard module consists of copper tracks, which act as a **variable resistor**. Its resistance varies with respect to the wetness on the rainboard.

Figure 3.11 Rain Sensor

3.5 Microcontroller System

NodeMCU, Figure 3.12 has been chosen as it can develop quickly an IoT application with less integrated circuits. It is an open-source firmware and development kit that plays a vital role in designing a proper IoT product using a few script lines. This module is mainly based on ESP8266 introduced by manufacturer Espressif Systems that is a low-cost Wi-Fi microchip incorporating both a full TCP/IP stack and microcontroller capability. It is a complex device combining some features of the ordinary Arduino board and connecting to the internet.

Arduino Modules and Microcontrollers have always been a great choice to incorporate automation into the relevant project. But these modules are not perfect as they do not feature a built-in WiFi capability. Therefore, a NodeMCU which is based on ESP8266 WiFi SoC is used to replace the Arduino Modules as it is a device that has some features of the Arduino board. This NodeMCU is also an open-source firmware and development kit that helps you to prototype your IOT product within a few lines of LUA script and it can be programmed easily using C or C++ language in Arduino IDE (A.A.Dahoud and M.Fezari, 2018).

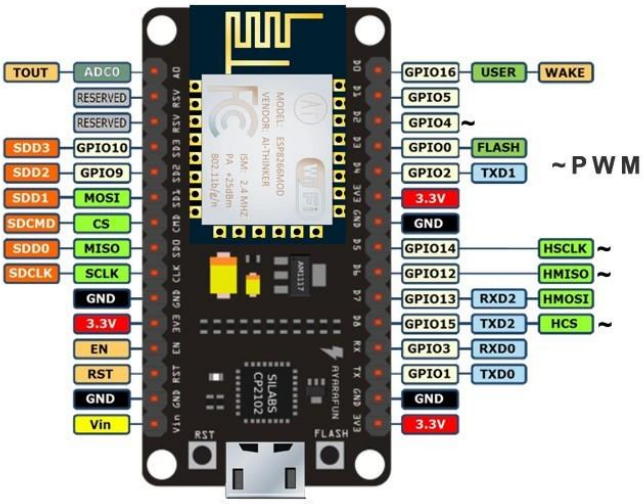

Figure 3.12 NodeMCU and Pinout function

3.6 Flowchart

Figure 3.13 below shows the flowchart of communication system. This flowchart is used as a guidance to the user to understand how the command system flow and the corresponding of the system.

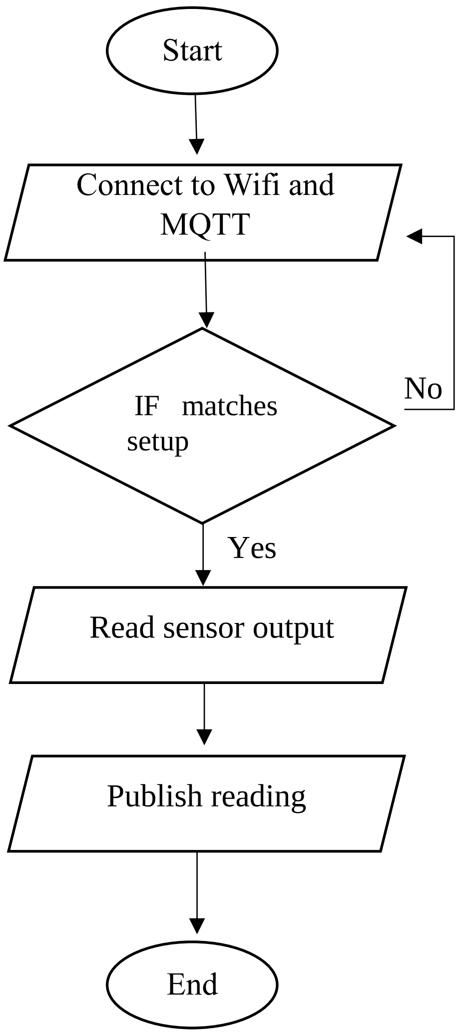

Figure 3.13 Flowchart of Microcontroller System

3.7 Mobile Application Design

The Figure 3.7.1 below show the mobile application design of this project. This mobile application allow user to control the desire value of time to start the irrigation through the buttons and the LCD display show user the information of surrounding conditions if their plants.

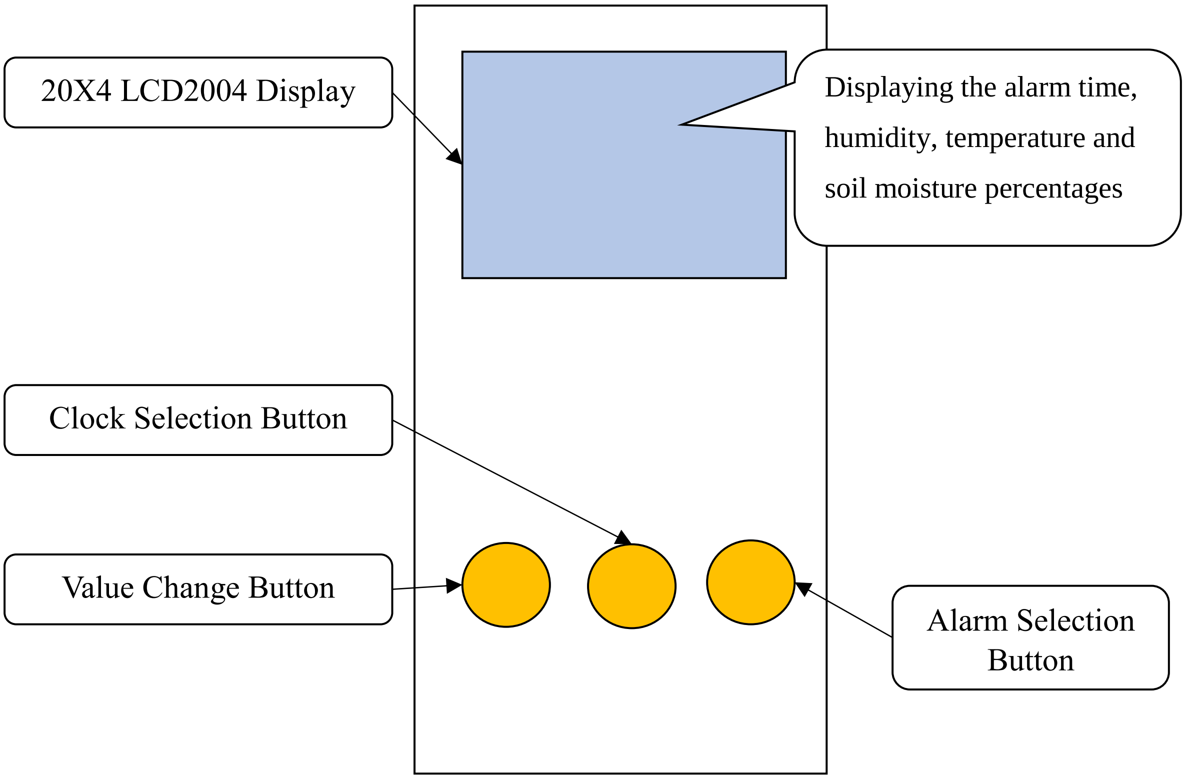

Figure 3.14 Mobile Application Design

3.8 Timeline

The timeline of SDP 1 was from February 2020 to July 2020. The tasks are equally distributed among group members, so everyone has their own scope of work need to be done within time provided. Gantt Chart for SDP 2 also had been planned and done to use as a guidance for the incoming next semester. The Gantt Chart for SDP 1 and 2 can be found in appendix A.

3.9 Cost Analysis

In this project, our target is to design and develop a solar automated irrigation with monitoring system which affordable for the farmers nowadays. A low consumption of power is important as the cost of energy will be burden to the farmers. Therefore, solar panel is recommended to use in this project as it can supplying renewable energy without paying money and it is environment friendly. Using a solar powered irrigation with monitoring system success to achieve the requirement of products nowadays and acceptable by the public especially the youth who mostly have the smartphone in their life. The listing of items, quantity, price per unit and the total price of all items is show in the appendix B.

CHAPTER 4
RESULT & DISCUSSION

4.1 INTRODUCTION

In this chapter, the results and outcomes of the project will be listed and showed in detail. The information and design of the system is showed by figure in below.

4.2 CIRCUIT SETUP FOR MICROCONTROLLER AND SENSORS

The microcontroller was set-up in a microcontroller box Figure 4.1 that including the electrical component such as NodeMCU, Raspberry Pi, relay, 9V battery to switch on the microcontroller and the 12V battery the switch on the water pump. The microcontroller box was located inside the upper box. The water pump was located inside the lower part of the prototype. Besides, the solar panel and the solar charge controller also attached with the prototype. In addition, the soil moisture sensor and humidity and temperature sensor also attached at the Parit tray.

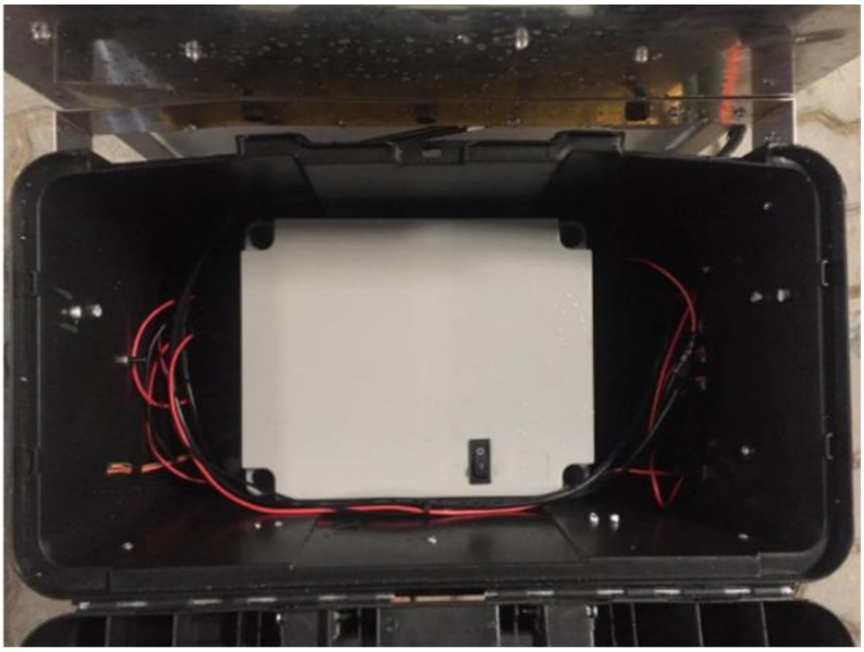

Figure 4.1 Box for Microcontroller

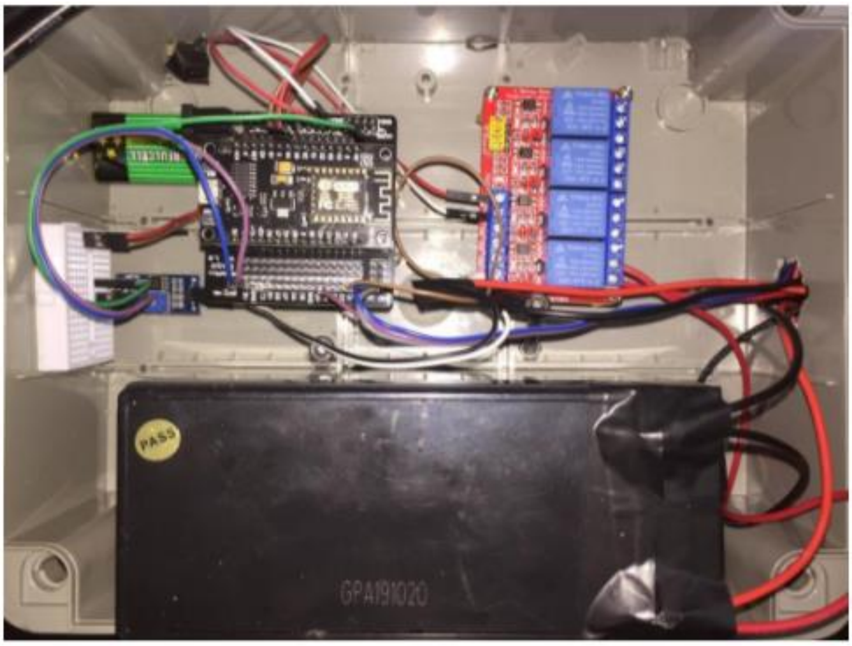

Figure 4.2 Circuit for Microcontroller

In the figure 4.2 above is the cicuit connection for NodeMcu Esp8266. The circuit is connected for the sensors and also solenoid valve. For figure 4.3 below, it is the setup at the pre-nursery site.

Figure 4.3 Setup at site

The rain sensor and soil moisture sensor had been setup at the parit tray as shown in Figure 4.4 and Figure 4.5.

Figure 4.4 Rain sensor setup

Figure 4.5 Soil moisture setup

4.3 MOBILE APPLICATION

The interface had been design to show the reading of soil moisture sensor, humidity sensor, temperature sensor and also rain water sensor. This mobile application can be used by the user to monitor the sensor parameter and also to controll on off of the solenoid valve. This application had been setup by using coding in Arduino IDE software.

Figure 4.6 Blynk App Interface (OFF)

In figure 4.1 above is the interface of the Blynk application when the condition off where the valve is off. The reading of soil moisture is in dr condition because there is no water irrigation process when valve is off. For figure 4.2 below, the interface of blynk application is in ON mode. So the user can see the reading of the soil moisture and also rain sensor will change.

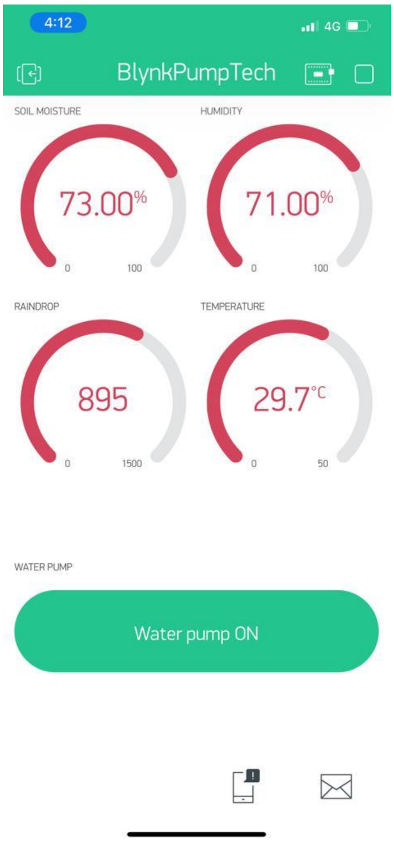

Figure 4.7 Blynk App Interface (ON)

In Figure 4.8 below, it is where the condition when the rain sensor detect the overflow of water. This notification will alert the user in the application and also give the notification at email of user. The user should turn off the valce if this notification alert pop up.

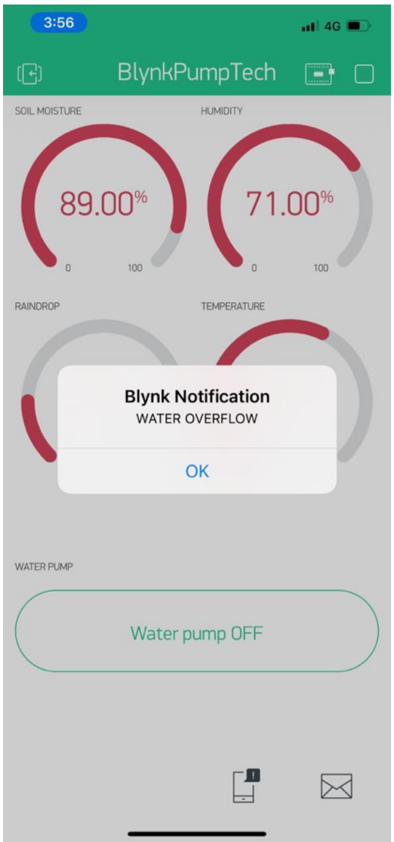

Figure 4.8 Overflow notification

4.4 NodeRed Webpage

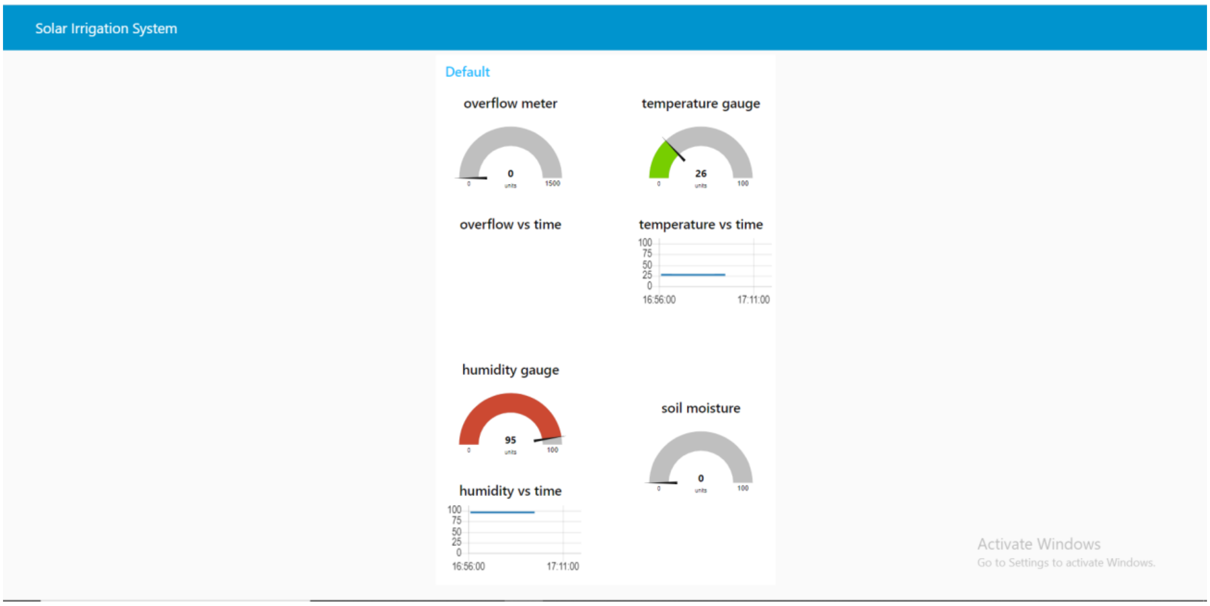

Figure 4.9 Web interface

In the figure 4.9 above, it is the interface of web based monitoring by using NodeRed. This web based can be acces by using the IP adress that had been setup for this system. It can be used only to monitor the reading of the sensors at the pre-nursery.

4.5 Discussion

In discussion, the results show that there is different between the reading of sensor before and after the solenoid valve is ON in blynk application. This result means that the information of the sensor is vital to let the user or farmer alert with the condition of soil at the nursery. The sensor reading may be differ because of the sensitivity of the sensors that has been used.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Introduction

In this chapter, the overall project will be summarized, and also will stated the limitations of the project, recommendation is suggested to give an idea to other researcher who refer to this thesis.

5.2 Conclusion

For the conclusion, the objectives of this project are achieved. This project had been successfully to develop an IoT-based solar irrigation system which can be operated by solar energy. The system can be controlled and monitored by the microcontroller through mobile application and also can be monitored using the web based interface. The mobile application Blynk can be downloaded from the application store such as iOS Appstore or Android Playstore for user to use in their smartphones. The web based can be acces by using the IP adress that had been setup for this system. The usages of water and electricity can be optimized by using this system because this system use the drip irrigation system and this system has a feature where it will notify the user the condition of the soil. The electricity can be optimize because this system is powered up by using solar. This system is using a low-cost material with RM468.70 which make it affordable for small scales of farmers and for big scale farmers this system can be custom based on the condition. This system can be defined as a low cost budget system and an environmental-friendly as it is powered by solar energy. With the hope that this system can help all the farmers in agricultural insdustry can have a better and good crop. Furthermore it can also help them ease their work at the nursery

5.3 Limitation

This system that had been develop had a limitation. Therefore this system will need some improvement that can be done to increase the efficiency, performance, safety, and functionality. The limitations had been found during the testing phase where the problem is the microcontrollers need to be use in this project is more than one because of the amount of sensor . This will cause the designing and implementation of this system will become more complex and also increase the cost of product.

Other than that, the limitation of this system is it is not a fully automated system that will automatically stop the irrigation when the soil moisture is achieved the appropriate amount of value or when the rainwater sensor detec the overflow water. Furthermore, the limitation of this system is it can only turn ON or OFF the solenoid valve by using Blynk application. The other limitation is the stability and accuracy of the sensor reading. The sensor used in this system may no be really accurate because of the accuracy and sensitivity of the sensors.

5.4 Recommendation

. For the recommendation, to reduce the complexity of this system if the system need to integrate with many sensors, it can be solved by using a microcontroller that has more pin and able to process large memory of the system. This also can be solved by further study in the programming part of the microcontroller. The system also can be improved to let the user set the timing for the valve ON/OFF by using a real time clock module to the microcontroller. Real time clock module provides the system with a time that allow the microcontroller to be improved in any features that has relationship with time.

5.5 Future Work

Future work that can be done is to change to more powerful and stable wifi module microcontroller. It is so that the system can be integrate with many sensors and stable. Other tthan that, the work that can be done in the future is to improve the we-based monitoring by adding the database using cloud or firebase system.

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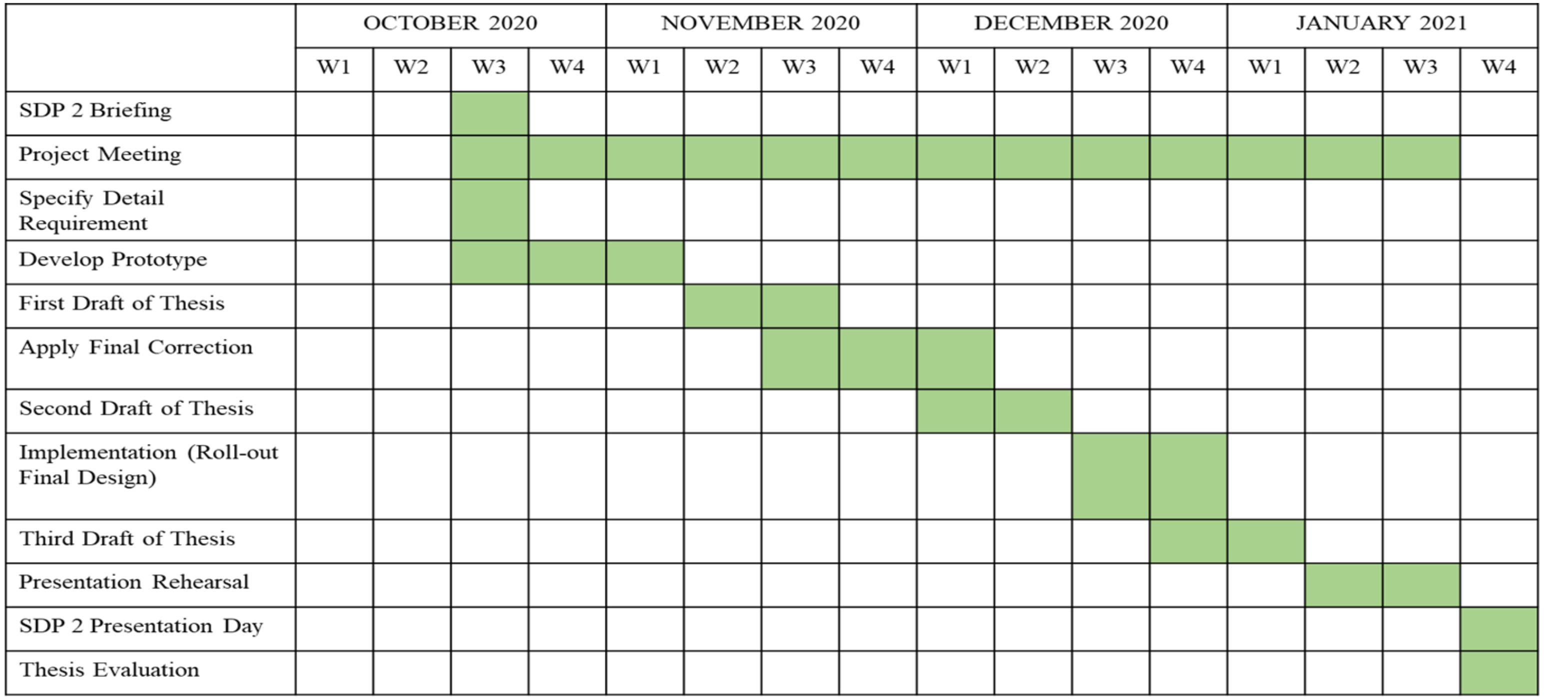
APPENDIX A

A1 GANTT CHART SDP1

	FEBRUARY 2020				MARCH 2020				JUNE 2020				JULY 2020			
	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
SDP 1 Briefing																
Project Meeting																
Gather Information																
Project Statement & Design Features																
Evaluate Design Concept																
Cost Analysis																
First Draft of Proposal																
Second Draft of Proposal																
Third Draft of Proposal																
Presentation Rehearsal																
SDP 1 Presentation Day																
Procurement																

APPENDIX A

A2 GANTT CHART II SDP2



APPENDIX B

BUDGET

No.	Items	Unit Price	Quantity	Amount
1	NodeMCU Board with Baseboard	RM24.80	2	RM24.80
2	3/4" PVC Pipe	RM9.00	1	RM9.00
3	3/4" PVC Pipe Fittings	RM4.80	1	RM4.80
4	16mm Drip Tape Fittings	RM22.00	1	RM22.00
5	16mm Drip Tape (50m)	RM30.00	1	RM30.00
6	PVC Socket Reducer 3/4" x 1/2"	RM0.45	1	RM0.45
7	LCD Module 16x2	RM20.30	1	RM20.30
8	Rain Sensor	RM7.00	1	RM7.00
9	Soil Moisture Sensor	RM7.00	1	RM7.00
10	40P Jumper Wires 20cm	RM4.00	3	RM12.00
11	12V DC Solenoid Valve	RM28.00	1	RM28.00
12	Water Flow Sensor	RM23.00	1	RM23.00
13	9V Battery Holder and Connector	RM3.00	1	RM3.00
14	1/2" PVC Pipe Fittings	RM5.35	1	RM5.35
15	1/2" PVC Pipe (1m)	RM1.60	1	RM1.60
16	Orange PVC Hose (5m)	RM13.00	1	RM13.00
17	2" 4bar Water Pressure Gauge	RM25.00	1	RM25.00
18	1/4" x 3/8" Bush	RM3.50	1	RM3.50
19	3/8" x 1/2" Bush	RM4.00	1	RM4.00
20	2 Core Pvc Twin Flat Cable 23/0.14x2C (per m)	RM1.00	18	RM18.00
21	Raspberry Pi 3 Model B+ with Micro SD Card	RM192.00	1	RM192.00
22	Arduino UNO	RM14.90	1	RM14.90
		Total		RM468.70

APPENDIX C

SITE VISIT

1. Visit at Merchong Nursery

Pre-Nursery

Sprinkler system at pre-nursery

Group Photo with YPPH

2. Site Visit at Endau Rompin

Pre Nursery

Pond

Group Photo

APPENDIX D

CODING

```
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include <DHT.h>
// You should get Auth Token in the Blynk App.
// Go to the Project Settings (nut icon).
char auth[] = "FqL29ghfSfstbk0lle79NGsvTcn7-CQh";
// Your WiFi credentials.
// Set password to "" for open networks.
char ssid[] = "Aiman's Iphone";
char pass[] = "aiman123";
int sensorState = 0;
int lastState = 0;
int sensorPin = A0;
int sensorValue = 0;
int percent = 0;
#define DHTPIN 0  // D3
// Uncomment whatever type you're using!
#define DHTTYPE DHT11     // DHT 11
//#define DHTTYPE DHT22   // DHT 22, AM2302, AM2321
//#define DHTTYPE DHT21   // DHT 21, AM2301
DHT dht(DHTPIN, DHTTYPE);
BlynkTimer timer;
// This function sends Arduino's up time every second to Virtual Pin
(5).
// In the app, Widget's reading frequency should be set to PUSH. This
means
// that you define how often to send data to Blynk App.
void sendSensor()
{
```

```
  float h = dht.readHumidity();
  float t = dht.readTemperature(); // or dht.readTemperature(true) for Fahrenheit
  if (isnan(h) || isnan(t)) {
    Serial.println("Failed to read from DHT sensor!");
    return;
  }
  // You can send any value at any time.
  // Please don't send more that 10 values per second.
  Blynk.virtualWrite(V5, t);
  Blynk.virtualWrite(V6, h);
}
void setup()
{
  // Debug console
  Serial.begin(9600);
  Blynk.begin(auth, ssid, pass);
  // You can also specify server:
  //Blynk.begin(auth, ssid, pass, "blynk-cloud.com", 8442);
  //Blynk.begin(auth, ssid, pass, IPAddress(192,168,1,100), 8442);
  pinMode(sensorPin, INPUT);
  dht.begin();
  pinMode(D1,OUTPUT);
  digitalWrite(D1,HIGH);
  // Setup a function to be called every second
  timer.setInterval(1000L, sendSensor);
}
void loop()
{
  Blynk.run();
  timer.run();
  sensorValue = analogRead(sensorPin);
  percent = convertToPercent(sensorValue);
  printValuesToSerial();
```

```
  delay(1000);
  }
int convertToPercent(int value)
{
  int percentValue = 0;
  percentValue = map(value, 1023, 465, 0, 100);
  return percentValue;
}
void printValuesToSerial()
{
  Serial.print("\n\nAnalog Value: ");
  Serial.print(sensorValue);
  Serial.print("\nPercent: ");
  Serial.print(percent);
  Serial.print("%");
  Blynk.virtualWrite(V4, percent);
}
#include <Blynk.h>
#include <ESP8266WiFi.h>
#include <PubSubClient.h>
#include <BlynkSimpleEsp8266.h>
#define BLYNK_PRINT Serial
BlynkTimer timer;
char auth[] = "FqL29ghfSfstbk0lle79NGsvTcn7-CQh";
char ssid[] = "Aiman's Iphone";
char pass[] = "aiman123";
const char* ssid2 = "Aiman's Iphone";
const char* password = "aiman123";
const char* mqtt_server = "172.20.10.2";
WiFiClient nodemcu1;
PubSubClient client(nodemcu1);
void setup_wifi() {
  // Connecting to a WiFi network
  WiFi.begin(ssid2, password);
```

```
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
}
void reconnect() {
  // Loop until we're reconnected
  Serial.println("In reconnect...");
  while (!client.connected()) {
    Serial.print("Attempting MQTT connection...");
    // Attempt to connect
    if (client.connect("Arduino_Moisture")) {
      Serial.println("connected");
    } else {
      Serial.print("failed, rc=");
      Serial.print(client.state());
      Serial.println(" try again in 5 seconds");
      delay(5000);
    }
  }
}
void setup(void) {
  Serial.begin(9600);
  setup_wifi();
  client.setServer(mqtt_server, 1883);
  Blynk.begin(auth, ssid,pass);
}
void loop()
{
  timer.run(); // Initiates SimpleTimer
  Blynk.run();
  char rainmsg[15],rainmotor1[5];
  int motoronoff;
```

```
  if(!client.connected()){
  reconnect();
}
int rainsensor = analogRead(A0);
Serial.print("rainsensor");
Serial.print(rainsensor);
if((rainsensor>100) && (rainsensor<450))
{
  sprintf(rainmotor1,"0",motoronoff);
  Blynk.notify("WATER OVERFLOW");
}
else
{
  sprintf(rainmotor1,"1",motoronoff);
}
sprintf(rainmsg,"%i",rainsensor);
client.publish("rainsensor",rainmsg);
client.publish("valve",rainmotor1);
Blynk.virtualWrite(V1,rainsensor);
delay(2000);
}
/*void getSendData()
{
data1 = analogRead(rainsensor);
  Blynk.virtualWrite(V1, data1); //virtual pin V3
if((data1>100) && (data1<450)) {
  Blynk.notify("WATER OVERFLOW");
}
}*/
```