POLITEKNIK SULTAN HAJI AHMAD SHAH

SELF-WATERING SYSTEM

NAME	REG. NUMBER
ALLHAM ZIQRI BIN ABDULLAH	02DKM19F1122
NURUL AMIRAH NABILAH BINTI MOHD HISHAM	02DKM19F1012
MAIZATUL NADHIRAH BINTI MUHAMAD	02DKM19F1007
MUHAMMAD FIRDAUS BIN ANUAR	02DKM19F1102

DEPARTMENT OF MECHANICAL ENGINEERING

2021/22

1.0CHAPTER 1

1.1 INTRODUCTION

Self-watering system (SWS) is a one system that controlled wirelessly using WIFI connection. This system is app enabled connection between mobile apps and watering system. Its help orchard owner to minimize their work on watering their plant and can focus on another job.

This watering system is powered by Arduino board that control valve, by checking and monitoring plant soil moisture level and notified the farmer. Arduino will open the valve and supply the water from water tank to the sprinkler and water the plant. This system could provide more time to farmer to manage more time and work on something else.

From the farmer POV (point of view), they would like to have automatic self-watering to help them watering plant so they can do some other tasks. SWS can help to water the plant as they need.

In involving of moisture level sensor, SWS will keep providing water until the soil moisture level needed is achieve. This way can provide enough water for plant and does not make plants dehydrate. SWS sensor will keeping working to sense the moisture in certain period time and push notification on app to notified farmer smartphone.

1.2 RESEARCH BACKGROUND

In this new era, fresh vegetables and fruit is highly demand. No matter who are they, either people or restaurant, they will get fresh vegetables and fruit from market. and restaurant demand from direct supplier which is farm.

This is quite important for farmer to boost their production to fulfill society need. To ensure they can keep up with boosting production. In need to boost production, it's hard to water the plant is large scale. in existence of SWS, it will help farmer to water the plant and can be used to provide fertilizer to plant.

SWS has featured in controlled wirelessly, the farmer can do another work task and just tap their smartphone screen to make SWS working, due to its connectivity through WIFI network. The farmer can water the plant even when they are away from farm. Farmer also can track water level and moisture in the apps.

1.3 PROBLEM STATEMENT

It really commons to notice that it is hard to working on watering the plant by one in large scale. or opening the valve and monitor the soil moisture to make sure it's enough to the plant. Every plant needs enough water so they can do photosynthesis that is a process used by plant to produce nutrient, water also help to move nutrient across the plant. So, having enough water is important to plant to keep healthy.

1.4 OBJECTIVE

The objective of this project research is:

I. Design self-watering system (SWS).
II. Develop a software or apps to controls SWS.
III. Analyze and test the effectiveness of the SWS to completely function.

1.5 RESEARCH QUESTION

This project research will answer the following question,

I. Does this system will reduce time use?
II. Will this system provide more time for farmer to do another task?
III. Does this system can fulfill watering in large scale?

1.6 SCOPE OF RESEARCH

The limits and scope to this research are,

I. The design of self-watering system is based on feature of Arduino system software.
II. Power by WIFI connection to connect into an apps or link through apple or Samsung house management.
III. Focusing on farm to enlarge the watering scales.
IV. Monitoring based on built in sensor.

1.7 SIGNIFICANCE OF RESEARCH

There is only self-watering system based on timer setting but not having app or any source to control and monitor the watering progression. The existing device could not control and track progression, this could lead to over watering to plant. Over watering can cause a big damage to plant. This disadvantage can cause a big loss to farmer in term of spending and time. This research came up with easy solution to help farmer in need.

1.8 HYPOTHESIS

In terms of our project, this research goals are to manage a healthy and neat work style. In specific, the farmer didn't need to worry about carrying huge load of water to watering the plant under scorching hot in the noon or struggling to opening the valve one by one. They can control valve in just one tap.

1.9 CHAPTER SUMMARY

In this chapter, the studies explain about the origin ideas and inspirations in orders to help producing crops yield. All the objectives made out from the problems statement. The objectives of this project and research are to help farmer to producing crops yields in massive. This product will be most convenient and easy to use. And the job scope really aims for farm in orders to help farmer to water their plant. Other than that, this system can be used for a long time and can be update for new feature or new apps interface that suits new era of farming.

2.0 CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, description of literature review regards to the project tittle of design and fabrication of self-watering system provided. This literature review with most common self-watering watering that being use at home or garden/farm. There are many products that have same function but with different design and scope usage. The explanation of each product will make a spark of ideas of building new self-watering product with specific function and scope for farmer use. With all the explanation gathered, the advantages and disadvantages seen on each common product is a good thing to be reviewed for making new product with an upgraded components to make better product.

Self-watering containers work on a reservoir system. There is a water storage tank, usually at the bottom of the container, which you fill. There is an overflow hole, so excess water simply drains away. The soil soaks up the water from the bottom, so if you keep the reservoir filled, your plants get a consistent level of moisture, delivered directly to their roots.

The reservoir system makes self-watering containers very water efficient. Because the water is stored out of the sun and wind, it evaporates slowly and with less water loss than if you sprayed water on your plants. There is also less chance of fungus and disease because you keep water off your plants' leaves by feeding them directly through their roots.

2.2 PRODUCT CAMPARISON

There are many types of self-watering system that already been made. But it's hard to find specific one that compatible with current issues or the situation. From the basic to advance type of self-watering system, none of them can cover up with all the problem occurred in the farm with specific problem. Those price range comes ion between RM 20 – RM 500. And it can go higher within the specific kind of land structure.

The most basic self-watering system is timer valve-control (as shown in figure 2.1). Which is only control valve opening and closing within time sets, but it cannot diagnose the moisture level. As the time sets comes, the valve will be opened to water the plant. But the water level in soil cannot be controlled.

Figure 2.1

The valve control in figure 2.1 allows user to set the timer as they like to water the plant. This type of valve control will go on repeat cycle as the timer sets. And only off when users turn the device off themselves. On longer period usage, whether the plant is well watered or not, the valve only keeps working by the time sets.

Figure 2.1 Calber 8053 Oasis

The Claber 8053 Oasis is the most expensive watering system on our list. It has many enticing features to make up for the cost. Features

4 Program Settings on the Timer. This is important because it allows you to choose how often your plants are watered, based on their needs, without your own scheduling needing to adjust.20 Plant Capacity. The Claber Oasis can water up to 20 plants at once, allowing for a larger indoor garden that is maintained well.

Everything Needed is Included. Everything, except the battery, is included in the package. This means you can set it up right away without the extra hassle or cost of order other parts.Award-Winning. The Claber Oasis is award-winning and reliable. The design is well-functioning and customizable to your needs.

Easy to Use and Install. The Claber Oasis is easy to install and set up and is ready to use in minutes. There is only one set of easy-to-understand controls that make your watering needs easily taken care of.

As stated above, this system is the most expensive on our list, but it is also highly efficient. The Claber Oasis system is reliable, as well, with a 2-year manufacturer’s warranty included with your purchase.

Figure 2.3 Blumat Automatic Watering Sensors

The Blumat Automatic Watering Sensors are the second-most expensive item on our list. This is a starter drip system and is ready for your beginner garden. In your order, you will find all your needs, such as the tubes, the sensors, the nozzles, and connectors. This is also the best eco-friendly design, so other eco-friendly choices such as the lack of electricity used.

How the System Works,

First, the tubes with the nozzles and sensors attached, are connected to an elevated water reservoir such as a bucket. Next, the nozzles are placed in the soil in the pots with the plants. Then, when the sensor detects dry soil, it will cause the tube that is clamped to open and release water into the plant. Finally, when the sensor detects enough moisture, the clamp goes back down, and the water stops flowing.

While this product does not include the reservoir for water, and it only comes with a set of 5 tubes and nozzles with sensors, it is automatic detection of watering need makes the Blumat system one of the top systems. Not only will this save your water usage, but this would also be ideal for a rain-catching reservoir due to its already eco-friendly design.

Figure 2.4 GARDENA WATER TIMER

something more sophisticated than a simple twist timer like the Gardena reviewed below, then consider this cracking fully-auto battery-powered entry from Amazon player OMORC. For the price (under £25), it offers loads of handy automation like daily timers (every day to odd days), length of watering, plus a rain delay button which you need to manually tap if precipitation is on the horizon. It also has a child lock so youngsters cannot screw things up.

PRODUCT COMPARISON

PRODUCT	CHARACTERISTICS	PROBLEMS	REFERENCES
	-Automatic valve control -Timer controlled -LED display	-no water controls - no equipment included	Shoppe.my
	-4 program setting -support to 20 plants -complete set -easy to use and install	-indoor plant only -most expensive	Amazon.my
	-sensor built in - complete set -easy to set up	-Limited planting - product does not include the reservoir for water	Amazon.my
	-dial style timer -Easy to use	-1 time use per setting	Amazon.my

2.3 COMPONENT EXPLANATION

2.3.1ARDUINO

What is Arduino?

Arduino is an open-source hardware and software company, project and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices. Its hardware products are licensed under a CC-BY-SA license, while software is licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL),[1] permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially from the official website or through authorized distributors.

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards ('shields') or breadboards (for prototyping) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs. The microcontrollers can be programmed using the C and C++ programming languages, using a standard API which is also known as the "Arduino language". In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) and a command line tool (Arduino-cli) developed in Go.

The Arduino project began in 2005 as a tool for students at the Interaction Design Institute Ivrea in Ivrea, Italy,[2] aiming to provide a low-cost and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors.

Type of Arduino board

ARDUINO UNO

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

You can tinker with your Uno without worrying too much about doing something wrong, worst-case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases.

The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards**.**

2.3.2 MOISTURE SENSOR

What is moisture sensor?

Soil moisture sensors measure the volumetric water content in soil.[1] Since the direct gravimetric measurement of free-soil moisture requires removing, drying, and weighing of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content.

The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric conductivity. Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture. Portable probe instruments can be used by farmers or gardeners.

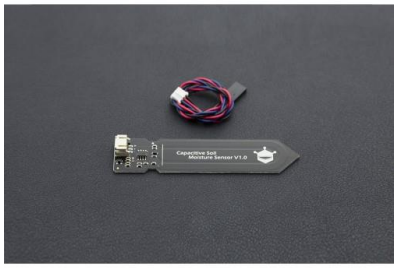
Soil moisture sensors typically refer to sensors that estimate volumetric water content. Another class of sensors measure another property of moisture in soils called water potential; these sensors are usually referred to as soil water potential sensors and include tensiometers and gypsum blocks.

Types of moisture sensor

Grove - Soil Moisture Sensor

This Moisture Senor can be used for detecting the moisture of soil or judge if there is water around the sensor, let the plant in your garden able to reach out for human's help when they are thirsty. This sensor is very easy to use, you can just simply insert in into the soil and read the data. With this sensor, you can make a small project that can let the plant send a message to you like " I am thirsty now, please feed me some water."

Grove - Soil Moisture Sensor can measure soil moisture for plants. The soil moisture sensor consists of two probes that allow the current to pass through the soil and then obtain resistance values to measure soil moisture content. It can be used to decide if the plants in a garden need watering. You can also use soil moisture sensors in gardens to automate watering plants. It can be used very easily by just inserting the sensor into the soil and reading the output using ADC.



GRAVITY: ANALOG CAPACITIVE SOIL MOISTURE SENSOR - CORROSION RESISTANT

This soil Moisture sensor is made of a corrosion resistant material giving it a long service life. Insert it into soil and impress your friends with the real-time soil moisture data!

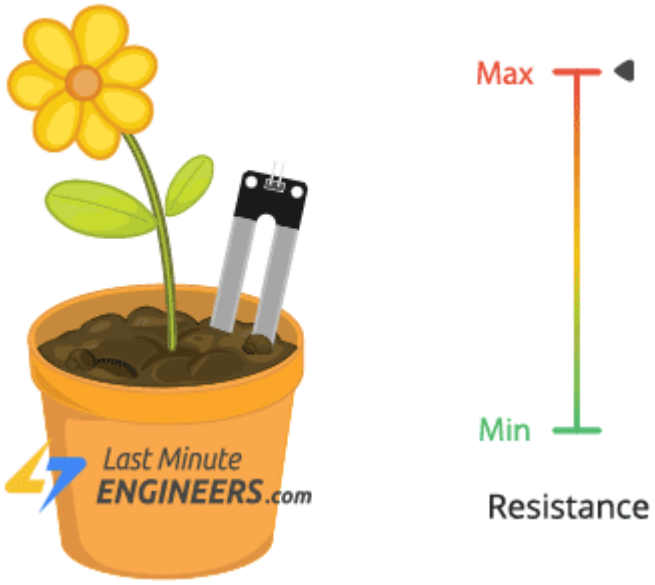
The product includes an on-board voltage regulator which gives it an operating voltage range of 3.3 ~ 5.5V. It is compatible with low-voltage MCUs (both 3.3V and 5V logic). Perfect for checking your plant's health, you can get text if your plant is getting too dry and you can use this sensor for other awesome projects.

This sensor is compatible with our 3-pin "Gravity" interface, which means it can be directly connected to the Gravity I/O Expansion Shield.

How moisture sensor work?

The working of the soil moisture sensor is straightforward. The fork-shaped probe with two exposed conductors, acts as a variable resistor (just like a potentiometer) whose resistance varies according to the water content in the soil.

This resistance is inversely proportional to the soil moisture:



The more water in the soil means better conductivity and will result in a lower resistance. The less water in the soil means poor conductivity and will result in a higher resistance.

The sensor produces an output voltage according to the resistance, which by measuring we can determine the moisture level.

Hardware Overview

A typical soil moisture sensor has two components.

The Probe

The sensor contains a fork-shaped probe with two exposed conductors that goes into the soil or anywhere else where the water content is to be measured.Like said before, it acts as a variable resistor whose resistance varies according to the soil moisture.

The Module

The sensor also contains an electronic module that connects the probe to the Arduino. The module produces an output voltage according to the resistance of the probe and is made available at an Analog Output (AO) pin.

The same signal is fed to a LM393 High Precision Comparator to digitize it and is made available at a Digital Output (DO) pin.

The module has a built-in potentiometer for sensitivity adjustment of the digital output (DO). You can set a threshold by using a potentiometer; So that when the moisture level exceeds the threshold value, the module will output LOW otherwise HIGH.

This setup is very useful when you want to trigger an action when certain threshold is reached. For example, when the moisture level in the soil crosses a threshold, you can activate a relay to start pumping water.

2.3.6. AUTOMATIC VALVE

What is automatic valve?

Automatic control valves are specialty valves fitted with actuators that can be controlled by temperature or flow sensors. The valves are controlled by electrical, hydraulic, or pneumatic signals from sensors. The valves can be set to open, closed or anywhere in between to accurately control flow. Uses include water treatment plants, multi-story buildings, water storage towers, and reclaimed water systems.

Control valves

regulate the flow or pressure of a fluid. They normally respond to signals generated by independent devices such as flow meters or temperature gauges. They are fitted with actuators and positioners. Pneumatically actuated globe valves are widely used for control purposes in many industries, although quarter-turn types such as (modified) ball and butterfly valves are also used.

They regulate the flow of a fluid (gases, liquids, fluidized solids, or slurries) by opening, closing, or partially obstructing various passageways. They are technically pipe fittings but are usually discussed as a separate category. In an open valve, fluid flows in a direction from higher pressure to lower pressure.

Pressure Control

Water Control valves can also work with hydraulic actuators (also known as hydraulic pilots). The hydraulic actuators will respond to changes of pressure or water flow and will open/close the valve. Flow-matic also carries actuated solenoid valves.

Flow Control

These are used in a variety of contexts, including industrial, military, commercial, residential, and transportation. The industries in which the majority of valves are used are oil and gas, power generation, mining, water reticulation, sewerage and chemical manufacturing.

Plumbing valves, such as taps for hot and cold tap water are the most noticeable types of valves. Other valves encountered daily include gas control on cookers, small valves fitted to washing machines and dishwashers, and safety devices fitted to hot water systems.

They may be operated manually, either by a hand wheel, lever, or pedal. Valves may also be automatic, driven by changes in pressure, temperature, or flow. These changes may act upon a diaphragm or a piston which in turn activates the valve. Examples of this type of valve found commonly are safety valves fitted to hot water systems or boilers.

More complex control systems using valves requiring automatic control based on an external input (i.e., regulating flow through a pipe to a changing set point) require an actuator. An actuator will stroke the valve depending on its input and set-up, allowing the valve to be positioned accurately, and allowing control over a variety of requirements.

2.3.7 IRRIGATION SPRINKLER

DIAGRAM 2.3

An irrigation sprinkler (also known as a water sprinkler or simply a sprinkler) is a device used to irrigate agricultural crops, lawns, landscapes, golf courses, and other areas. They are also used for cooling and for the control of airborne dust. Sprinkler irrigation is the method of applying water in a controlled manner in way similar to rainfall. The water is distributed through a network that may consist of pumps, valves, pipes, and sprinklers.

Irrigation sprinklers can be used for residential, industrial, and agricultural usage. It is useful on uneven land where sufficient water is not available as well as on sandy soil. The perpendicular pipes, having rotating nozzles on top, are joined to the main pipeline at regular intervals. When water is pressurized through the main pipe it escapes from the rotating nozzles. It gets sprinkled on the crop. In sprinkler or overhead irrigation, water is piped to one more central location within the field and distributed by overhead high-pressure sprinklers or guns.

Types

Industrial

Higher pressure sprinklers that themselves move in a circle are driven by a ball drive, gear drive, or impact mechanism (impact sprinklers). These can be designed to rotate in a full or partial circle.

Rain guns are like impact sprinklers, except that they generally operate at very high pressures of 2.8 to 9.0 bar (280 to 900 kPa; 40 to 130 lbf/in2) and flows of 3 to 76 L/s (50 to 1,200 US gal/min), usually with nozzle diameters in the range of 10 to 50 mm (0.5 to 1.9 in). In addition to irrigation, guns are used for industrial applications such as dust suppression and logging.

Many irrigation sprinklers are buried in the ground along with their supporting plumbing, although above ground and moving sprinklers are also common. Most irrigation sprinklers operate through electric and hydraulic technology and are grouped together in zones that can be collectively turned on and off by actuating a solenoid valve.

Residential.

Home lawn sprinklers vary widely in their size, cost, and complexity. They include impact sprinklers, oscillating sprinklers, drip sprinklers, underground sprinkler systems, and portable sprinklers. Permanently installed systems may often operate on timers or other automated processes. They are occasionally installed with retractable heads for aesthetic and practical reasons, reducing damage during lawn mowing. These types of systems usually can be programmed to start automatically on a set time and day each week.

Small portable sprinklers can be placed temporarily on lawns if additional watering is needed or if no permanent system is in place. These are often attached to an outdoor water faucet and are placed for a short period of time. Other systems may be professionally installed permanently in the ground and are attached permanently to a home's plumbing system.

An antique sprinkler developed by Nomad called a 'set-and-forget tractor sprinkler' was used in Australia in the 1950s. Water pressure ensured that the sprinkler moved slowly across a lawn.

Agricultural science

The first use of sprinklers by farmers was some form of home and golf course type sprinklers. These ad hoc systems, while doing the job of the buried pipes and fixed sprinkler heads, interfered with cultivation and were expensive to maintain. Center-pivot irrigation was invented in 1940[3] by farmer Frank Ziebach, who lived in Strasburg, Colorado. In the 1950s, Stout-Wyss Irrigation System, a firm based in Portland, Oregon, developed a rolling pipe type irrigation system for farms that has become the most popular type for farmers irrigating large fields. With this system, large wheels attached to the large pipes with sprinkler heads move slowly across the field.[4]

Underground sprinklers

Underground sprinklers function through means of basic electronic and hydraulic technology. This valve and all the sprinklers that will be activated by this valve are known as a zone. Upon activation, the solenoid, which sits on top of the valve is magnetized lifting a small stainless-steel plunger in its center. By doing this, the activated (or raised) plunger allows water to escape from the top of a rubber diaphragm located in the center of the valve.

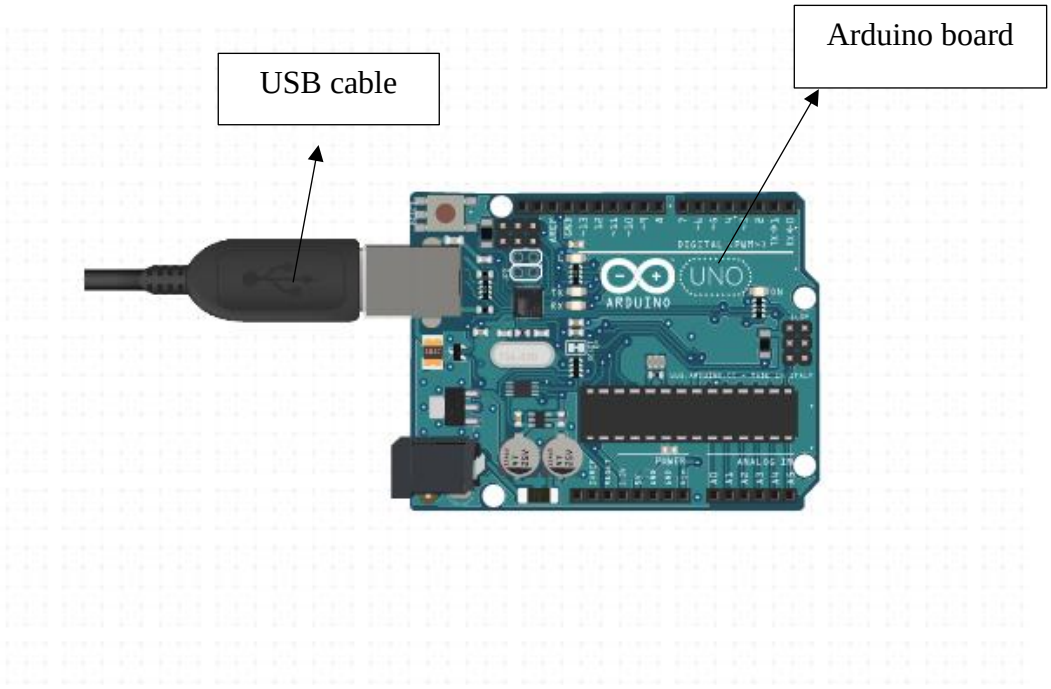
Water that has been charged and waiting on the bottom of this same diaphragm now has the higher pressure and lifts the diaphragm. This pressurized water is then allowed to escape downstream of the valve through a series of pipes, usually made of PVC (higher pressure commercial systems) or polyethylene pipe (for typically lower pressure residential systems).

At the end of these pipes and flush to ground level (typically) are premeasured and spaced-out sprinklers. These sprinklers can be fixed spray heads that have a set pattern and generally spray between 1.5 and 2 m (5 and 7 ft), full rotating sprinklers that can spray a broken stream of water from 6 to 12 m (20 to 40 ft), or small drip emitters that release a slow, steady drip of water on more delicate plants such as flowers and shrubs. Use of indigenous materials also recommended.

2.1 BUILD ARDUINO CIRCUIT

i. Step 1

Select suitable Arduino board. Start Programming on the board. Program the board to constantly check water level and soil moisture. And signal the valve to open to flow water to water the plant.

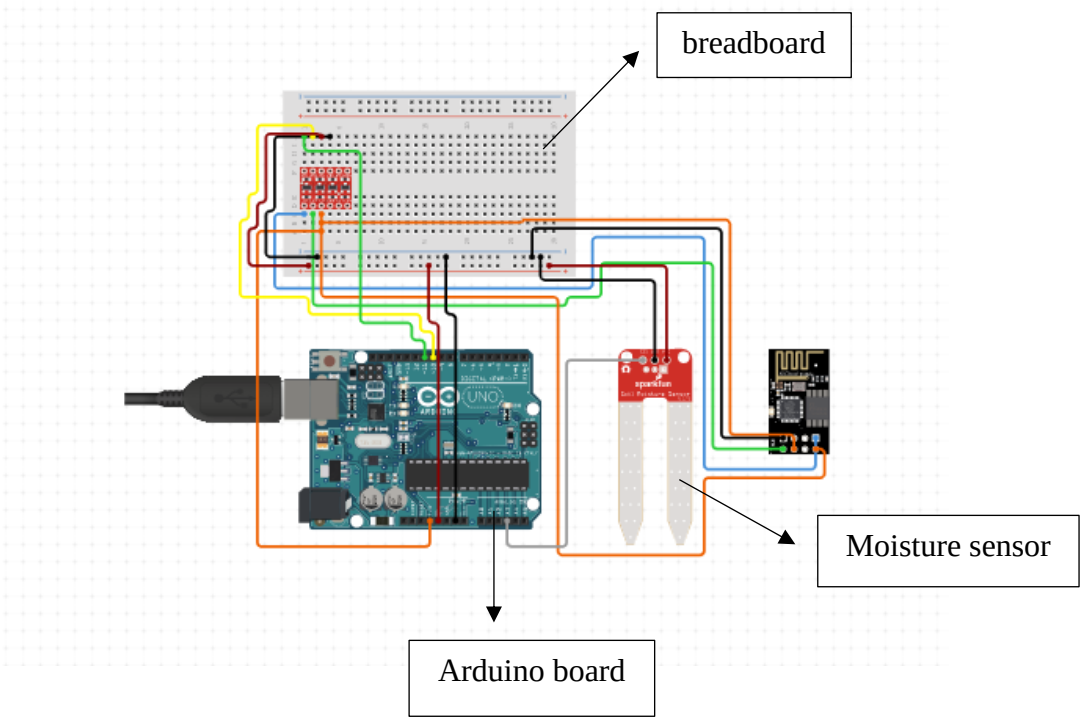


ii. Step 2

Connect Arduino board to USB cable to start coding and programming.

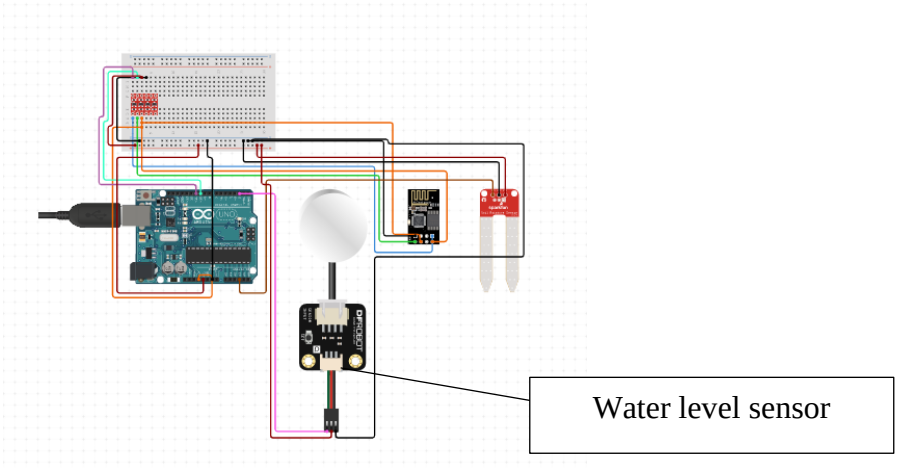
iii. Step 3

Add moisture sensor into the board.



iv. Step 4

Then connect water level sensor.



2.2CHAPTER SUMMARY

As the conclusion, all product listed have its own characteristic and specialty. The advantages and disadvantages give spark to develop new idea to build self-watering system with specific for farm.

3.0 CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

Methodology is "'a contextual framework' for research, a coherent and logical scheme based on views, beliefs, and values, that guides the choices researchers [or other users] make".

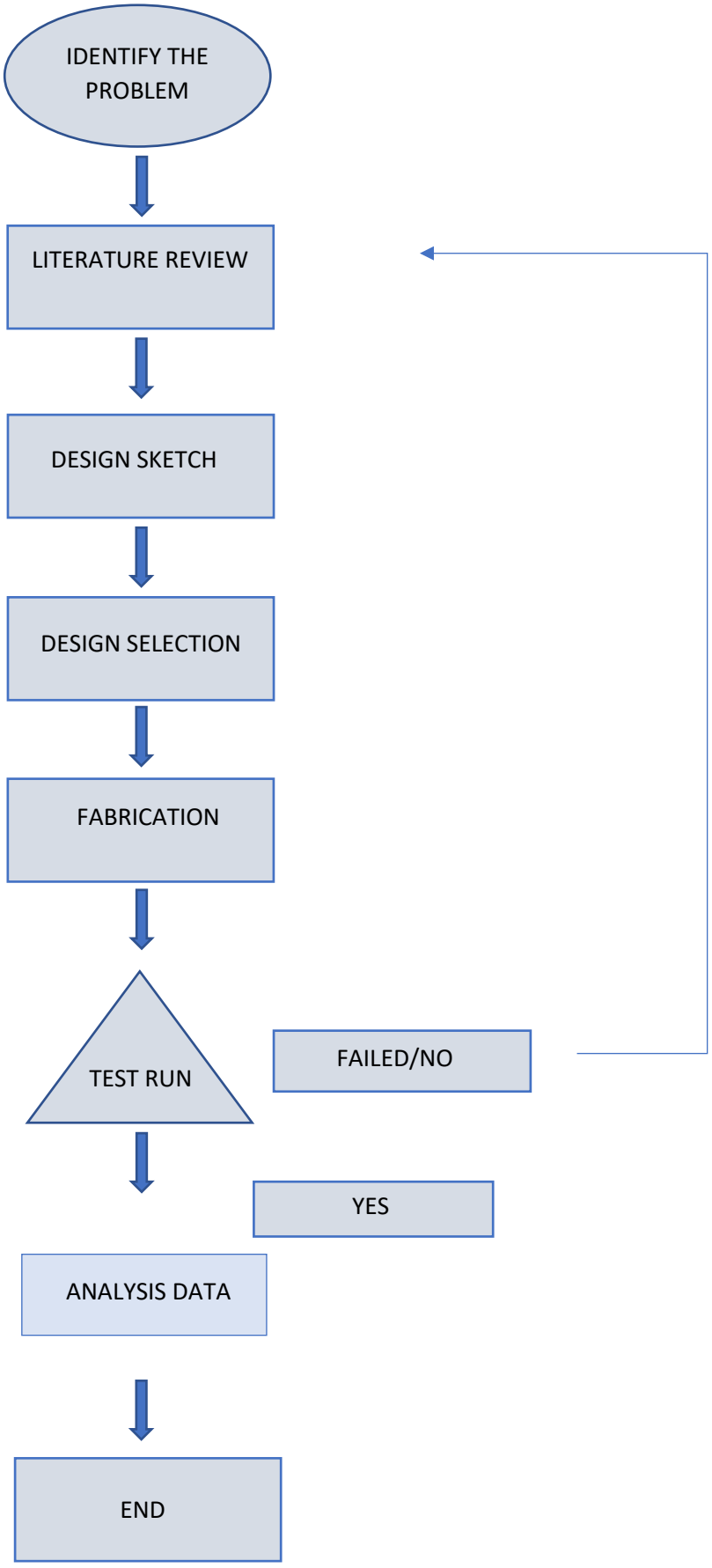
It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge such that the methodologies employed from differing disciplines vary depending on their historical development. This creates a continuum of methodologies that stretch across competing understandings of how knowledge and reality are best understood. This situates methodologies within overarching philosophies and approaches.

Methodology of this project is when the different component with different use and function is put together as new system. For example, solenoid and digital component as sensor is combined together in 1 system.

To make it simple, Arduino used to program and control the solenoid and the digital component together to make this project works. Arduino receive input from digital component and send output as solenoid open and close due to sets command.

Using Arduino as base, and connect digital component using jumper wire through breadboard, settle the input wiring before connects to the output, which is the solenoid.

3.2 FLOW CHART



3.3 PROBLEM STATEMENT

At the beginning of the project, we tried to identify the problems that existed in our daily living environment. As a result of our observations, we found that many Malaysian farmers are actively engaged in agricultural activities. We found that some of the problems that exist in terms of cost required in are quite high. The previous method of watering was manually, and this watering system was less systematic and ineffective.

3.4 LITERATURE REVIEW

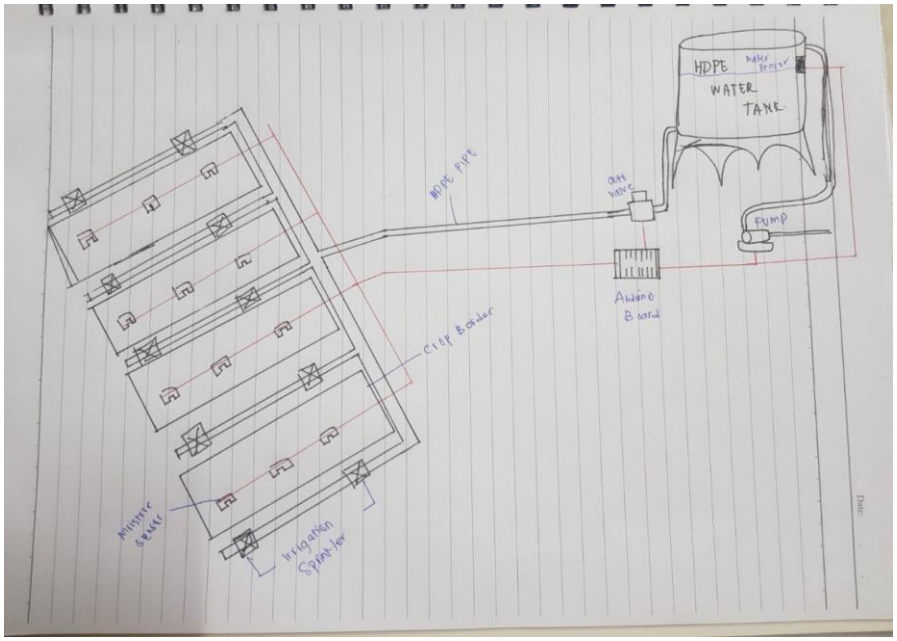
Based on the problem, we are trying to conduct field studies on the types of watering systems available in Malaysia. We found some flaws in the existing system that could be improved from existing products to increase the effectiveness of existing products. Among the disadvantages of the previous system is the high cost of requiring maximum manpower and it increases the cost of paying salaries.

Besides that, the agricultural produce is poor in quality as there is no watering in each tree. If we can see the previous system is to use a host and of course we need to constantly make observations for the watering process because this process is manual.

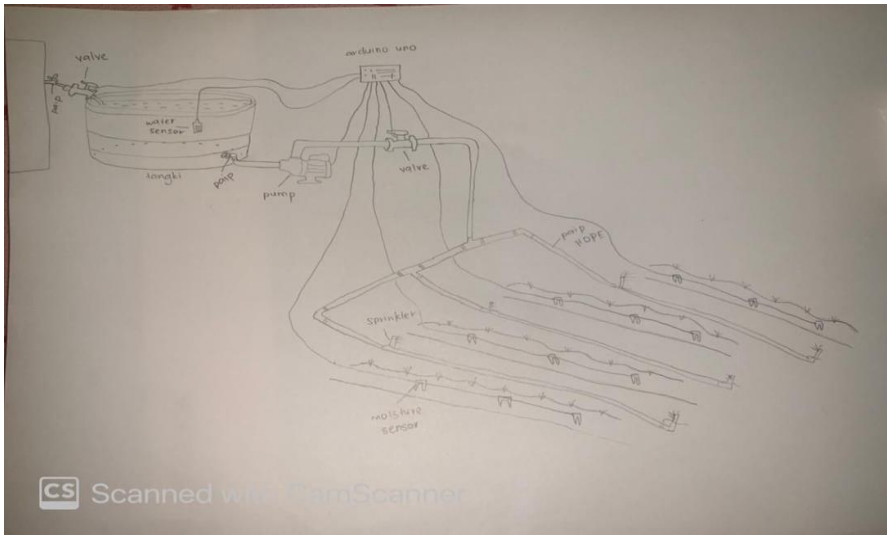
3.5 IDEA SKETCH

Based on literature review, below is some sketch sample for self-watering system. The plan and circuit of Arduino board.

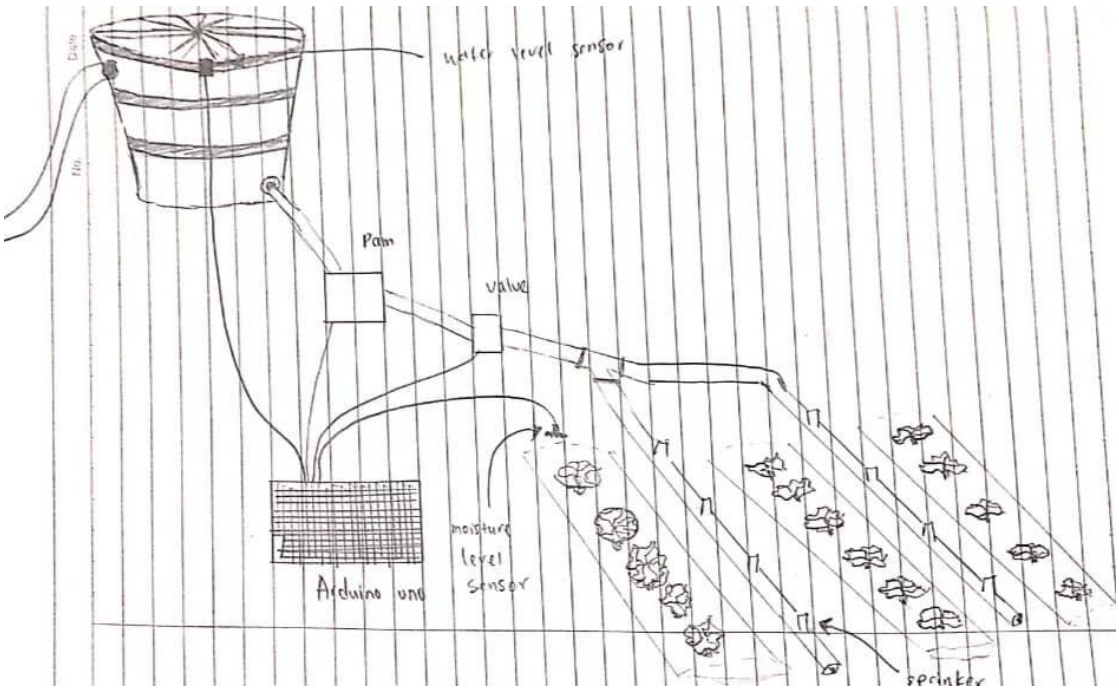
3.5.1 SKETCH 1



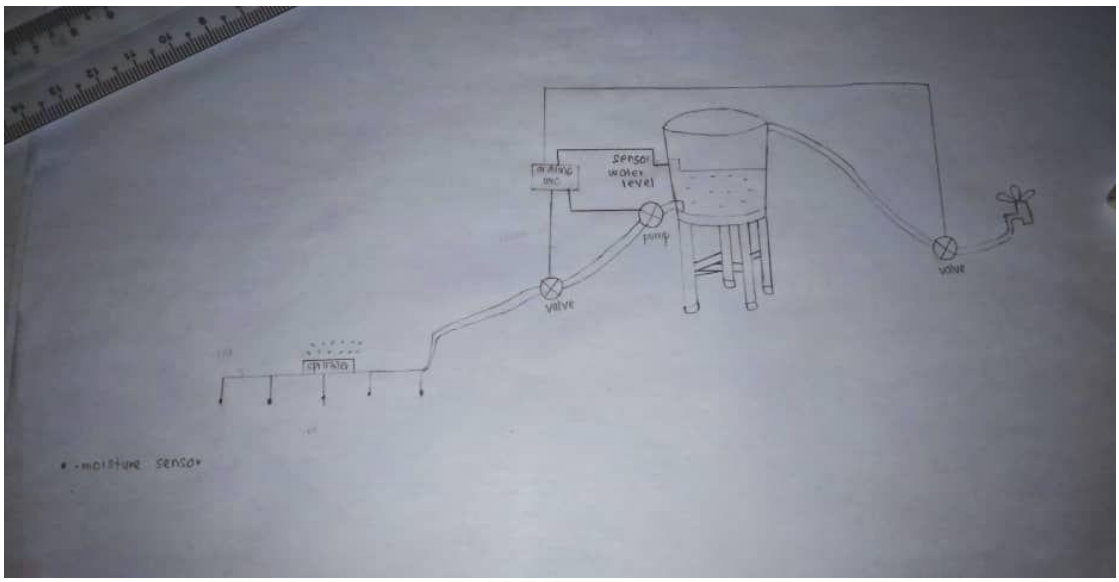
3.5.2 SKETCH 2



3.5.3 SKETCH 2



3.5.4 SKETCH 4



3.6 FABRICATION

As a result of the selection of ideas, we have done the product fabrication method. The process of product formation requires the use of tanks as a place for storage and supply of water and involves the use of sensors to detect moisture and water levels in tanks and programming of Arduino control systems. We have also used the valve for control of in and out of water, the valve will open upon obtaining instructions from the programmed Arduino system. Sprinklers are also used to ensure water watering standardization for all trees. The use of pumps is also required to assist the process of draining water from the tank to each sprinkler.

3.7 RUN TEST

As a result of the products produced, we carry out a run test process to ensure that the products produced achieve the set objectives. If the project does not meet the objectives set, we will re-design ideas, as well as conduct literature studies to find the cause of the problem. If the product is successful, then our study could be considered completed for achieving the set objectives.

3.8 CONCLUSION

As the conclusion, this chapter conclude the final decision for the self-watering system invention with details in sketching, component, journey, and methodology. By using the system that we have innovation, the workload of the farmers can be reduced besides saving time, saving the cost of hiring and crop skin is also maintained. This can produce quality breeds. Therefore, this self-watering system is a wise choice and benefits many farmers.

REFRENCE

https://sanifix.com.my/?p=640

https://www.elprocus.com/water-pump-types-and-applications/

https://store.arduino.cc/usa/arduino-uno-rev3

https://store.arduino.cc/usa/gravity-analog-capacitive-soil-moisture-sensor-corrosion-resistant

https://lastminuteengineers.com/soil-moisture-sensor-arduino-tutorial/

https://en.wikipedia.org/wiki/HDPE_pipe

https://www.flomatic.com/valves/automatic-control-valves/

http://www.fao.org/3/s8684e/s8684e06.htm