POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH

COMPARISON OF ACCURACY SOIL MOISTURE TEST USING STANDARD METHOS TEST WITH IR4.0 TECHNOLOGY

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CIVIL ENGINEERING DEPARTMENT

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This report is submitted to the Department of Civil Engineering as fulfilling part of the conditions of the award Diploma of civil engineering

CIVIL ENGINEERING DEPARTMENT

DECEMBER 2021

AKUAN KEASLIAN DAN HAK MILIK

COMPARISON OF ACCURACY SOIL MOISTURE TEST USING STANDARD METHOD TEST WITH IR4.0 TECHNOLOGY

1. Kami, **NISSANTI A/P SIVA KUMAR (NO KP: 010208-01-0814)** dan **ANUSHA SUBRAMANIAM (N0 KP:)**adalah pelajar **Diploma Kejuruteraan Awam, Politeknik Sultan Salahuddin Abdul Aziz Shah**, yang beralamat di **Persiaran Usahawan, 40150 Shah Alam, Selangor.**

2. Saya mengakui bahawa comparison of accuracy soil moisture test using standard method test with IR4.0 technology dan harta intelek yang ada di dalamnya adalah hasil karya/ reka cipta asli saya tanpa mengambil atau meniru mana-mana harta intelek daripada pihak-pihak lain.

3. Saya bersetuju melepaskan pemilikan harta intelek comparison of accuracy soil moisture test using standard method test with IR4.0 technology kepada Politeknik Sultan Salahuddin Abdul Aziz Shah bagi memenuhi keperluan untuk penanugerahan **Diploma Kejuruteraan Awam** kepada saya.

Diperbuat dan dengan sebenar-benarnya diakui
oleh yang tersebut;

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sebagai Penyelia Projek pada tarikh: ……..………….	NORLIZA BT MD JAHID

APPRECIATION

Thank God we were able to complete the final project with excellence within the stipulated period of 12 months without facing any problems that are difficult to resolve as a condition for the awarding of the Diploma in Civil Engineering session Dec 2021. We express our appreciation to all parties involved directly or indirectly especially our supervisor Pn Norliza bt MD Jahid who has given us a lot of guidance, advice, encouragement and constructive criticism so that we managed to complete this final project report. Not forgetting also to the friends and family members who helped a lot in terms of views and finances in completing this final project assignment.

With this we are thankful to god then this final project is ready. We hope that this report can be used as an example and guide to the relevant parties in the future.

ABSTRAK

Air bawah tanah sering menjadi punca pertikaian antara pemilik dan kontraktor dalam projek pembinaan. Isu air tanah yang biasa semasa pembinaan ialah kebocoran air, ruang bawah tanah basah dan pertumbuhan acuan. Air bawah tanah juga menjejaskan fungsi dan reka bentuk kemudahan, dan kos pembinaannya. Sensor kelembapan tanah mengukur kandungan air dalam tanah. Mengukur kelembapan tanah adalah penting untuk aplikasi pembinaan untuk membantu jurutera menguruskan sistem pengairan mereka dengan lebih cekap. Ciptaan baharu ini akan membantu jurutera atau pelajar dalam kursus kejuruteraan awam untuk mengenal pasti kelembapan tanah. Sensor kelembapan tanah mengukur atau menganggarkan jumlah air di dalam tanah. Ia boleh menjadi pegun atau mudah alih seperti probe pegang tangan. Sensor Kelembapan Tanah boleh memantau kandungan air tanah menggunakan rintangan atau perubahan kemuatan. Kajian literatur ini akan mengkaji penggunaan penderia dan bahan yang sesuai untuk menghasilkan penderia kelembapan tanah. Penderia lembapan tanah kapasitif mengesan kelembapan dengan memantau perubahan dalam kapasiti. Kapasitan ialah ukuran jumlah cas elektrik yang boleh ditahan merentasi potensi elektrik. Proses pemadatan yang digunakan untuk menilai kandungan air optimum di mana tanah boleh dipadatkan untuk mendapatkan ketumpatan tertinggi (berat unit kering). Jadual 2.1 menunjukkan pangkalan data dan penyelidikan terdahulu mengenai sensor kelembapan tanah sebagai cara manual dan juga menggunakan beberapa alat IR juga. Penderia adalah mudah dalam reka bentuk, kos terhad, kepekaan tinggi, kawasan penderiaan yang besar dan masa tindak balas yang baik. Bahan yang dipertingkatkan, proses pembuatan mems, titik kuantum graphene (gqds) sebagai grafena sifar dimensi (0d). Penderia lembapan tanah kapasitif medan pinggiran menggunakan teknologi papan litar bercetak.

ABSTRACT

Groundwater is a frequent cause of disputes between owners and contractors in construction projects. Common ground water issues during construction is water leaks, wet basements, and mold growth. Groundwater also affects the function and design of the facility, and the cost of its construction. Soil moisture sensors measure the water content in soil. Measuring soil moisture is important for construction applications to help engineers manage their irrigation systems more efficiently. This new invention will help out the engineers or students in civil engineering course to identify the moisture of the soil. Soil moisture sensors measure or estimate the amount of water in the soil. They can be stationary or portables such as handheld probes. Soil Moisture Sensor may monitor soil water content using resistance or capacitance changes. This literature review will examine the use of appropriate sensors and materials to produce soil moisture sensors. A capacitive soil moisture sensor detects moisture by monitoring changes in capacitance.Capacitance is a measure of the amount of electrical charge that can be held across an electrical potential. A compacting process used to evaluate the optimal water content at which a soil may be compacted to get the highest density (dry unit weight). Table 2.1 shows database and previous research regarding soil moisture sensor as manual way and also using some IR gadgets too. The sensor is simple in design, limited cost, high sensitivity, large sensing area and good response time. Improved materials, mems manufacturing process, graphene quantum dots (gqds) as zero-dimensional (0d) graphene. A fringing field capacitive soil moisture sensor using the printed circuit board technology.

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LIST OF SYMBOL

IOT	Internet Of Thing
IR4.0	Industrial Revolution

LIST OF ABBREVIATIONS

ABBREVIATIONS	TITLE	PAGE
A	Cost	**65**
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CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Construction Industry is one of the important and wanted in all over country. The geotechnical engineering Soil and environmental monitoring is an integral part of Civil Engineering structural solutions for long-term stability and safety. Long term soil moisture monitoring provides indication of soil saturation, water leaking under structures, and weakness associated with excess moisture. Soil sensors may be installed through or under asphalt or concrete structures and buried in place. The sensor data cables connect to a data logger, which provides periodic readings that are recorded in the data logger memory. This information is key to safety, soil and structure stability, or for providing compliancy and regulatory agency documentation, and may provide warning levels that the moisture is too high, or subject to shearing movements as well as other issues. The installation of soil sensors at varying depths indicates water movement and the changes in water balance. Buildings and some structures require moist soil to maintain the foundation's stability. Both soil-monitoring needs are solved with the soil sensors and loggers. The loggers provide set points that will trigger irrigation or alarms when soil is too dry, and have alarms available when the soil is too wet. From this, research this project will easily detect the soil moisture easily and will help out the engineers at the construction areas. By using Iot products and gadgets and Iot programming systems too. This method won't be thread to the users or effect the environment.

At Malaysia, soil moisture sensors have helped many engineers around the globe to enhance their construction soil moisture content. The devices have significant economic. Through the use of soil moisture sensors, engineers are able to know the exact soil moisture on their construction site. Modern commercial landscapes and residential lawns have been installed with soil moisture sensors that are compatible with irrigation controllers.

A probe is inserted into the soil for a few minutes, and a meter subsequently indicates the moisture content. Soil moisture sensors influence the engineer's techniques to be used for optimal performance. Torsiometers, Electrical resistance blocks, Time Domain Reflectometry (TDR Sensors), Frequency Domain Reflectometry (Capacitance Sensors), Neutron moderation 2 used in instantaneous measurement of the soil moisture content, salinity and temperature. Helps to track down the health of the soil. These are essential factors which every engineers, which are going to increase the quality of the soil, should focus on. Different kind of soil measurements and sensor are available with affordable price which every conscious engineers should use to check moisture contents.

Soil moisture sensors are ideal for research and experiments relating to relevant disciplines such as soil science, Geotechnics, environmental science and agriculture science and construction (civil engineering). The devices are also used as supplementary sensors for measurements relating to soil respiration and solute transport studies.

1.2 RESEARCH OF BACKGROUND

Types of soil tests for building construction works depend on properties of soil. Design of the foundation is based on soil test report of construction site. Soil moisture tests for construction of buildings or any structure is the first step in construction planning to understand the suitability of soil for proposed construction work.

Soil which is responsible for allowing the stresses coming from the structure should be well tested to give excellent performance. If soil shouldn't have tested correctly, then the whole building or structure is damaged or collapsed or leaned. So, soil inspection or testing is the first step to proceed any construction. Test for moisture content is an atterberg limits tests. Moisture content or water content in soil is an important parameter for building construction. Atterberg limits tests to measure the critical water content of a fine grained soil, atterberg provided three limits which exhibits the properties of fine grained soil at different conditions.

This study was conducted because soil moisture sensor is a humidity sensor that can detect moisture under the ground. These sensors are advanced, but ideal for monitoring residential area, and water levels construction areas. This sensor consists of two probes to pass current through the ground, then read the resistance to get the moisture level value. More water making the soil easier to transmit electricity which is small resistance, while if the soil is dry it’s very difficult to transmit electricity which make large resistance. This sensor is very helpful for alerting the moisture level to buildings areas of monitoring soil moisture.

1.3 PROBLEM STATEMENT

One of the problems is experienced by engineers in particular is the difficulty of monitoring soil moisture underground at construction areas or residential areas. Moisture measurement were measured alternately in a soil tester to generate data. Soil Moisture tests takes a quite long period to do and generate data. It almost takes 12 until 24 hours to identify the soils moisture content. Mostly soil moisture sensors are invented for to test gardening and plants soil accurately.

A site should have adequate soil volume to support the growth and development of the buildings selected. Avoid selecting a site where layers of rocks are near the soil surface, because there is little soil to absorb the water. Below ground soil layers that are impervious to or restrict water infiltration can cause problems. Hardpan that occurs within 30 inches of the surface should be penetrated.

Whenever construction must take place below the water table or soil is used to retain water, groundwater affects the project by impacting the function and design of the facility, and the cost of its construction. Groundwater is a frequent cause of disputes between owners and contractors in construction projects. Common ground water issues during construction is Construction delays, Unstable subgrade , Unstable excavation and **c**ommon ground water problems after construction is water leaks, wet basements, and mold growth ,Cracked and uneven floors, Cracked and uneven walls, unstable slopes and retaining walls, delayed movements of foundations.

1.4 OBJECTIVES OF THE PROJECT

The objectives of this project is: -

i. To validate the accuracy of standard method test in laboratory.

ii. To validate the accuracy of IR4.0 in site construction field

iii. To compare accuracy measurement of standard method test anfd IR4.0 technology.

1.5 SCOPE OF THE PROJECT

This study or project is focuses on the civil engineering field. This project is mainly focused for geotechnics subject. This study or project is to determine the moisture of the soil at construction or residential areas accurately. This project will be tested at Geotechnics Lab to test the dry and wet soil easily. This research will be done about one month to complete the project and to be tested at the Lab. For this project ESP32, soil moisture sensor, project board and connector wires will be used.

1.6 IMPORTANCE OF THE PROJECT

This project will contribute towards the construction sector. This research involves the soil moisture towards the construction sector. Therefore, this research will help to determine the soil moisture accurately and easily. This new invention will help out the engineers or students in civil engineering course to identify the moisture of the soil. Therefore, through this research we able to test and measure completely the hypothesis and concepts.

1.7 DEFINITION OF TERMS

Soil moisture sensors measure the water content in soil. Measuring soil moisture is important for construction applications to help engineers manage their irrigation systems more efficiently. Knowing the exact soil moisture conditions on their site, able to generally investigate the water content. They are also able to identify the moisture level easily using this gadget at construction sites.

CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

Literature review is a study conducted based on true theories and applied in fields related to the study such as journal, articles, books and newspaper studies. Therefore, in this chapter 1 some theories related to this study will be put forward such as to create an advanced soil moisture sensor.

To set the soil moisture sensor, the researcher began with a brief overview of the appropriate sensors to be used in the production of products with international standards of soil moisture for civil engineering purpose. Followed by this, several country comparisons were reviewed and summarized for their best practices.

This literature review will examine the use of appropriate sensors and materials to be used to produce soil moisture sensors using the concept of IR4.0 with the aim of obtaining soil moisture readings quickly and accurately in percentage form. This will be followed by some materials that have the potential to produce our products and then the sensors studied in previous studies will be compared to determine a good sensor.

2.2 UNDERSTANDING OF SOIL MOISTURE SENSOR

Soil moisture sensors measure or estimate the amount of water in the soil. These sensors can be stationary or portables such as handheld probes. Stationary sensors are placed at the predetermined locations and depths in the field, whereas portable soil moisture probes can measure soil moisture at several locations.

2.3 TYPES OF SOIL MOISTURE SENSORS

Soil moisture sensors are divided into two types depending on the technology they use

i. Measures moisture through the electrical properties of the soil

ii. Measures water potential through the use of gypsum blocks and tensiometers

2.4 ELECTRICAL PROPERTIES OF THE SOIL

A Soil Moisture Sensor may monitor soil water content using resistance or capacitance changes.

2.4.1 RESISTIVE SOIL MOISTURE SENSOR

A resistive soil moisture sensor measures soil moisture levels by using the link between electrical resistance and water content. A current is transmitted from one probe to the other, allowing the sensor to determine the resistance of the soil between them.

When the soil has a high water content, it has a greater electrical conductivity which water is an excellent conductor of electricity. As a result, a lower resistance value is obtained, indicating increased soil moisture.

When the water content of the soil is low, the electrical conductivity of the soil is reduced. Hence, a higher resistance reading is obtained, which indicates low soil moisture.

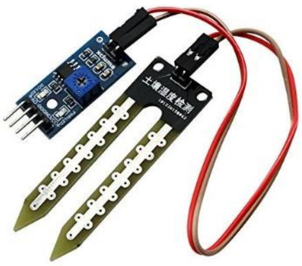


FIGURE 2.1 : Resistive soil moisture sensor

2.4.2 CAPACITIVE SOIL MOISTURE SENSOR

A capacitive soil moisture sensor detects moisture by monitoring changes in capacitance. Capacitance is a measure of the amount of electrical charge that can be held across an electrical potential. A capacitive soil moisture sensor is typically constructed with a positive and negative plate separated by a dielectric medium in the centre.

The dielectric medium is dirt, and its capacitance varies with moisture content. We obtain an analogue voltage that can be read with an Arduino board by connecting the sensor to a timer circuit. This voltage, in turn, has a direct link with the moisture content of the soil.

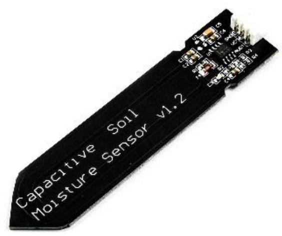


FIGURE 2.2 : Capacitive soil moisture sensor

2.5 TYPE OF SOIL MOISTURE TEST

There are a few method been use to record the soil moisture reading via lab. Here are some

i. Atterberg limit test

ii. Soil moisture test

iii. Compaction test

2.5.1 ATTERBERG LIMIT TEST

The Atterberg limits test is a type of classification test that is used to measure the moisture content at which fine-grained clay and silt soils shift between phases. The test for Atterberg limits is done on the proportion of soil that will pass through No. 40, 425m, or 0.425mm sieve.

The test assists in the categorization of soil and its plasticity properties, as well as the evaluation of near-surface soil shrink or swell potential. It may be used to differentiate between silt and clay and to calculate the shrinkage limit (SL), plastic limit (PL), and liquid limit (LL) of a soil sample.

FIGURE 2.3 : Atterberg limit test

2.5.2 SOIL MOISTURE TEST

This approach applies to the laboratory assessment of a soil's moisture content as a percentage of its oven-dried weight. The approach is applicable to fine, medium, and coarse-grained soils with particle sizes ranging from 2 mm to >10 mm. The approach relies on oven-drying a soil sample until the weight remains constant to remove soil moisture. The moisture content (percentage) is estimated by weighing the sample before and after drying.

FIGURE 2.4 : Soil moisture test

2.5.3 COMPACTION TEST

A laboratory compacting process used to evaluate the optimal water content at which a soil may be compacted to get the highest density (dry unit weight). The method entails inserting a soil sample with a known water content in a mould of specified dimensions, subjecting it to a controlled magnitude compactive effort, and calculating the resulting unit weight in a specific way. The method is continued for varying water contents until a relationship between water content and unit weight is established. The greatest dry density for a given compactive effort will generally provide a sample with near-maximal saturated strength.

FIGURE 2.5 : Compaction test

2.6 PREVIOUS RESEARCH

Table 2.1 shows database and previous research regarding soil moisture sensor as manual way and also using some IR gadgets too. The Table also shows effectiveness towards each research and components that had been used.

2.6.1 MICRO STRIP RING RESONATOR SENSOR

The sensor used in Peat and sandy soils. Its tested with dielectric and shape medium. This prediction model was found to agree well with the commercial dielectric probe in the dielectric prediction of peat (P28% m.c.) and sandy (P10% m.c.) soils.The sensing area is improved and the measurement accuracy is improved .A prediction model using an analytical ring resonant model with polynomial interpolation approximation via lumped element model.

(Limin Yu1, 2021)

2.6.2 A SENSOR BASED ON GRAPHENE QUANTUM DOTS (GQDS)

The sensor used in bentonite clay. Its tested with materials, nanostructured materials medium. The simplicity of the process and use of cheap gqd material make it an affordable sensing unit in comparison to existing soil moisture sensing units. With very high sensitivity, simple process and cheap materials, low cost sensing unit. Improved sensing materials, mems manufacturing process,

graphene quantum dots (gqds) as zero- dimensional (0d) graphene.
(Yanjun , 2021)

2.6.3 A FRINGING FIELD CAPACITIVE SENSOR

The sensor used in Four soil samples were collected from different locations. It tested with resistance. This research studied the optimization and implementation of a fringing field capacitive soil moisture sensor using the printed circuit board technology It is simple in design, limited cost, high sensitivity, large sensing area and good response time. Electrode thickness, separation of two adjacent electrodes, thickness of the substrate circuit board technology.
(Zhang2 , 2017)

2.6.4 THE IMPROVED ECH2O SENSOR

The sensor used in Soil, peat, perlite, and vinegar residue . It tested with Materials, nanostructured materials medium. Here, the relationship between the output of the sensor and the soil water content calibration model (β parameter model) was studied. A two- step calibration β-method was developed. With very high sensitivity, simple process and cheap materials, low cost sensing unit. A two- step calibration β parameter model.
(Rabelo S. L 2020)

2.6.5 A NEW CAPACITIVE SENSOR

The sensor used in homogen eous silt- clay-loam soil . The tested medium did not been mentioned. A new capacitive low- cost soil moisture sensor incorporates SDI 12 communication, allowing one to select the calibration equation for different soils. The cost is reduced while maintaining sufficient accuracy.
(Laura Gasperini,201 8)

2.6.6 A HOMEMADE LOW-COST SENSOR

The sensor used in homogeneous silt- clay-loam soil . It tested with resistance medium. Measuring soil moisture along depth helps determine the appropriate time for water supply to reach crop roots. This method has the advantages of low equipment cost and simple operation
(Alessandro Grassi , 2019)

2.6.7 SKU:SEN0 193

The sensor used in silica sandy soil . It tested with resistance medium. A prototype was developed for automated soil moisture monitoring using a low-cost capacitive soil moisture sensor (SKU:SEN0193) for data acquisition, connected to the internet. Low-cost and high- resolution. The developed soil-specific calibration function.
(Andrea Scorzoni,2016)

2.6.8 A TDM SENSOR

The soil used did not mentioned . It tested with the calibration model is established by a polynomi al (third- order) fitting equation medium. Low-cost and high- resolution. The sensor can be used for continuous SM measurements, which will be beneficial for planning irrigation practices in arid and irrigated areas.

2.6.9 10 HS SENSOR

The sensor used sandy soils, the clay soils in . It tested with two- point and multipoint specific calibration equations medium. Capacitance principle. It is sensitive to soil types. Required specific calibration. The response of the 10 HS sensor in bi- layered systems was also investigated. The results obtained from the experiments suggested that there is a distinct instrument sensitivity to soil type, thus indicating the necessity for individual soil calibration.

2.6.10 RESONATOR SENSOR

The sensor used in peat and sandy soils . It tested with a prediction model using an analytical ring resonant model with polynomial interpolation approximation via lumped element model. medium. Dielectric principle. This prediction model was found to agree well with the commercial dielectric probe in the dielectric prediction of peat (P28% m.c.) and sandy (P10% m.c.) soils.

2.7 SUMMARY OF RESEARCH GAP

This figure shows the types of components that is used during this research and which industries it is useful too.

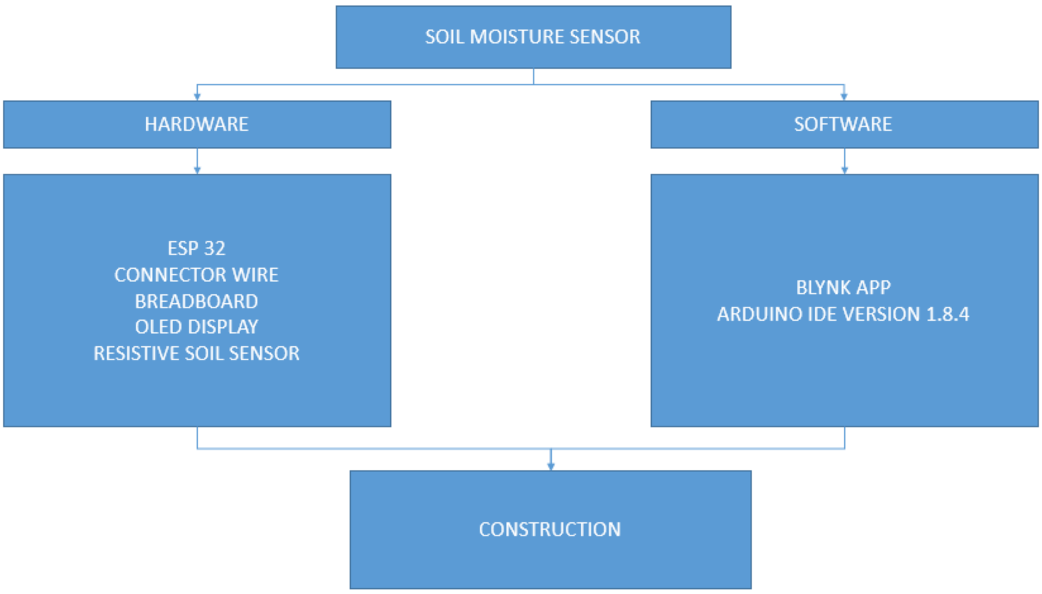


FIGURE 2.6 : SUMMARY OF RESEARCH GAP

2.8 SUMMARIZE OF LITERATURE REVIEW

From previous researches, long term soil moisture monitoring provides indication of soil saturation, water leaking under structure and weakness associated with excess moisture

Soil sensors may be installed or under asphalt or concrete structures and buried in place. The sensor data cables connect to a data logger, which provides periodic readings that are recorded in the data longer memory. This information is key to safety , soil and structure stability, or for providing compliancy and regulatory agency documentation and may provide warning levels that the moisture is too high or subject to shearing movements as well as other issues.

The installation of soil sensors at varying depths indicates water movement and the changes in water balance. Buildings and some structure requires moisture soil to maintain the foundation's stability . both soil monitoring need are solved with the dynamax soil sensord and loggers. The loggers provide set points that will trigger irrigation when soil is too dry and when the soil is too wet.

CHAPTER 3
METHODOLOGY

3.1 INTRODUCTION

The aim of the methodology research is to achieve the objectives of the study as stated in chapter 1. Planning is very, important in every study to be conducted. To ensure that the planning for each procedure is need match with the objectives, which already set up and to get the same answers for each objective. The research method will be designed to achieve the objective. To explain the implementation method of this project more clearly with referring diagrams, tables, chart, and drawings. This product is need to produce to make easy work to the users. If use this product it will help to make the work easier from the manual method. It also will save more the time for the users. Finally, it also helps to get the accurate reading for each sample.

3.2 FLOW CHART OF METHODOLOGY

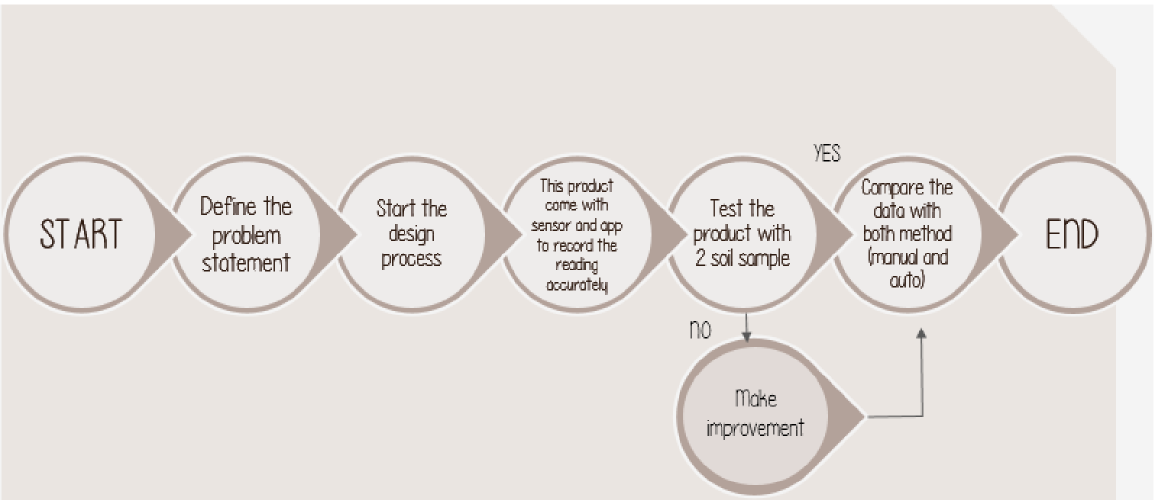
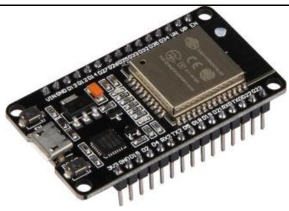
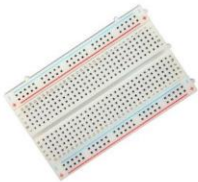


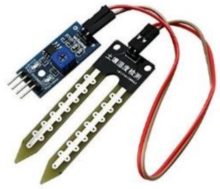
FIGURE 3.1 : Flow chart of methodology

3.3 MATERIAL AND EQUIPMENT

This table 3.1 shows the hardware and software that will be used in the produce of our product.

TABLE 3.1 : Material and equipment

NO.	DIAGRAM	SOFTWARE & HARDWARE
1.		Arduino IDE version 1.8.4
2.		ESP 32
3.		Connector wire
4.		Breadboard
5.		OLED Display

6.		Resistive soil sensor
7.	Blynk	BLYNK Apps

3.4 DATA ANALYSIS METHOD

The data analysis shown which sensor that we used in our modal and there are a few step how the sensor works to measure the soil moisture accurately.

3.4.1 SENSOR THAT WE USED IN OUR PRODUCT

Sensor that we used in our project is resistive soil sensor. The sensor consists of two probes which are used to measure the volumetric content of water. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value.

When there is more water, the soil will conduct more electricity which means that there will be less resistance. Therefore, the moisture level will be higher. Dry soil conducts electricity poorly, so when there will be less water, then the soil will conduct less electricity which means that there will be more resistance. Therefore, the moisture level will be lower.

3.4.2 WAYS TO USE THIS SENSOR

First we will select 2 types of soil to be sampled. Then we will use this sensor to get the reading of soil moisture through the IoT Blynk application where will process or shows the sensor reading. This reading will be display on the OLED Display the soil moisture level or unit in percentage. Then this reading will be automatically transferred to the Blynk application that have been programmed. the reading will be displayed as a graph where every two seconds a new reading will be recorded. In addition, the readings in these apps are recorded into the laptop using the concept of wireless. Besides that, in the Blynk App the readings will be recorded in digital form where this application will store all the information in the smartphone. The recorded readings will be compared with the readings recorded when performing the atterbag limit test in the laboratory using the same soil sample. The purpose of this comparison is to determine the accuracy of readings obtained manually or using the IR4.0 concept. In addition, we will also compare our readings with Malaysian soil moisture standards to ensure the suitability of land use for development construction.

3.5 INFLUENCED FACTORS OF THE RESEARCH

This research contains few factors such as consumer, enviromental, ergonomics material and equipment and safety. This factors will influence in the project to acknowledge the advanntages and disadvantanges of this research to improve ii in upcoming projects.

3.5.1 CONSUMER FACTORS

This device can be used at age 18 above but it is restricted for children because this device is electronic based gadgets so it may harm them. If they misuse this, it will lead into some electrical problems such as electrical shocks or harm themselves. This device is can be used by both genders by men and women. Civil engineers will use this to find the water content of soil with help of electric conductivity. Soil moisture sensor measures water content indirectly by using other properties of soil such as dielectric constant, electrical resistance and interaction of neutrons. It is connected with Arduino board; it uses capacitance to find the moisture content of soil. Sensor is simply inserted into the soil where we want to find water content then after running code system using Arduino IDE and will be reported in percentage. Before this civil engineers were using Moisture Logging, Tests such as moisture content test ,atterberg limit test ,dry density test and more at laboratory's. The common people also can use this device to test the soil moisture level for some simple construction works at their residential area.

3.5.2 ENVIRONMENTAL FACTORS

This soil moisture sensor device will be used at almost every location such as at construction site or residential are too, not only at Laboratory it can be used or test soil moisture level at the current places by using the Arduino device and apps in phones. The sample soil must be treated well and kept safely and can be tested directly to find out the soil moisture level accurately. This device can't be used during rainy weather because the device is an electronic device so it will affect the sensors functions. But the device can be used during summer season and also can use it at any types of temperature too. The main element soil need be treated well and must handle it properly to get the reading accurately during the soil moisture test by using this sensor. Engineers can carry over the sites to test the soil moisture and it will be easy to handle.

3.5.3 ERGONOMICS

Soil moisture device is easy to carry and use. The soil moisture sensor consists of two probes that are used to measure the volumetric content of water. The two probes allow the current to pass through the soil, which gives the resistance value to measure the moisture value. When there is water, the soil will conduct more electricity, which means that there will be less resistance. Dry soil conducts electricity poorly, so when there is less water, then the soil will conduct less electricity, which means that there will be more resistance. This sensor can be connected in analog and digital modes. First, we will connect it in analog mode, and then digital. Then, connected to Blynk, showing how to send data from the plant to the Cloud.Blynk is an IoT analytic platform service that allows to aggregate, visualize and analyse data flows in real time in the Cloud. Data can be sent to Blynk from computational devices, instant data views can be created, and alerts using Web services like Twitter can be sent. With within Blynk, it is possible to write and execute MATLAB code to perform pre-processing, visualizations, and analysis. Blynk allows engineers and scientists to prototype and create IoT systems without configuring servers or developing web software .It is also easy to access by Iot system in phone .It will be easy to handle during the soil test.

3.5.4 MATERIAL & EQUIPMENT

Materials that used in this devices is easy to find during innovation total cost for this soil moisture sensor around RM 100 . The materials used during this project is not much costly, each component cost about RM 20-RM25.Few materials also can order in online or can buy at electronic shop. We can equip things easily with reasonable price.AS we can see, the soil moisture is an electronic gadget or device. It may lead or occur any problem in systems. So this, device can be serviced 2 or 3 times between 2 months or 3 months. As we face any error during, soil moisture readings we can test it 2-3 times to test whether it works properly or not. This test also can have done by manual way to see accurately the readings. The equipment also can be changed after a specific time period to avoid any damages or repair.

3.5.5 SAFETY

An act to make further provisions for ensuring the safety, health and welfare of persons at work, to protect others against risks to safety or health in connection with the activities of persons at work, to establish the National Council for Occupational Safety and health, and for matters related to it. Materials used in soil moisture sensors are natural or artificial materials, whether in solid or liquid form or any combination thereof of materials for use while making means any material intended or supplied for use, whether exclusively or not, by people while working is safe during the project.

3.6 SOIL SAMPLING

Soils can make or break construction projects. Building on the wrong soil, or without footings on unstable clay or sand, leads to foundations that crack, landfills that leak, dams that break, and sports fields that flood. Assess the suitability of the soil for your construction project with vital data for informed decision making and planning. As a result, you need to identify the characteristics of the soil to determine its ability to support your structure. The physical properties do not change at all. So, the soil samples can be kept for six months under shade safely. However, I do not support keeping the soil for long time without analyzing. It should be tested within 3-5 days of its collection. If samples cannot be taken to the lab within 24 hours after collection, they should be dried, refrigerated or. Dry soil samples by spreading them out to air dry at room temperature for two to three days, depending on air circulation and humidity.

3.6.1 STEPS FOR SOIL SAMPLING

Sampling should be done when soils are at field capacity. This ensures appropriate interpretation of field penetration resistance measurements, facilitates proper mixing of sub samples, and prevents soils from smearing during sampling and transport. In general, within the area you would like to test that are representative of the field. The following recommended guidelines are similar to sampling for nutrient analysis. Irregular areas in a field, such as the low spot in to the right, should be avoided, unless a sample is specifically being collected from a problem area to identify constraints.

First of all, remove surface debris and set of a spade to dig a small hole about 8" deep from the side of the hole take a vertical, rectangular slice of soil 6" deep and about 2" thick. Ensure that the sample is the same width at the top and bottom of the slice. It is important to collect the same amount of soil from all soil depths so the sample is not biased with more soil from the top compared to the bottom, especially since soil biological properties vary with depth. After that, manually remove any extra soil to ensure an even, rectangular 6" deep x 2" thick slice of soil, the width of the shovel and place into clean pail. At each sub-sample location collect soil hardness information with a penetrometer. Record maximum hardness (in psi) from the 0-6" and the 6-18" depth ranges in the sample Submission form. Repeat steps to collect the remainder of the subsamples. Mix thoroughly and place at least 4 full cups of soil into a clearly label one-gallon re-closable freezer bag.

3.6.2 SOIL SAMPLE STORAGE REQUIREMENTS

The steps of taking a soil health sample. The microorganisms in the soil are sensitive to heat. Keep samples out of the direct sunlight and keep as cool as possible during the sampling. Store samples in a refrigerator or cold room after returning from the field. Always keep samples out of direct sunlight, and if possible, in a cooler in the field. High temperatures in a bag of soil sitting in the sun will have a detrimental impact on biological indicator measurements. Upon returning from the field, store samples in refrigerator or cold room as soon as possible, cool overnight, and ship for analysis as soon as possible, mainly do not freeze the samples and do not dry the samples.

3.6 SUMMARY OF METHODOLOGY

The flow of methodology is a creative way,to get know the path way of our project very well. It shown that , after the test of product success we can compare the data with Malaysia standard soil moisture for civil engineering purpose which is the optimum moisture content are be written as 10% - 28.8% in BS1377. Besides that, there are two categorize of component that will be used to produce the product which are hardware and software. There are 3 types of software will be use which is Arduino IDE version 1.8.4 where the software is a cross-platform application for Microsoft Windows, mac OS, and Linux that is written in the Java programming language. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus. Next , is Blynk apps where it is a channels for store data. It can upload data from the web or send data from devices to a chart form. With these apps it can transform and visualize data or trigger an action. The software is Blynk apps inventor where we can make our own website where all the data will transfer to mobile phone and we can active the on /off button where we can use the sensor even though we far away. The main hardware will be used is ESP32 and Oled Display resistive soil sensor is a sensor to take the soil moisture readings in percentages. There are also some factors that influenced the research which are environmental, consumer, ergonomic material &equipment, safety and soil sample storage.

CHAPTER 4
FINDINGS

4.1 INTRODUCTION

In this chapter , will identify and present the results of the study conducted to determine the function of the IR 4.0 soil moisture sensor .The aim of this study is to develop or create an IR 4.0 soil moisture sensor by using IoT components and applications and compare the accuracy of the soil moisture results with the manual laboratory test .

i. To validate the accuracy of standard method test in laboratory.
ii. To validate the accuracy of IR 4.0 soil moisture sensor at site .
iii. To compare accuracy measurement of standard method test and IR 4.0 soil moisture sensor technology.

4.2 VALIDATE THE ACCURACY OF STANDARD METHOD TEST

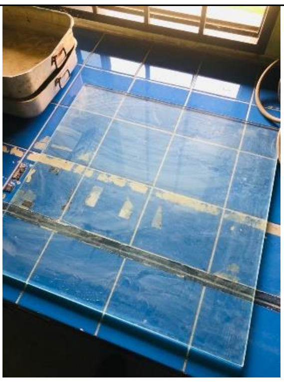
The standard method test to validate the accuracy of soil moisture , which is commonly used at lab is Atterberg limit test . The Atterberg limits test is a classification test for determining the moisture content at which fine-grained clay and silt soils transition between phases. The test for Atterberg limits is performed on the fraction of soil that will pass through a , 425m, or 0.425mm sieve.

The test aids in the classification of soil and its plasticity characteristics, as well as the evaluation of near surface soil shrink or swell potential. It can be used to differentiate between silt and clay and to calculate the shrinkage limit (SL), plastic limit (PL), and liquid limit (LL) of a soil sample. The moisture content of a soil at the boundary between the liquid and plastic states of consistency is expressed as a percentage of the weight of the oven-dried soil. The moisture content at this boundary is defined arbitrarily as the amount of water at which two halves of a soil cake will flow together over a distance of 12 in. (12.7 mm) along the bottom of a standard-sized groove separating the. When the cup of a standard liquid limit apparatus is dropped 25 times, it splits into two halves,at a rate of two drops per second from a height of 0.3937 in. (10 mm).

4.2.1 MATERIAL AND EQUIPMENT

This is a material that have been use to do standard method test or atterberg limit.

TABLE 4.1 : Material and equipment

NO	MATERIAL	NAME
1.		• SCOPE
2.		• FLAT GLASS PLATE
3.		• SPATULA

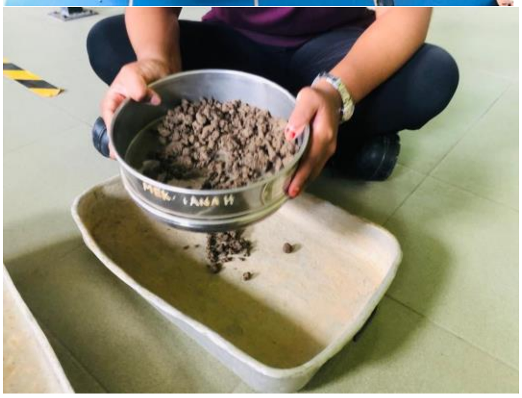
4.		• ELECTRONIC DIGITAL GRAM
5.		• TRAY
6.		• CONE PENETROMETER
7.		• 425UM TEST SIEVE
8.		• MOISTURE CAN

9.		• CONTAINERS
9.		• DISTILLED WATER
10.		• SOIL SAMPLE A
11.		• SOIL SAMPLE B

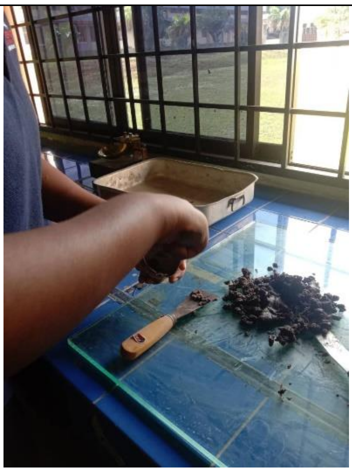
4.2.2 STANDARD METHOD TEST PROCEDURE (ATTERBERG LIMIT TEST)

The Liquid Limit (LL or wLL), often known as the upper plastic limit, is the water concentration at which soil transitions from liquid to plastic. It is the minimal moisture content at which a soil flows when a very tiny shear force is applied.Standard test techniques are used to define the liquid limit precisely. The Casagrande cup technique or a cone penetrometer can be used to determine the liquid limit. In this test we use cone penetrometer to find the moisture content.

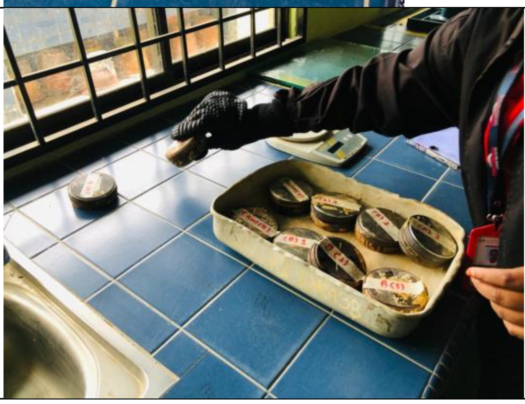
TABLE 4.2 : Standard method test procedure

NO		PROCEDURE
1.	 	A sample of the soil of sufficient size is taken to give a test specimen weight at least 300 g which passed the 425 um test sieve.
2.		The soil sample A is transferred to a flat glass plate. The distilled water is added and mixed thoroughly with 2 palettes knives the mass becomes a thick homogenouspaste

<table>
<tr><td></td><td></td><td></td></tr>
<tr><td>3.</td><td></td><td>If necessary more distilled water is added</td></tr>
<tr><td>4.</td><td></td><td>A portion of the soil sample A is pushed into the cup with palette knife taking care not to trap air.</td></tr>
<tr><td>5.</td><td></td><td>Excess soil sample A is strike off with the straight edge to give a smooth level surface.</td></tr>
</table>

		
6.		With the penetration cone locked in the raised position lower the supporting assembly so that the tip of cone just touches the surface soil.
7.		The stem of the dial gauge is lower to contact the cone shaft and the reading of the dial gauge is recorded.
8.		The difference between the beginning and the end of the drop cone penetration are recorded. The cone is lifted out and it is cleaned carefully to avoid

		scratching.
9		Little more distilled water is added to the cup. The difference between first and second penetration reading is record.
10.		A moisture content sample of about 10 g is taken from the area penetrated by the cone.
11.		Steps 2 to 11 are repeated at least 3 more times.

		
12.		Steps 2 to 11 are repeated for sample B
13.		Then all soil samples are weighed using electronic digital scales each. Then record it.
14.		Place all soil sample containers into a tray. Then put in the oven for 24 hours at a temperature of 250 degrees.Make sure put label for esch container.

		
15.	 	After 24 hours take out the sample from the oven and weigh each container. Write down all the data and put it in the table to find moisture content in percentage.

4.2.3 DATA OF SOIL MOISTURE BY STANDARD METHOD TEST

This data has been collected during standard method test. There are two type of table which are for soil sample A and soil sample B.

4.2.3.1 TEST DATA SAMPLE A

TABLE 4.3: Soil Sampel A

LIQUID LIMIT	Test no.		1	2	3	4
	Cone Penetration Dial gauge reading (mm)	1	65	71	85	86
		2	58	82	85	86
		3	59	70	84	86
	Average (mm)		61	74	85	86
	Container no.		**1**	**2**	**3**	**4**
	Mass of wet soil + container	g	59	59	58	59
	Mass of dry soil + container	g	57	56	57	57
	Mass of container	g	30	28	28	29
	Mass of water	g	2	3	1	2
	Mass of dry soil	g	27	28	29	28
	Moisture content	%	7.41	10.71	7.14	7.14

4.2.3.2 TEST DATA SAMPLE B

TABLE 4.4 Soil Sample B

LIQUID LIMIT	Test no.		1	2	3	4
	Cone Penetration Dial gauge reading (mm)	1	78	79	85	90
		2	63	72	86	86
		3	66	85	83	90
	Average (mm)		69	79	85	89
	Container no.		**1**	**2**	**3**	**4**
	Mass of wet soil + container	g	57	52	60	56
	Mass of dry soil + container	g	52	46	53	50
	Mass of container	g	28	28	28	28
	Mass of water	g	5	6	7	6
	Mass of dry soil	g	24	18	25	22
	Moisture content	%	20.83	33.33	28	27.27

4.2.3.3 TEST DATA SOIL SAMPLE FOR COMPACTION TEST

This is data that uses a compaction test where a soil sample will be placed into a container and the weight will be taken. Then, the soil sample container will be placed in the oven for 24 hours at a temperature of 250 degrees. After that, the soil will be take out from the oven. Then the weight of the soil sample will be taken. Lastly, the data will be placed into a table and the calculation of soil moisture will be calculated in the form of percentage.

TABLE 4.5 : Compaction Test Sample

Container no :		**A**	**B**
Mass of wet soil + container	g	65	60
Mass of dry soil + container	g	61	53
Mass of container	g	28	28
Mass of water	g	4	7
Mass of dry soil	g	33	25
Moisture container	%	12.12	28

4.3 VALIDATE THE ACCURACY OF IR 4.0 SOIL MOISTURE SENSOR

IR 4.0 soil moisture sensor is an IoT based soil moisture monitoring system with ESP32 and Blynk application.This sensor is to measure or estimate the amount of moisture in the soil. The soil moisture sensor consists of two probes that are used to measure the volumetric content of water or moisture in the soil .This sensor also, will construct a soil moisture monitor that will display the percentage of moisture in the soil on an OLED display and an Arduino serial monitor. Furthermore, it will integrate Blynk application into project and send the soil moisture percentage to the software's dashboard using the MQTT protocol. As a result, it will be able to monitor the readings in a line chart from anywhere and at any time.

Blynk app is a highly interactive tool that allows users to manage the projects remotely by the internet. Blynk app makes the project very accessible, from controlling

LEDs, relays, and electric motors to obtaining sensor data. It becomes extremely interactive and simple for the user to use this application to control any ESP32 GPIO from anywhere on the internet. Similarly, a soil moisture sensor module also has 4 terminals but we will connect 3 of these with the ESP32 board as we are only using analog output.The OLED display has 4 terminals which we will connect with the ESP32 board.

The VCC pin of the soil moisture sensor will be connected with the 3.3V pin of the ESP32 board. The A0 pin of the sensor will be connected with VP (GPIO36) of the ESP32 board. All three devices will be commonly grounded.the OLED display requires an operating voltage in the range of 3.3-5V hence we will connect the VCC terminal with 3.3V which will be in common with the ESP32 board.SCL of the display will be connected with the SCL pin of the module.SDA of the display will be connected with the SDA of the module.the I2C pin in ESP32 for SDA is GPIO21, and for SCL is GPIO22.

4.3.1 SOIL MOISTURE SENSOR

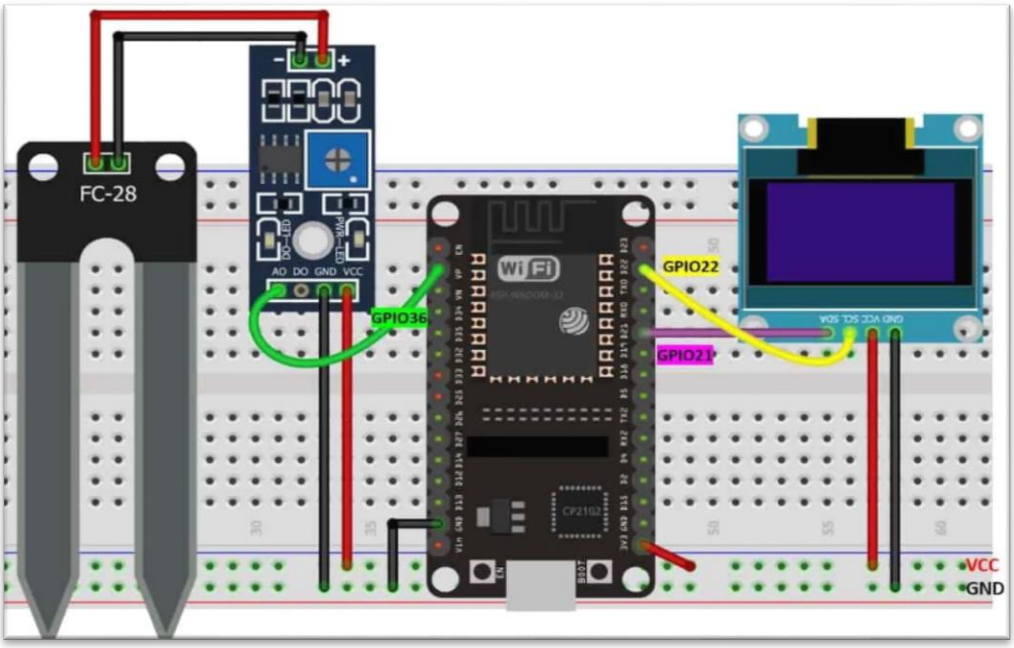


FIGURE 4 .1: Circuit Diagram

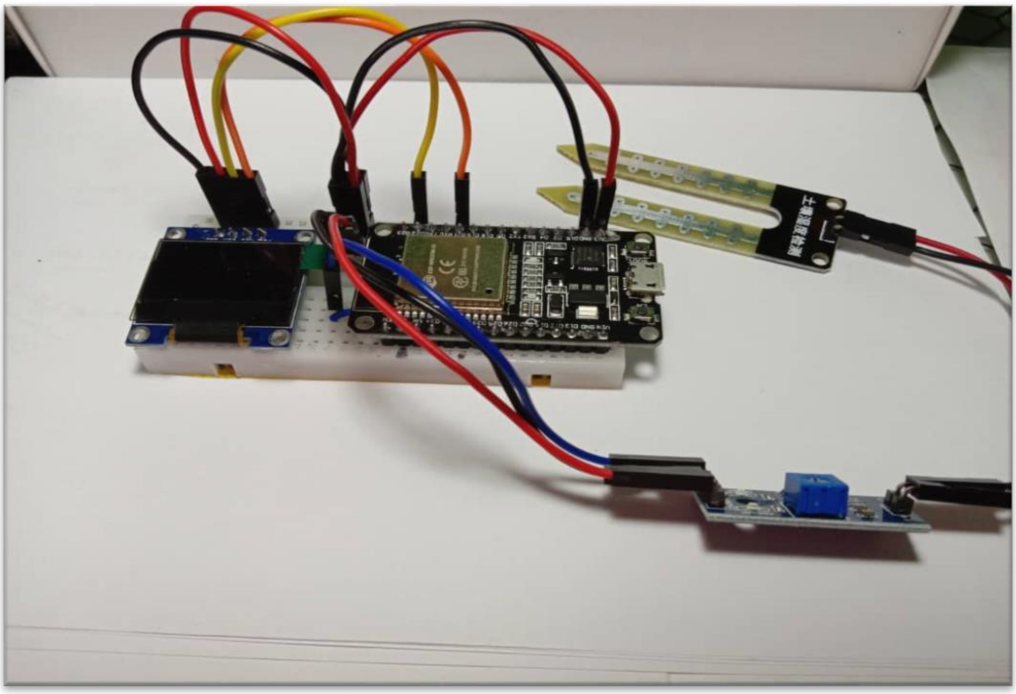
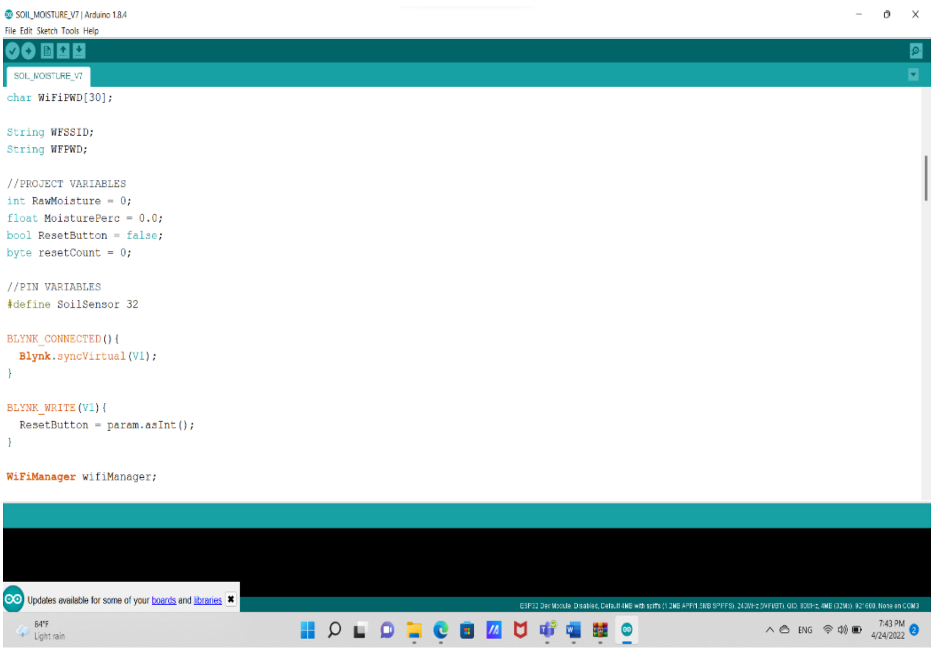


FIGURE 4.2: IR 4.0 Soil Moisture sensor Design



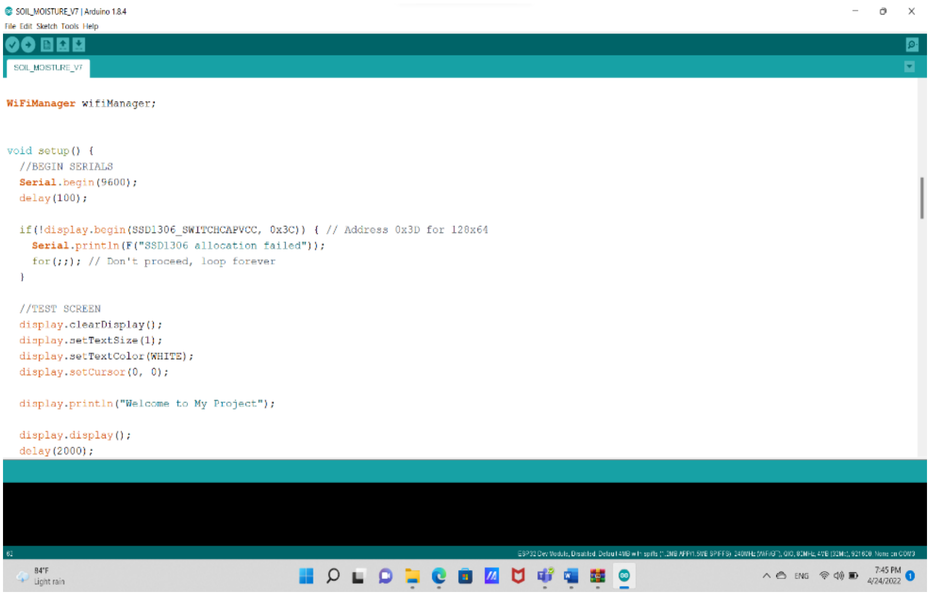


FIGURE 4.3: complete coding installed in ESP32 using Arduino IDE

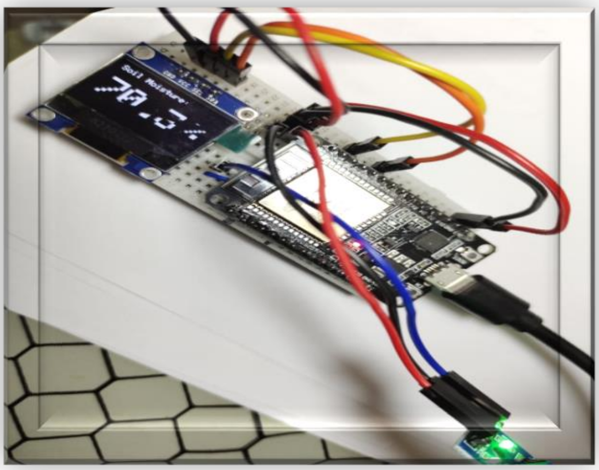


FIGURE 4.4: Soil Moisture Reading Show On OLED

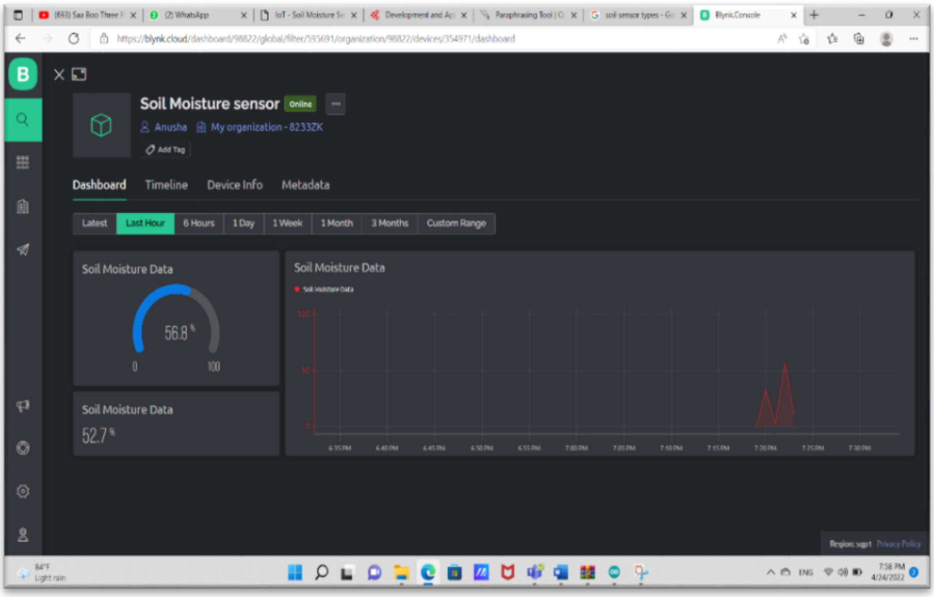


FIGURE 4.5 : Soil Moisture Sensor Reading Show In Blynk Application In A Chart Form.

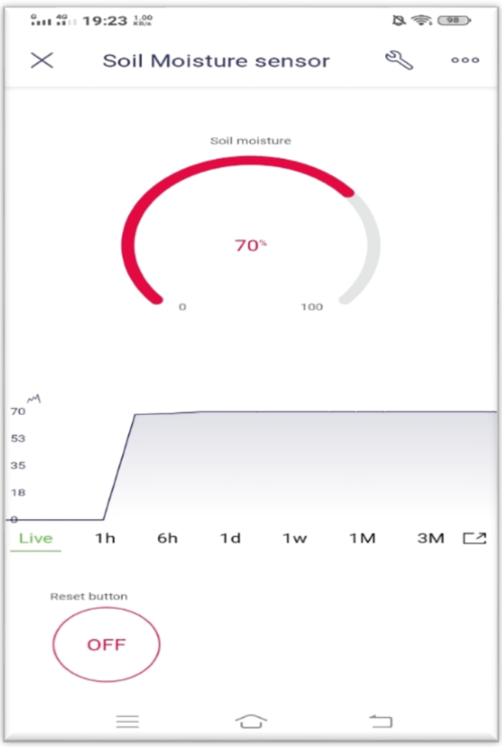
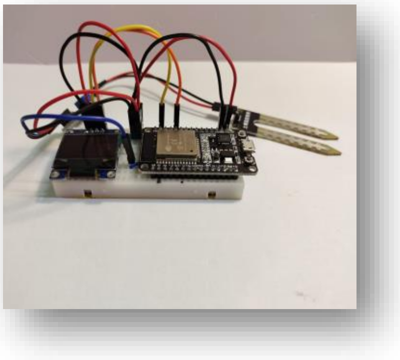


FIGURE 4.6 : Soil Moisture Reading Shown On Smartphone In Graph And Percentage Form. It Even Have On And Off Button Which We Can Active The Sensor With Using This Button.

4.3.2 MATERIAL AND EQUPMENT

This are material that have been used to record soil moisture reading by using IR4.0 method

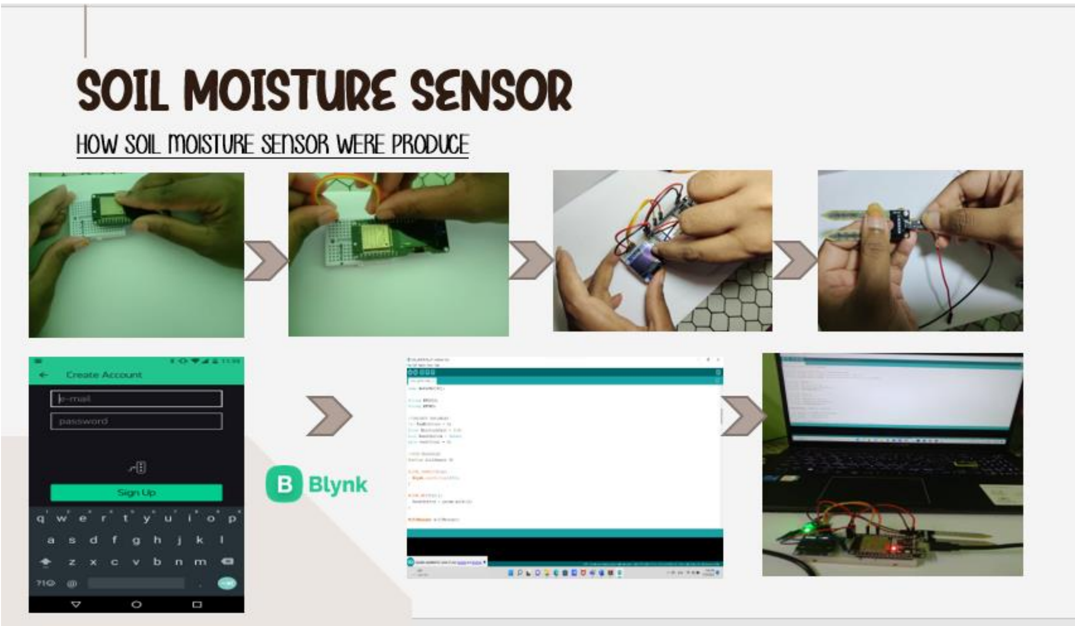
TABLE 4.6 : MATERIAL AND EQUIPMENT

NO	MATERIAL	NAME
1.		• SOIL SAMPLE A
2.		• SOIL SAMPLE B
3.		• SOIL MOISTURE SENSOR

4.3.3 SOIL MOISTURE SENSOR PROCEDURE

This is a way to measure soil moisture content by soil sensor.

FIGURE 4.7 : soil moisture sensor procedure



4.4 SOIL MOISTURE SENSOR DATA

Data was recorded for two day which is in rainy day and usual day.

4.4.1 USUAL DAY

FIGURE 4.8 : Usual day soil moisture data

SAMPLE	A	B
SOIL MOISTURE SENSOR READING (%)	8.1	23.1
	8.4	23.8
	8.9	24.4
AVERAGE (%)	8.4	24

4.4.2 RAINY DAY

FIGURE 4.9 : Rainy day soil moisture data

SAMPLE	A	B
SOIL MOISTURE SENSOR READING (%)	12.0	26.0
	10.1	28.7
	12.5	28.1
AVERAGE (%)	11.53	82.8

4.5 COMPARE ACCURACY MEASUREMENT OF STANDARD METHOD TEST AND IR 4.0 SOIL MOISTURE SENSOR

Data was compare between three test which is atterberg limit test, compaction test and soil moisture sensor.

FIGURE 4.1 A : Compression of soil moisture

METHOD	ATTERBERG LIMIT TEST (LIQUID LIMIT)		COMPACTION TEST		SOIL MOISTURE SENSOR	
SAMPLE	A	B	A	B	A	B
SOIL MOISTURE READING (%)	8.1	27.36	12.12	28	8.4	24

FIGURE 4.1.B : Compression of soil moisture

STANDARD METHOD TEST		SOIL MOISTURE SENSOR
Complicated method	METHOD	Simple method of measurement
Takes about 30 hours	TIME	Delivers the results immediately
Expensive (to many material need for measure the moisture content)	COST	Cheap
Error may occur	ACCURACY	Accurate results.(error may occur due to weather)

4.6 QUESTIONNAIRE

To further strengthen this study, the questionnaire method was done by involving students, lectures and civil engineers. The data obtained will be in the form of pai chart to facilitate the information studied and analyzed. The following is information related to the questionnaire that was conducted.

4.6.1 SECTION A (DEMOGRAPHY OF RESPONDENTS)

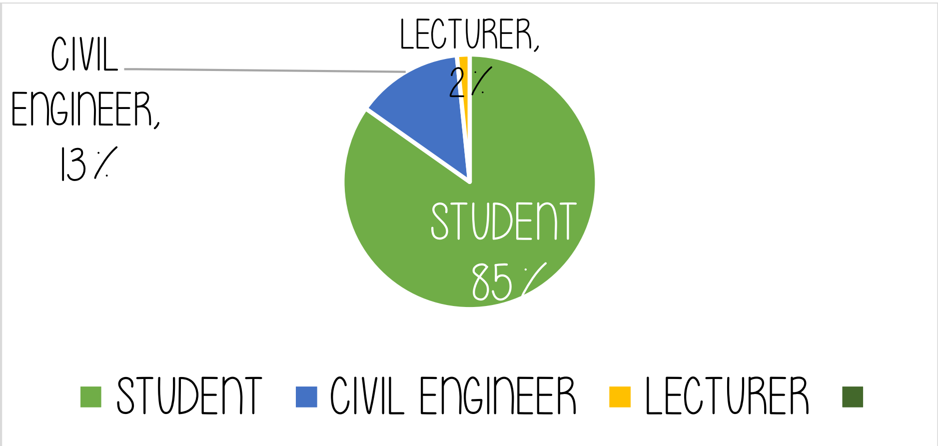


FIGURE 4.1 C : Role

4.6.2 SECTION B (OVERVIEW OF THE STUDY)

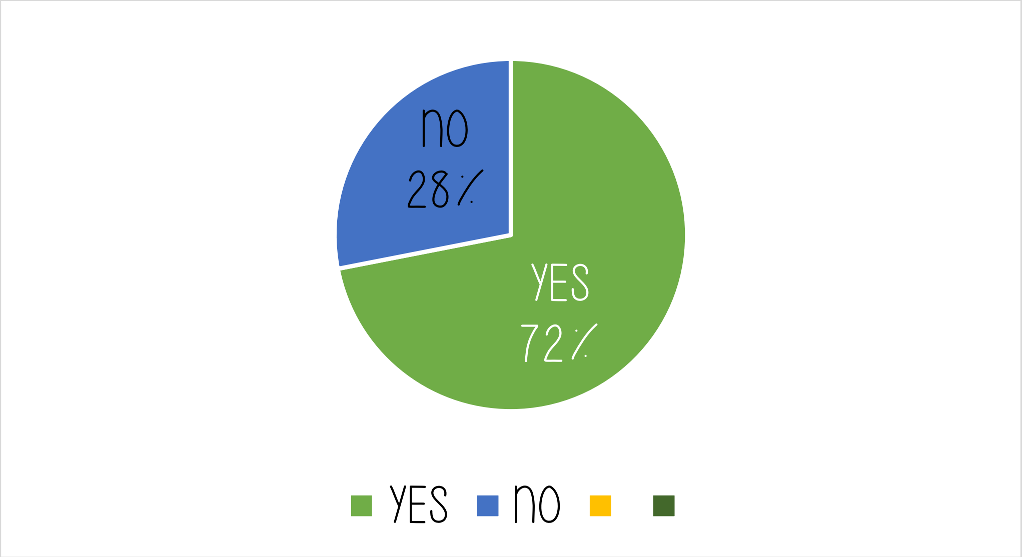


FIGURE 4.1 D : percentage of respondents who have ever taken the atterberg limit test

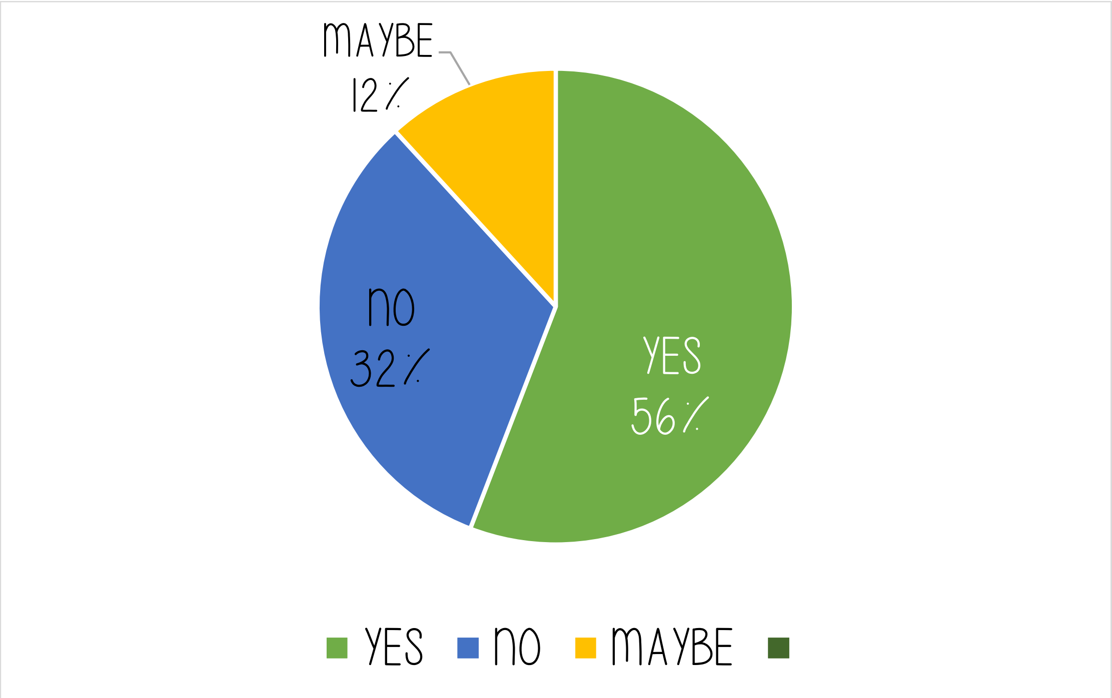


FIGURE 4.1.E : percentage of respondents knowing about soil moisture sensors

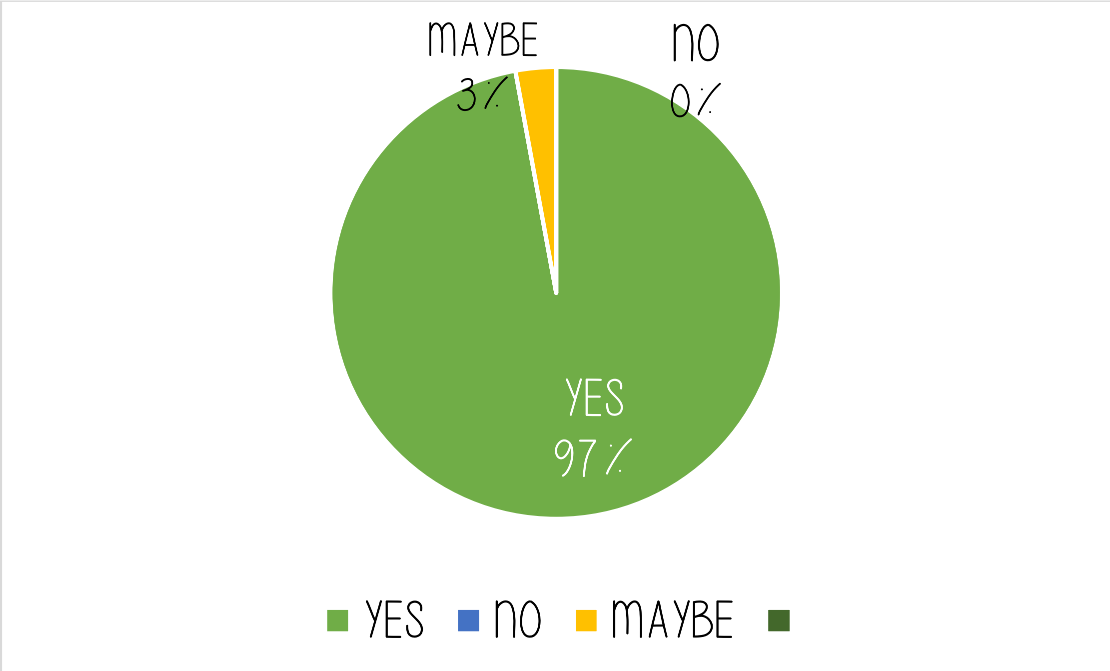


FIGURE 4.1.F : percentage of respondents agree that soil moisture sensor can save time

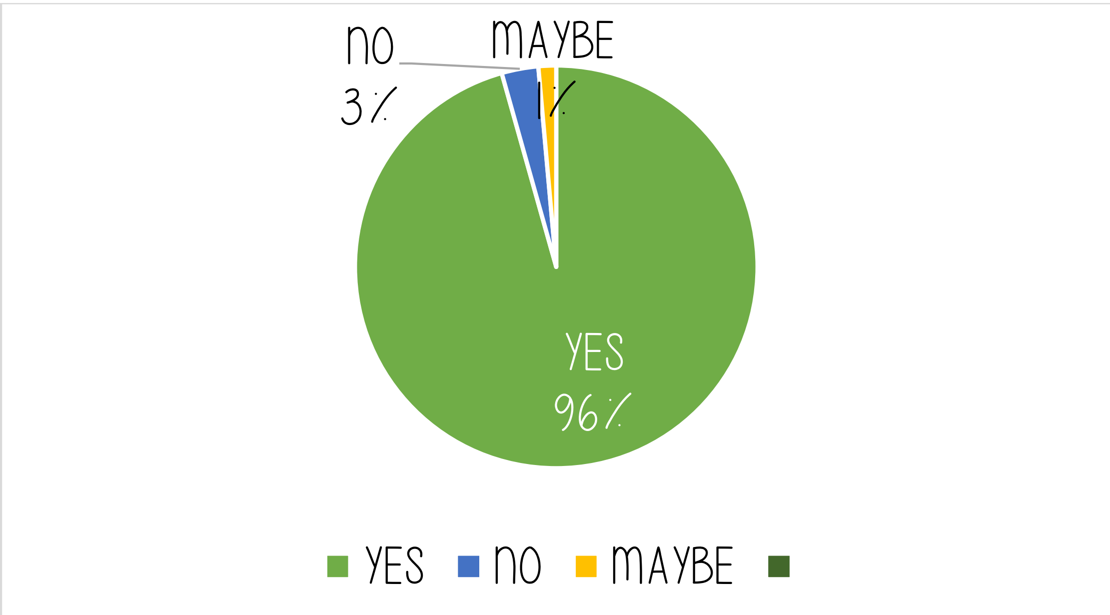


FIGURE 4.1.G : percentage of respondents agree that soil moisture readings can be easily recorded

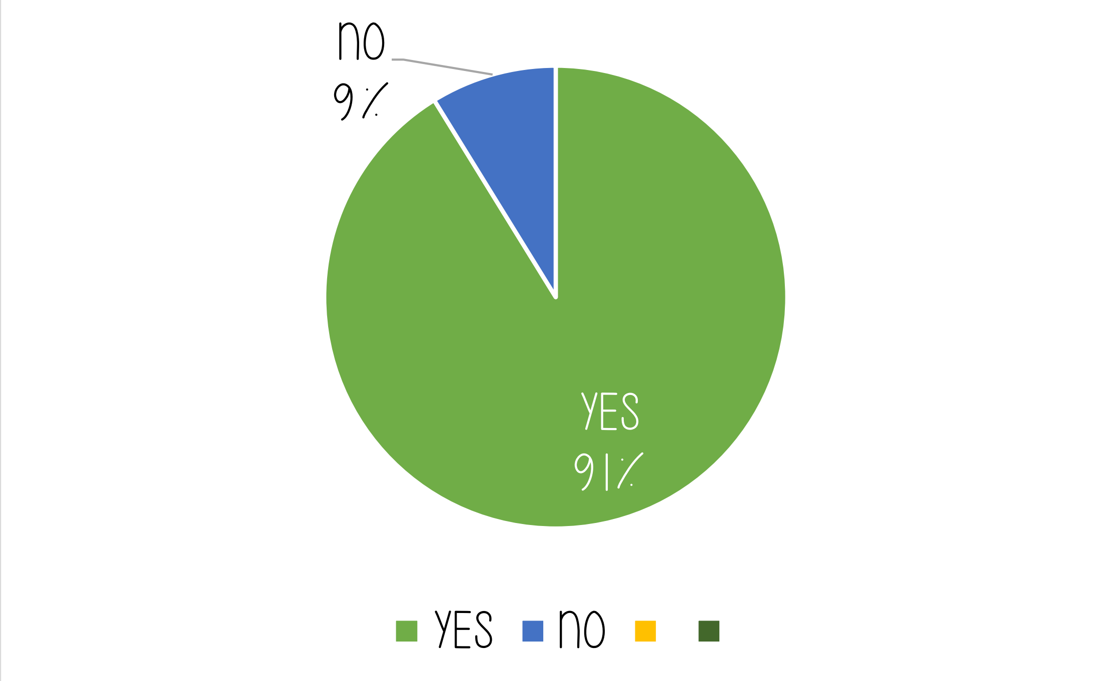


FIGURE 4.1.H : percentage of respondents agree that the soil moisture sensor method can replace the atterberg limit test

4.7 SUMMARY

As a overall results , it is proved that this innovation IR 4.0 soil moisture sensor was useful and easy to handle to monitor or compare the accuracy of soil moisture at the site. However, there might be few errors on the soil moisture reading around .The error happens during, placing the sensor probe at a different depth and placing it at different types of soil , surroundings weather on that day.Futhermore, this sensor was easy to handle it had saved time to read the soil moisture compare with the standard method which is Atterberg limit test and it also immediately shows the moisture readings at phone in a graph form as it shows the time that we excute the testing at the site as well.

CHAPTER 5
CONCLUSION AND SUGGESTION

5.1 INTRODUCTION

The main purpose of this project is to develop or create an IR 4.0 soil moisture sensor based on IoT using application to monitor the readings of the soil at the specific locations or sites.This chapter is focusing on the discussion ,conclusion by refering data that had been collected by testing standard soil moisture test and any suggestions to make any other developments in this project in future to make it much better and innovative.This chapter also will conclude the data and some alternative ways to improve the problems faced by this project.

5.2 DISCUSSION

The result from the IR 4.0 soil moisture sensor it shows that the application had been used in this project which is Blynk app is very effective and easy to operate in phone and laptop to monitor the readings in graph form and also saves the data easily and keeps the data almost for 2 months for future project purposes.This sensor will able to detect the soil moisture easily without waiting for a long period time or days.From this project , it has proven that the project is successfully achieved the objectives and integrated the expected data’s easily through the process and by using the application in a short period.

5.3 SUGGESTION

Findings from the questionnaire, many have given ideas to improve soil moisture sensors among them are

i. The soil moisture sensor can be made waterproof to make it more sophisticated.

ii. Improve design product

iii. Add an element measuring the temperature of the current area

iv. Using more advanced technology to facilitate the work done at the study site

vi. Place a container or hard plastic on top of the chips to avoid getting wet material when it rains

vii. The tool is equipped with accessories to be more durable

5.4 COCNLUSION

The main objective of this study was to compare soil moisture values between manual methods and IR4.0 technology products. data collection between these two methods will be compared against agreed soil moisture standards. This study is also supported by a survey that proves the soil moisture sensor method is better than the manual method. This is because, it provides data quickly which can save time. In addition, this method can also provide accurate readings without having to bring the soil to the laboratory to obtain soil moisture readings. In conclusion, with the soil moisture sensor it can help teachers, students and civil engineers to get soil moisture readings quickly and easily.

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ATTACHMENT

ATTACHMENT A : COST

ATTACHMENT B : QUESTIONNARIES

ATTACHMENT C : GANTT CHART FYP 1

ATTACHMENT D : GANTT CHART FYP 2

ATTACHMENT A : PROJECT COST ESTIMATE

To produce this sensor there will have some financial. This is the cost of the materials that we use to do this product. Table below shows the estimate price of the materials.

NO.	MATERIAL	PRICE
1.	ESP32	RM 22.50
2.	CONNECTOR WIRE	RM 3.70
3.	BREADBOARD	RM 2.50
4.	OLED DISPLAY	RM 14.90
5.	RESISTIVE SOIL MOISTURE SENSOR	RM 3.90
		RM 47.50

ATTACHMENT B : QUESTIONNERIES


Soil Moisture Sensor (SOMOS4.0)

SELAMAT SEJAHTERA. TERIMA KASIH KEPADA ANDA KERANA TELAH MELUANGKAN SEDIKIT MASA UNTUK MEMBANTU KAMI MENYELESAIKAN KAJI SELIDIK INI. KAJI SELIDIK INI ADALAH UNTUK MEMBANDINGKAN UKURAN KETEPATAN TANAH UJIAN KAEDAH STANDARD DAN TEKNOLOGI SENSOR KELEMBAPAN TANAH IR4.0.

BAHAGIAN A : DEMOGRAFI RESPONDEN

1.JANTINA *

- PEREMPUAN
- LELAKI

2.UMUR *

- 18-20 TAHUN
- 21-25 TAHUN
- 26-30 TAHUN
- 30 & KEATAS

3.SIAPAKAH ANDA (ROLE) *

- PELAJAR
- JURUTERA AWAM
- PENSYARAH

Section 2 of 2

Soil Moisture Sensor (SOMOS4.0)

BAHAGIAN B : PANDANGAN UMUM TERHADAP KAJIAN

UJIAN ATTERBERG LIMIT DAN JUGA SOIL MOISTURE SENSOR DIGUNAKAN UNTUK MENGUKUR KELEMBAPAN TANAH. UJIAN ATTERBERG LIMIT BOLEH DILAKUKAN DI MAKMAL MANAKALA SOIL MOISTURE SENSOR BOLEH DILAKUKAN DI TAPAK TANAH YANG PERLU DIUJI SEPERTI TAPAK PEMBINAAN.

DI SINI KAMI SERTAKAN LINK BAGAIMANA BACAAN KELEMBAPAN TANAH DIAMBIL MENGGUNAKAN SOIL MOISTURE SENSOR. SELAIN ITU, ANDA JUGA DAPAT LIHAT PERBANDINGAN DATA ANTARA SOIL MOISTURE SENSOR DAN JUGA ATTERBERG LIMIT TEST.

1.ADAKAH ANDA PERNAH MELAKUKAN UJIAN ATTERBERG LIMIT DI MAKMAL ? *

- YA
- TIDAK

2.PERNAHKAH ANDA MENGGUNAKAN ATAU DENGAR TENTANG SOIL MOISTURE SENSOR ? *

- YA
- TIDAK
- MUNGKIN

3.ADAKAH ANDA BERSETUJU PENGGUNAAN SOIL MOISTURE SENSOR DAPAT MENJIMATKAN MASA ANDA ? *

- YA
- TIDAK
- MUNGKIN

4.ADAKAH ANDA BERSETUJU PENGGUNAAN SOIL MOISTURE SENSOR ADALAH CARA YANG MUDAH UNTUK MEREKODKAN BACAAN KELEMBAPAN TANAH? *

- YA
- TIDAK
- MUNGKIN

5.ADAKAH SOIL MOISTURE SENSOR BOLEH MENGANTIKAN UJIAN ATTERBERG LIMIT TEST DI MAKMAL? *

- YA
- TIDAK

6.SILA NYATAKAN SEBAB UNTUK PERTANYAAN SOALAN SECTION B(5) DI ATAS. *

Long answer text

7.PADA PENDAPAT ANDA PENAMBAHBAIKAN APA YANG BOLEH DILAKUKAN PADA SOIL MOISTURE SENSOR ? *

Long answer text

ATTACHMENT C : GANTT CHART FYP 1

Week / Activity	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15
Discuss about title of project															
Choose a title															
Analyse the process															
Identify the problem															
Objective setting															
Set scope of the project															
Do pervious research															
Prepare for presentation															
Presentation 1															
Make a improvement															
Do methodology															
Prepare for presentation															
Presentation 2															

ATTACHMENT D : GANTT CHART FYP 2

MINGGU/ AKTIVITI PROJEK	STATUS	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16
Taklimat pengenalan projek akhir tahun 2 besama penyelaras	R																
	L																
Menggunakan lab geo bagi ujian atterbag limit	R																
	L																
Menyiapkan penyambungan komponen bagi teknogi sensor IR4.0	R																
	L																
Bengkel mendeley bersama puan nor hazlin	R																
	L																
Mencari maklumat berkaitan dengan projek IR4.0	R																
	L																
Taklimat penulisan bab 4 & 5 bersama DR. seri Bunian	R																
	L																
Menyiapkan slide “progress presentation”	R																
	L																
Menyiapkan report bab 4	R																
	L																

MINGGU/ AKTIVITI PROJEK	STATUS	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16
Taklimat pengenalan projek akhir tahun 2 besama penyelaras	R																
	L																
Menggunakan lab geo bagi ujian atterbag limit	R																
	L																
Menyiapkan penyambungan komponen bagi teknogi sensor IR4.0	R																
	L																
Bengkel mendeley bersama puan nor hazlin	R																
	L																
Mencari maklumat berkaitan dengan projek IR4.0	R																
	L																
Taklimat penulisan bab 4 & 5 bersama DR. seri Bunian	R																
	L																
Menyiapkan slide “progress presentation”	R																
	L																
Menyiapkan report bab 4	R																
	L																