Design & Implementation of Soil Quality Measurement System to Determine Fertilizer Requirement & Suitable Crop for Farmers

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Declaration

It is hereby declared that

1. The Final Year Design Project (FYDP) submitted is my/our own original work while completing degree at Brac University.
2. The Final Year Design Project (FYDP) does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The Final Year Design Project (FYDP) does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I/We have acknowledged all main sources of help.

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Approval

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Ethics Statement

We thus state and certify that this Final Year Design Project titled "Design & Implementation of Soil Quality Measurement System to Determine Fertilizer Requirement & Suitable Crop for Farmers" complies with requirements for completion of the Final Year Design Project set by the BRAC University Authority and the Department of Electrical and Electronic Engineering of BRAC University in partial fulfillment of the requirement for the degree of Bachelor of Science (B.Sc.) in Electrical & Electronic Engineering. This project report has been compiled with the help of all the members of the group including our findings, designs, test results and details of our prototype. All the resources and literature reviews have been cited properly with the guidance of our ATC Panel.

The plagiarism index of our project report is found to be 9% after consulting with the Ayesha Abed Library of BRAC University for a similarity check.

Abstract/Executive Summary

The process of soil degradation is primarily associated with the excessive application of chemicals and unregulated practices in crop production, resulting in a notable reduction in the availability of essential macro nutrients within the soil which then leads to decrease in production of crops. The present research work examines the viability of implementing a full system for evaluating soil health, enhancing soil quality, and determining appropriate crop choices based on the current state of soil health. This research work focuses on the conception and implementation of a wireless and portable system for measuring soil quality. The primary objective of this study is to develop a system that not only assesses the soil's condition but also provides recommendations for optimal fertilizer application and suggests the most suitable crops based on the specific soil conditions. This study aims to make a valuable contribution to the field of sustainable agricultural practices and the mitigation of soil degradation challenges. By thoroughly examining and addressing these various aspects, the study aims to provide insights and potential solutions to these significant challenges.

Keywords: Soil NPK, pH, Moisture sensors; Crop suggestion; Fertilizer recommendation, Cloud Computing.

Dedication

We will always be grateful to the Almighty for whom this project has been completed successfully. We would like to dedicate this work to our parents for their unwavering support throughout the whole duration of this project. Without their support and prayers, completion of this project might not have been so smooth.

Acknowledgement

We would like to acknowledge and thank the Chair of our ATC Panel Dr. AKM Abdul Malek Azad, Professor, Department of EEE, BRAC University for his continuous support and guidance throughout the completion of this project. We would also like to acknowledge and convey our gratitude to Dr. Touhidur Rahman, Professor, Department of EEE, BRAC University and Mohammad Thushar Imran, Lecturer, Department of EEE, BRAC University for sharing their valuable insights and recommendations for further improvement of our initial idea for this project.

We would also like to express our gratitude to Afrida Malik, Lecturer, Department of EEE, BRAC University for her assistance during the initial stages of this project.

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1.1 Introduction

Soil quality measurement refers to monitoring fertility that coincides with the availability of Nitrogen, Potassium, Phosphorous, and other minerals in the soil along with other parameters namely soil moisture, pH, and temperature [1]. These days, there is a high necessity for this since yields are lower and there is an increased demand for food production in comparison to earlier eras [2].

Long ago when population growth was slower and annual agricultural yields were sufficient to feed the whole country, Bangladesh's claim to fame as a land of fertile soils may have been justified. However, the current scenario is far from it. Farmers are clueless about improving crop production through the use of fertilizer and pesticides because of their lack of knowledge of soil quality. They usually pick up the habit of applying fertilizer inherently. They just assume and apply fertilizer without any knowledge but from experience. This strategy may be effective in certain instances, but not always because it lacks scientific evidence. Having proper knowledge about the fertility of the soil and suitable environments for different crops is a must for higher yields.

However, such knowledge is scarce among the farmers due to quite low literacy rate among the farmers in general [3]. Therefore, having a system that considers current soil health and uses agricultural knowledge to provide suggestions regarding fertilizer to improve soil health and suitable crops for current soil health can improve overall soil fertility and consequently yields in order to somewhat tackle food scarcity.

1.1.1 Problem Statement

20 or 30 years ago, Bangladesh was regarded to have one of the most fertile lands due to favorable climate and geographical location. An abundance of rivers flowing through our country only helped the case. Unfortunately, recent scenario is far from it. Pollution and climate degradation affected our environment and soil fertility heavily. According to the Global Climate Risk Index, Bangladesh is the most climate change vulnerable country in the world [3]. Increasing temperature, increasing salinity, irregular rainfall, excess heat waves and calamities in recent years have had considerable negative impacts on the agricultural position of this country. Also, with climate change, the crops have also evolved and now just one crop has many variants that are suitable for different environments. So, the requirements have also changed for different crops in recent times. Updated agricultural knowledge has become a must.

Increasing population has created a large demand of food. Conventional methods were convenient and supported food demand for a long time. But now it has become a must to look for better ways to increase yields and food production to be at least on par with the exponentially increasing demand. Planting the same crop over and over again applying same type of fertilizers of the same amount over the years has seen a fall in yields. Traditional methods like chemically soil testing is too time consuming and not readily available for anyone to use [4]. As a result, such methods nowadays have become almost redundant.

Using improper and imbalanced amount of fertilizer can hamper the growth of the crops. Lack of knowledge among the farmers result in applying fertilizer and pesticides without any control or observations [5]. Application of proper fertilizer is necessary for better yields which is a concern considering the rate of literacy among the farmers.

Furthermore, increasing population has decreased per capita agricultural land. Meaning, it is necessary to increase crop productivity to sustain food production. Therefore, it is high time to look for technologically advanced opportunities that can increase soil fertility and food production.

1.1.2 Background Study

Background research for this project reveals that many attempts have been made by a lot people to monitor the soil quality using IoT. Using various sensors for measuring different parameters of soil quality, collection of the data from all the sensors, using IoT to store and monitor the data and estimation of required fertilizers based on the macronutrient availability in the soil is quite common. Autonomous sensors connected and able to communicate with each other is known as Wireless Sensor Network (WSN) which has been used for such a research. Multiple sensor nodes which consist of a microcontroller and various soil quality measuring sensors, are connected to a gateway node that is again accessed using another microcontroller [1]. A cloud platform is used to store and analyze the data and show results like fertilizer requirement [2]. Primitive technology like lab testing of the soil has been digitalized by meshing electronics to monitor soil quality. The changing color is detected with a sensor to determine the nutrients and PH level [4]. Depending upon the availability of soil nutrients measured through sensor data, fertility rating can be given. Also, by comparing the measured values with ideal nutrient values, fertilizer is recommended [5]. The collected and stored data is fed into a machine learning algorithm that allows users to understand the investigated probability distribution of soil nutrients more thoroughly [6]. Using a machine learning algorithm that takes all the sensor data as input, suitable crop for the land can be detected as well by comparing the requirement levels of available crops [7], [8]. Image processing has also been used as a method of collecting soil quality parameter data like moisture content and PH level [8]. Image processing can also be used to detect plant diseases or if crops are suffering from lack of nutrition [9], [10]. Such data is taken into account while recommending fertilizers or pesticides. Automation in the form of robotics has also been included in projects like this. Determining fertilizer requirement and spraying required fertilizer is done with a robot without human intervention [11]. Automation is further included in the irrigation process. If moisture level is below par then with a simple command on the webpage, irrigation process turns on and off [12]. Even ploughing or seed planting can be done using robots which in turn lessens manual labor by a significant amount [13].

1.1.3 Literature Gap

From our literature review we have seen that all the researches or projects have made significant advancements towards smart agriculture. Wireless Sensor Network (WSN) has been used widely for collection of soil data but no recommendations have been provided regarding suitable crops [1], [2]. A few papers dived into the estimation of fertilizer requirements based on the current soil health [5]. Very few projects tried to recommend suitable crops for the land [7], [8]. Some has investigated using image processing for detection of soil health and crop diseases [8], [9], [10]. Some projects are a bit too advanced consisting fertilizer spraying or dispensary systems that may be hard to control and use for a regular farmer [11], [12], [13]. However, none of them have been implemented or designed successfully that have met all the desired criteria namely collecting soil quality parameter data, estimation of required fertilizer for soil quality improvement, estimation of best suited crop for current soil health, user friendliness, portability of the whole system. Each research or project has looked into specific areas and not as a whole. The proposed system meets all the desired criteria while avoiding any primitive technology or way too advanced ones to make sure of improvement in agriculture without using inefficient methods and having user objection. This system is light, portable, easy to use and provides necessary suggestions based on the soil health for soil health improvement and better yields.

1.1.4 Relevance to Current and Future Industry

Our climate has changed drastically over the years causing fall of yield and the land for cultivation per capita has been decreasing continuously [3]. In such scenario, it is necessary for us to evolve regarding farming. Traditional ways of growing whatever crops we like in whatever type of land is not able to cut it anymore. Proper knowledge and scientific applications are required to make best use of the farming land. Using technical knowledge of fertilizer application and suitable crops for different types of environments can heavily boost the yields. Food is one of the basic needs of people. However, it is regrettable that in a developing country like Bangladesh, around 30 percentage of people are still facing food scarcity [14]. Food production not being able to keep up with the exponentially increasing population is one of the biggest reasons for such crisis. Again, to tackle adverse weather, genetic engineering is being used to develop different varieties of just one type of crop [15]. Continuous development of crops thus will continue as we traverse into challenging climate conditions every day. Furthermore, the population all over the world will continue to increase for as long as humanity exists. With increasing population at such rate, not only Bangladesh but also many first world countries will be facing food crisis. This demands improvement in the farming industry. Having a system that can measure soil quality and suggest suitable crops alongside required fertilizers can make the best use of whatever land we have for cultivation. Tackling food scarcity in the present and in the future will be much easier if the proposed project is successfully implemented.

1.2 Objectives, Requirements, Specification and constraints

1.2.1. Objectives

We live in a modern phase where population is exponentially increasing, and land mass is decreasing. The demand for food is rising with time. In this situation all we are doing is applying more and more fertilizers to decrease the cultivating time of crops. But this leads to soil degradation, as applying more and more fertilizers and pesticides makes the crops, vegetables, fruits hazardous for our health. That is why our goal is to:

- Designing a system for decision-making purposes with sensor data and considering crop requirements.
- Implementation of an algorithm that provides suggestions to the user regarding suitable crops for the land and total fertilizer requirement for better yields.
- Develop an IoT-based system for algorithm implementation and to monitor real-time nutrient levels.
- Analyzing sensor data using designed algorithms to estimate fertilizer requirements for crops and suitable crops for current soil health.

1.2.2 Functional and Nonfunctional Requirements

Functional Requirements:

1. Proper placement of sensor probes to ensure the best contact with e-testing materials (soil N, P, K, pH) to get maximum accurate data for analysis.
2. Processing multiple sensor data within the device.
3. Using proper algorithm to detect favorable crops.
4. Upload the real-time data to the cloud and store it for further analysis.
5. Develop a user interface or a mobile application to show all the data and results.

Non-Functional Requirements:

1. Getting generalized ideas from soil experts and farmers regarding the amount of fertilizer be applied in the required field based on the sample data taken from some specific places.
2. According to stakeholder requirements, the design should be affordable and easy to use for them.
3. Getting approval regarding the NPK sensor data accuracy from Bangladesh Standards and Testing Institution (BSTI).

1.2.3 Specifications

System Level Specification:

Table 1: System level requirement from Stakeholder (Farmer) technical term

System level	Specification
Potential Area	Collect sensor data after every 435.6 Sq. Ft
Operating Time	4-hour constant run time
Soil Nutrient Data Collection	Collect from 4 inch (10 cm) below the surface [16]
Weight and Dimension	430 gm and 35” x 25” x 5”

For measuring the soil quality, we need to put the sensor 4 inch deeper inside the soil. Therefore, we need to ensure that the probe length is 4 inches [16]. Also, the system should be lightweight and easy to carry so that farmers can easily use the device whenever necessary. Soil quality measurement and analysis should be fast and accurate at the same time so that the required decision can be taken. Excessive cost will make this device out of reach from the farmer’s budget. Mobile application system is implemented for better visualization of data and to see the fertilizer requirement. The device and mobile application will work wirelessly. Lastly, for accurate data from the field we need to take multiple data therefore the device should have enough battery pack to with stand data processing 5-6 times.

Component Level Specification:

Table 2: Details of Component level Specification

Sl.	Component	Model	Description	Specification
1.	Soil Nutrient Sensor	NPK sensor RS485	The soil NPK sensor is suitable for detecting the content of nitrogen, phosphorus, and potassium in the soil, and judging the fertility of the soil by detecting the content of N, P, and K in the soil. We use this sensor for collecting the nitrogen, phosphorus and potassium data from the soil.	**Dc power supply:** 5-30v **Maximum power consumption:** ≤0.15W (at 12V DC, 25°C) **Operating temperature:** 0°C~55°C **Nitrogen phosphorus potassium range:** 1-1999 mg/kg (mg/L); resolution rate: 1 mg / kg (mg / L), accuracy of: ± 2% FS **Response time** <1S **Protection:** IP68 **Probe materials:** stainless steel **Dimensions:** 45*15*123mm **Output signal:** RS485 (Modbus protocol)
2.	Temperature and Humidity Sensor Module	DHT11 SEN-00236	The DHT11 is a basic, ultra-low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air. We use this sensor for collecting the temperature data of the field environment.	**Power Supply:** 3.5 ~ 5.5V DC **Relative Humidity** **Resolution:** 16Bit **Repeatability:** ±1% RH **Accuracy:** At 25℃ ±5% RH **Response time:** 6s **Temperature** **Resolution: 16Bit** **Repeatability: ±0.2℃** **Range: At 25℃ ±2℃** **Response time: 10S**
3.	Soil Moisture Sensor Module	FC-28	FC-28 is a Soil Moisture Sensor which is a simple breakout for measuring the moisture in soil and similar materials.	**Power supply:** 3.3V-5V **PCB Dimension:** (Approx)3cm x 1.5cm **Soil Probe Dimension:** Approx. 6cm x 3cm
4.	Soil pH Detector Sensor Module	SEN-00PH02 RS485	The soil pH sensor is a device that measures the current pH of the soil. It detects the pH value of the soil by inserting two stainless steel probes vertically into the soil. We, detect the soil pH value with this sensor.	**DC supply :**12-24v DC **Power consumption:** 0.15w (12v DC,25°C) **Measurement accuracy:** +-0.3PH **PH measurement range:** 3-9PH **Output signal:** RS485/ 0-5V **Operating temperature:** 0-55°C **Response speed:** < 15S **Sensor line length:** 1.2 meter

5.	Processing Unit	ESP-WROOM-32	ESP-WROOM-32 Board is a fast-leading edge low-cost Wi-Fi technology. Modern high-level mature LUA based technology. It is an integrated unit with all available resources on board. We use this board for transferring data with the use of internet.	**Power input:** 4.5V ~ 9V (10VMAX), **Transfer rate:** 110-460800bps **Working temperature:** -40°C ~ + 125°C **Drive Type:** Dual high-power H-bridge **Flash size:** 4MByte
6.	LCD Display	LCD1602	This is LCD1602 Parallel LCD Display that provides a simple and cost-effective solution for adding a 16×2 White on RGB Liquid Crystal Display into your project. We use this display for visual understanding of data right on the device.	**16×2 LCD display** **Characters:**1-15 **Dimensions:** 9 × 5 × 1 cm
7.	Battery	9V and 11.1 V battery	This battery is developed for use in the portable high drain digital electronic devices	**Normal Voltage:** 11.1V. **Capacity:** 1000mAh. **Charging Cycle:** 1000 Time. **Length:** 48mm **Width:** 26mm **Height:** 17mm **Weight:** 30gm
8.	Jumper Wire		Jumper wires are just connecting wire.	**Male to Male** **Male to Female** **Female-Female** **2.54mm spacing pin headers**

1.2.4 Technical and Non-technical Consideration and Constraint in Design Process

Technical Consideration and Constraint in Design Process

- **Making a portable device:** Making a compact, easy to use, portable system containing all the sensors, components, wiring and microcontroller that can be used anywhere.
- **Collection and Transmission of Data:** Collection of data from actual scenario of farming land for the testing phase. Data transmission latency might interrupt real time data processing and output.

Non-technical Consideration and Constraint in Design Process

- **Different sample for testing:** Collecting data for different soil types and different types of farming land sizes.
- **Availability of components:** Sensors and components availability during development of the prototype.

1.2.5 Applicable Compliance, Standards, and Codes

Standards and Codes:

IEEE SA - P1451.99

This standard defines a method for data sharing, interoperability, and security of messages over a network, where sensors, actuators, and other devices can interoperate, regardless of underlying communication technology.

IEEE SA - P3109

This standard defines a binary arithmetic and data format for machine learning-optimized domains. It also specifies the default handling of exceptions occurring in this arithmetic.

IEEE SA - P3123

The standard defines specific terminology utilized in artificial intelligence and machine learning (AI/ML). The standard provides clear definitions for relevant terms in AI/ML. Furthermore, the standard defines requirements for data formats.

IEEE SA - IEEE 1625-2008

This standard establishes criteria for design analysis for qualification, quality, and reliability of rechargeable battery systems for multi-cell mobile computing devices.

IEEE SA - IEEE 802.11-2016

IEEE Standard for Information Technology--Telecommunications and information exchange between systems Local and metropolitan area networks—Specific requirements—Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications.

ISO 18644:2016

Fertilizers and soil conditioners — Controlled-release fertilizer — General requirements.

ISO/DIS 4974

Soil quality — Guidance on soil temperature measurement.

Practices:

Soil sample collection depth:

This practice defines that soil samples should be collected 10 cm or 4-inch-deep from the ground level [16].

Number of samples:

One sample from each 435.6 Sq. Ft

Presence of water in the sample:

Sample soil should contain enough water in it so that sensors can take more accurate data.

1.3 Systematic Overview/Summary of the Proposed Project

Based on an extensive literature review and in-depth discussions with farmers, it has been determined that a comprehensive analysis of seven key parameters, namely nitrogen, phosphorus, potassium, humidity in air, moisture, temperature, and soil pH, can facilitate the identification of the most suitable crop based on the existing soil nutrient levels.

In summary, we have put in a proposed device that possesses the capability to extract all the parameters mentioned earlier from the soil. In the context of data acquisition, the utilization of microcontrollers has been growing in popularity. These compact electronic devices serve as a crucial intermediary between the data source and the server, facilitating the seamless transmission of collected data. Once the data is successfully transmitted to the server, it is then processed and made available to the user in an easy-to-understand format, thereby enabling the user to access and interpret the collected values. We will use a machine learning algorithm to find out the best suitable crops of a particular land along with the fertilizer requirement.

In the pursuit of our project objectives, we have chosen to focus on some selected individual crops. Therefore, our system consistently correlates soil nutrient and pH and other data with the pre-existing nutrient data integrated within the program. This enables our system to provide users with the appropriate fertilizer for each specific plant. In the context of agricultural practices, it is noteworthy that farmers may have the desire to cultivate crops that are not recommended by the machine learning algorithm. However, it is important to mention that the user has the option to choose from a predetermined list of crops generated by the algorithm. Furthermore, the user is also provided with information regarding the appropriate amount of fertilizer required to optimize the soil conditions for the selected crops.

1.4 Conclusion

This system is designed with the motive to help the agriculture industry with new upcoming technology. The focus is to help the farmers to take decisions based on the science of soils and crops. For centuries farmers have been growing crops randomly. They don’t know the condition of the soil and even if the crops they are growing are suitable for the land or not. With the help of our device, they will be able to grow crops suitable for that land. Even while growing the crops, they would be able to understand the required amount of fertilizer that is needed for that specific land which would help us reduce the use of excess fertilizer on land.

Chapter 2: Project Design Approach [CO5, CO6]

2.1 Introduction

In this segment we will discuss the multiple approaches or the methods through which the problem can be solved. In this world the same problems can have different way of solution. That is the main theme of this chapter. Here, we also discuss about the functionality of the whole system, the working procedure in every approach.

2.2 Identify Multiple Design Approach

We have three different designs to implement our system. All the designs have a data collection parts where all the sensors basically collect the data from the soil sample. Here, for all three designs we have processing unit. For design approach 1, we use hard coded C++ programming algorithm where as approach 2 uses python programming algorithm and design approach 3 uses machine learning algorithm. Except the design approach 1, other two design shows the output in user friendly mobile interface.

2.2.1 Design Approach 1

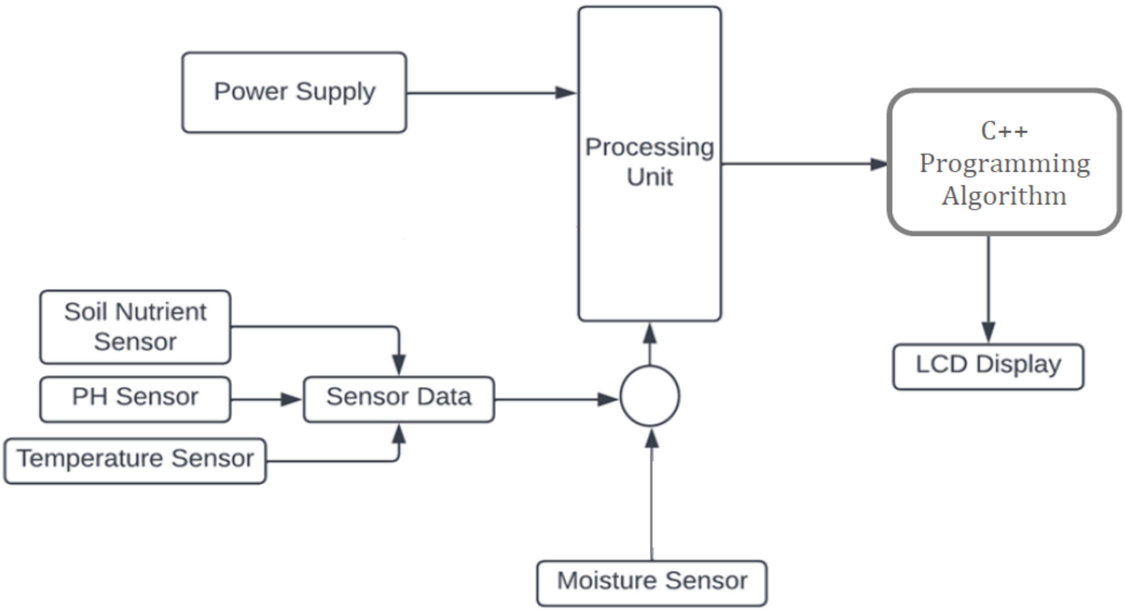


Fig 1: Design Approach 1 Block Diagram

For the first design, various sensors are connected with the processing unit. These sensors can collect data regarding soil nutrients or soil health. A rechargeable battery has been used so that the battery will power the sensors along with the processing unit and necessary modules and this battery can be easily recharged at times of need.

The processing unit collects all the data and uses a C++ programming based decision-making algorithm in order to make decisions regarding fertilizer requirements for the land for better yields or suitable crops for current soil health.

An LCD display is connected to the processing unit in order to let the farmers know on-spot and instantly the decisions made by the algorithm. The algorithm will give out crop preferences sequentially.

2.2.2 Design Approach 2

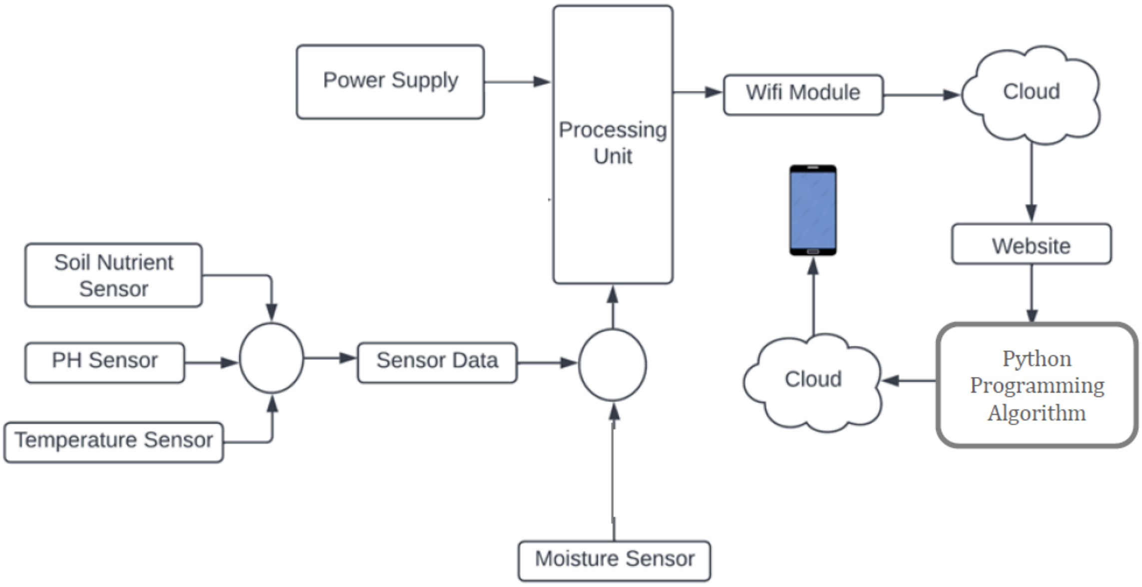


Fig. 2: Design Approach 2 Block Diagram

For the second design, data acquisition is done in the same process as the first design. The difference comes after gathering the data in the processing unit.

From the processing unit, the collected data is sent to the cloud storage. This cloud server stores the data and provides other infrastructure needed to allow the web services for processing the data in web-accessible applications. The stored data is passed through a Python programming based decision-making algorithm similar to the first design to make decisions on fertilizer requirements and suitable crops.

The decisions made as well as other parameters such as current nutrient levels, temperature, soil moisture etc. are displayed in detail through a mobile application.

2.2.3 Design Approach 3

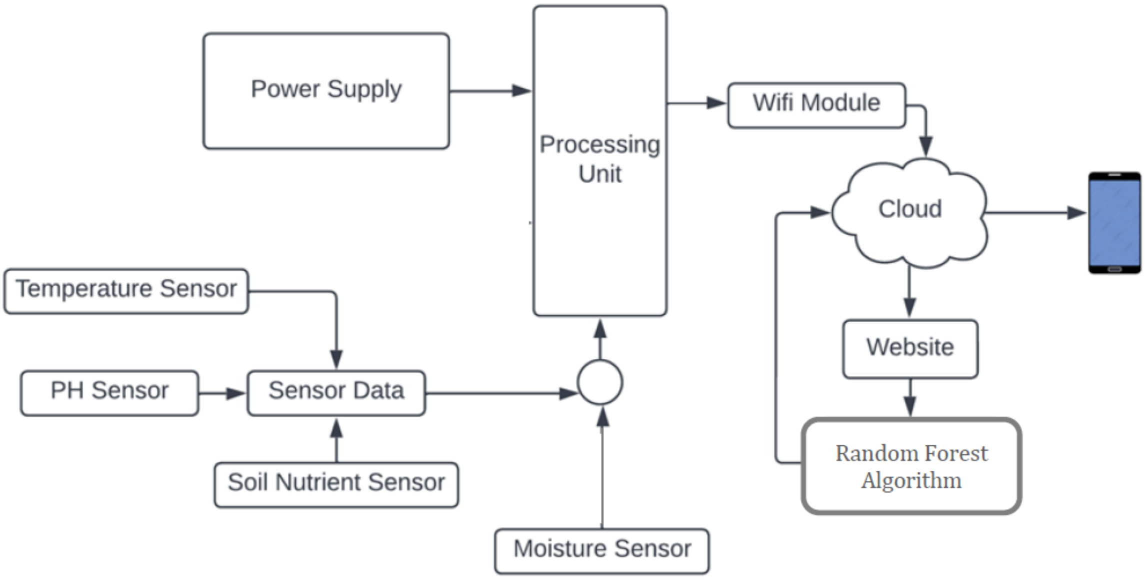


Fig. 3: Design Approach 3 Block Diagram

The only difference between the second and third design is the algorithm used to make decisions. The third design implements a Machine Learning algorithm (Random Forest). This ML algorithm can make decisions based on the input. The algorithm is fed with huge data set for training purposes. After the training period data is given as input and based on the trained data the algorithm compares and classifies.

Although the crop suggestions are derived using the ML algorithm, the fertilizer requirements are derived with the help of Python programming based decision-making algorithm similar to design approach 2 since the fertilizer requirement does not change overtime.

The decisions made along with different parameter data are sent to the user through mobile application similar to the second design.

2.3 Analysis of Multiple Design Approach

Analyzing our all three design approaches we can find the optimal solution based on different criteria.

Cost: In our design approach 1, we need all the basic sensors like soil nutrient sensor, temperature, soil moisture, soil pH sensor and an LCD display to show the output. As, here we are doing on board processing so we do not need any Wi-Fi module. Secondly, in design approach 2, as here we chose to process the data on cloud and decided to show the output in a mobile application or in a website so we need an extra Wi-Fi module to send the data to the cloud which added some extra cost in this design. Then, for design approach 3, there is basically no component level changes with design approach 2, the only changes are in data processing part so the cost of these two designs is very close to each other. Finally, we can say that, though there are some changes of component between the designs but the cost varies between 21,000 and 22,000 Taka. However, we can conclude that, design 1 cost less money in comparison with design 2 and design 3. Whereas specifically design 3 is the costlier one.

Efficiency: Our objective is to develop a system which can determine the suitable crop for a particular land and should give the suggestion to the farmer that which fertilizer he can use in order to prepare the land for some different crops other than the suggestions. Also, it was expected that the system will be able to measure the soil moisture and give suggestion to water the plant accordingly. Now, our design approach 1 can detect the suitable crop for a particular land based on the sensor parameters but cannot give suggestion of fertilizer requirement. Besides that, as this design uses on board processing method with just a simple LCD display to show output it cannot also show the real time data collection.

However, in design approach 2, it is using a code-based processing system with a strong real time user interface to show the output, it can give the suggestion more accurately and in very details than design approach 1. Then, in design approach 3 we use machine learning algorithm to process the data. So, this design can also give the output or suggestions almost accurately.

Now, to conclude with efficiency our design approach 2 and 3 gives us the more efficient output while design approach 1 will remain at the bottom of this list.

Usability: In terms of usability, design approach 2 and 3 are more user friendly as it allows a mobile application-based user interface to see the real time data collection and all the suggestion remotely. Whereas design approach 1 does not have these facilities and cannot give the details suggestion. Moreover, design approach 2 and 3 also allow to store the data that have been collected from previous test which can be accessed by the farmers at any time in future if needed.

Manufacturability: For design approach 1, we need to add an LCD display embedded with the system as this is the only way to show output with this design approach. And for design approach 2 and 3 we need add a Wi-Fi module which will be used to transfer the collected data from device to cloud. Other than this, as all the design have the same sensors and devices so our manufacturing process is almost same for all three designs.

Impact: As design approach 2 and 3 can give details suggestion than design approach 1. So, its economic impact can also be higher. For example, the device shows that that particular land is suitable for maize, but the farmer does not have seed of maize to plant it and he had planned to plant rice. In such scenario, design 2 and design 3 can give proper suggestion to the farmer that how he can prepare that land for rice with proper use of fertilizer which to more extend ultimately impact on economy.

Sustainability: In design approach 1, there is no option to store data as it is doing on board processing and shows a precise output on an LCD display. While design approach 2 and design approach 3 have the facilities to keep the data safe on cloud as in these designs after collecting all the data from field, they are sent to a cloud server for processing and this server stores the data. Furthermore, these designs provide details of the current land climate and nutrition. So, we can say design 2 and design 3 is more sustainable in this case.

Maintainability: Maintenance of our designs are not that much difficult. All of their design and manufacturing is almost same. But here, as our device is not designed to be water resistant it should be used on dry land or should keep it away from water because that can hamper the sensors reading and the overall system as well.

Comparison:

Table 3: Comparison of three design approaches

Criteria	Design Approach 1	Design Approach 2	Design Approach 3
Data Processing	The processing of the acquired data is done by the processing unit, and a C++ programming algorithm is used in the processing unit to make on spot decisions.	The data acquired is sent to a web server where the data is collected, stored, and used as input for a Python programming algorithm to make decisions.	The data acquired is sent to a web server where the data is collected and used as input for a Machine Learning (Random Forest) algorithm to make decisions.
User Interface	An LCD display attached to the processing unit shows decisions made by the algorithm.	The decision made by the algorithm is delivered to the user's mobile phone through a mobile application.	The decision made by the algorithm is delivered to the user's mobile phone through a mobile application.
Decision Making Algorithm	A C++ programming algorithm is used to make decisions for	A Python programming algorithm is used to make decisions for	A machine learning algorithm is used to make decisions for

	fertilizer requirements and suitable crop selection.	fertilizer requirements and suitable crop selection.	fertilizer requirements and suitable crop selection for different crops.
Implementation	Easiest to implement among all the approaches as it requires good programming skill only.	Harder to implement as it requires good programming skill as well as cloud understanding and web access for decision making purposes and also mobile application is needed.	Hardest to implement as it requires moderate programming skill as well as cloud and Machine Learning understanding and web access for decision making purposes and also mobile application is needed.
Usability	Very easy to use.	Harder to use since it requires web access and a mobile application.	Harder to use since it requires web access and a mobile application.
Functionality	It has very limited functionality.	It has more functionality through interaction with a mobile application.	It has more functionality through interaction with a mobile application.
Efficiency	Least efficient as not much details are shown as output.	More efficient as a lot of details are shown through a mobile application.	More efficient as a lot of details are shown through a mobile application.

2.4 Conclusion

Considering all these aspects and from the comparison table, we can conclude that our design approach 3 is the optimal solution. Our design approach 3 lets users know more information such as nutrient levels, humidity, pH, soil moisture through the mobile application and can tell us how much of what type of fertilizer is needed for a crop. In contrast, from design approach 2 we get almost perfect accuracy through rigorous testing for all the integrated crop details. However, design approach 2 requires hard coding of different parameters for every new crop we want to integrate with our system which is a tiresome and lengthy process. Since we use Machine Learning Algorithm for design approach 3, all we need to do is collect enough data for every new crop we want to integrate with our system and update our database. The algorithm uses the updated database every time to provide suggestions of different crops. Furthermore, design approach 1 does not provide detailed suggestions due to lack of a good or proper user interface.

Thus, we can say that design approach 3 is our optimal solution which coincides with our assumption made in our proposal of this project.

Chapter 3: Use of Modern Engineering and IT Tool. [CO9]

3.1 Introduction

For developing a project, the first thing that we require is testing of the system through which we can ensure the validity of the project and test our theoretical idea in real life. Different software tools are required for such purpose. After that we construct the prototype using technical and hardware tools.

3.2 Select Appropriate Engineering and IT Tools

3.2.1 Software Tool Selection

Python Language: Python language has been primarily selected due to ML algorithm implementation in our design approach 3. Also, this language is easy to use and has a plethora of library available. Also, cloud computing is easier with Python language which is required for our design approach 2 and 3.

C++ Language: C++ language is used in our project since we are using ESP module to connect to cloud and gather soil data for analysis. ESP module works with C++ language only. Therefore, the processing unit requires C++ language and hence the selection.

Arduino IDE: This software tool has been selected in order to program the processing unit in order to collect soil data and send the collected data through Wi-Fi to the cloud.

Blynk IoT: Blynk IoT is selected due its simplicity and ease of use. This application is able to show our collected data from the sensor as well as crop suggestion and fertilizer requirements for different crops. This application is free and requires no subscription for daily usage. Since our project is intended as a helping hand for the farmers, we opted to select this free application rather than other paid ones.

Proteus Software: Proteus software has been selected for simulation purposes. We simulate all our design approaches before starting with hardware implementation in order to get a proper idea about how we should approach the hardware implementation or which approach would be the best one.

Google Colab: We select Google Colab for implementing the ML algorithm with Python language. This works as the cloud which we use for cloud computing purposes and it provides us with crop suggestions and fertilizer recommendations.

3.2.2 Hardware Tool Selection

Soil Nutrient Sensor (NPK Sensor RS485): We selected this sensor for collecting the Nitrogen, Phosphorus and Potassium data from the soil. These three nutrients are known as macro nutrients and are mostly responsible for crop growth.

Temperature and Humidity Sensor Module (DHT11 SEN-00236): We selected this sensor for collecting the temperature and humidity data of the field.

Soil Moisture Sensor Module (FC-28): We opted to use this sensor for measuring the soil moisture percentage of the field.

Soil pH Detector Sensor Module (SEN-00PH02 RS485): We opted to use this sensor to detect the pH value of the field. Neutral soil is usually required for plant growth. If the soil is too much acidic or basic the crops will not grow.

Processing Unit (ESP-WROOM-32): We use this processing unit in order to combine all the sensors and collect the data form the sensors and for transferring data with the use of internet.

Battery (9V and 12V battery): We selected this battery as per our sensor and processing unit requirements to run the whole system.

3.3 Use of Modern Engineering and IT Tools

3.3.1 Description of Software Tools:

Python Language: Python is an interpreted high-level programming language with a syntax that emphasizes code readability and simplicity. It is an interpreted language, which means that Python code is immediately executed by an interpreter rather than being compiled to machine code. Python is thus a highly portable language that can operate on a variety of platforms. Python is popular due to its ease of use and simplicity, as well as its versatility and strength. Because of the availability of powerful libraries such as NumPy, Pandas, and TensorFlow, it is frequently used in areas such as data science and machine learning. We are using python language in order to implement the machine learning aspect of design approach 3.

C++ Language: C++ is a commonly used general-purpose programming language for software development. It is a high-level language recognized for its efficiency and effectiveness. C++ is utilized in a variety of applications, including operating systems, device drivers, games, and scientific simulations. Embedded systems, such as the microcontrollers used in the Arduino platform, are a common application of C++. The Arduino platform's primary programming language is a variation of C++. This variety is known as "Arduino C++" or "Arduino language" and it includes libraries and functions specific to the Arduino platform. Arduino C++ is used to program the microcontrollers on Arduino boards, enabling them to control a variety of electronic devices like sensors, motors, and LEDs. The language includes a variety of libraries and functions that make interacting with various devices simple. C++ is a powerful programming language that is suited for embedded systems. We need this language in our project to program our Arduino Mega.

Arduino IDE: The Arduino IDE (Integrated Development Environment) is a software platform used for programming and developing applications for Arduino microcontroller boards. Arduino is an open-source electronics platform that provides a user-friendly way for both beginners and experienced developers to create projects involving hardware and software interactions.

The IDE provides a simplified programming language based on C/C++ and a set of libraries that abstract low-level hardware operations, allowing users to focus more on the logic of their projects rather than dealing with the intricacies of microcontroller programming.

Blynk IoT: Blynk is a mobile app that allows Internet of Things (IoT) project remote control and monitoring. It offers a user-friendly interface that enables users to design custom interfaces and link them to a variety of IoT devices including Arduino, Raspberry Pi, and ESP-WROOM-32. On the app, we build a new project by selecting a device type, such as Arduino or Raspberry Pi, and establishing a connection to the device. The user interface can be customized by dragging and dropping widgets onto the screen that lets users to interact with their IoT project. Users can also configure notifications to get alerts when particular events occur, such as a sensor reading exceeding a predetermined threshold. The Blynk application also provides real-time data visualization capabilities that enable users to monitor and analyze project data. This information can be presented in many formats, such as graphs or charts, to assist users in identifying patterns. We use this application to build our smartphone-based user interface.

Proteus Software: Proteus is a software application used for the design of electronic circuits, simulation, and PCB layout. Engineers, designers, and students use it extensively for developing, testing, and troubleshooting electronic circuits. The software includes two primary components which are the schematic capture tool and the PCB layout tool. The schematic capture tool enables users to construct and simulate electronic circuits utilizing a broad variety of components, such as resistors, capacitors, inductors, transistors, integrated circuits, various microcontrollers, and sensors. One of the key benefits of Proteus is its ability to simulate circuits in real-time. This saves time and money throughout the design process by allowing users to test and troubleshoot their circuits prior to their actual physical structure. We use Proteus software to simulate the data collection of the sensors and overall processing of the entire design.

Google Colab: Google Colab, sometimes known as Google Colaboratory, is a cloud-based tool that enables collaboration on Python programming using Jupyter notebooks. It offers a free computing environment with access to a variety of potent machine learning libraries and tools, making it a popular option among data scientists, academics, and students. Users have the option of creating new Jupyter notebooks or uploading existing ones. These notebooks can contain text, code, and graphic representations, making them a versatile instrument for data analysis and machine learning. Google Colab gives customers with access to a variety of computing resources, including CPUs and GPUs, enabling them to execute computationally heavy tasks with ease. In addition, it offers pre-installed libraries like as NumPy, Pandas, TensorFlow, and Keras, making it simple to start machine learning projects.

3.3.2 Description of Hardware Tools:

Soil Nutrient Sensor (NPK Sensor RS485): The soil NPK sensor is suitable for detecting the content of nitrogen, phosphorus, and potassium in the soil, and judging the fertility of the soil by detecting the content of N, P, and K in the soil. We use this sensor for collecting the nitrogen, phosphorus and potassium data from the soil.

Temperature and Humidity Sensor Module (DHT11 SEN-00236): The DHT11 is a basic, ultra-low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air. We use this sensor for collecting the temperature data of the field.

Soil Moisture Sensor Module (FC-28): FC-28 is a Soil Moisture Sensor which is a simple breakout for measuring the moisture in soil and similar materials.

Soil pH Detector Sensor Module (SEN-00PH02 RS485): The soil pH sensor is a device that measures the current pH of the soil. It detects the pH value of the soil by inserting two stainless steel probes vertically into the soil. We, detect the soil pH value with this sensor.

Processing Unit (ESP-WROOM-32): ESP-WROOM-32 Board is a fast-leading edge low-cost Wi-Fi technology. Modern high-level mature LUA based technology. It is an integrated unit with all available resources on board. We use this board for transferring data with the use of internet.

Battery (9V and 12V battery): Lipo battery of 9v and 12v have been used. These batteries lead to heavy duty discharge while minimizing resistance and sustain high current loads.

3.4 Conclusion

We have used different types of tools accountable for various tasks. We selected these tools based on the requirement of the project. Initially, we use proteus for simulation purposes as we need a clear idea if the project, we plan on doing is actually viable or not. Then for running the program we use Colab as, it gives us free and easy access to python libraries. Blynk IoT has been used for the user interface and usability then we have selected the necessary components for successful completion of our project. The various engineering tools are listed and explained in this chapter.

Chapter 4: Optimization of Multiple Design and Finding the Optimal Solution. [CO7]

4.1 Introduction

In order to develop the system that we want, we have suggested three possible designs. To determine the best approach, we are testing out various design approaches. We evaluated the performance, effectiveness, accuracy in data analysis, and cost-effectiveness of all three designs after simulating them in Proteus. We will discuss the methodology that we have suggested in the design approaches in this chapter with the Proteus software. In front of the stakeholders, these optimized solutions have the consistency to preserve the viability of these concepts.

4.2 Optimization of multiple design approach

In order to optimize multiple design approaches, we simulate all three designs and evaluate their performance. We first design the data collection system since all three designs have the same data collection approach and optimize the system. Then we further develop the three designs for optimization purpose and finding out which would be the best one.

4.2.1 Data Collecting System for all three Designs:

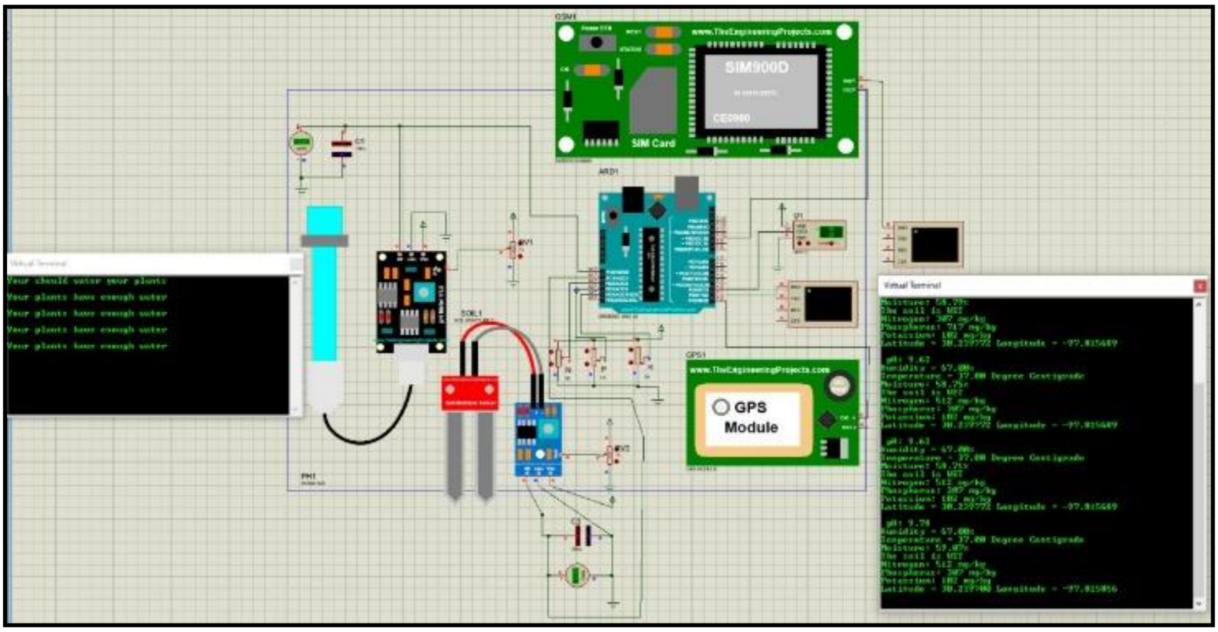


Fig. 4: Data acquisition using sensors

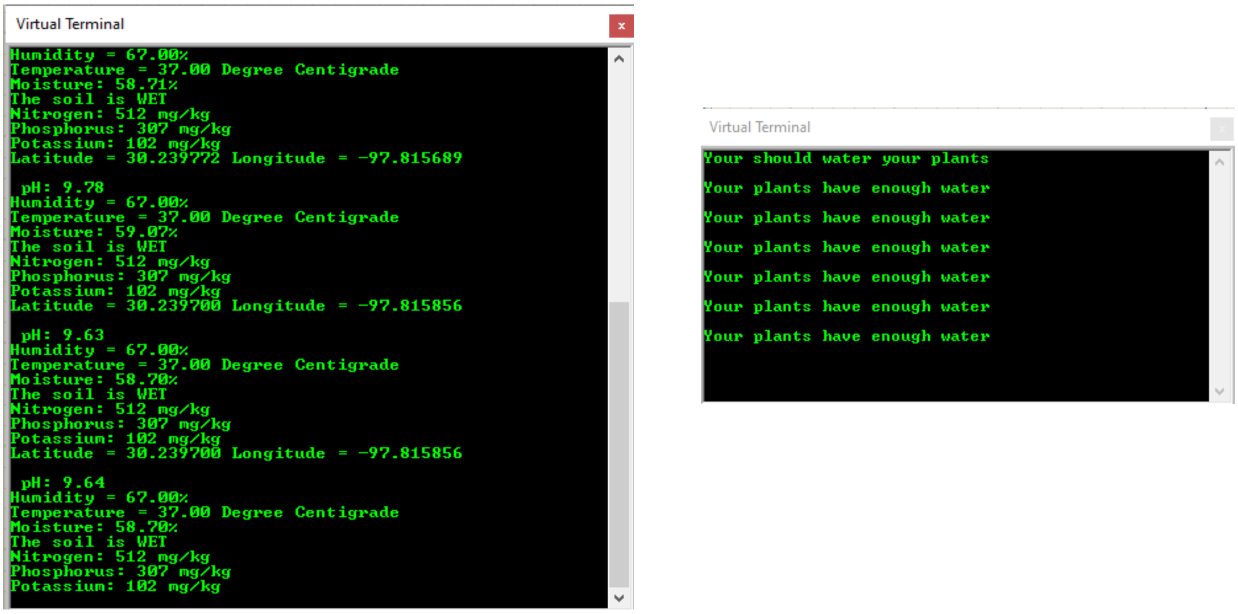


Fig. 5: Data acquisition results

Initially, we focused on the data acquisition part of our system which remains the same for all our designs. Hence, we set up all the required component library in proteus software and for some of the unavailable components we had to fully rely on potentiometer. The main purpose of pH sensor was to measure the pH value of the land provided, the moisture sensor is to determine the available water particle in the soil. However, the core sensor of our system is NPK sensor, for which we could not find any proteus library and that is why we used three potentiometers for three core nutrients of soil which are Nitrogen, Phosphorus and Potassium. A temperature sensor is used for estimating the current temperature of the field surrounding. Lastly, we connect all the sensors to Arduino, which we use as our processing unit. We gather all the data from the sensors and store it in our micro controller and later we display the data through a virtual terminal. We were also able to integrate a threshold-based system.

4.2.2 Design Approach 1

Previously, we acquired all the data as shown above. Now our main moto is to run the system with the acquired data. The data are set based on the threshold data of the crop that we collected from data sets for machine learning and Fertilizer Recommendation Guide-2018 [17]. As we are working on a system, we need to have a specified range of crops that we want to work with. Now, the crops we want to work on are rice, maize, lentil, jute and cotton.

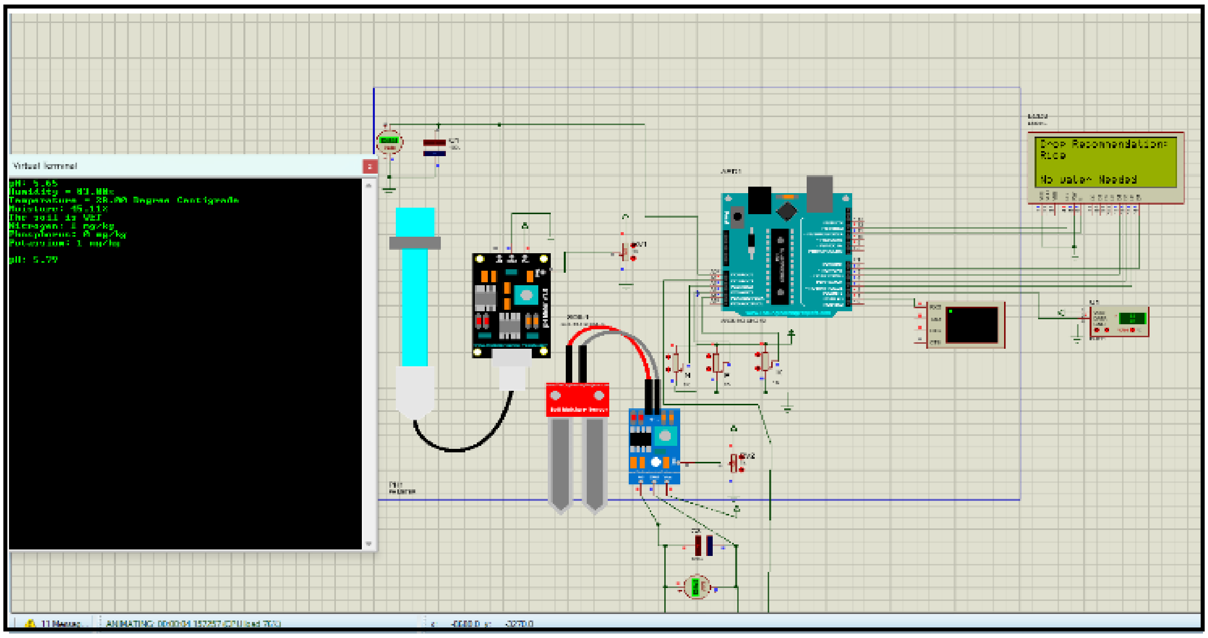


Fig. 6: Simulation showing crop recommendation for rice when the threshold values match

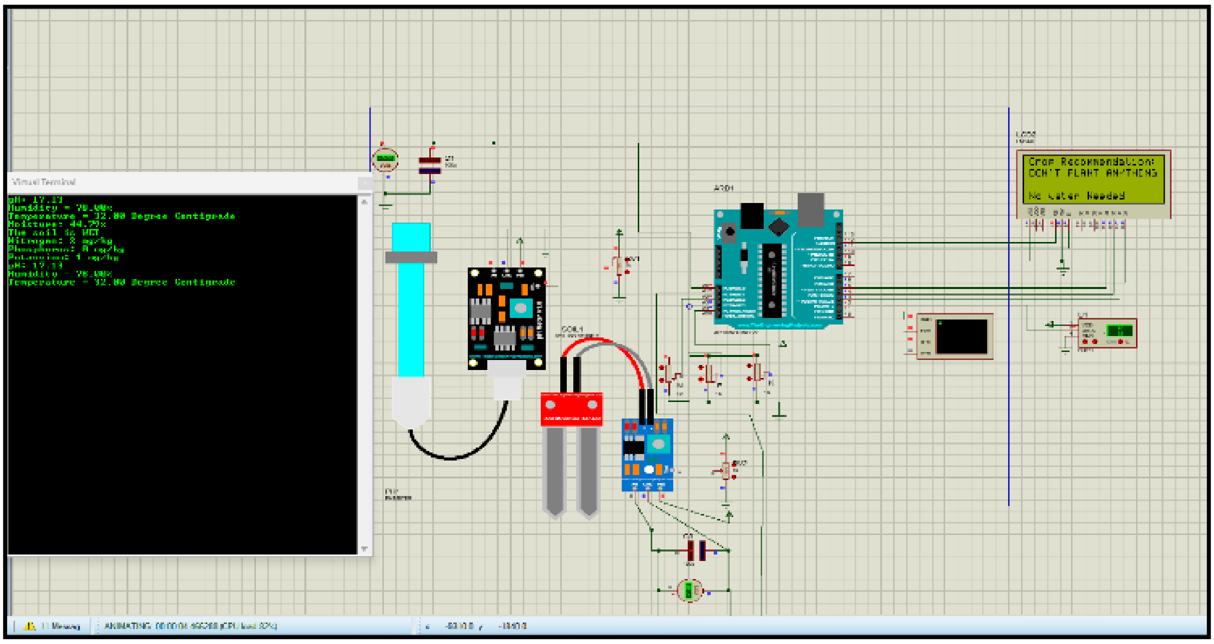


Fig. 7: Simulation showing don't plant anything as the threshold value does not match

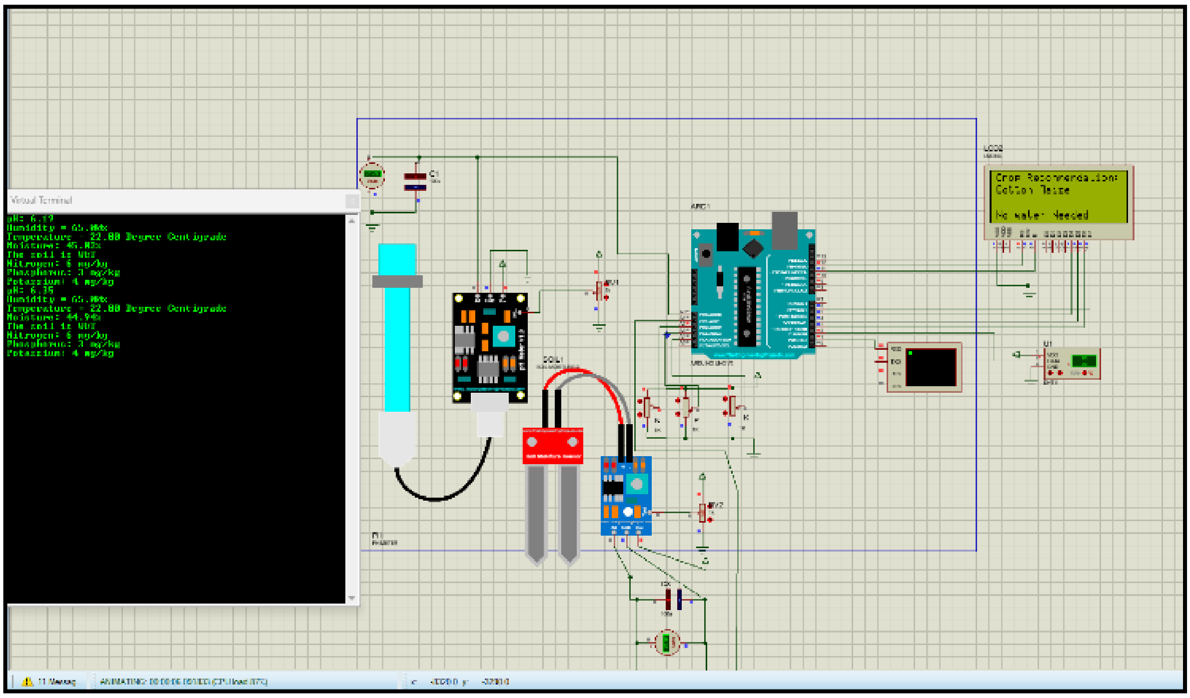


Fig. 8: Simulation showing crop recommendation for cotton and maize when the threshold values match for both

In our design approach 1 we intend to make a system which is able to work without any internet connection and is independent of external system. Everything is built inside the system and provide a on board processing abilities. We use the pH values, temperature values, humidity in the environment, nitrogen values, potassium values and the phosphorus values. All the sensor values are accumulated through Arduino Uno and the decision and suggestions are displayed through an LCD display. Here, the above figures show when the sensor values are within the range of the threshold values the system shows the recommended crop from the list.

We set the threshold values in the Arduino so that when the device gets with in the threshold parameters it recommends the crops whose parameters matches. The output is displayed through an LCD Display and the recommended crops and the suggestion are easily interpretable.

4.2.3 Design Approach 2

For this design we collect the data similar to as we have already done for design approach 1.

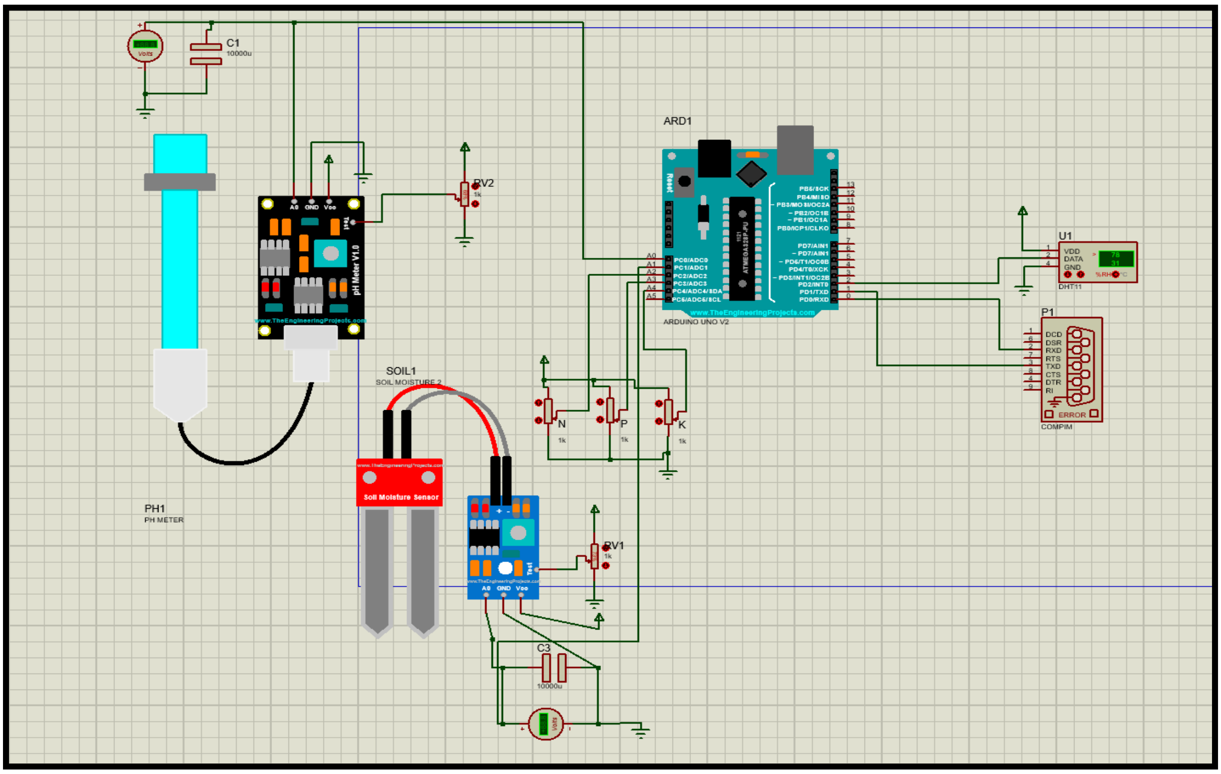


Fig. 9: Simulation Circuit set up for design approach 2 in Proteus

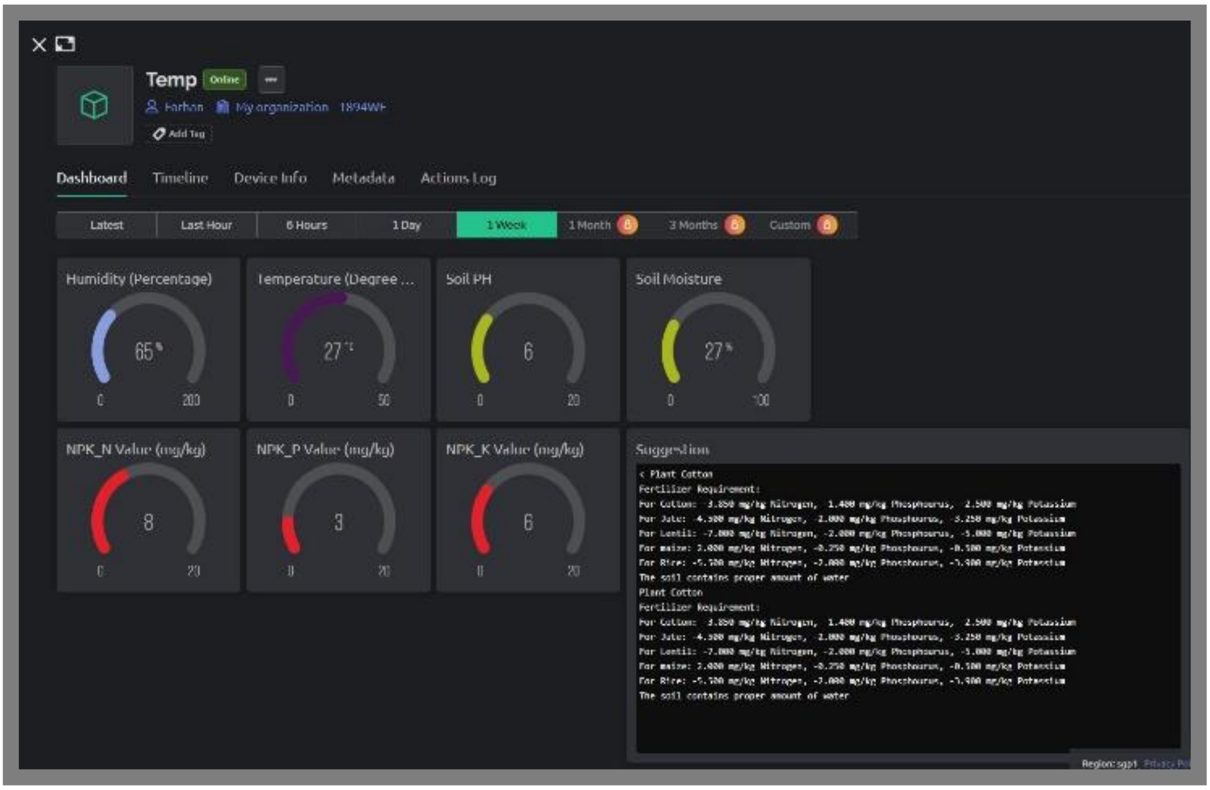


Fig. 10: Data collection and displaying output in the Blynk web console

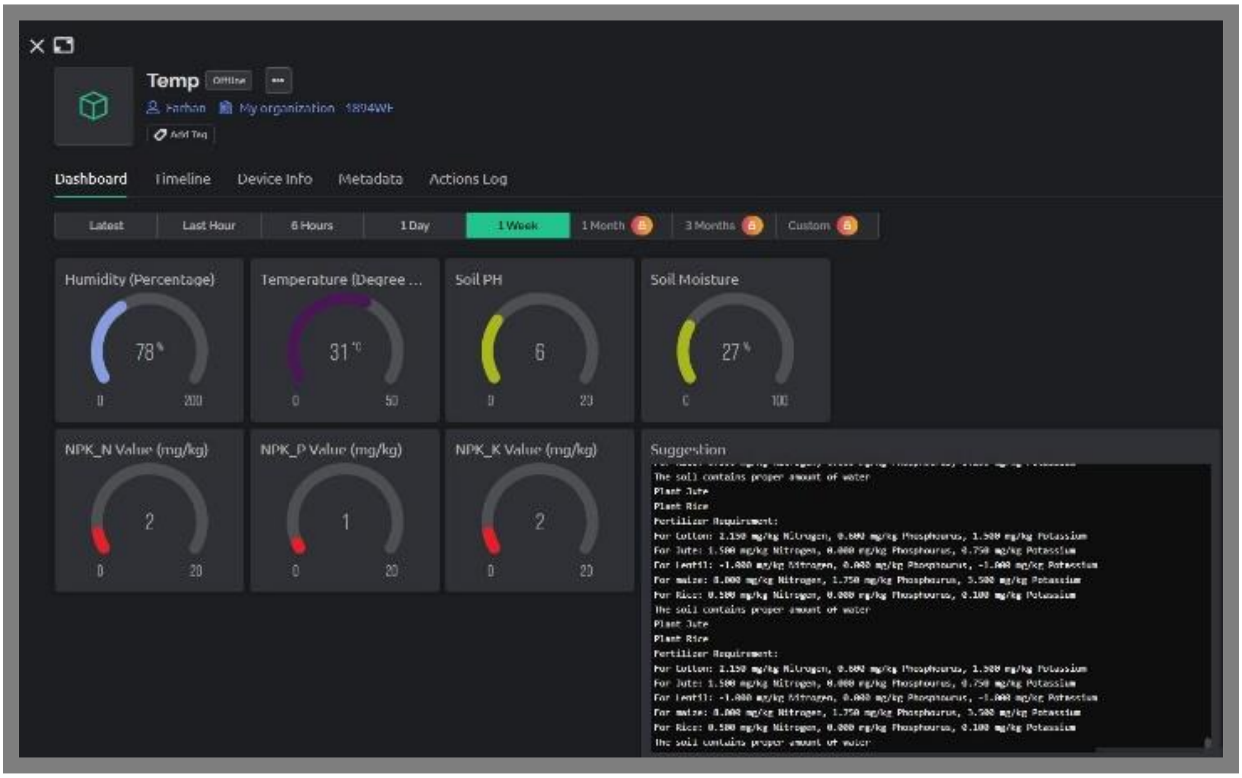


Fig. 11: Data collection and displaying output in the Blynk web console

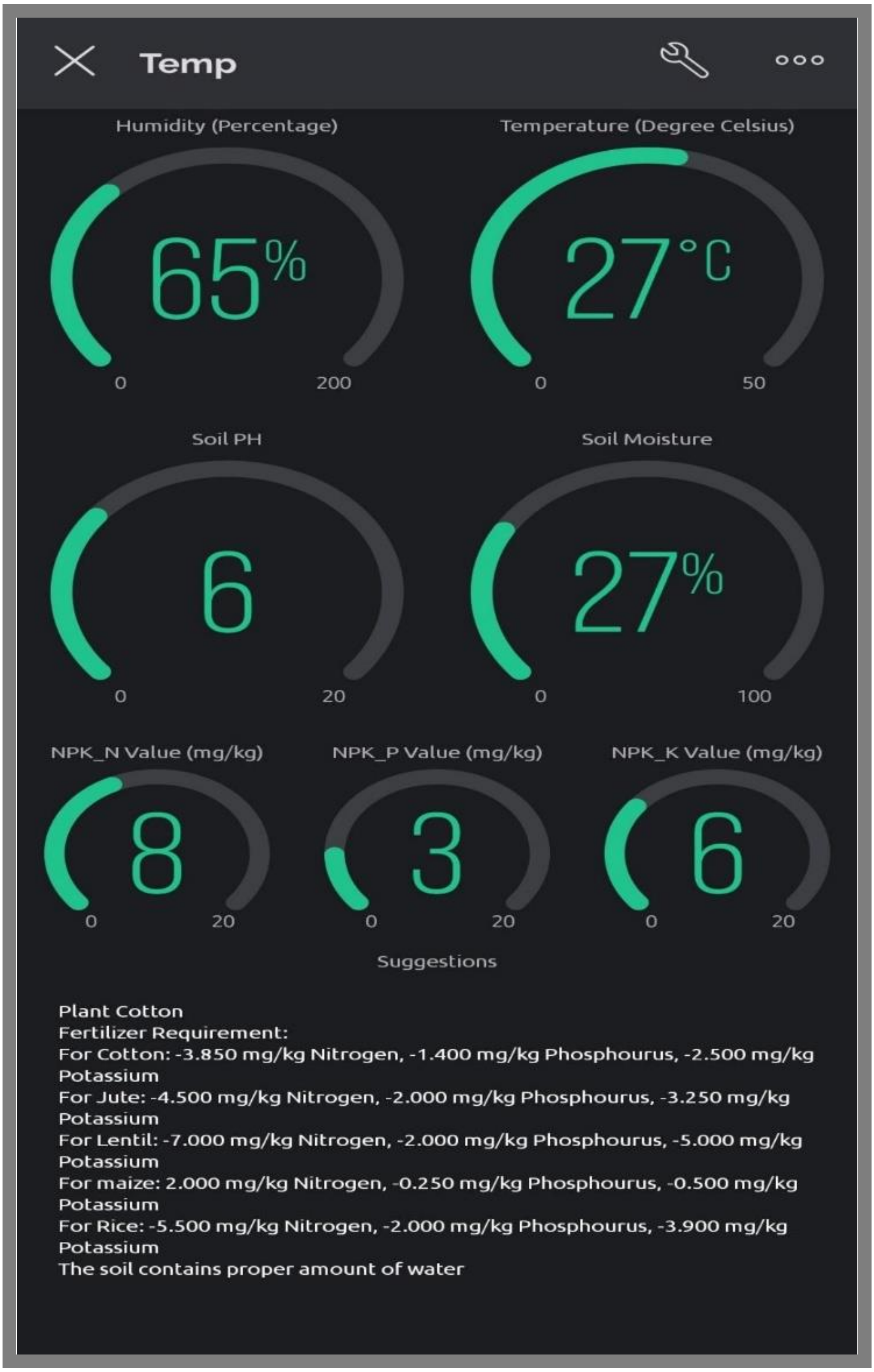


Fig. 12: Displaying result and suggestion in the mobile interface

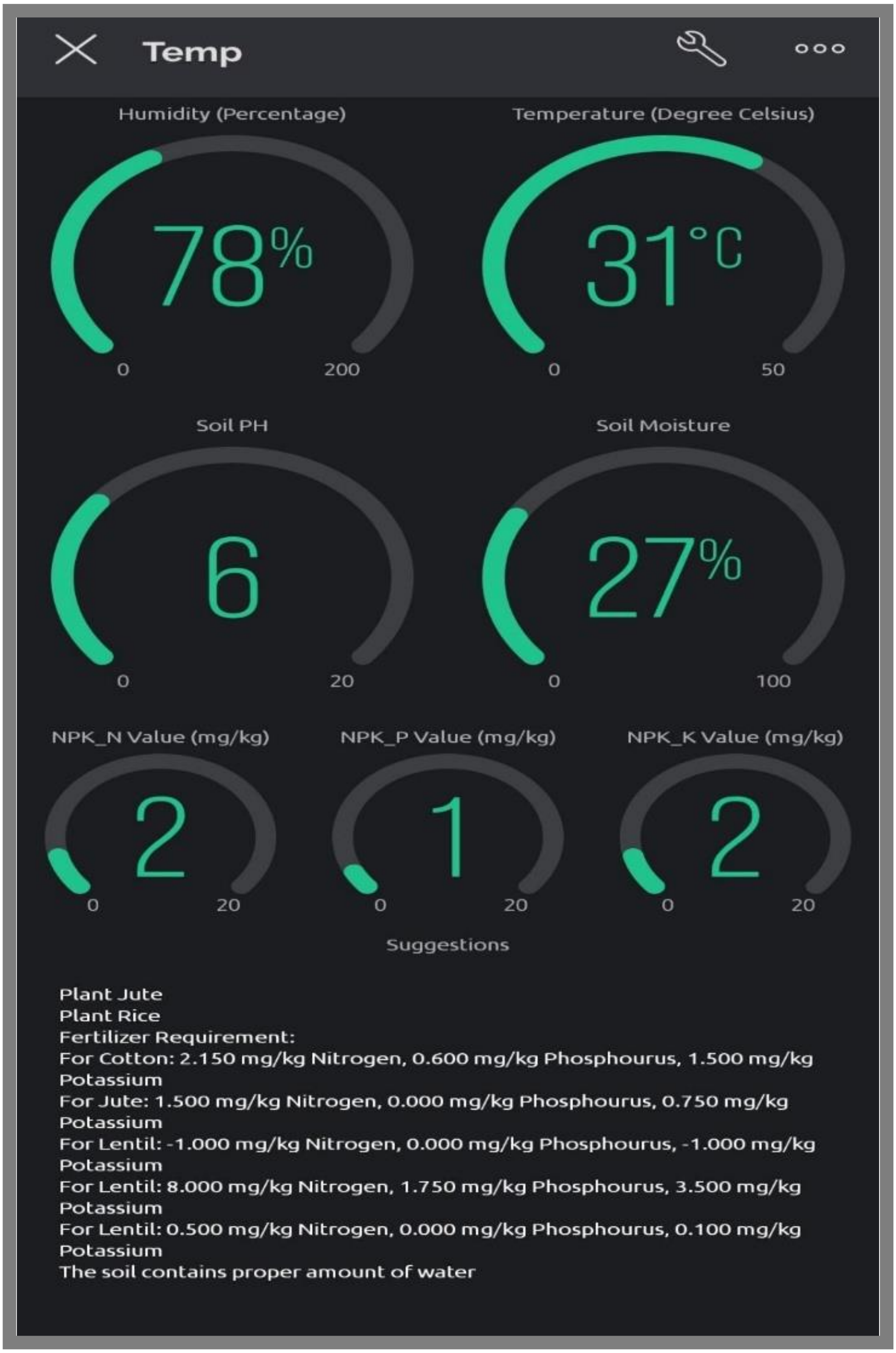


Fig. 13: Displaying result and suggestion in the mobile interface

In this design approach, we add all the sensors in proteus and connect them with Arduino. Sensors collect the data and then Arduino processes the collected data. After collecting the data, a COMPIM in proteus is used in place of ESP module to send the collected data in Blynk web server. In Blynk web server, we display the parameter value in real time while sensors are collecting data. Blynk database stores all the sensor data. For data processing, we have used Google Colab which is an online IDE. Now, in this IDE we used Python programming language. While processing, we compare the collected data from Blynk database with the predetermined threshold values which we get from the Fertilizer Recommendation Guide 2018 [17]. As threshold, we use the pH values, temperature values, humidity in the environment, nitrogen values, potassium values and the phosphorus values for five different crops. Now, from overall analysis of all parameter our system can suggest the suitable crop for this particular soil and environmental parameters, give suggestion of fertilizer requirement if in case the farmers want to plant some other crops and based on the water availability it will also suggest that whether the farmer should water the field or not. These suggestions are then sent to the Blynk database. Then we use Blynk mobile application that serves as the user interface and displays all the parameters that are available as well as suggestions.

4.2.4 Design Approach 3

In design approach 3 we implement Machine Learning for the prediction of Crops. The data acquisition part is the same as the rest approach. As previously mentioned, the NPK sensor provides us the nitrogen, phosphorus, and potassium values from the soil again pH sensor gives us the level of acidic or alkaline properties from our soil. The remaining sensors are Moisture sensor for showing us the percent of moisture available in our soil while, another sensor named DHT11 provides us both temperature and air humidity data. Now after accumulating all these data, we send these to the Blynk server. When the Blynk server is able to receive the data, our data is being stored on which we will use our machine learning algorithm.

Our second purpose in this design approach is that we need to create a machine learning model which will learn to predict the crop name for the given soil quality of the land. For the machine to learn we need a data set. We have collected the data set from “Kaggle” [18] named “Crop Recommendation Dataset”. This data set contains a total of 2200 data where there are 22 crops and 100 data on each. But as we have selected 5 crops for our FYDP purpose to keep the system simple we only kept the data of rice, jute, cotton, maize and lentil. Therefore, now we have a total of 500 data set in our hand.

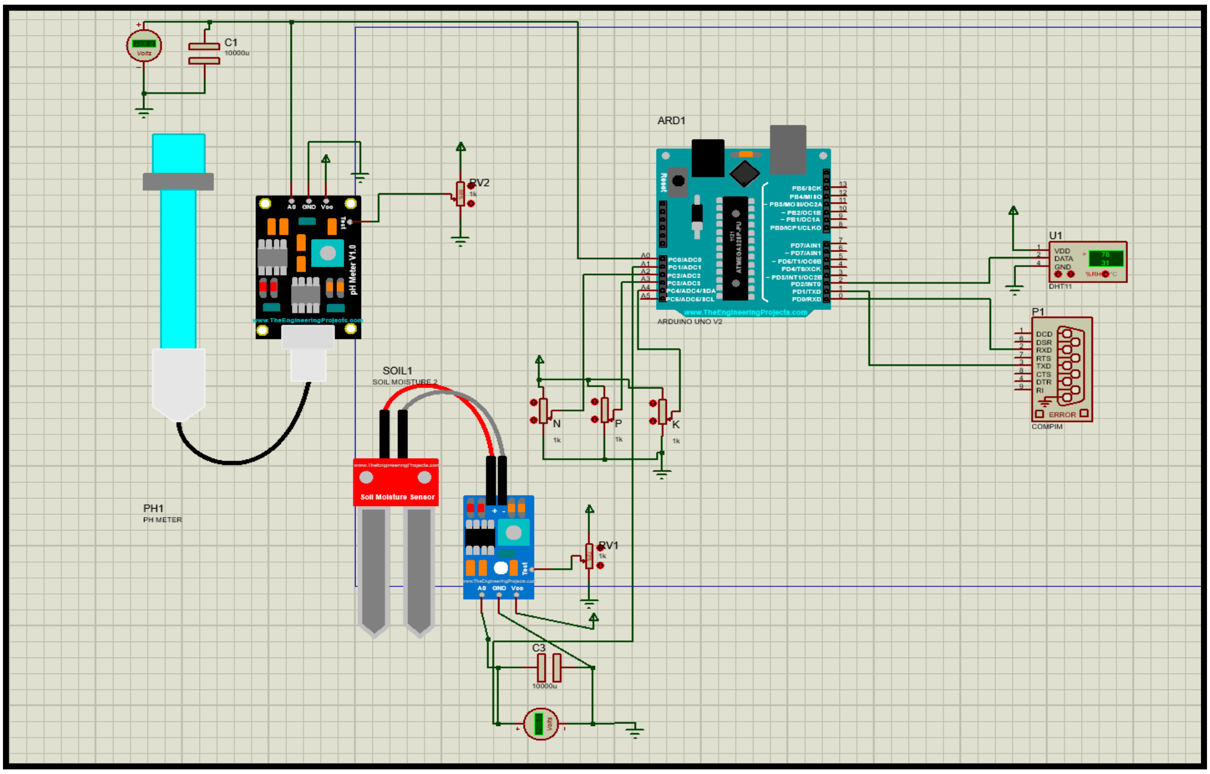


Fig. 14: Simulation Circuit set up for design approach 3 in Proteus

	label	K	N	P	humidity	ph	temperature
0	cotton	19.56	117.77	46.24	79.843474	6.912675	23.988958
1	jute	39.99	78.40	46.86	79.639864	6.732778	24.958376
2	lentil	19.41	18.77	68.36	64.804785	6.927932	24.509052
3	maize	19.79	77.76	48.44	65.092249	6.245190	22.389204
4	rice	39.87	79.89	47.58	82.272822	6.425471	23.689332

Fig. 15: Mean value for our data sets for design approach 3

The only part remaining right now is building the machine learning model. We have used "Google Colab" as our cloud processing and for creating and running the model. We import the required library for execution of machine learning code. Then we import the data set in the google collab environment so that those data set can be fed to machine learning algorithm. The data set is afterwards split for training and testing. We used 30 percent of our data set for testing and the remaining data sets are used for training.

We have almost arrived at the end point of our design approach 3 and the next step is selecting the algorithm for model training and testing the accuracy level for each one.

We have used Random Forest algorithm for our design approach 3. Now, for the fertilizer requirement we have used the same procedure as design approach 2.

```
features = np.array([[89,54,38,24.51588066,83.5352163,6.685346424]])
prediction = classifier_rf.predict(features)
print("Prediction: {}".format(prediction))

Prediction: ['rice']

features = np.array([[67,35,22,23.30546753,63.24648023,6.385684214]])
prediction = classifier_rf.predict(features)
print("Prediction: {}".format(prediction))

Prediction: ['maize']

features = np.array([[18,66,22,25.87990287,67.55109024,6.347379185]])
prediction = classifier_rf.predict(features)
print("Prediction: {}".format(prediction))

Prediction: ['lentil']
```

Fig. 16: Output from ML model

Here, our ML model can predict the crop name based on the nutrient level available on the soil. The next part is conveying the output from this cloud processing platform again to our "Blynk IoT" application.

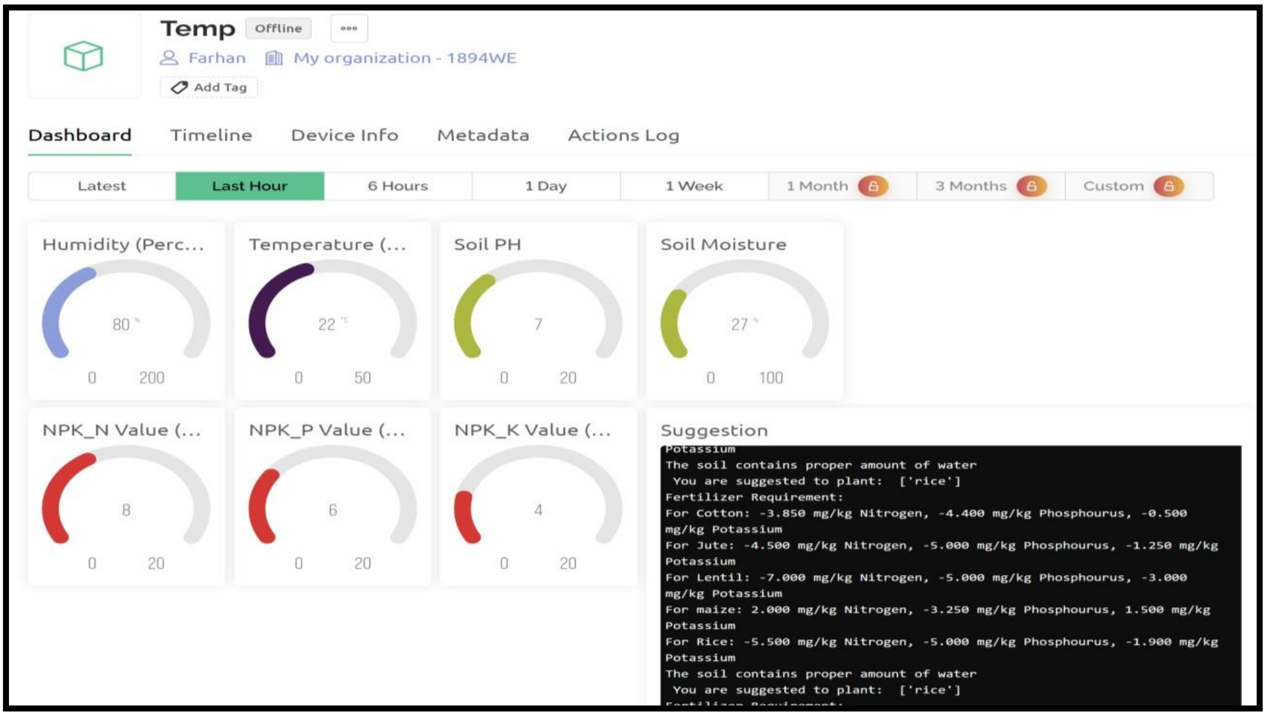


Fig 17: Data collection and displaying output in the Blynk web console

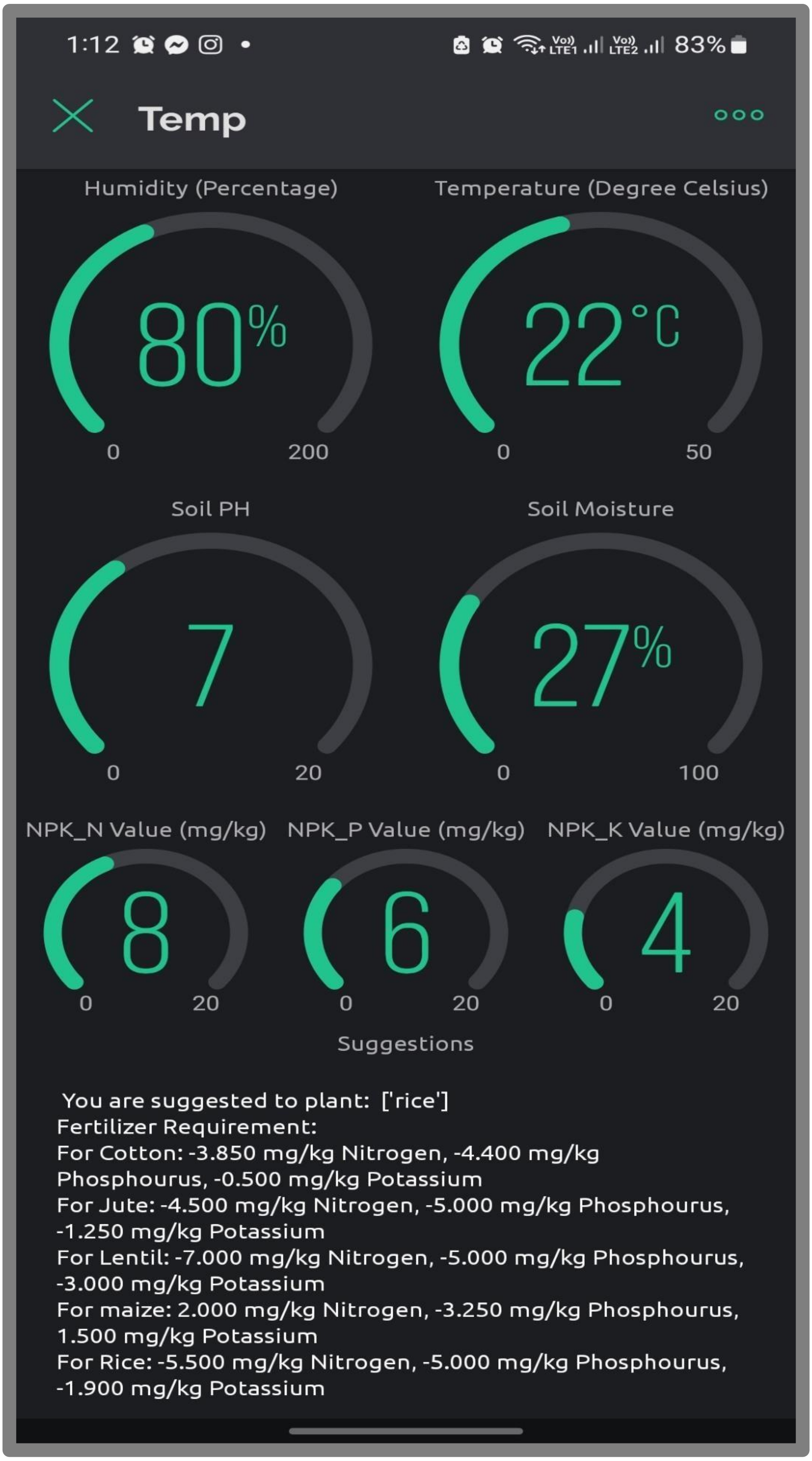


Fig. 18: Displaying result and suggestion in the mobile interface

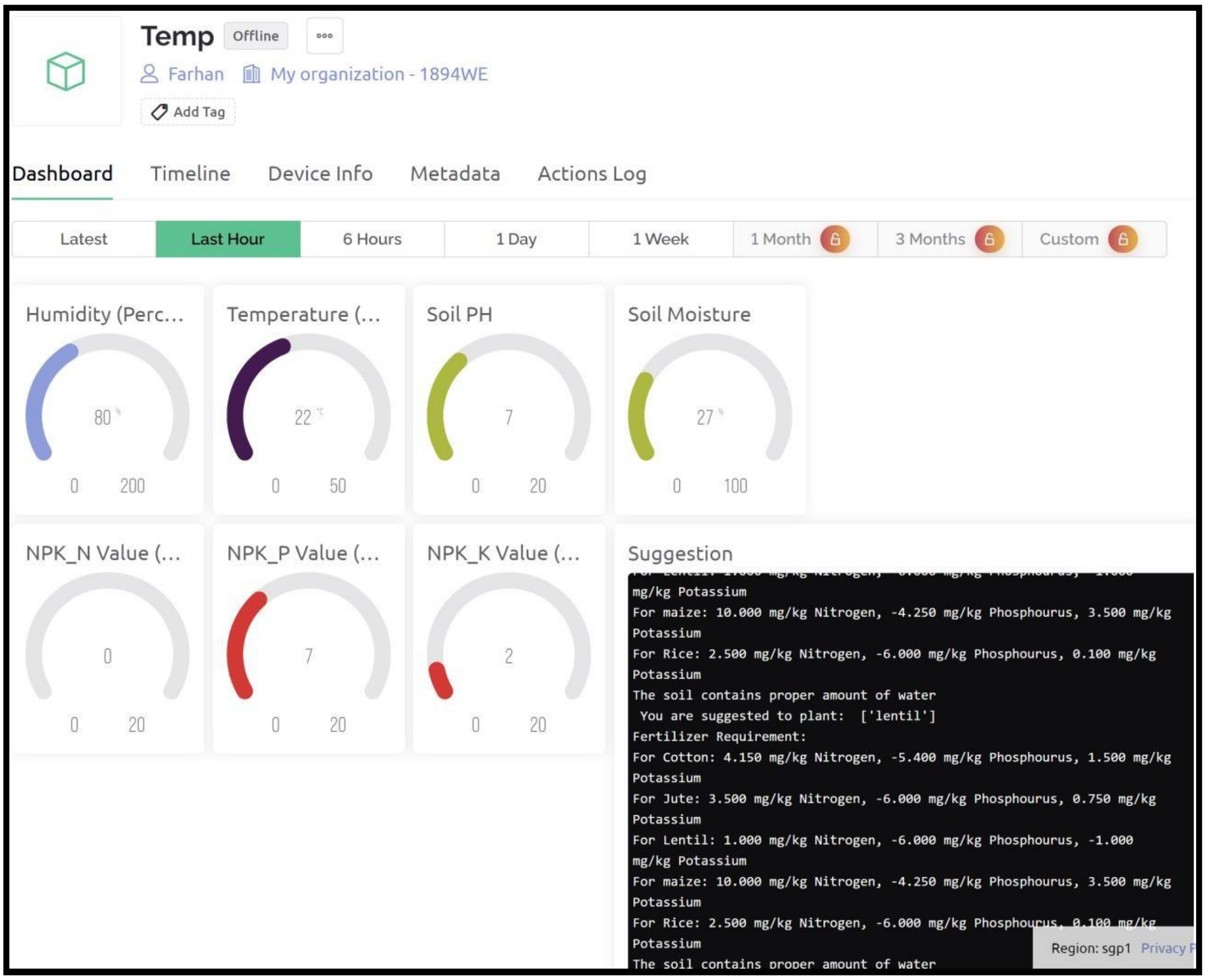


Fig.19 : Data collection and displaying output in the Blynk web console

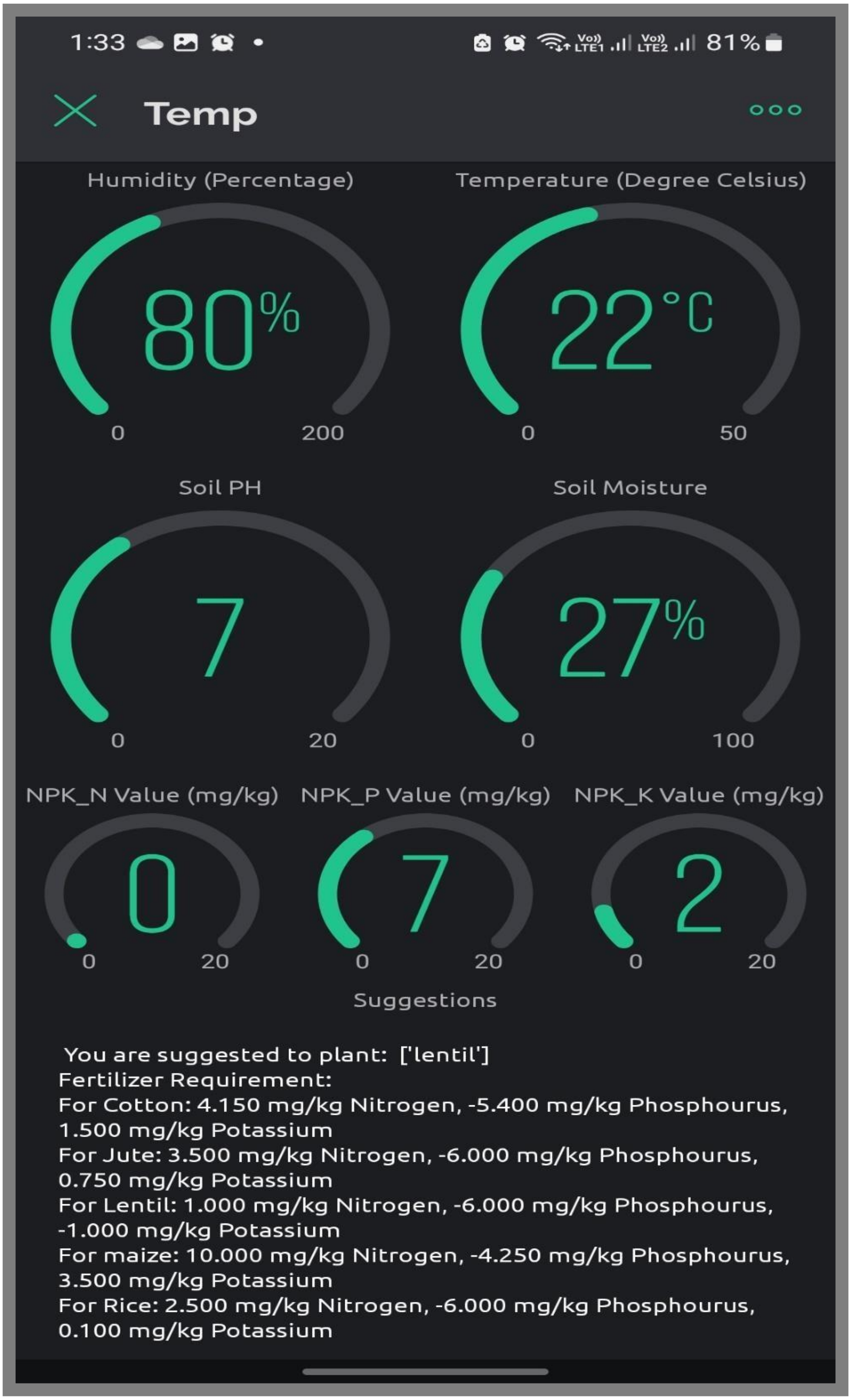


Fig. 20: Displaying result and suggestion in the mobile interface

4.3 Identify Optimal Design Approach

Considering all the aspects, we can conclude that our design approach 3 is the optimal solution. Our design approach 3 lets users know more information such as nutrient levels, humidity, PH, soil moisture through the mobile application and can tell us how much of what type of fertilizer is needed for a crop with around 96% accuracy. In contrast, from design approach 2 we get almost a perfect accuracy through rigorous testing for all the integrated crop details. However, design approach 2 requires hard coding of different parameters for every new crop we want to integrate with our system which is a tiresome and lengthy process. Since we use Machine Learning Algorithm for design approach 3, all we need to do is collect enough data for every new crop we want to integrate with our system and update our database. The algorithm uses the updated database every time to provide suggestion of different crops. Furthermore, design approach 1 does not provide detailed suggestions due to lack of a good or proper user interface. Thus, we can say that design approach 3 is our optimal solution which coincides with our assumption made in our proposal of this project.

4.4 Performance Evaluation of Developed Solution

All of our three design approaches have more or less the same procedure of data collection. As a result, the data collection part does not differ for all three approaches. However, for design approach 1, the data processing for crop suggestion and fertilizer requirements is hard coded in the processing unit. Which is why there is no scope of learning for the system on its own. The accuracy of the system would be 100% for only a specific area. But for different areas the accuracy might plummet. For every area, in order to get 100% accuracy every time the code would have to be changed with different values. For design approach 2, we use hard code again but this time due to usage of cloud for cloud computing, the code can be changed easily for different areas and different purposes. This approach allows the users to get a comprehensive analysis by having access to different sensor data. However, for design approach 3, we use ML algorithm that can compare the collected data with the provided data set to provide a suggestion. This approach may not perform the best initially but with every collected data if the data is stored within the data set and used again for prediction of the crops, with enough collected data, the system will be almost very accurate at least above 90% for all types of crops for any areas without having to change the code. Also, in order to test which ML algorithm would be best fit for such applications, we tested out a few.

The list of algorithms that we select for our model training are.

- Logistic Regression
- Decision Tree
- LightGBM
- Random Forest
- Support Vector Machine

After implementing each of these algorithms we find accuracy for then where Random Forest is working best among all.

```
from sklearn.metrics import accuracy_score
accuracy=accuracy_score(y_pred, y_test)
print('Random Forest Model accuracy score: {0:0.4f}'.format(accuracy_score(y_test, y_pred)))

Random Forest Model accuracy score: 0.9600
```

Fig. 21: Random Forest with highest accuracy among all algorithms

The accuracy of all the ML algorithms is shown in the table

Table 4: ML Algorithms Accuracy

Sl.	Name of algorithms	Accuracy
1.	Logistic Regression	81.33%
2.	Decision Tree	92.67%
3.	LightGBM	95.33%
4.	Random Forest	96%
5.	Support Vector Machine	88%

Therefore, we use Random Forest ML algorithm for our design approach 3 which we consider as our best design.

4.5 Conclusion

As the conclusion of the discussion above, we have determined that Design-3 is the best option for achieving all of the project's goals while maintaining the efficiency of the system. As a result, we have concluded that Design Approach 3 performs better than design approach 1 and 2 in practically all aspects based on our stated study and simulated results.

Chapter 5: Completion of Final Design and Validation. [CO8]

5.1 Introduction

The details of all three-design approach and the implementation details is already been discussed in the previous chapters. We have simulated all the 3-design approach to determine the feasibility, accuracy and the optimized solution. Now based on the comparison of the design approaches, we developed a prototype so that we can test different soil sample from different site, make comparative analysis and troubleshoot our system accordingly. So, to develop our prototype, we chose our design approach 3 which having a machine learning algorithm with relatively better accuracy. This chapter will discuss the summary and the evaluation of the final design.

5.2 Completion of Final Design

To build the prototype following the final design approach we need all the sensors to collect the data of available soil health determining parameters like soil NPK, Soil pH, Temperature, Humidity and Soil Moisture.

Fig. 22: Soil pH Sensor

For prototype we chose this Soil pH sensor because it is designer in such a way that it totally water proof and can even be buried into the soil. The soil pH sensor can be used extensively in a variety of soils and can endure long-term electrolysis and corrosion. It also has excellent accuracy, quick measurement speed, and stable output. In addition, the electrode is constructed of a highly treated alloy material that is difficult to disintegrate and can sustain significant external impact. This sensor has a very quick response time and can provide accuracy of up to ±0.3PH.

Fig. 23: Soil NPK Sensor

This soil NPK sensor has been selected as our prototype. The type of soil NPK sensor is extensively applicable to the cultivation of rice, vegetables, orchard nurseries, flowers, and soil in open fields and greenhouses. To ensure the long-term functionality of the probe component, the sensors' probes are made of stainless steels with anti-rust, electrolysis, and salt and alkali corrosion resistance properties. It measures between 0 and 1999 mg/Kg and responds quite quickly (within 10 s).

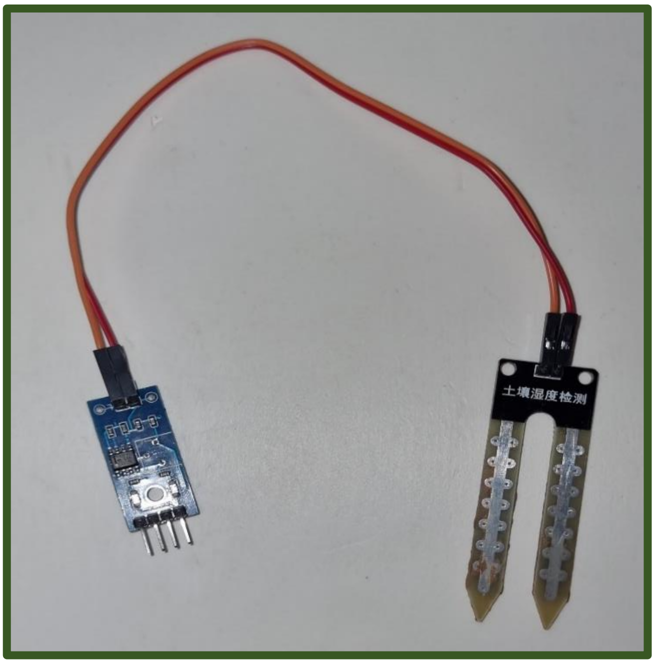


Fig.24 : Soil Moisture Sensor with driver

Soil moisture sensor that we have used in our prototype is like a soil hygrometric transducer that can read the amount of moisture present in the soil surrounding it. The nickel probes on these moisture sensor probes are shielded from oxidation by an immersion gold coating.

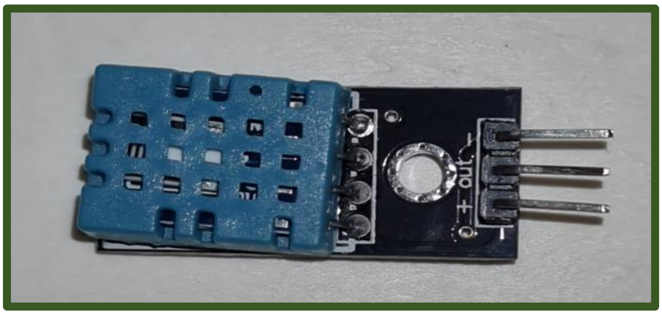


Fig.25 : Temperature and Humidity Sensor

To measure the temperature and humidity of the environment or that particular location of the site we use this sensor. This single device that can measure humidity and temperature together can allow us to avoid the use of two individual sensors.

Fig. 26: Processing Unit

In order to collect the data and send it to the cloud through Wi-Fi for further processing we use this processing unit also known as ESP-32 module. This module can also power up different sensors that require 3.3V input power.

Fig.27 : Power supply

To power up the prototype system, we use a 12V Lipo battery. This battery is able to simultaneously power up the different sensors as well as the processing unit.

Fig. 28: Soil bed for test purpose

This is the soil bed that we are using to collect different sample from different regions or from different fields. This small soil beds allow us to go through a convenient indoor testing and where we can put our sensors to collect data. This bed also allows us to customize soil parameters like we can make a particular sample alkaline or acidic for our testing purpose.

Fig. 29: Prototype framework of the project

This is the prototype body of the project. The dimensions and weight of the prototype was considered taking into account that this device would be mobile and easy to carry. Users can take this box in the field and use the sensors to collect the soil data according to which crop suggestions and fertilizer recommendations are provided in their mobile phone.

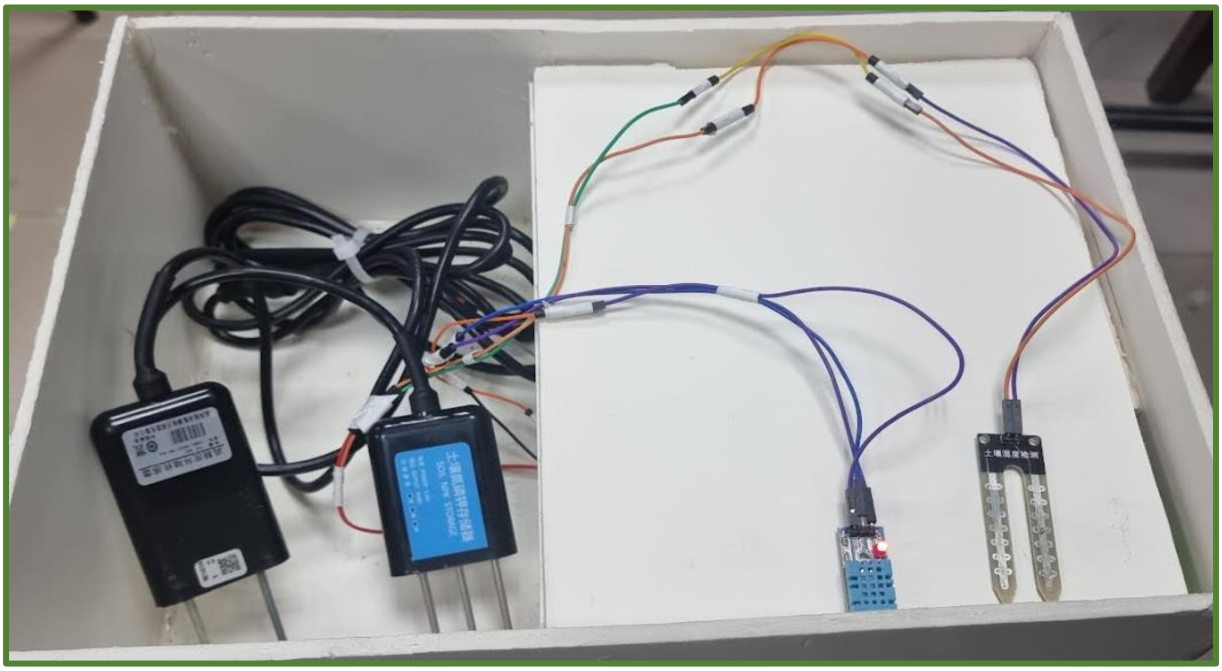


Fig. 30: Inside view of the prototype with all the sensors

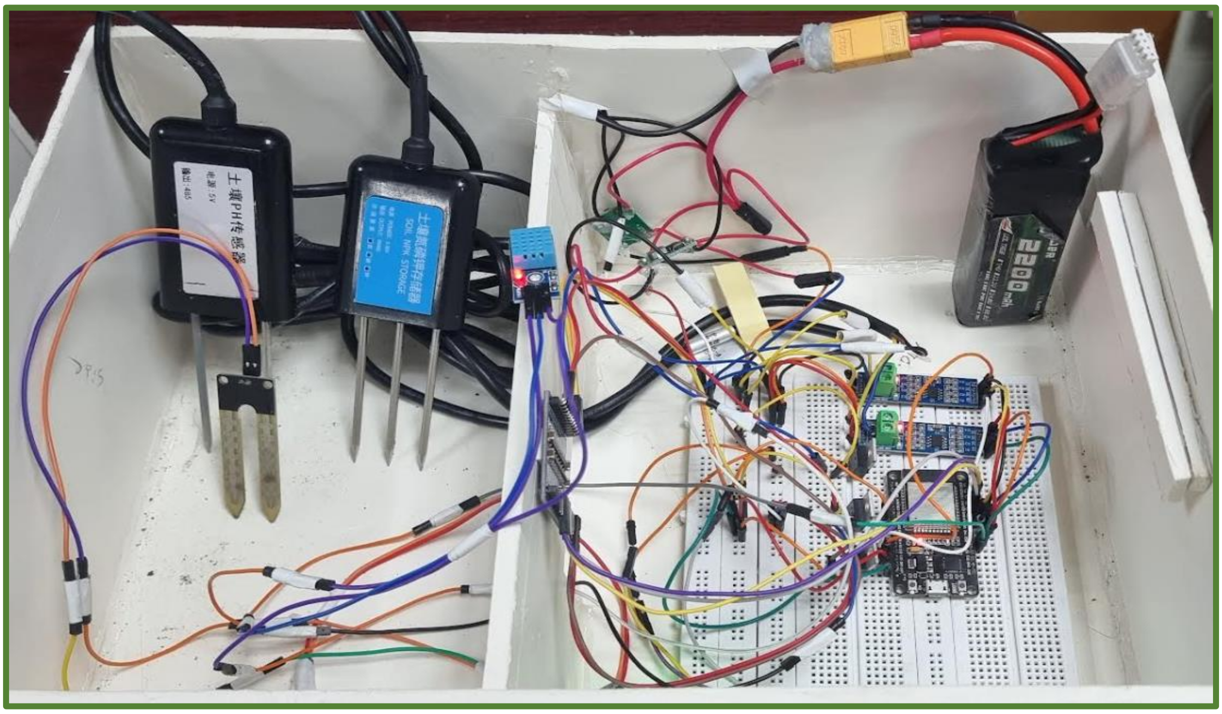


Fig.31 : Inside of the prototype with circuit view

Removing the lid of our prototype, the users will be able to use the sensors to put them in the soil to collect data. However, if there is any concern regarding the circuit part or if there is any malfunction, we have kept access to the circuit for the developers. Such access should be only for those who knows how the circuit works for safety purposes.

5.3 Evaluate the Solution to Meet Desired Need

Testing Barguna Soil Sample:

Fig.32 : Barguna soil sample testing with prototype

Fig. 33: Blynk output in computer display for Barguna soil sample

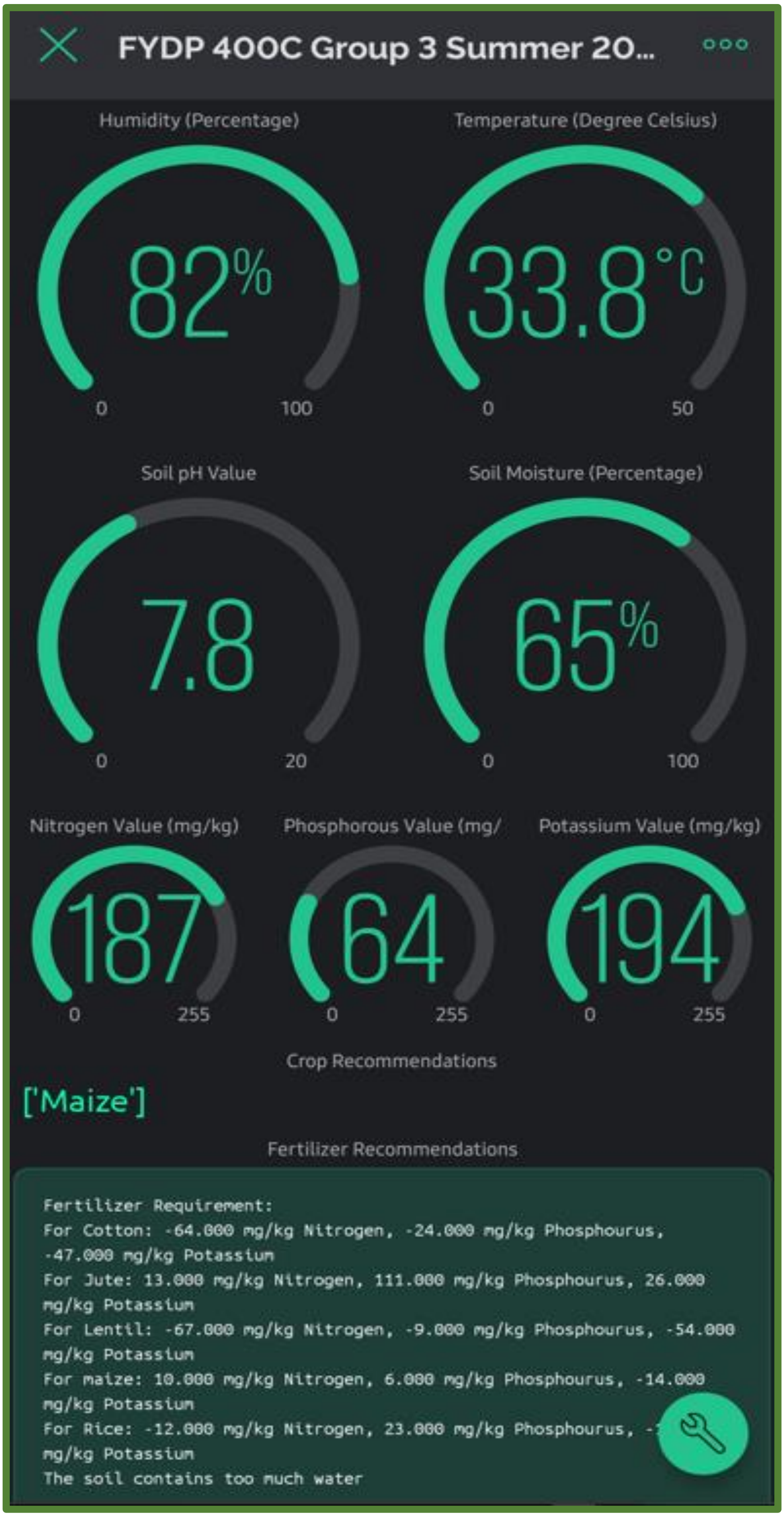


Fig. 34: Blynk output in mobile phone display for Barguna soil sample

Testing Tangail Soil Sample:

Fig.35 : Tangail soil sample testing with prototype

Fig.36 : Blynk output in computer display for Tangail soil sample

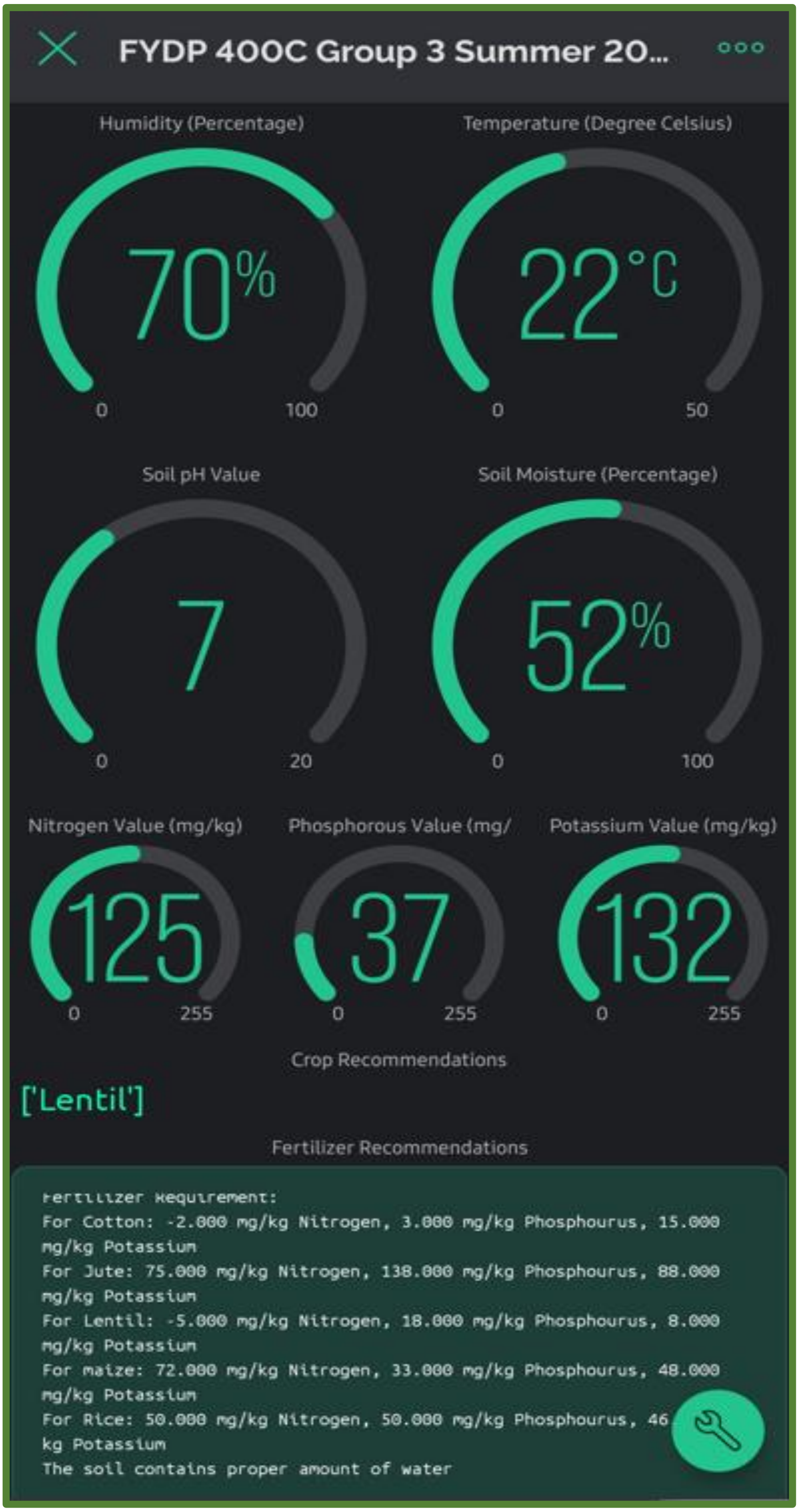


Fig. 37: Blynk output in mobile phone display for Tangail soil sample

Testing Khulna Soil Sample:

Fig. 38: Khulna soil sample testing with prototype

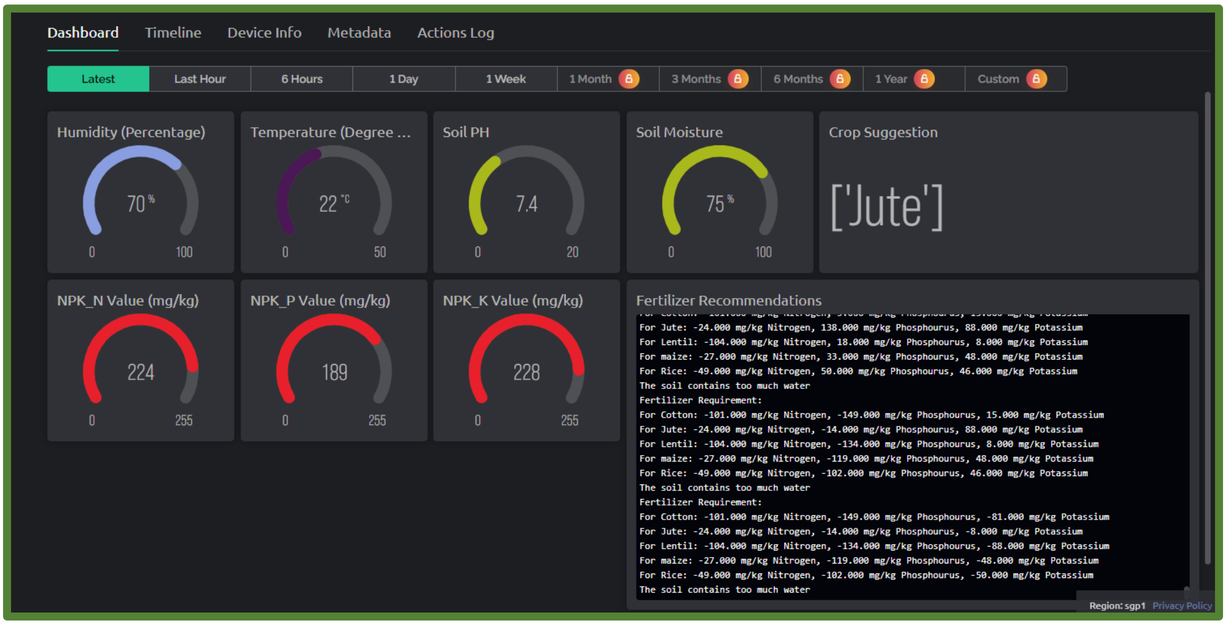


Fig. 39: Blynk output in computer display for Khulna soil sample

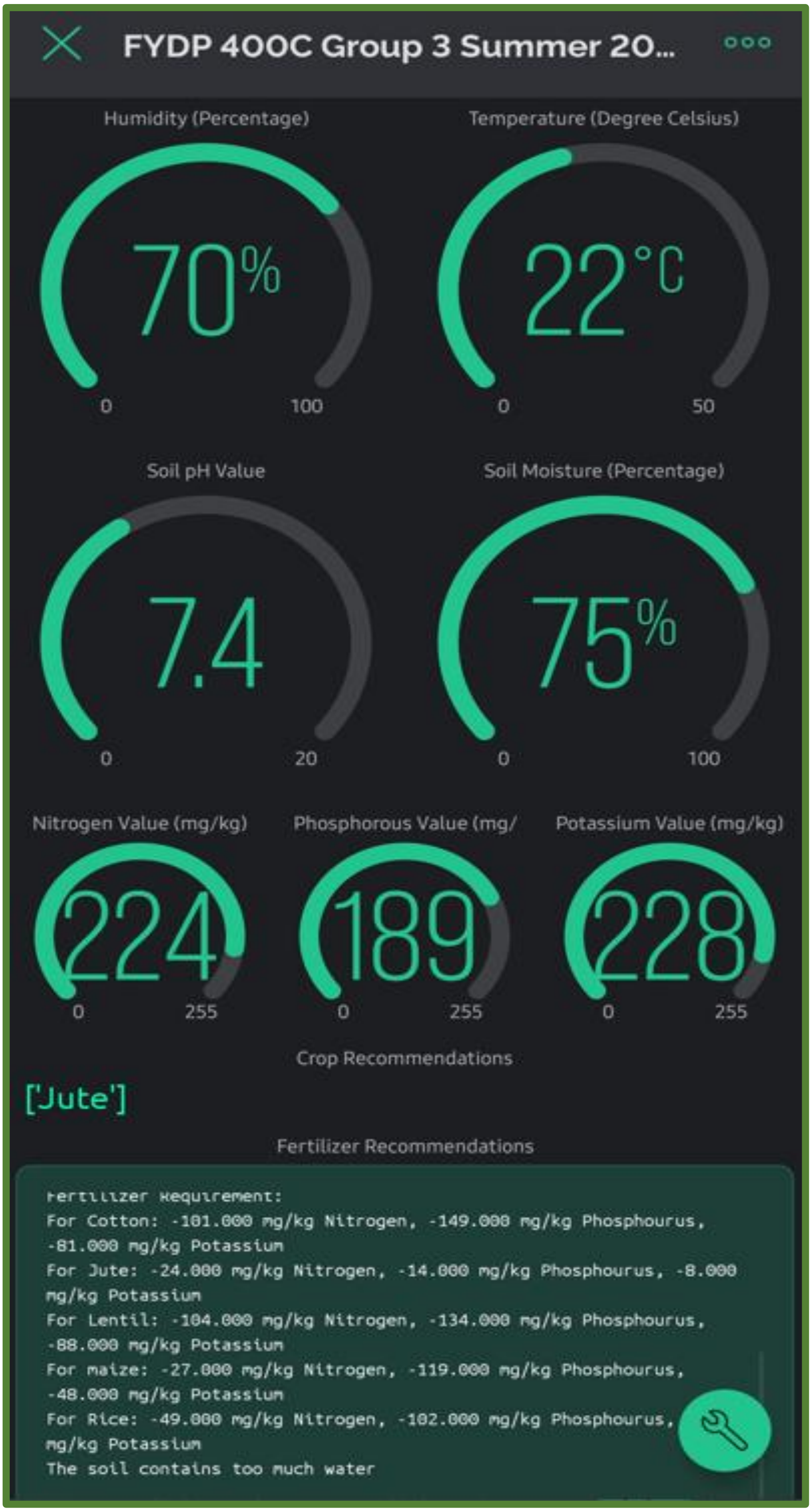


Fig. 40: Blynk output in mobile phone display for Khulna soil sample

From all three lab test cases, we see that after putting in the sensors in the soil samples, the Blynk IoT application can show us all the soil data in both computer display and mobile phone. The collected data is sent to the cloud to match up with the existing values to predict the crop that would be most suitable for the land as well as fertilizer recommendations [17]. We see that for different soil samples the soil data is different and both crop and fertilizer recommendation also vary. Meaning our prototype works as expected and has all the functionality we needed. So, our prototype meets our desired needs.

Here, one thing can be seen from the lab test cases that we have not used all the sensors in the same compartment for one soil sample. This is because the sensors let out a small amount of current through the sensor probes into the soil for measuring the sensor associated parameters. If the sensors are too close to each other in the soil, the current from each of the sensor probes creates issues within the sensors and the sensor data starts fluctuating. To prevent this, each of the sensors must be isolated from each other so that one sensor current does not affect another sensor. To do this, we have made three compartments for soil moisture, soil pH and soil NPK sensor. Thus, the three sensors are isolated from each other.

However, this issue does not occur when we tested our prototype in the actual field if we keep our sensors approximately one foot away from each other. Because the sensors have a certain range up to which it lets out current in the soil for measuring soil sensor data.

Testing Niketon Park Soil:

Fig.41 : Soil testing in the actual field at Niketon Park

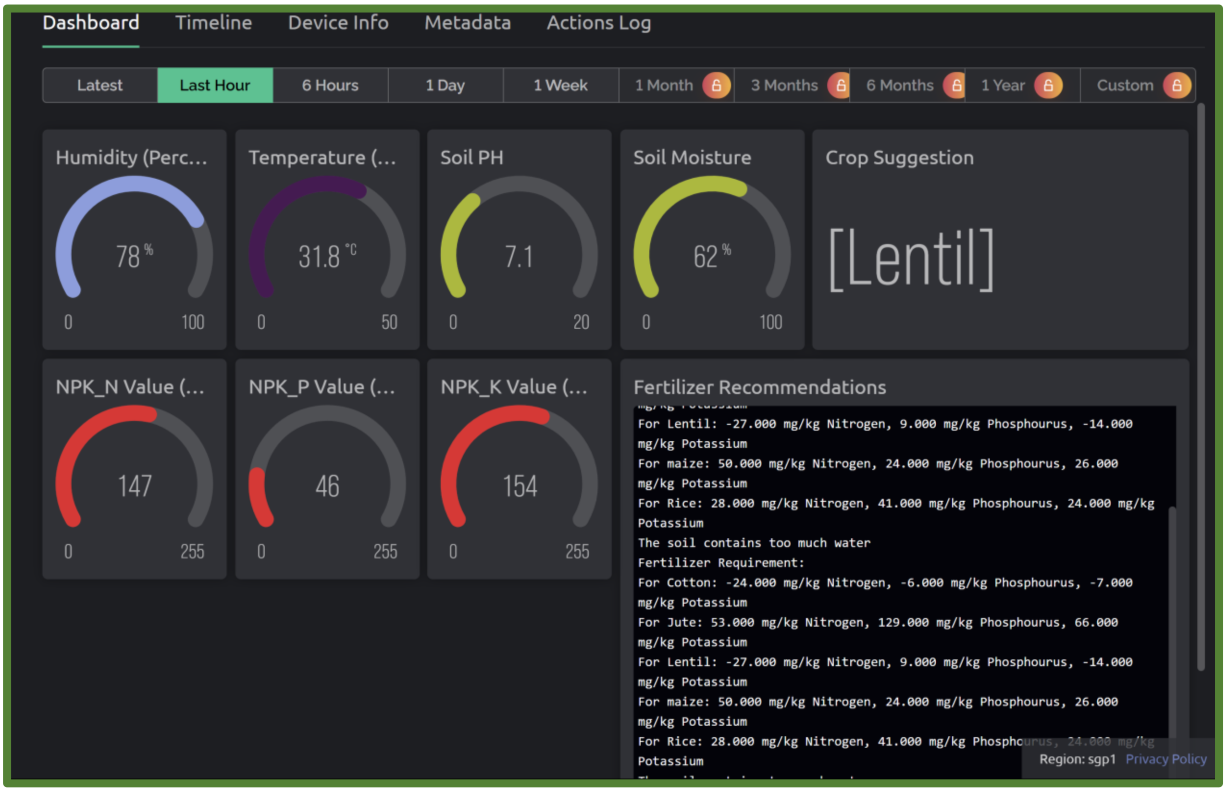


Fig.42 : Blynk output in computer display for actual field at Niketon Park

Keeping the soil sensors approximately one foot away from each other, we can see that the sensors work properly and according to the values the ML code provides us with a prediction that suggests suitable crops and fertilizer requirements.

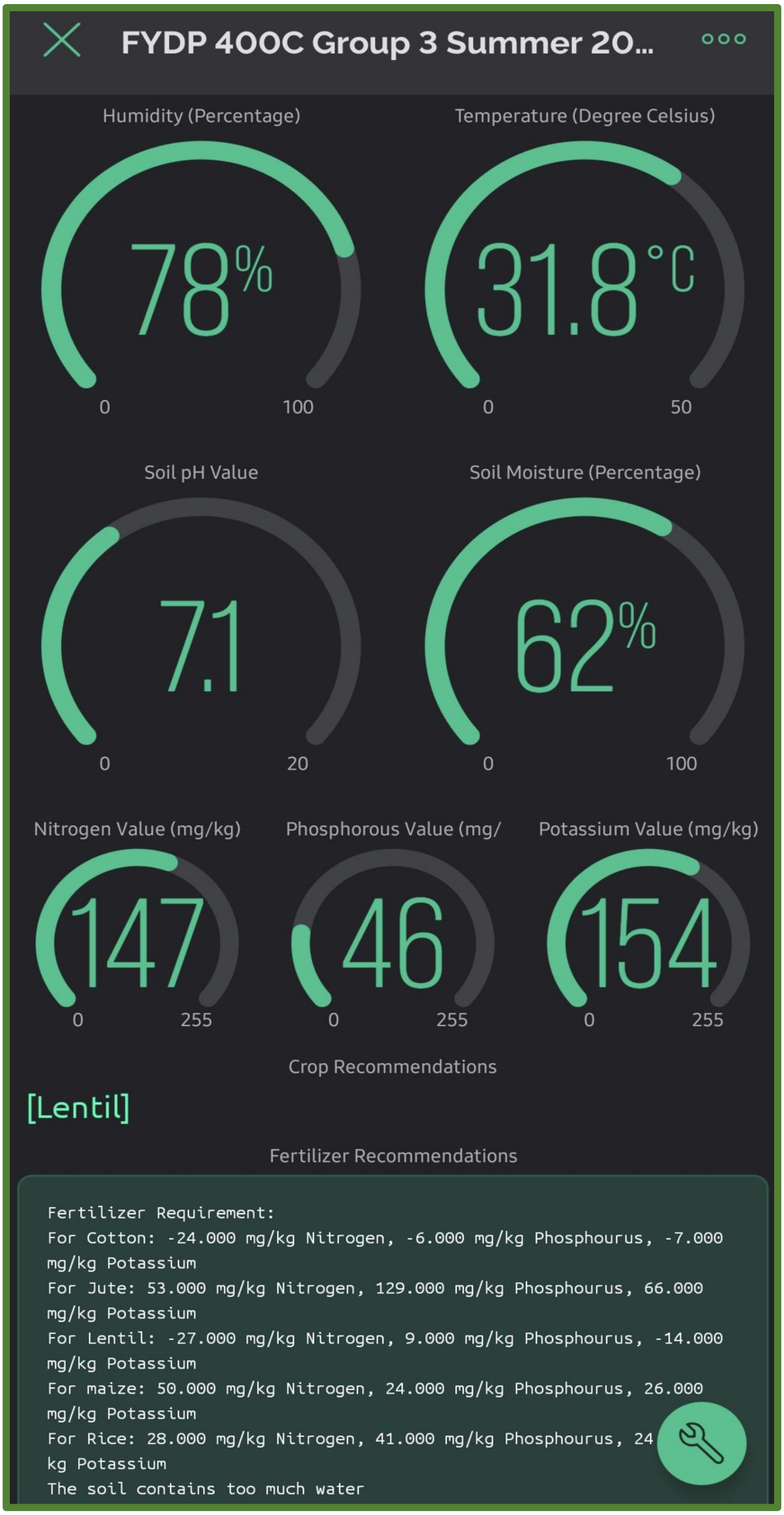


Fig. 43: Blynk output in mobile phone display for actual field at Niketon Park

Table 5 : Comparative data of different soil samples

Soil Samples	Temperature (°C)	Humidity (%)	Moisture (%)	pH	N (mg/kg)	P (mg/kg)	K (mg/kg)	Crop Suggestions
Soil Samples from Barguna	22	70	63	7.8	190	65	197	Maize
Soil Samples from Tangail	22	70	52	7	125	37	132	Lentil
Soil Samples from Khulna	22	70	75	7.4	224	189	228	Jute
Soil Samples from Niketon Park	31.8	78	62	7.1	147	46	154	Lentil

- **Fertilizer Requirements:**

Our system provides fertilizer recommendations in mg/kg unit. But kg/ha unit is wide used among the farmers and agricultural authorities. That is why we have made the chart considering the availability of fertilizers, widely used unit and the trend of fertilizer usage in Bangladesh [17]. We have taken into consideration the fact that Urea contains 46% Nitrogen, TSP or Triple Super Phosphate contains 20% Phosphorus and MOP or Muriate of Potash contains 60% Potassium while creating this chart. Our NPK sensor provides us values in a unit of mg/kg but we have the values for N, P and K in the fertilizer recommendation guide in a unit of kg/ha. So, we have taken the help of conversion to coincide sensor values with the fertilizer recommendation guide values. The conversion process is given below,

To convert mg/kg to kg/ha we need (i) area (ii) bulk density and (iii) layer depth

If area is 1 ha, consider bulk density on average in Bangladesh is 1.2 t/m^3 [17] and consider soil depth on average in Bangladesh is 30 cm or 0.3m,

Volume of soil layer is 10000 X 0.3 = 3000 m^3

Mass of soil layer is 3000 m^3 X 1.2 t/m^3 = 3600 t or 360000 kg

Now for example, if No3 content per kg soil is 10 mg

360000 X 10 mg = 3.6 kg NO3 /ha at a layer depth of 30 cm

From this we can get,

1 mg/kg = 0.36 kg/ha

Table 6: Applicable Amount of Fertilizers Chart

Fertilizer Requirements Shown by Our System	Applicable Amount of Fertilizers		
	Urea for Nitrogen (N)	TSP for Phosphorus (P)	MOP for Potassium (K)
Less than 0 mg/kg	N/A	N/A	N/A
0 mg/kg	N/A	N/A	N/A
10 mg/kg	7.8 kg/ha	18 kg/ha	6 kg/ha
20 mg/kg	15.6 kg/ha	36 kg/ha	12 kg/ha
30 mg/kg	23.4 kg/ha	54 kg/ha	18 kg/ha
40 mg/kg	31.2 kg/ha	72 kg/ha	24 kg/ha
50 mg/kg	39 kg/ha	90 kg/ha	30 kg/ha
60 mg/kg	46.8 kg/ha	108 kg/ha	36 kg/ha
70 mg/kg	54.6 kg/ha	126 kg/ha	42 kg/ha
80 mg/kg	62.4 kg/ha	144 kg/ha	48 kg/ha
90 mg/kg	70.2 kg/ha	162 kg/ha	54 kg/ha
100 mg/kg	78 kg/ha	180 kg/ha	60 kg/ha

If our system shows 1 mg/kg requirement for Nitrogen, the calculation for applicable amount of Urea is something like this:

We know,

1 mg/kg = 0.36 kg/ha

So, 46% of required Nitrogen is provided by 0.36 kg/ha Urea

So, 100% of required Nitrogen is provided by ((0.36 x 100) /46) kg/ha Urea or 0.78 kg/ha Urea.

If our system shows 1 mg/kg requirement for Phosphorus, the calculation for applicable amount of TSP is something like this:

We know,

1 mg/kg = 0.36 kg/ha

So, 20% of required Phosphorus is provided by 0.36 kg/ha TSP

So, 100% of required Phosphorus is provided by ((0.36 x 100) /20) kg/ha TSP or 1.8 kg/ha TSP

If our system shows 1 mg/kg requirement for Potassium, the calculation for applicable amount of MOP is something like this:

We know,

1 mg/kg = 0.36 kg/ha

So, 60% of required Potassium is provided by 0.36 kg/ha MOP

So, 100% of required Potassium is provided by ((0.36 x 100) /60) kg/ha MOP or 0.6 kg/ha MOP.

Similarly, we do the calculation for the values shown by our system. If our system shows N, P, K values in the negative then it means the soil contains too much of that nutrient. If our system shows 0 for any n, p, k values then it means it has the perfect amount of that nutrient. Which is why N/A is written in the chart for such cases.

5.4 Conclusion

In conclusion, the data from the soil and that was depicted in the preceding part could potentially be analyzed using our final design. Our system can now determine the optimum crop to grow on a given soil sample from these data using machine learning algorithms, as well as the amount of fertilizer needed to prepare the soil or grow another sort of crop. Moreover, the needs of the stakeholders are also given special consideration, and the prototype will be revised if the needs change. After various difficulties and trials, the demonstration's desired prototype has been created.

Chapter 6: Impact Analysis and Project Sustainability. [CO3, CO4]

6.1 Introduction

The use of this soil quality measurement system to determine the suitable crop production and the fertilizer requirement is an impactful idea with various terms of health and economic benefits. The optimum design of this system can have several possible outcomes that can shape many perspectives and ways of farming among the farmers. This system will help the farmers to choose the best suitable crops for his/her land and can collect the seeds accordingly. Besides that, if he/she wants to plant different kind of crops than this system will also help him to prepare the land by using proper amount of fertilizer. This system will help the farmers to make more profit while ensuring minimum degradation of soil health. However, specific metrics and criteria must be defined from strategic planning through the planning phase, conceptualization, design, evaluation, funding, execution, surveillance, and assessment to maintain the project sustainability.

6.2 Assess the Impact of Solution

The following list includes the project's expected impacts as well as the approaches that will be taken to achieve them:

- **IoT based system to monitor and provide suggestions regarding fertilizer requirement and suitable crops:**

With this proposed design, it is possible to measure the soil's nutrients, temperature, and moisture level with sensors and decision making. Based on the sensor data, a mobile application then suggests the recommended fertilizer for the land's suited crops. We store the data on a web-based cloud server, and with the help of a few criteria, we can track the fertility and quality of the soil during the cultivation.

- **Acquisition of real-time data and analysis:**

Various non-invasive sensors are used to acquire the current soil quality data from the land. A developed system analyses these collected data for the decision-making purpose and suggests the required fertilizer and suitable crops to the user.

- **Comparison of the collecting data:**

The fertility rate of the land and the present level of soil nutrients can be determined with this proposed design and data analysis process. It can also be compared with different crops nutrients with current soil nutrients condition.

- **Freedom to choose suitable crops for the land to the user:**

The users have a freedom of a choice to select the suitable crops with the nutrition and fertilizer requirements for the specific land.

Our nation's soil quality and nutrient assessment technology is still not that much advanced. Only in the laboratory is a chemical testing process available for detecting soil nutrients. However, there is no technology available to propose the best crop based on that result. The major goal of this project proposal is to create a compact system that offers a flimsy solution for this issue, familiarizes farmers with this technology, and ultimately aids in increasing crop yield. The higher output improves the farmer's financial situation and elevates his or her social standing. Additionally, by showing the young generation this promising and stable future, it will encourage them to pursue careers in agriculture and launch new businesses in the industry. As a result, both the GDP and the rate of national economic growth will rise [3], while the reliance on imports for food would decline. Additionally, farmers' familiarity with the internet, mobile apps, and digital technologies modernizes and advances their technical knowledge. This proposed initiative will serve to boost an unfertilized land's fertility rate and assure high-quality, nutritious food, both of which will improve overall health and reduce food scarcity and the risk of famine [6]. There are no legal concerns or boundaries of government rules and regulations to implement in the agriculture sector, and the proposed project is user-friendly and simple to use with some basic understanding. This compact system will develop by guaranteeing human safety, and providing cloud coverage. In conclusion, we believe that the suggested project may improve the social standing of farmers, digitalize soil quality measurement, raise crop yield, and balance nutrients. It can also increase the national GDP. It might be a component of the digitalization of the agricultural industry and of Bangladesh.

6.3 Evaluate the Sustainability

Sustainability of a project gives us a view to the future of the project. The project should not lose its usability in future. Environment issue is an important part of sustainable project. As our project is agriculture based, so we need to bear in mind that excess fertilizer can also be hazardous to the environment. When excess fertilizers are applied on the land after being getting mixed with the water applied for cultivation the water might get from land to near river or reservoirs. Our device can estimate the necessary amount of fertilizer for the specific land thus it can limit the number of fertilizers. Excess use of fertilizers can also make the food ecosystem unhealthy that increases a health hazardous issue in our daily life. As our device can sense the right measurement of fertilizer necessary for the land, it helps in increasing the production level and decrease the scarcity of food. Again, it also increases the nutrient level of the crops. The main moto for developing such device is so that the soil can regain its nutrients which results to lower application of fertilizers. Implementation of this project also brings a range of new culture to the existing one. As for using the device the farmers need to be introduced to the internet and smart phone which will change the previous culture of illiteracy in farming business. They will be exposed to the modern technology which will also help them to search for the problem they are facing and find suggestion from the internet. When the device helps in increasing production, this will also influence the current generation and apply more technology for better yields. If the young people get benefit from farming industry and learn to earn on their own a huge number of entrepreneurs might come out which will support the future of farming industry. This will bring the economic condition more stable.

6.3.1 SWOT Analysis for Optimal Design:

Now, by implementing SWOT analysis the sustainability of the project can be evaluated. The strength of the device likely, soil nutrient measurement, crop suggestion, monitoring system, portability or easy to use features makes the device more suitable for the farmers to use. On the other hand, the sensor data collection might sometimes be not fully correct which might be a major issue. Future investment along with new technology implementation helps us enlarges its opportunities. With strength comes threat, system malfunction, data leakage is currently the issue that we must deal with but that is also fixable with time. Thus, with pro and cons our project is still have a chance to change the farming industry.

Strength	**Weakness**
• Soil quality measurement • Crop suggestion • Monitoring on regular basis • Portable, manageable, easy to use device	• Accurate sensor data collection • Working on flood or rainy day • Lack of internet access in rural area
Opportunity	**Threat**
• Future investment • Image processing for crop health monitoring. • Deep learning architecture can be used for crop related suggestion which gives more faster output	• System malfunction • Not waterproof • Data leakage

	Concepts						
Selection Criteria	Design 1		Design 2		Design 3		Weights
	Rating	Score	Rating	Score	Rating	Score	
Handling ease	3.5	0.525	3	0.45	3	0.45	15%
Ease of use	2.5	0.25	3	0.30	4	0.40	10%
Metering accuracy	4	1.60	4	1.60	4	1.60	40%
Durability	2.5	0.375	4	0.60	4	0.60	15%
Ease of manufacture	3.5	0.35	2.5	0.25	3	0.30	10%
Portability	3.5	0.35	3.5	0.35	3.5	0.35	10%
Total Score	3.45		3.55		3.70		100%
Rank	3		2		1		
Optimal Solution	No		No		Develop this design		
	*This rating is out of 5						

Based on the literature review and we arrange this sustainability matrix and we put the rating accordingly. As our system is sensor based that is why we put more weight for the accuracy. Then comes durability and handling ease with a weight of 15 percent each due to the level of priority we put on our system. As we are designing this advanced system for the farmers, we want the device to be easy to use and enduring for harsh conditions. Also, we need to consider the system portability along with ease of use and manufacture since mass production requires simpler design and light weight system will help the device to gain more flexible usage for the farmers.

6.4 Conclusion

Economic sustainability is having the ability to fulfill environmental demands from both consumers and companies without compromising the environment's capacity to sustain modern agricultural technologies for future generations. The soil quality measuring system that we have created to be customized is for customers that need to conduct regular soil tests to ensure the optimum crop output. In conclusion, this chapter covers how this project can have an impact if we can improve the system to make it user-friendly, simple, capable of providing adequate charging backup for routine usage, and less expensive over time.

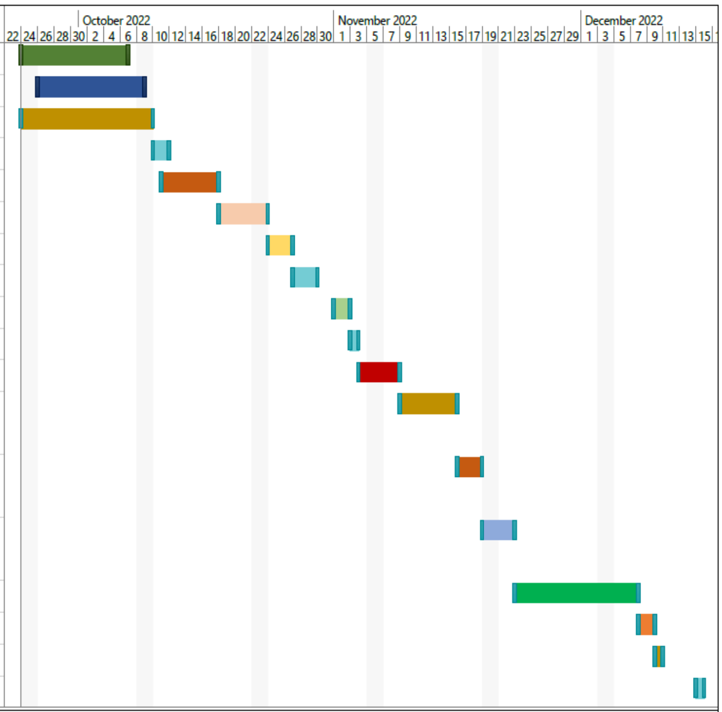
Chapter 7: Engineering Project Management. [CO11, CO14]

7.1 Introduction

Applying the necessary skills and expertise is an essential aspect of managing a project from the beginning to the end so that it stays on track with every necessary requirement, on budget, and on schedule. Initially in the project's development, the goals must be clearly defined while rigidly sticking to a predetermined timeframe. We can define the plan for accomplishing the project's objectives as well as its particular procedures and deliverables with the help of project management. Along with overseeing project-related responsibilities, management also comprises making sure that participants in the project and other appropriate stakeholders communicate on a regular basis. The following phase is to draft backup plans in case of unexpected crises. Project management expertise is readily exhibited when the project demonstration is carried out within the predetermined time range.

7.2 Define, Plan, and Manage Engineering Project

EEE400P



ID	Task Name	Duration
1	Find Complex Engineering problem	10 days
2	Related Paper and Journal	11 days
3	Select Final Topic	12 days
4	Tentative Problem Statement and Objectiv	2 days
5	Multiple Design Approach	5 days
6	Specications,Requirement and Constraints	5 days
7	Applicable Standards and Codes	3 days
8	Final Concept Note	3 days
9	Preparation of Slides for Presentation 1	2 days
10	Progess Presentation 1	1 day
11	Background Research and Project Plan	3 days
12	Methodology, Budget, impact, Expected Outcome	5 days
13	Sustainibility, Ethical Consideration,Safety consideration	3 days
14	Risk Factor Management, Safety Consideration	3 days
15	Final Project Proposal Note	11 days
16	Preparation of Slides for Presentation 2	2 days
17	Mock Progress Preseantation	1 day
18	Final Preseantition	1 day

Fig. 44 : Gantt chart for EEE400P

EEE400D

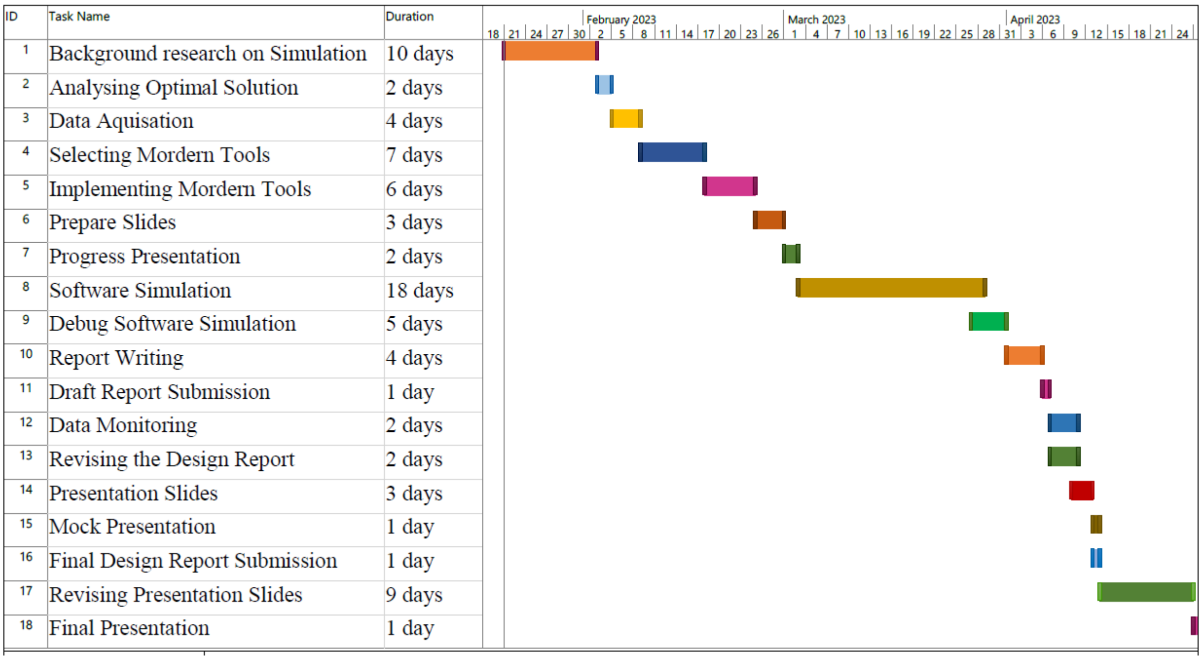


Fig. 45: Gantt chart for EEE400D

EEE400C

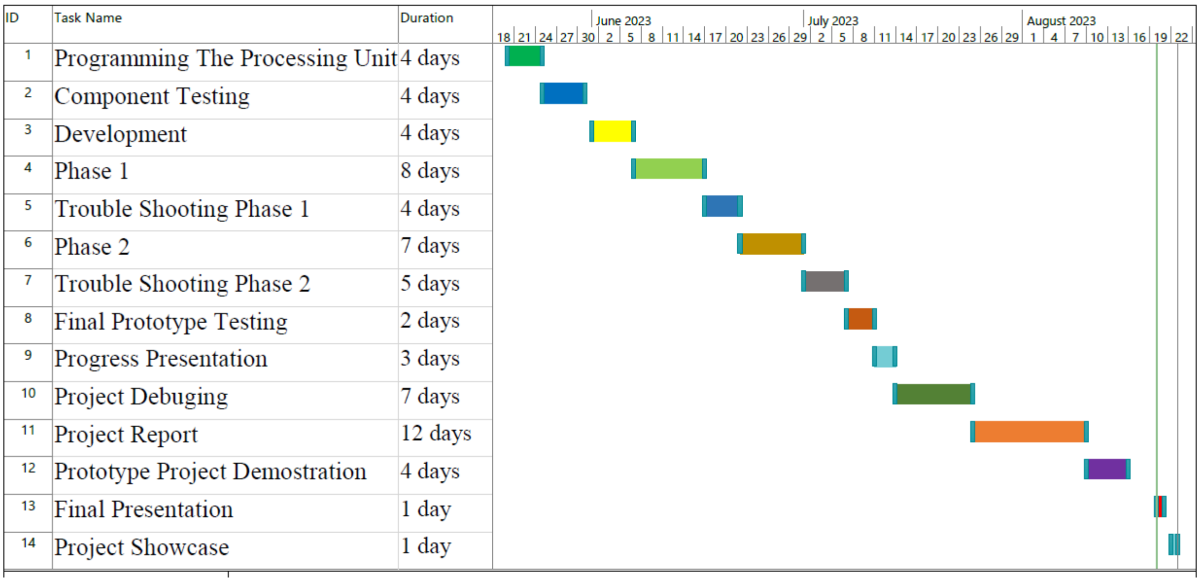


Fig. 46: Gantt chart for EEE400C

7.3 Evaluate Project Progress

We planned out our project progress at the start of our FYDP P. We envisioned how we will work when and who will take responsibilities of each duties. After coming to an end of our Project duration, if we look back, we can say that our FYDP 400P progress was almost always on par with the Gantt chart. However, during FYDP 400D, we were on par with our planned schedule for the first half but for the second half we were lagging behind due to sensor availability issues in simulation software and debugging. The coding part for our project also proved to be handful for us. For FYDP 400C, we started off strong but soon started facing problems in hardware implementation. Whenever we tried to focus on hardware implementation, we couldn't do much work on the report and vice versa. As a result, we were almost always lagging behind the schedule but we were able complete the project along with all the required documentations before the deadlines.

7.4 Conclusion

A good project must have set deadlines and the deadlines must be followed for successful completion of the project. Even if the deadlines are not met every time, the urge should be there always to catch up. Only then a good idea becomes a good and successful project. We tried our level best to be on time as per our planned schedule which is why we believe we have done well to complete this project successfully.

Chapter 8: Economical Analysis. [CO12]

8.1 Introduction

Any product analysis needs to incorporate an economic analysis. It is used to evaluate the benefits and drawbacks of the project's results. It gives the developers a comprehensive picture of how practical and profitable the project product is. Regardless of the different objectives of such a study, evaluating and anticipating consumer responses to a product is a key element of it. Making a profit represents one of them, and it reveals how that business outcome will pan out.

8.2 Economic Analysis

To analyze our project economically we can uphold a comparison between the existing soil testing sensors available in the market, their features and cost with our system.

<u>Soil pH & Moisture Sensor (Commercially Available):</u>

Fig.47 : Soil pH and Moisture Meter DM-15

This analog sensor is now commercially available in our country and this is used to measure the soil pH and moisture of the soil. Soil PH & moisture meter DM-15 has ± 0.2 pH resolution, 3 – 8 pH range, 10%–80% moisture, with ± 0.2 pH accuracy which is suitable for agricultural field test. But its price is 6500 BDT which is too much.

Environment temperature and Humidity meter (commercially available):

Fig.48: UNI-T UT333S Digital Temperature Humidity Meter

This sensor can measure environment humidity and temperature and display it in an OLED display with some functionality. The present applications of this sensor include material management, forestry and animal husbandry, health care, educational experimentation, the public sector, and the home. But its price is 3500 BDT which is too much.

These are the only sensors available with analog meter or with digital display. So, the general practice is the farmers have to collect the soil sample and go for a lab test with relevant testing authority. The authority then uses the chemical analysis method to determine the soil NPK value and give the result to the farmers. Then the farmers have to choose the crops based on these manually and find the required fertilizer based on these data. So, though the farmers can measure the pH, moisture, temperature, humidity by using the above-mentioned meters, they have to go for lab test to find out the soil nutrients.

But in our system, we use all sensors together to get the seven important parameters of soil and environment, analyze then within a single device and then give output within seconds in a user-friendly mobile and web interface. Not only we are showing the values, but also our system can analyze the data using machine learning algorithm to suggest the best suitable crops for the particular land. Besides that, our system can determine the fertilizer requirement which help the farmers to prepare the land without degrading the soil health by using excess fertilizer. The total cost of our system is 22455 BDT while the commercially available sensors all together will cost 10000 BDT. But if we trade of between tour system and the existing manual system our system is more economic as it ensures more life time, on spot hassle free testing, crop recommendation and fertilizer requirement.

8.3 Cost Benefit Analysis

If a project is feasible or not, it is determined by a cost-benefit analysis. The pros and cons of a particular component of economic analysis are also present. The benefits of a project provide precise, quantitative guidance when decisions relating to product developments are correctly carried out under precise assumptions. It's not necessary to execute a project for the least amount of money for it to be economical. The most important considerations are the project's components' efficacy, performance, and durability as well as its viability. For a product to be useful, it must be precise. It is more difficult to select acceptable components in terms of price and performance because the market offers a large variety of components. As engineers, it is our responsibility to select project components that are both economical and efficient. Three possible designs have been taken into account. First, some of the technique's components cost more than others, but we had to make intelligent decisions because we needed the most effective ones for various applications.

8.4 Evaluate Economic and Financial Aspects

Design Approach 01:

Table 7: Budget details for design approach 1

Sl.	Component	Quantity	Price (BDT)	References
1.	Soil Nutrient Sensor	1	11,990	https://store.roboticsbd.com/sensors/1833-soil-npk-sensor-agricultural-robotics-bangladesh.html
2.	Temperature Sensor Module	1	155	https://www.techshopbd.com/detail/3471/DHT11_Sensor_Module_techshop_bangladesh
3.	Soil Moisture Sensor Module	1	800	https://bdspeedytech.com/index.php?route=product/product&product_id=3420
4.	Soil pH Detector Sensor Module	1	7,000	https://bdspeedytech.com/index.php?route=product/product&product_id=3959
5.	Processing Unit	1	650	https://store.roboticsbd.com/arduino-bangladesh/948-esp32-esp-32s-30p-nodemcu-development-board-wireless-wifi-robotics-bangladesh.html
6.	LCD Display	1	255	https://store.roboticsbd.com/display/1164-lcd-display-16x2-with-header-robotics-bangladesh.html
7.	Miscellaneous cost	N/A	500	
8.	Battery	1	1090	https://store.roboticsbd.com/battery/928-lipo-battery-1200mah-111v-3s-robotics-bangladesh.html
	Total		**22,350**	

Design Approach 02:

Table 8: Budget details for design approach 2

Sl.	Component	Quantity	Price (BDT)	References
1.	Soil Nutrient Sensor	1	11,990	https://store.roboticsbd.com/sensors/1833-soil-npk-sensor-agricultural-robotics-bangladesh.html
2.	Temperature Sensor Module	1	155	https://www.techshopbd.com/detail/3471/DHT11_Sensor_Module_techshop_bangladesh
3.	Soil Moisture Sensor Module	1	800	https://bdspeedytech.com/index.php?route=product/product&product_id=3420
4.	Soil pH Detector Sensor Module	1	7,000	https://bdspeedytech.com/index.php?route=product/product&product_id=3959
5.	Processing Unit	1	650	https://store.roboticsbd.com/arduino-bangladesh/948-esp32-esp-32s-30p-nodemcu-development-board-wireless-wifi-robotics-bangladesh.html
6.	Miscellaneous cost	N/A	500	
7.	Battery	1	1090	https://store.roboticsbd.com/battery/928-lipo-battery-1200mah-111v-3s-robotics-bangladesh.html
	Total		**22,185**	

Design Approach 03:

Table 9 : Budget details for design approach 3

Sl.	Component	Quantity	Price (BDT)	References
1.	Soil Nutrient Sensor	1	11,990	https://store.roboticsbd.com/sensors/1833-soil-npk-sensor-agricultural-robotics-bangladesh.html
2.	Humidity and Temperature Sensor Module	1	155	https://www.techshopbd.com/detail/3471/DHT11_Sensor_Module_techshop_bangladesh
3.	Soil Moisture Sensor Module	1	800	https://bdspeedytech.com/index.php?route=product/product&product_id=3420
4.	Soil pH Detector Sensor Module	1	7,000	https://bdspeedytech.com/index.php?route=product/product&product_id=3959
5.	Processing Unit	1	650	https://store.roboticsbd.com/arduino-bangladesh/948-esp32-esp-32s-30p-nodemcu-development-board-wireless-wifi-robotics-bangladesh.html
6.	PVC board	1	250	https://www.daraz.com.bd/products/3mm-pvc-board-for-diy-project-model-or-robotic-chasis-i231970210.html
7.	Battery	1	1090	https://store.roboticsbd.com/battery/928-lipo-battery-1200mah-111v-3s-robotics-bangladesh.html
8.	Wires, Switch & Miscellaneous	N/A	520	
	Total		**22,455**	

8.5 Conclusion

In conclusion, based on the above-mentioned discussion regarding economic analysis, budget analysis we can say that our design approach three or the final design is more economic. Though the farmers can collect few parameters using two commercially available sensors but, in that case, they have to go for the lab test to find out the soil nutrients value While our system can give seven parameters with real time update and the testing time is few seconds with proper crop suggestion and fertilizer requirement. Using economic analysis, we may more thoroughly assess the numerous tradeoffs needed to boost the project's sustainability and accessibility.

Therefore, it is essential that a thorough analysis be carried out as the project is being developed.

Chapter 9: Ethics and Professional Responsibilities. [CO13, CO2]

9.1 Introduction

The consideration of ethical and professional responsibilities is a must since in this day and age, it is very easy to use someone else's content for personal and academic reasons. This creates a false and misinterpretation of people's hard work. For any project, it is expected that one will not do everything rather one will use ideas and content from someone else's work. There are no restrictions in doing so since engineers must collaborate for the benefit of the society. But proper citation, dedication, acknowledgement must be maintained. Also, stakeholder or the user concern must be considered for implementation of the project for the project to be ethical and professional.

9.2 Identify Ethical Issues and Professional Responsibility

Collection of soil quality data and using the collected data to estimate the fertilizer requirement and suitable crops for farming lands is the goal of this project. However, on a large scale, the ultimate objective of this project is to ensure higher production of food, improving rural environment, improving economy and mitigating chances of food scarcity. A project having such high ambitions should maintain professionalism and ethics. The sensors used in the project should be commercially, globally approved and thoroughly tested. This is a must since every sensor data must be correct to make sure of no faulty suggestions and consequently harm to the crops and environment. The project requires IoT technology for wireless communication of the sensor collected data. The project should be evaluated through a trial phase in real world scenarios multiple times before finalization to make sure of fulfilling stakeholder requirements and proper operation of the system. Besides these, any type of project related report should have clarity and plagiarism must be avoided. The protocols implemented by the Ethical Review Committee of BRAC University must be maintained and approval from the committee along with stakeholders is also fundamental.

9.3 Apply Ethical Issues and Professional Responsibility

Any project when implementing, has quite a few risks even when all the adverse conditions are considered. The proposed system is an agricultural project with integrated electronic components. Whenever there are electrical components integrated, the project tends to be prone to risks. Furthermore, since the proposed system is connected to agricultural yield, there are even more risks related to health. These risks along with the management procedures are given below in a tabular format:

Table 10: Expected risk events and Contingency Plan

No.	Risk Event	Contingency Plan
1	Electrical hazards	Ensuring proper isolation and insulation of all the connections and components.
2	Component accessibility	Making sure of alternate component availability.
3	Erroneous sensor data acquisition	Checking all the components thoroughly and buying them from reliable sources.
4	Soil, crop, environmental concern	Having too much fertilizer in the soil will give out an alert to the user.
5	Proper application and usage of the system	Reminder to collect data in a regular interval.
6	Handling without care	Training program and user manual for users.

9.4 Conclusion

In conclusion, proper management of the system from the user end and production end should be done in order to maintain ethical and professional perspectives of all parties involved. Also, as for any project we should maintain proper credentials and citations of every personnel and documents involved.

Chapter 10: Conclusion and Future Work.

10.1 Project Summary/Conclusion

Our project is about design and implementation of soil quality measurement system to determine fertilizer requirement and suitable crop for farmers. The use of IoT in monitoring soil quality has been attempted by many using wireless sensor networks (WSN) and various sensors for measuring soil parameters. The collected data is stored and analyzed using a cloud platform and machine learning algorithms to estimate required fertilizers, detect suitable crops, and even detect plant diseases. Primitive technologies like lab testing of soil have been digitalized through sensor networks, and automation in the form of robotics has also been included in some projects. However, no system has successfully met all the desired criteria of collecting soil parameter data, estimating required fertilizers, detecting suitable crops, user-friendliness, and portability. The proposed project aims to address these challenges using efficient and user-friendly methods to improve agriculture.

The main objective of this project is to design a system for decision-making purposes with sensor data and considering crop requirements with the help of implementing a proper algorithm and the system should be IoT-based. Stakeholders' requirements and any functional, non-functional requirement or any constraints have also been considered.

We proposed three design approaches for our system. 1st design approach uses C++ algorithm for on board processing and 2nd design approach uses similar algorithm but the data is processed in a cloud server using Python algorithm. 3rd design also uses similar C++ algorithm for data collection but for data processing we use ML algorithm in a cloud server.

The data acquisition of the three design approaches are similar. We tested all the sensors in the Proteus software for proper data acquisition for the sensors. We build the circuit for design approach-1 that used on board Arduino processing for data collection and providing the suggestions by using an LCD display. However, in this design approach we could not show any details of fertilizer requirements, land climate or nutrition. In our next design, design approach-2 we collect the data and stored it in a cloud server. We used these data for cloud processing using Python language and it provides suggestions by using a mobile application. Then in design approach-3 we similar processes are performed but we used machine learning algorithm for processing the data.

Considering different aspects and comparing all three designs, we conclude that our design approach 3 is the optimal solution since, detailed suggestion, land climate and land nutrition is shown to the user through the mobile interface and integrating more crops into our system is much easier for this design approach.

The proposed project aims to develop an IoT-based system that can monitor soil quality and suggest suitable crops and fertilizer requirements for farmers. The system includes non-invasive sensors that acquire real-time data on soil quality, which is then analyzed to provide suggestions for crop selection and fertilizer application. The proposed system also allows farmers to choose suitable crops based on their land's nutrition and fertilizer requirements. The ultimate goal of this project is to increase crop yield, improve the financial situation and social standing of farmers, and encourage the younger generation to pursue careers in agriculture. The proposed system is user-friendly and simple to use, and it has no legal concerns or boundaries of government rules and regulations to implement in the agriculture sector. The system is expected to improve the fertility rate of unfertilized land, assure high-quality, nutritious food, and reduce food scarcity and the risk of famine. This project could be a component of the digitalization of the agricultural industry in Bangladesh.

To achieve these high ambitions, professionalism and ethics must be maintained, including using commercially approved and tested sensors, evaluating the project in real-world scenarios multiple times, avoiding plagiarism, and following the protocols implemented by the Ethical Review Committee of BRAC University and getting approval from stakeholders. The project requires IoT technology for wireless communication of the sensor collected data. Correct sensor data is crucial to avoid faulty suggestions that could harm crops and the environment. Furthermore, risk management and contingency plan consideration is a must for mitigating any health risks.

10.2 Future Work

This research project aims to utilize modern sensing technologies in order to effectively measure and analyze crucial parameters related to soil fertility. These parameters include but are not limited to nutrient composition, pH level, as well as moisture and humidity levels. Further boost in efficiency can be achieved if the same device is used to collect a local dataset. Alongside to that actuator-based system can reduce the works of farmers.

The present research work involves the development of a device that aims to facilitate the measurement of nutrient levels in a convenient and practical manner. This research project aims to utilize modern sensing technologies in order to effectively measure and analyze crucial parameters related to soil fertility. These parameters include but are not limited to nutrient composition, pH level, as well as moisture and humidity levels. Many researches have been done on different aspects of agriculture. One such area is disease indication, which represents a promising aspect for research. Specifically, the utilization of image processing techniques, facilitated by a camera, to identify and detect diseases in plants based on the analysis of leaf and color and condition, is ideal in this area of study [8], [9], [10]. In addition to the mentioned benefits, the integration of an actuator-based system has the potential to enhance the effectiveness of automated fertilizer application systems while simultaneously ensuring optimal soil moisture levels [12], [13]. Moreover, the integration of multiple algorithms has the potential to enhance the overall performance of the system.

Chapter 11: Identification of Complex Engineering Problems and Activities.

11.1 Identify the Attribute of Complex Engineering Problem (EP)

Table 11: Attributes of Complex Engineering Problem

	Attributes	Put tick (✓) as appropriate
P1	Depth of knowledge required	✓
P2	Range of conflicting requirements	
P3	Depth of analysis required	✓
P4	Familiarity of issues	
P5	Extent of applicable codes	✓
P6	Extent of stakeholder involvement and needs	✓

11.2 Provide Reasoning How the Project Address Selected Attribute (EP)

P1. Depth of knowledge required: This project requires knowledge from many a field of electrical engineering. Digital logic design and hardware implementation knowledge is needed for implementing the hardware circuit setups. Sensor data processing, microprocessor interfacing, IoT based signal processing, cloud data processing is needed to collect the data and processing. Also, algorithm designing and machine learning knowledge is needed to make proper decisions based on input data. Thus, depth of knowledge is a must for this project.

P3. Depth of analysis required: Using the collected data, decisions will be made regarding fertilizer requirement and suitable crop selection. For such purposes all sensor data must be analyzed thoroughly to compare with optimum situation data and give out results.

P5. Extent of applicable codes: Although this project must maintain a lot of standards and codes for wireless communication, data security, decision making algorithm and fertilizer usage, some practice that are not defined by any codes must be added as well to make sure of proper operation of the system. As a result, there occurs an extent of applicable codes.

P6. Extent of stakeholder involvement and needs: In recent years the agricultural sector of our country has fallen rapidly. So, the farmers are in need of such a system and modernization that would help them grow better crops and develop rural culture which is the goal of this project. In order to do so, feedback from the farmers is a must since they will the users. Also, expert advice is required to understand soil qualities and parameters. Finally, improvement of agriculture sector would reduce risk of food scarcity and develop further economic stability. So, stakeholder involvement and needs has been extended.

11.3 Identify the Attribute of Complex Engineering Activities (EA)

Table 12: Attributes of Complex Engineering Activities

	Attributes	**Put tick (✓) as appropriate**
A1	**Range of resource**	✓
A2	**Level of interaction**	✓
A3	**Innovation**	
A4	**Consequences for society and the environment**	✓
A5	**Familiarity**	

11.4 Provide Reasoning How the Project Address Selected Attribute (EA)

A1. Range of resource: Expert knowledge is required to gather knowledge about soil and crops and a lot of parameter data is required to set a threshold. Also, farmer experience and knowledge gathering are a must since they will be the ones using the system. Crop nutrient database is also needed to develop the decision-making algorithm.

A2**.** Level of interaction: To complete this project we need to talk to the expert level for acquiring the parameters of the data for crop's fertilizer requirement. We also gather feedback and suggestions from the stakeholders about the system level design and their requirements.

A4. Consequences to Society and the Environment: Most farmers in our culture are technologically illiterate and live in poverty. Our proposed project will improve their financial condition by increase the crops production and influenced the young generation in agricultural sector. Over excessive and unbalanced fertilizer in crops are the main cause of the water and soil pollution, that hampers ecosystem and the environmental balance. This excessive fertilizer use can be avoided by our suggested project, reducing environmental damage.

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Appendix

Arduino/C++ Code for Data Acquisition System:

```
#include "DHT.h"
#include <TinyGPS.h>
#include <SoftwareSerial.h>
#define dht_1 2
#define DHTTYPE DHT11
#define SensorPin A0
#define AOUT_PIN A1// the pH meter Analog output is connected with the Arduino's Analog
#define THRESHOLD 20
DHT dht(dht_1, DHTTYPE);
TinyGPS gps;
SoftwareSerial mySerial(9, 10);
unsigned long int avgValue1;
float c;
int cuf[50],temp1;
unsigned long int avgValue;  //Store the average value of the sensor feedback
float b;
int buf[50],temp;

int N=A2, P=A3, K=A4;
int N_val=0, P_val=0, K_val=0;

void setup()
{
  mySerial.begin(9600);
  Serial.begin(9600);
  dht.begin();
}

void loop()
{
  for(int i=0;i<50;i++)       //Get 50 sample value from the sensor for smooth the value
  {
    buf[i]=analogRead(SensorPin);
    delay(10);
  }
  for(int i=0;i<49;i++)        //sort the analog from small to large
  {
    for(int j=i+1;j<50;j++)
    {
      if(buf[i]>buf[j])
      {
        temp=buf[i];
        buf[i]=buf[j];
        buf[j]=temp;
      }
```

```
  }
}
avgValue=0;
for(int i=0;i<49;i++)                    //take the average value of 6 center sample
  avgValue+=buf[i];
float phValue=(float)avgValue*5.0/1024/50; //convert the analog into millivolt
phValue=3.5*phValue;                      //convert the millivolt into pH value

Serial.println(" ");
Serial.print("pH: ");
Serial.print(phValue,2);
Serial.println(" ");
delay(100);


float humid = dht.readHumidity();
float temp = dht.readTemperature();
Serial.print("Humidity = ");
Serial.print(humid);
Serial.println("%");
Serial.print("Temperature = ");
Serial.print(temp);
Serial.println(" Degree Centigrade");
delay(100);


for(int i=0;i<49;i++)       //Get 50 sample value from the sensor for smooth the value
{
  cuf[i]=analogRead(AOUT_PIN);
  delay(10);
}
for(int i=0;i<49;i++)        //sort the analog from small to large
{
  for(int j=i+1;j<49;j++)
  {
    if(cuf[i]>cuf[j])
    {
      temp1=cuf[i];
      cuf[i]=cuf[j];
      cuf[j]=temp1;
    }
  }
}
avgValue1=0;
for(int i=0;i<49;i++)                    //take the average value of 50 center sample
  avgValue1+=cuf[i];
float value = (float)avgValue1*5.0/1024/50;
value=20*value;

Serial.print("Moisture: ");
```

```
 Serial.print(value);
 Serial.println("%");

 if (value < THRESHOLD)
   Serial.println("The soil is DRY ");
 else
   Serial.println("The soil is WET ");
 delay(100);


N_val=analogRead(N);
P_val=analogRead(P);
K_val=analogRead(K);

Serial.print("Nitrogen: ");
Serial.print(N_val);
Serial.println(" mg/kg");

Serial.print("Phosphorus: ");
Serial.print(P_val);
Serial.println(" mg/kg");

Serial.print("Potassium: ");
Serial.print(K_val);
Serial.println(" mg/kg");

delay(100);


bool newData = false;
 unsigned long chars;
 unsigned short sentences, failed;
 char d;

 // For one second we parse GPS data and report some key values
 for (unsigned long start = millis(); millis() - start < 500;)
 {
   while (Serial.available())
   {
     char d = Serial.read();
     //Serial.print(d);
     if (gps.encode(d))
       newData = true;
   }
 }
 if (newData)      //If newData is true
 {
   float flat, flon;
   unsigned long age;
   gps.f_get_position(&flat, &flon, &age);
```

```
    Serial.print("Latitude = ");
    Serial.print(flat == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flat, 6);
    Serial.print(" Longitude = ");
    Serial.println(flon == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flon, 6);
  }
  Serial.println(" ");
  delay(100);

  Serial.write(mySerial.read());
  if (value < THRESHOLD)
  {
    mySerial.println("You should water your plants");
    mySerial.println(" ");
    delay(100);
  }
  else
  {
    mySerial.println("Your plants have enough water");
    mySerial.println(" ");
    delay(100);
  }
}
```

Arduino/C++ Code for Design Approach 1:

```
// include the library code:
#include <LiquidCrystal.h>
#include "DHT.h"
#include <TinyGPS.h>
#include <SoftwareSerial.h>
#define dht_1 2
#define DHTTYPE DHT11
#define SensorPin A0
#define AOUT_PIN A1// the pH meter Analog output is connected with the Arduino’s Analog
#define THRESHOLD 30

const int rs = 12, en = 11, d4 = 5, d5 = 4, d6 = 3, d7 = 6;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);
DHT dht(dht_1, DHTTYPE);
TinyGPS gps;
SoftwareSerial mySerial(9, 10);
unsigned long int avgValue1;
float c;
int cuf[50],temp1;
unsigned long int avgValue;  //Store the average value of the sensor feedback
float b;
int buf[50],temp;

int N=A2, P=A3, K=A4;
```

```
int N_val=0, P_val=0, K_val=0;

void setup()
{
  mySerial.begin(9600);
  Serial.begin(9600);
  dht.begin();
  // set up the LCD's number of columns and rows:
  lcd.begin(20, 4);
  lcd.clear();
  // Print a message to the LCD.
  lcd.print("Crop Recommendation:");
}

void loop()
{
  for(int i=0;i<50;i++)       //Get 50 sample value from the sensor for smooth the value
  {
    buf[i]=analogRead(SensorPin);
    delay(10);
  }
  for(int i=0;i<49;i++)        //sort the analog from small to large
  {
    for(int j=i+1;j<50;j++)
    {
      if(buf[i]>buf[j])
      {
        temp=buf[i];
        buf[i]=buf[j];
        buf[j]=temp;
      }
    }
  }
  avgValue=0;
  for(int i=0;i<49;i++)                      //take the average value of 6 center sample
    avgValue+=buf[i];
  float phValue=(float)avgValue*5.0/1024/50; //convert the analog into millivolt
  phValue=3.5*phValue;                      //convert the millivolt into pH value

  Serial.print("pH: ");
  Serial.print(phValue,2);
  Serial.println(" ");
  delay(500);


  float humid = dht.readHumidity();
  float temp = dht.readTemperature();
  Serial.print("Humidity = ");
  Serial.print(humid);
  Serial.println("%");
```

```
 Serial.print("Temperature = ");
 Serial.print(temp);
 Serial.println(" Degree Centigrade");
 delay(500);


 for(int i=0;i<49;i++)       //Get 50 sample value from the sensor for smooth the value
 {
   cuf[i]=analogRead(AOUT_PIN);
   delay(10);
 }
 for(int i=0;i<49;i++)        //sort the analog from small to large
 {
   for(int j=i+1;j<49;j++)
   {
     if(cuf[i]>cuf[j])
     {
       temp1=cuf[i];
       cuf[i]=cuf[j];
       cuf[j]=temp1;
     }
   }
 }
 avgValue1=0;
 for(int i=0;i<49;i++)                    //take the average value of 50 center sample
   avgValue1+=cuf[i];
 float value = (float)avgValue1*5.0/1024/50;
 value=20*value;

 Serial.print("Moisture: ");
 Serial.print(value);
 Serial.println("%");

 if (value < THRESHOLD)
   Serial.println("The soil is DRY ");
 else
   Serial.println("The soil is WET ");
 delay(500);


N_val=analogRead(N);
P_val=analogRead(P);
K_val=analogRead(K);

Serial.print("Nitrogen: ");
Serial.print(N_val/100);
Serial.println(" mg/kg");

Serial.print("Phosphorus: ");
Serial.print(P_val/100);
```

```
 Serial.println(" mg/kg");

 Serial.print("Potassium: ");
 Serial.print(K_val/100);
 Serial.println(" mg/kg");

 delay(500);


lcd.setCursor(0, 1);
   if (phValue>6 && phValue<6.5 && humid>60 && humid <70 && temp>20 && temp<32 && (N_val/100)>0 && (N_val/100)<8.31 && (P_val/100)>0 && (P_val/100)<3.324 && (K_val/100)>0 && (K_val/100)<6.925)
    {
     lcd.print("Cotton ");
     delay(100);
     }

if (phValue>6 && phValue<7.5 && humid>70 && humid <80 && temp>24 && temp<37 && (N_val/100)>0 && (N_val/100)<6.925 && (P_val/100)>0 && (P_val/100)<1.108 && (K_val/100)>0 && (K_val/100)<5.54)
    {
     lcd.print("Jute ");
     delay(100);
     }

if (phValue>6 && phValue<7.8 && humid>60 && humid <70 && temp>20 && temp<28 && (N_val/100)>0 && (N_val/100)<1.939 && (P_val/100)>0 && (P_val/100)<1.108 && (K_val/100)>0 && (K_val/100)<1.939)
    {
     lcd.print("Lentil ");
     delay(100);
     }

if (phValue>5.7 && phValue<6.9 && humid>55 && humid <75 && temp>21 && temp<27 && (N_val/100)>0 && (N_val/100)<20.775 && (P_val/100)>0 && (P_val/100)<5.54 && (K_val/100)>0 && (K_val/100)<11.08)
    {
     lcd.print("Maize ");
     delay(100);
     }

if (phValue>5.5 && phValue<7.5 && humid>70 && humid <85 && temp>25 && temp<35 && (N_val/100)>0 && (N_val/100)<5 && (P_val/100)>=0 && (P_val/100)<1 && (K_val/100)>0 && (K_val/100)<4.155)
    {
     lcd.print("Rice ");
     delay(100);
     }
```

```
      else
{
      lcd.print("DON'T PLANT ANYTHING");
      delay(100);
  }


  lcd.setCursor(0, 3);
 if (value < THRESHOLD)
  {
    lcd.print("Water the soil       ");
    delay(100);
  }
  else
  {
    lcd.print("No water Needed     ");
    delay(100);
  }

}
```

Arduino/C++ Code for Design Approach 2:

```
/* Fill-in information from Blynk Device Info here */
#define BLYNK_TEMPLATE_ID           "TMPL6gLZszAaC"
#define BLYNK_TEMPLATE_NAME         "Temp"
#define BLYNK_AUTH_TOKEN            "1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6"

#define BLYNK_PRINT SwSerial

#include <SoftwareSerial.h>

SoftwareSerial SwSerial(10, 11); // RX, TX
SoftwareSerial mySerial(12, 13);

#include <BlynkSimpleStream.h>
#include <DHT.h>

#define DHTPIN 2          // What digital pin we're connected to

#define DHTTYPE DHT11     // DHT 11

float readp,readn,readk,readph,readmois;

DHT dht(DHTPIN, DHTTYPE);
BlynkTimer timer;

WidgetTerminal terminal(V11);
```

```
void sendSensor()
{
  float h = dht.readHumidity();
  float t = dht.readTemperature(); // or dht.readTemperature(true) for Fahrenheit

  if (isnan(h) || isnan(t)) {
    SwSerial.println("Failed to read from DHT sensor!");
    return;
  }
  // You can send any value at any time.
  // Please don't send more that 10 values per second.
  Blynk.virtualWrite(V5, h);
  Blynk.virtualWrite(V6, t);
}

void setup()
{
  // Debug console
  mySerial.begin(9600);
  SwSerial.begin(9600);

  // Blynk will work through Serial
  // Do not read or write this serial manually in your sketch
  Serial.begin(9600);
  pinMode(A4, INPUT);
  pinMode(A3, INPUT);
  pinMode(A2, INPUT);
  pinMode(A1, INPUT);
  pinMode(A0, INPUT);
  Blynk.begin(Serial, BLYNK_AUTH_TOKEN);

  dht.begin();

  // Setup a function to be called every second
  timer.setInterval(1000L, sendSensor);
}

void loop()
{
  Blynk.run();

readp = analogRead(A3);
Blynk.virtualWrite(V3, readp/100);

readn = analogRead(A2);
Blynk.virtualWrite(V2, readn/100);

readk = analogRead(A4);
Blynk.virtualWrite(V4, readk/100);
```

```
readph = analogRead(A0);
Blynk.virtualWrite(V1, readph/50);

readmois = analogRead(A1);
Blynk.virtualWrite(V7, readmois/10);

  timer.run();
}
```

Google Colab/Python Code for Design Approach 2:

```
import requests
import time

while True:
	hum = requests.get('https://sgp1.blynk.cloud/external/api/get?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V5')
	hum=hum.text
	temp = requests.get('https://sgp1.blynk.cloud/external/api/get?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V6')
	temp=temp.text
	ph = requests.get('https://sgp1.blynk.cloud/external/api/get?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V1')
	ph=ph.text
	mois = requests.get('https://sgp1.blynk.cloud/external/api/get?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V7')
	mois=mois.text
	n = requests.get('https://sgp1.blynk.cloud/external/api/get?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V2')
	n=n.text
	p = requests.get('https://sgp1.blynk.cloud/external/api/get?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V3')
	p=p.text
	k = requests.get('https://sgp1.blynk.cloud/external/api/get?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V4')
	k=k.text
	time.sleep(1)
	if int(ph)>=6 and int(ph)<6.5 and int(hum)>60 and int(hum)<70 and int(temp)>20 and int(temp)<32 and int(n)>0 and int(n)<8.3 and int(p)>0 and int(p)<3.3 and int(k)>0 and int(k)<7:
```

```
requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V11=Plant Cotton ')
        if int(ph)>=6 and int(ph)<7.5 and int(hum)>70 and int(hum)<80 and int(temp)>24 and int(temp)<37 and int(n)>0 and int(n)<7 and int(p)>0 and int(p)<1.108 and int(k)>0 and int(k)<5.5:

requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V11=Plant Jute ')
        if int(ph)>=6 and int(ph)<7.8 and int(hum)>60 and int(hum)<70 and int(temp)>20 and int(temp)<28 and int(n)>0 and int(n)<2 and int(p)>0 and int(p)<1.108 and int(k)>0 and int(k)<2:

requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V11=Plant Lentil ')
        if int(ph)>=5.7 and int(ph)<6.9 and int(hum)>55 and int(hum)<75 and int(temp)>21 and int(temp)<27 and int(n)>0 and int(n)<20.7 and int(p)>0 and int(p)<5.5 and int(k)>0 and int(k)<11.08:

requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V11=Plant Maize ')
        if int(ph)>=5.5 and int(ph)<7.5 and int(hum)>70 and int(hum)<85 and int(temp)>25 and int(temp)<35 and int(n)>0 and int(n)<5 and int(p)>0 and int(p)<=1 and int(k)>0 and int(k)<4.115:

requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V11=Plant Rice ')
        #else:
         #
requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V11=Do Not Plant Anything ')


requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V11=Fertilizer Requirement: ')

         n_req_cot=123-int(n)
         p_req_cot=40-int(p)
         k_req_cot=147-int(k)

requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V11=For Cotton: %.3f mg/kg Nitrogen, %.3f mg/kg Phosphourus, %.3f mg/kg Potassium '% (n_req_cot, p_req_cot, k_req_cot))

         n_req_jut=200-int(n)
         p_req_jut=175-int(p)
         k_req_jut=220-int(k)

requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0Zi
```

```
nvoXSC0D6&V11=For Jute: %.3f mg/kg Nitrogen, %.3f mg/kg Phosphourus, %.3f mg/kg Potassium '% (n_req_jut, p_req_jut, k_req_jut))

        n_req_len=120-int(n)
        p_req_len=55-int(p)
        k_req_len=140-int(k)

requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0Zi
nvoXSC0D6&V11=For Lentil: %.3f mg/kg Nitrogen, %.3f mg/kg Phosphourus, %.3f mg/kg Potassium '% (n_req_len, p_req_len, k_req_len))

        n_req_mai=197-int(n)
        p_req_mai=70-int(p)
        k_req_mai=180-int(k)

requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0Zi
nvoXSC0D6&V11=For maize: %.3f mg/kg Nitrogen, %.3f mg/kg Phosphourus, %.3f mg/kg Potassium '% (n_req_mai, p_req_mai, k_req_mai))

        n_req_ric=175-int(n)
        p_req_ric=87-int(p)
        k_req_ric=178-int(k)

requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0Zi
nvoXSC0D6&V11=For Rice: %.3f mg/kg Nitrogen, %.3f mg/kg Phosphourus, %.3f mg/kg Potassium '% (n_req_ric, p_req_ric, k_req_ric))


       if int(mois)>30:

requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0Zi
nvoXSC0D6&V11=The soil contains too much water \n')
       elif int(mois)<20:

requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0Zi
nvoXSC0D6&V11=The soil does not have enough water \n')
       else:

requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0Zi
nvoXSC0D6&V11=The soil contains proper amount of water \n')
```

Arduino/C++ Code for Design Approach 3:

```
#include <SoftwareSerial.h>
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>
#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>


#include "DHT.h"
#define DHTPIN 4     // esp8266 D2 pin map as 4 in Arduino IDE
#define DHTTYPE DHT11   // there are multiple kinds of DHT sensors


#define SCREEN_WIDTH 128    // OLED display width, in pixels
#define SCREEN_HEIGHT 64    // OLED display height, in pixels
#define OLED_RESET -1       // Reset pin # (or -1 if sharing Arduino reset pin)
Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, OLED_RESET);

#define RE 19
#define DE 18

#define BLYNK_TEMPLATE_ID "TMPL6gLZszAaC"
#define BLYNK_TEMPLATE_NAME "Temp"
#define BLYNK_AUTH_TOKEN "1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6"
#define BLYNK_PRINT Serial

char ssid[] = "UB5_Thesis LAB_01";
char pass[] = "00001111";


byte values[11];
SoftwareSerial mod(16,17);//NPK
SoftwareSerial mod1(13, 14);//Ph

DHT dht(DHTPIN, DHTTYPE);

const int sensor_pin = 32;  /* Connect Soil moisture analog sensor pin to A0 of NodeMCU */

const byte code[]= {0x01, 0x03, 0x00, 0x1e, 0x00, 0x03, 0x65, 0xCD};
const byte nitro[] = {0x01,0x03, 0x00, 0x1e, 0x00, 0x01, 0xe4, 0x0c};
const byte phos[] = {0x01,0x03, 0x00, 0x1f, 0x00, 0x01, 0xb5, 0xcc};
const byte pota[] = {0x01,0x03, 0x00, 0x20, 0x00, 0x01, 0x85, 0xc0};
const byte ph[] = {0x01, 0x03, 0x00, 0x0d, 0x00, 0x01, 0x15, 0xC9};

int moistPin=22;
int NPKPin=23;
```

```
//int NPKPin2=23;
int pHPin=21;
WidgetTerminal terminal(V11);


void setup() {
  Serial.begin(9600);
  Serial.setTimeout(2000);
  pinMode(moistPin,OUTPUT);
  mod.begin(4800);
  mod1.begin(9600);
  pinMode(RE, OUTPUT);
  pinMode(DE, OUTPUT);

  Blynk.begin(BLYNK_AUTH_TOKEN, ssid, pass);
  terminal.flush();

  // Clear the terminal content
  //terminal.clear();




  display.begin(SSD1306_SWITCHCAPVCC, 0x3C); //initialize with the I2C addr 0x3C (128x64)
  delay(500);
  display.clearDisplay();
  display.setCursor(0, 0);
  display.setTextSize(1);
  //display.setTextColor(WHITE);
  display.println(" NPK Sensor");
  display.setCursor(25, 35);
  display.setTextSize(1);
  display.print("Initializing");
  display.display();
  delay(1000);

  // Wait for serial to initialize.
  while(!Serial) { }

  dht.begin();

  Serial.println("Device Started");
  Serial.println("-------------------------------------");
  Serial.println("Running DHT!");
  Serial.println("-------------------------------------");

}
```

```
int timeSinceLastRead = 0;
void loop() {


Blynk.run();

  digitalWrite(pHPin,HIGH);
  delay(1000);
  byte val;
  digitalWrite(DE, HIGH);
  digitalWrite(RE, HIGH);
  delay(10);
  if (mod1.write(ph, sizeof(ph)) == 8)
  {
    digitalWrite(DE, LOW);
    digitalWrite(RE, LOW);
    for (byte i = 0; i < 11; i++)
    {
      values[i] = mod1.read();
      Serial.print(values[i], HEX);
    }
    Serial.println();
  }

  float soil_ph = float(values[4]) / 10;
  Serial.print("Soil Ph: ");
  Serial.println(soil_ph, 1);
  digitalWrite(pHPin,LOW);
  Blynk.virtualWrite(V1, soil_ph);
  delay(1000);




digitalWrite(NPKPin,HIGH);
delay(1000);
  byte val1,val2,val3;
  val1 = nitrogen();
  delay(500);
  val2 = phosphorous();
  delay(500);
  val3 = potassium();
  delay(500);


  Serial.print("Nitrogen: ");
  Serial.print(val1);
  Serial.println(" mg/kg");
  Blynk.virtualWrite(V2, val1);
  Serial.print("Phosphorous: ");
```

```
  Serial.print(val2);
  Serial.println(" mg/kg");
  Blynk.virtualWrite(V3, val2);
  Serial.print("Potassium: ");
  Serial.print(val3);
  Serial.println(" mg/kg");
  Blynk.virtualWrite(V4, val3);
  delay(1000);

  display.clearDisplay();


  display.setTextSize(2);
  display.setCursor(0, 5);
  display.print("N: ");
  display.print(val1);
  display.setTextSize(1);
  display.print(" mg/kg");

  display.setTextSize(2);
  display.setCursor(0, 25);
  display.print("P: ");
  display.print(val2);
  display.setTextSize(1);
  display.print(" mg/kg");

  display.setTextSize(2);
  display.setCursor(0, 45);
  display.print("K: ");
  display.print(val3);
  display.setTextSize(1);
  display.print(" mg/kg");

  display.display();
 digitalWrite(NPKPin,LOW);
delay(1000);


   float moisture_percentage;
digitalWrite(moistPin,HIGH);
delay(1000);
  moisture_percentage = ( 100.00 - ( (analogRead(sensor_pin)/4095.00) * 100.00 ) );

  Serial.print("Soil Moisture = ");
  Serial.print(moisture_percentage);
  Serial.println("%");
  digitalWrite(moistPin,LOW);
  delay(1000);
  Blynk.virtualWrite(V7, moisture_percentage);
```

```
  delay(500);


  // Report every 2 seconds.
  if(timeSinceLastRead > 2000) {
    // Reading temperature or humidity takes about 250 milliseconds!
    // Sensor readings may also be up to 2 seconds 'old' (its a very slow sensor)
    float h = dht.readHumidity();
    // Read temperature as Celsius (the default)
    float t = dht.readTemperature();
    // Read temperature as Fahrenheit (isFahrenheit = true)
    float f = dht.readTemperature(true);

    // Check if any reads failed and exit early (to try again).
    if (isnan(h) || isnan(t) || isnan(f)) {
      Serial.println("Failed to read from DHT sensor!");
      timeSinceLastRead = 0;
      return;
    }

    // Compute heat index in Fahrenheit (the default)
    float hif = dht.computeHeatIndex(f, h);
    // Compute heat index in Celsius (isFahreheit = false)
    float hic = dht.computeHeatIndex(t, h, false);

    Serial.print("Humidity: ");
    Serial.print(h);
    Serial.print(" %\t");
    Serial.print("Temperature: ");
    Serial.print(t);
    Serial.println(" *C ");

    Blynk.virtualWrite(V5, h);
    Blynk.virtualWrite(V6, t);


    timeSinceLastRead = 0;
  }
  delay(100);
  timeSinceLastRead += 10000;
}

//digitalWrite(NPKPin2,HIGH);
//delay(1000);
byte nitrogen(){
  digitalWrite(DE,HIGH);
  digitalWrite(RE,HIGH);
  delay(10);
  if(mod.write(nitro,sizeof(nitro))==8){
    digitalWrite(DE,LOW);
```

```
    digitalWrite(RE,LOW);
    for(byte i=0;i<7;i++){
    //Serial.print(mod.read(),HEX);
    values[i] = mod.read();
    //Serial.print(values[i],HEX);
    }
    //Serial.println();
  }
  return values[4];
}

byte phosphorous(){
  digitalWrite(DE,HIGH);
  digitalWrite(RE,HIGH);
  delay(10);
  if(mod.write(phos,sizeof(phos))==8){
    digitalWrite(DE,LOW);
    digitalWrite(RE,LOW);
    for(byte i=0;i<7;i++){
    //Serial.print(mod.read(),HEX);
    values[i] = mod.read();
    //Serial.print(values[i],HEX);
    }
    //Serial.println();
  }
  return values[4];
}

byte potassium(){
  digitalWrite(DE,HIGH);
  digitalWrite(RE,HIGH);
  delay(10);
  if(mod.write(pota,sizeof(pota))==8){
    digitalWrite(DE,LOW);
    digitalWrite(RE,LOW);
    for(byte i=0;i<7;i++){
    //Serial.print(mod.read(),HEX);
    values[i] = mod.read();
    //Serial.print(values[i],HEX);
    }
    Serial.println();
  }
  return values[4];
  //digitalWrite(NPKPin2,LOW);
}
```

Google Colab/Python Code for Design Approach 3:

```
import requests
import time
import pandas as pd
import numpy as np
import warnings
warnings.filterwarnings("ignore")

while True:

    from google.colab import drive
    drive.mount('/content/drive')

    data = pd.read_excel("/content/drive/MyDrive/tewrgt4g/dfr .xlsx")

    X = data.drop('label', axis=1)
    y = data['label']

    from sklearn.model_selection import train_test_split
    X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.20,shuffle = True,
random_state = 0)

    from sklearn.ensemble import RandomForestClassifier
    model_rf= RandomForestClassifier(n_estimators= 10, criterion="entropy")
    model_rf.fit(X_train, y_train)

    y_pred= model_rf.predict(X_test)

    hum =
requests.get('https://sgp1.blynk.cloud/external/api/get?token=1ZAEivkGjB2jldi3RZrm0Zinv
oXSC0D6&V5')
    hum=hum.text
    temp =
requests.get('https://sgp1.blynk.cloud/external/api/get?token=1ZAEivkGjB2jldi3RZrm0Zinv
oXSC0D6&V6')
    temp=temp.text
    ph =
requests.get('https://sgp1.blynk.cloud/external/api/get?token=1ZAEivkGjB2jldi3RZrm0Zinv
oXSC0D6&V1')
    ph=ph.text
    mois =
requests.get('https://sgp1.blynk.cloud/external/api/get?token=1ZAEivkGjB2jldi3RZrm0Zinv
oXSC0D6&V7')
    mois=mois.text
    n =
requests.get('https://sgp1.blynk.cloud/external/api/get?token=1ZAEivkGjB2jldi3RZrm0Zinv
oXSC0D6&V2')
    n=n.text
    n1= n
```

```
        p                                                                                       =
requests.get('https://sgp1.blynk.cloud/external/api/get?token=1ZAEivkGjB2jldi3RZrm0Zinv
oXSC0D6&V3')
        p=p.text
        p1= p
        k                                                                                       =
requests.get('https://sgp1.blynk.cloud/external/api/get?token=1ZAEivkGjB2jldi3RZrm0Zinv
oXSC0D6&V4')
        k=k.text
        k1= k
        time.sleep(1)

        features = np.array([[n1,p1,k1,temp,hum]])
        prediction = model_rf.predict(features)
        print("Prediction: {}".format(prediction))


requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0Zi
nvoXSC0D6&V8= %s '% (prediction))



requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0Zi
nvoXSC0D6&V11=Fertilizer Requirement: ')

        n_req_cot=123-int(n)
        p_req_cot=40-int(p)
        k_req_cot=147-int(k)


requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0Zi
nvoXSC0D6&V11=For Cotton: %.3f mg/kg Nitrogen, %.3f mg/kg Phosphourus, %.3f mg/kg
Potassium '% (n_req_cot, p_req_cot, k_req_cot))

        n_req_jut=200-int(n)
        p_req_jut=175-int(p)
        k_req_jut=220-int(k)


requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0Zi
nvoXSC0D6&V11=For Jute: %.3f mg/kg Nitrogen, %.3f mg/kg Phosphourus, %.3f mg/kg
Potassium '% (n_req_jut, p_req_jut, k_req_jut))

        n_req_len=120-int(n)
        p_req_len=55-int(p)
        k_req_len=140-int(k)


requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0Zi
```

```
nvoXSC0D6&V11=For Lentil: %.3f mg/kg Nitrogen, %.3f mg/kg Phosphourus, %.3f mg/kg Potassium '% (n_req_len, p_req_len, k_req_len))

        n_req_mai=197-int(n)
        p_req_mai=70-int(p)
        k_req_mai=180-int(k)


requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V11=For maize: %.3f mg/kg Nitrogen, %.3f mg/kg Phosphourus, %.3f mg/kg Potassium '% (n_req_mai, p_req_mai, k_req_mai))

        n_req_ric=175-int(n)
        p_req_ric=87-int(p)
        k_req_ric=178-int(k)


requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V11=For Rice: %.3f mg/kg Nitrogen, %.3f mg/kg Phosphourus, %.3f mg/kg Potassium '% (n_req_ric, p_req_ric, k_req_ric))


        if int(mois)>60:

requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V11=The soil contains too much water \n')
        elif int(mois)<20:

requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V11=The soil does not have enough water \n')
        else:

requests.get('https://sgp1.blynk.cloud/external/api/update?token=1ZAEivkGjB2jldi3RZrm0ZinvoXSC0D6&V11=The soil contains proper amount of water \n')
```

FYDP (P) Fall 2022 Summary of Group 03 Log Book/Journal

Group: 3

Project Title: Design & Implementation of Soil Quality Measurement System to Determine Fertilizer Requirement & Suitable Crop for Farmers.

Final Year Design Project (P) Fall 2022			
Student Details	**NAME & ID**	**EMAIL ADDRESS**	**PHONE**
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ATC Details			
ATC 3			
Chair	Dr. AKM Abdul Malek Azad, Professor, Department of EEE, Brac University	a.azad@bracu.ac.bd	
Member 1	Afrida Malik, Lecturer, Department of EEE, Brac University	afrida.malik@bracu.ac.bd	
Member 2	Mohammed Thushar Imran, Lecturer, Department of EEE, Brac University	thushar.imran@bracu.ac.bd	

General Notes:
1. In addition to detail journal/logbook fill out the summary/key steps and progress of your work
2. Reflect planning assignments, who has what responsibilities.
3. The logbook should contain all activities performed by the team members (Individual and team activities).

FYDP (P) Fall 2022 Summary of Group 03 Log Book/Journal

Date/Time/Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
29.09.2022 (FYDP committee class-1)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab **Faculty member:** 1. Mohaimenul Islam, Lecturer	Introductory Class **EEE400(P)**		
01.10.2022 (Group meeting-1)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Discussion on what field we want to work on 2. Generation of project ideas considering surrounding problems.	Task 1: Everyone Task 2: Everyone **Progress:** Task 1: Completed Task 2: Completed	
06.10.2022 (FYDP committee class-2)	**Students:** 1. Shabbir 2. Jiad 3. Farhan (Gourab was absent due to Durga Puja) **Faculty member:** 1. Dr. Md. Mosaddequr Rahman, Professor and Chair, Dept. of EEE.	Lecture-1: Introduction to Engineering Design Process		
08.10.2022 (Group meeting-2)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Sharing and discussion on project ideas 2. Shortlisting 6 viable ideas 3. Evaluated whether the selected topic ideas are complex engineering problems or not.	Task 1: Everyone Task 2: Everyone Task 3: Everyone **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed	

FYDP (P) Fall 2022 Summary of Group 03 Log Book/Journal

Date/Time/Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
09.10.2022 (ATC meeting-1)	**ATC members:** 1. Prof. Dr. AKM Abdul Malek Azad 2. Afrida Malik 3. Mohammed Thushar Imran **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. ATC Introduction. 2. Directed to do further background research on selected 3 ideas (at least 3 Journal / conference papers). 3. Send mail to ATC with our finalized ideas with supporting research papers.	Task 1: Everyone Task 2: Everyone Task 3: Farhan **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed	1. ATC meeting-2 scheduled on 29.10.2022 (Saturday) at 6.30pm 2. ATC meeting-3 scheduled on 10.12.2022 (Saturday) at 6.30pm 3. Extensive research on shortlisted ideas 4. Maintain log book 5. Send all files in pdf format.
10.10.2022 (Group meeting-3)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Background research on Soil Quality Measurement for Suitable Crop Production and Fertilizer Requirement. (one of the shortlisted ideas)	Task 1: Everyone **Progress:** Task 1: Completed	
11.10.2022 (Group meeting-4)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Background research on Water Surface Cleaning and Quality Control Vessels. (one of the shortlisted ideas)	Task 1: Everyone **Progress:** Task 1: Completed	
12.10.2022 (Group meeting-5)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Background research on Smart Irrigation System using IoT. (one of the shortlisted ideas)	Task 1: Everyone **Progress:** Task 1: Completed	
13.10.2022 (FYDP committee class-3)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab **Faculty member:** 1. Prof. Arshad Mahmud Chowdhury. Dean, School of Engineering.	Lecture-2: Complex Engineering Problem Identification		

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Date/Time/Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
16.10.2022 (Group meeting-6)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Get topic approval from ATC for FYDP. 2. Update log book 3. Mail the concept note draft by Oct 22, 2022	Task 1: Everyone Task 2: Everyone Task 3: Farhan **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed	
17.10.2022 (Group meeting-7)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Project Title Selection 2. Writing problem statement as a draft for concept note	Task 1: Everyone Task 2: Everyone **Progress:** Task 1: Completed Task 2: Completed	
18.10.2022 (Group meeting-8)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. In depth research and paper study for our project	Task 1: Everyone **Progress:** Task 1: Completed	
19.10.2022 (Group meeting-9)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Writing tentative objectives as a draft for concept note 2. In depth discussion and study research papers for multiple design approach as a draft for concept note	Task 1: Everyone Task 2: Everyone **Progress:** Task 1: Completed Task 2: Completed	
20.10.2022 (FYDP committee class-4)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab **Faculty member:** 1. Dr. Abu S.M. Mohsin, Associate Professor, Dept. of EEE.	Lecture-3: Case Study: How to Identify a Complex Engineering Design Project and Fulfill CO Criteria		
20.10.2022 (Group meeting-10)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Identify the functional, non-functional and system level requirements of our project. 2. Discussion about the specification of our project and finding the components based on the specification.	Task 1: Everyone Task 2: Everyone **Progress:** Task 1: Completed Task 2: Completed	

FYDP (P) Fall 2022 Summary of Group 03 Log Book/Journal

Date/Time/Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
22.10.2022 (Group meeting-11)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Identify the multiple constraints of our project. 2. Finding the applicable standards and codes for the project 3. Mail the logbook before October 29, Saturday ATC meeting	Task 1: Everyone Task 2: Everyone Task 3: Shabbir **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed	
27.10.2022 (FYDP committee class-5)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab **Faculty member:** 1. Mohaimenul Islam, Lecturer.	Lecture-4: Review of Project Proposal Preparation and Project Management		
29.10.2022 (ATC meeting-2)	**ATC members:** 1. Prof. Dr. AKM Abdul Malek Azad 2. Afrida Malik 3. Mohammed Thushar Imran **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. In depth discussion about our draft concept note and logbook and need a correction according to feedback. 2. Make a plan for implementation of our tentative design approach. 3. We need to contact an expert and farmers to know about the constraints and their required requirements. 4. Make a proper components list based on the project required. 5. Mail the corrected draft concept note, progress presentation slide and logbook within November 01, 2022. 6. Go to the library and read previous similar FYDP and thesis projects. 7. Practice and give mock presentations among ourselves.	Task 1: Everyone Task 2: Everyone Task 3: Everyone Task 4: Everyone Task 5: Farhan Task 6: Everyone **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed Task 5: Completed Task 6: Partially completed Task 7: Partially completed	1. Turn on the video during the meeting. 2. Add references in the concept note. 3. Follow IEEE format in references. 4. Cite referenced in the problem statement. 5. Use square box instead of diamond box in the design approach block diagram to show the algorithm. 6. Add more criteria in comparison. 7. Make slides according to the template.

FYDP (P) Fall 2022 Summary of Group 03 Log Book/Journal

Date/Time/Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
31.10.2022 (Group meeting-12)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Adding references in the concept note. 2. Citing references in the problem statement. 3. Adding more comparison criteria.	Task 1: Farhan Task 2: Gourab Task 3: Jiad & Shabbir **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed	
01.11.2022 (Group meeting-13)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Adding attributes of Complex Engineering Problems in the concept note. 2. Prepare progress presentation slides.	Task 1: Everyone Task 2: Everyone **Progress:** Task 1: Completed Task 2: Completed	
02.11.2022 (Group meeting-14)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Practice and give mock presentations among ourselves.	Task 1: Everyone **Progress:** Task 1: Completed	
03.11.2022 (FYDP Progress presentation with ATC panel and FYDP committee members)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab **ATC members:** 1. Mohammed Thushar Imran **Faculty member:** 1. Mohaimenul Islam, Lecturer.	1. Add conflicting requirements. 2. Add practices to extend applicable standards and codes. 3. Chronologically arrange tentative objectives according to the project title. 4. Look into the sources of the datasets to be used for design approach-3. 5. Add functional parameters into the functional requirement.		
09.11.2022 (Group meeting-15 with stakeholders)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab **Stakeholders:** 1. Md. Masud Molla - Local Farmer.	1. Meeting with stakeholders. 2. Inform them about our proposed project 3. Collect stakeholders' requirements. 4. Take feedback from the stakeholders about the proposed project.	Task 1: Everyone Task 2: Everyone Task 3: Everyone Task 4: Everyone Task 5: Gourab **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed	

	2. Md. Mizanur Rahman Mizan - Agri-Specialist & Local Farmer.	5. Mail the meeting minutes to the ATC	Task 5: Completed	
15.11.2022 (Group meeting-16)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Planning about writing the project proposal. 2. Planning the tentative budget. 3. Update logbook	Task 1: Everyone Task 2: Everyone Task 3: Shuvo **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed	
17.11.2022 (FYDP committee class-6)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab **Faculty member:** 1. Md. Rakibul Hasan, Lecturer.	Lecture-8: Report Writing and Presentation Techniques .		
18.11.2022 (Group meeting-17)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Started writing project proposal notes. 2. Update logbook.	Task 1: Everyone Task 2: Everyone **Progress:** Task 1: Partially Completed Task 2: Completed	
19.11.2022 (Group meeting-18)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Started working on Budget and Project planning. 2. Started writing the Problem Statement and Background part based on the collected 17 papers. 3. Started writing the Gantt chart and Tabulation. 4. Started making the flowchart for Methodology part 5. Started making the sustainability matrix.	Task 1: Everyone Task 2: Everyone Task 3: Everyone Task 4: Everyone Task 5: Everyone **Progress:** Task 1: Partially Completed Task 2: Partially Completed Task 3: Partially Completed Task 4: Partially Completed Task 5: Partially Completed	

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Date/Time/Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
21.11.2022 (Group meeting-19)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Complete background and problem statement. 2. Complete the detailed flowchart and start writing the Methodology. 3. Start writing the Expected outcome and impact.	Task 1: Everyone Task 2: Everyone Task 3: Everyone **Progress:** Task 1: Completed Task 2: Completed Task 3: Partially Completed	
24.11.2022 (Group meeting-20)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Complete the tentative budget for 3 design approaches. 2. Complete the gantt chart and project plan for 400P, 400C and 400D. 3. Start writing the sustainability and making the sustainability matrix.	Task 1: Everyone Task 2: Everyone Task 3: Everyone **Progress:** Task 1: Completed Task 2: Completed Task 3: Partially Completed	
26.11.2022 (Group meeting-21)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Complete the sustainability part. 2. Started writing the Ethical Consideration and Risk Management and analysis. 3. Complete writing Safety Considerations.	Task 1: Everyone Task 2: Everyone Task 3: Everyone **Progress:** Task 1: Completed Task 2: Partially Completed Task 3: Completed	
30.11.2022 (Group meeting-22)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Complete writing of Ethical Consideration and Risk management. 2. Update logbook.	Task 1: Everyone Task 2: Everyone **Progress:** Task 1: Completed Task 2: Completed	
01.12.2022 (FYDP committee class-7)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab **Faculty member:** 1. Mohaimenul Islam, Lecturer.	Lecture-6: Review of Engineering Ethics and Professional Practices. Lecture-7: Review of Project Proposal Preparation and Project Management.		

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Date/Time/Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
02.12.2022 (Group meeting-23)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Complete writing the methodology with detailed flowchart and also provide adequate explanation according to that. 2. Identify and start writing the explanation of the attributes of complex engineering problems (EP).	Task 1: Everyone Task 2: Everyone **Progress:** Task 1: Completed Task 2: Partially Completed	
03.12.2022 (Group meeting-24)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Provide explanation/justification for choosing the criteria of "Complex Engineering Problems (EP)" and "Complex Engineering Activities (EA)" 2. Update logbook.	Task 1: Everyone Task 2: Everyone **Progress:** Task 1: Completed Task 2: Completed	
07.12.2022 (Group meeting-25)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Add stakeholders' requirement to the functional, non-functional requirements 2. Started making the presentation slide	Task 1: Everyone Task 2: Everyone **Progress:** Task 1: Completed Task 2: Completed	
09.12.2022 (Group meeting-26)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Complete the project proposal draft. 2. Maintain the font size and page margin according to the given format. 3. Complete the presentation slide and send mail the slide to the ATC.	Task 1: Everyone Task 2: Everyone Task 3: Everyone **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed	
10.12.2022 (ATC meeting-3)	**ATC members:** 1. Prof. Dr. AKM Abdul Malek Azad 2. Afrida Malik 3. Mohammed Thushar Imran **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. In depth research and study on which decision-making ML Algorithm we will use. 2. Find out the proper research paper and journal about this ML algorithm as ground. 3. Find out the solid ground and proper reason why design approach-3 is the optimal solution. 4. Find out the proper ground of Sustainability matrix and how we rate these design approaches.	Task 1: Everyone Task 2: Everyone Task 3: Everyone Task 4: Everyone Task 5: Everyone Task 6: Everyone Task 7: Everyone Task 8: Everyone Task 9: Jiad **Progress:** Task 1: Partially Completed Task 2: Partially Completed Task 3: Partially Completed	1. Drop-out the conflicting requirement and reference slide. 2. Delete the reference number in the problem statement. 3. Summarize the comparison part and describe it on presentation. 4. Add land size in constraints slide.

		5. Find out why ML algorithm is more accurate than threshold-based C-programming algorithm. 6. Revise the slides and maintain the standard size of font and bold the main idea. 7. Rehearsal more and give mock presentations among us before the final presentation. 8. Update the logbook 9. Send mail with final presentation slides, project proposal notes and updated logbook before 15.12. 2022	Task 4: Partially Completed Task 5: Partially Completed Task 6: Completed Task 7: Completed Task 8: Completed Task 9: Completed	5. Add more relevant and highlight the technological info-graphics. 6. Add more slides of components if required. 7. Give a more precise and short presentation and give speech a little bit slower. 8. Add a short explanation on Methodology. 9. Mention the C-programming name and specific ML algorithm name in the design approach-2 and 3 slides 10. Send final Project proposal and logbook before 22.12.2022
12.12.2022 (Group meeting-27)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. In depth research and background study on different types of decision-making ML Algorithms we will use. 2. Selection of the preferable ML algorithm, SVM algorithm. 3. Find out the research paper and journal about SVM algorithms and threshold-based C-programming. 4. Find out the reasons why design approach-3 is optimal design. 5. Find out the grounds on Sustainability matrix rating. 6. Update Logbook.	Task 1: Everyone Task 2: Everyone Task 3: Everyone Task 4: Everyone Task 5: Everyone Task 6: Everyone **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed Task 5: Completed Task 6: Completed	

FYDP (P) Fall 2022 Summary of Group 03 Log Book/Journal

Date/Time/Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
14.12.2022 (Group meeting-28)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Revise and correct the presentation slides as instructed. 2. Practice and give mock presentations among ourselves. 3. Send mail with the presentation slide, proposal and logbook before 15.12.2022.	Task 1: Everyone Task 2: Everyone Task 3: Everyone **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed	

FYDP (D) Spring 2023 Summary of Log Book/ Journal

Project Title: Design and Implementation of Soil Quality Measurement System to Determine Fertilizer Requirement and Suitable Crop for Farmers.

Group-3

Final Year Design Project (D) Spring 2023			
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ATC Details			
ATC 3			
Chair	Dr. AKM Abdul Malek Azad, Professor, Department of EEE, Brac University	a.azad@bracu.ac.bd	
Member 1	Dr. Touhidur Rahman, Professor, Department of EEE, Brac University	touhidur.rahman@bracu.ac.bd	
Member 2	Mohammed Thushar Imran, Lecturer, Department of EEE, Brac University	thushar.imran@bracu.ac.bd	

General Notes:

1. In addition to detail journal/logbook fill out the summary/key steps and progress of your work
2. Reflect planning assignments, who has what responsibilities.
3. The logbook should contain all activities performed by the team members (Individual and team activities).

FYDP (D) Spring 2023 Summary of Log Book/ Journal

Date/Time /Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
26.01.2023 (FYDP committee class-1)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab **Faculty member:** 1. Tashfin Mahmud, Lecturer	1. Introductory Class of FYDP (D) 2. Gave the general guidelines and the tentative time schedules of FYDP-D. 3. Brief us about the 8-course outcome (COs) of FYDP-D. 4. Talked about how we should write the design report. 5. Suggested us about how we could develop and design our simulations.		
29.01.2023 (Group meeting-1)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Planning the steps that we will follow through FYDP-D 2. Categorizing the all tasks of the FYDP-D 3. Start writing the draft of report. 4. Add more explanation to the three design approaches. 5. Update logbook.	Task 1: Everyone Task 2: Everyone Task 3: Everyone Task 4: Everyone Task 5: Shabbir **Progress:** Task 1: Completed Task 2: Completed Task 3: Partially Completed Task 4: Completed Task 5: Completed	
04.02.2023 (Group meeting-2)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Collecting the appropriate simulation-based research papers and journals for the three-design approach. 2. Send mail to ATC with the draft report and logbook.	Task 1: Everyone Task 2: Jiad **Progress:** Task 1: Partially Completed Task 2: Completed	
08.02.2023 (ATC meeting-1)	**ATC Members:** 1. Prof. Dr. AKM Abdul Malek Azad.	1. Correct and follow the appropriate writing format of Logbook. 2. Revise the design approaches comparison part.	Task 1: Shabbir Task 2: Everyone Task 3: Everyone Task 4: Everyone Task 5: Everyone Task 6: Everyone Task 7: Everyone	1. ATC meeting on every Wednesday at 8.30 pm. 2. Send the mail attached with Project report and

	2. Prof. Dr. Touhidur Rahman. 3. Mohammed Thushar Imran **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	3. Add the component level specification's descriptions. 4. Add the system level specification in the report. 5. Revise and correct the assumption on best design approach part. 6. Find out the appropriate tools and software for the simulation. 7. Collect the supporting simulation-based papers or journals on the three design approaches.	**Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed Task 5: Completed Task 6: Partially Completed Task 7: Partially Completed	logbook on Monday. 3. Seat for minimum two group meeting in every week. 4. Send the project report and logbook in two separate PDF documents. 5. Maintain the IEEE format in Reference. 6. Active participation of each group member is highly recommended.
10.02.2023 (Group meeting-3)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Revise the design approaches comparison part. 2. Add components descriptions in component level specification. 3. Revise and correct the assumption on best design approach part. 4. Update logbook.	Task 1: Everyone Task 2: Everyone Task 3: Everyone Task 4: Shabbir **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed	
13.02.2023 (Group meeting-4)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Add the system level specifications in the report. 2. Finding out the appropriate simulation tools and software that we can use for the simulation. 3. Collecting the supporting simulation-based papers or journals on the three design approaches. 4. Send mail attached with the project report and logbook to ATC	Task 1: Everyone Task 2: Everyone Task 3: Everyone Task 4: Gourab **Progress:** Task 1: Completed Task 2: Partially Completed Task 3: Partially Completed Task 4: Completed	

FYDP (D) Spring 2023 Summary of Log Book/ Journal

15.02.2023 (ATC meeting-2)	**ATC Members:** 1. Prof. Dr. AKM Abdul Malek Azad. 2. Prof. Dr. Touhidur Rahman. 3. Mohammed Thushar Imran **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Revise and make the correction in the front page of logbook. 2. Select the modern engineering tools for the simulation of three design approaches. 3. Revise the Gantt chart and project plan. 4. Write down the reasons and facts, based on what design 3 will be of the most optimal design among the three designs. 5. Add modern engineering tools details in the report. 6. Add Data set reference in the references point.	Task 1: Shabbir Task 2: Everyone Task 3: Everyone Task 4: Everyone Task 5: Everyone **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed Task 5: Partially Completed Task 6: Completed	1. In project title "and (&)" should be in written form. 2. Try to maintain bigger text size in logbook. 3. In front page of logbook, write the email addresses in one line. 4. We are lagging behind, according to the Gantt chart. 5. Maintain the Gantt chart 6. It is important to work according to the project plan.
17.02.2023 (Group meeting-5)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Add the reasons and facts of why design three is the optimal design below the comparison table. 2. Revise and make a correction in the project plan. 3. Add Data set reference 4. Make the correction in log book	Task 1: Everyone Task 2: Everyone Task 3: Everyone Task 4: Everyone **Progress:** Task 1: Completed Task 2: Partially Completed Task 3: Completed Task 4: Completed	
20.02.2023 (Group meeting-6)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Select the appropriate modern engineering tools for the simulations of three design approaches. 2. Add the details of modern engineering tools in the design report. 3. Update the Gantt chart. 4. Send the draft report and updated logbook to the ATC on Monday	Task 1: Everyone Task 2: Everyone Task 3: Everyone Task 4: Jiad **Progress:** Task 1: Completed Task 2: Partially Completed Task 3: Completed Task 4: Completed	

FYDP (D) Spring 2023 Summary of Log Book/ Journal

22.02.2023 (ATC meeting-3)	**ATC Members:** 1. Prof. Dr. AKM Abdul Malek Azad. 2. Prof. Dr. Touhidur Rahman. 3. Mohammed Thushar Imran **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Revise the logbook and make the correction. 2. Correct the reference number-13, according to the IEEE format. 3. Make a little correction on budget amounts. 4. Start the simulation part of the three design approaches. 5. Make the progress presentation slide.	Task 1: Everyone Task 2: Everyone Task 3: Everyone Task 4: Everyone Task 5: Everyone **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Partially Completed Task 5: Completed	1. Simulation is most important. 2. Most significant outcome will come from this simulation part. 3. Make a video of the simulation task. 4. Improve the working efficiency
24.02.2023 (Group meeting-7)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Make a revision and correct the logbook. 2. Correct the reference number-13. 3. Correction on budget amounts. 4. Accumulate the sensor’s library file for simulation purpose.	Task 1: Everyone Task 2: Everyone Task 3: Everyone Task 4: Everyone **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed	
26.02.2023 (Group meeting-8)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Start working on data collecting simulation from sensors individually. 2. Combining the individual outputs from each sensor for showing output in one virtual terminal. 3. Update logbook.	Task 1: Everyone Task 2: Everyone Task 3: Everyone **Progress:** Task 1: Partially Completed Task 2: Partially Completed Task 3: Completed	
27.02.2023 (Group meeting-9)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Making the progress presentation slide. 2. Making the video of the simulation task. 3. Send mail to the ATC with updated logbook, design report and presentation slide	Task 1: Everyone Task 2: Everyone Task 3: Farhan **Progress:** Task 1: Completed Task 2: Partially Completed Task 3: Completed	

28.02.2023 (Group meeting-10)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Update the simulation process. 2. Integrate GPS, GSM module, NPK sensor. 3. Update the simulation video.	Task 1: Everyone Task 2: Everyone Task 3: Everyone **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed	
01.03.2023 (Group meeting-11)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Update the progress presentation slides as per new simulation process. 2. Make the correction on Presentation slides according to given feedback by mail from ATC panel. 3. Correction on Problem statement and back ground research. 4. Make the specification and project plan more clear. 5. Add shareholders requirement. 6. Correction on modern engineering/ IT tools descriptions. 7. Increase the font size of the budget.	Task 1: Everyone Task 2: Everyone Task 3: Everyone Task 4: Everyone Task 5: Everyone Task 6: Everyone Task 7: Everyone **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed Task 5: Completed Task 6: Completed Task 7: Completed	
01.03.2023 (ATC meeting-4)	**ATC Members:** 1. Prof. Dr. AKM Abdul Malek Azad. 2. Mohammed Thushar Imran **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Changing the title of the simulation part on the Progress presentation slides. 2. Add a short (30-sec) simulation video in the slides. 3. Make the correction of system level specifications based on the requirements of large-scale implementation. 4. Mention the types of algorithms that we will use for the three design approaches.	Task 1: Everyone Task 2: Everyone Task 3: Everyone Task 4: Everyone Task 5: Gourab **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed Task 5: Completed	1. Do not make mistakes in the slides like spelling of IoT. 2. Be confident during the progress presentation. 3. Practice and give a mock presentation among ourselves.

		5. Send the corrected Progress presentation slides.		
02.03.2023 (FYDP Committee-Progress presentation)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab **Faculty member:** 1. Tashfin Mahmud, Lecturer 2. Md. Mehedi Hasan Shawon, Lecturer.	1. FYDP committee suggested to include the soil parameters and threshold value 2. Add the references of the soil parameters. 3. Consult with the soil experts from the reputed institutes or university.	Task 1: Gourab, Jiad. Task 2: Farhan, Shabbir. Task 3: Farhan, Jiad, Gourab, Shabbir. **Progress:** Task 1: Completed Task 2: Completed Task 3: Not Completed	
14.03.2023 (Group meeting-12)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Update the design report based on the progress of simulation. 2. Update the logbook. 3. Send mail with the updated design report and logbook.	Task 1: Everyone Task 2: Everyone Task 3: Shabbir **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed	
15.03.2023 (ATC meeting-5)	**ATC Members:** 1. Prof. Dr. AKM Abdul Malek Azad. 2. Prof. Dr. Touhidur Rahman. 3. Mohammed Thushar Imran **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Correct the date writing in logbook. 2. Rewrite the statement of FYDP committee in logbook. 3. Add more explanation in data acquisition simulation part. 4. Remove the ADC part in component level specification section. 5. Add Battery specification in component level specification. 6. Remove data acquisition part in comparison.	**Task 1:** Shabbir **Task 2:** Shabbir **Task 3:** Gourab **Task 4:** Farhan **Task 5:** Gourab, Jiad **Task 6:** Farhan **Task 7:** Farhan **Task 8:** Farhan, Shabbir, Jiad, Gourab **Task 9:** Gourab, Jiad, Shabbir **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed Task 5: Completed Task 6: Completed Task 7: Completed Task 8: Partially Completed	1. Do not make mistake like writing the date format. 2. Be specified in task allocation. 3. Update the simulation part is mandatory.

		7. Make the correction on Gantt chart and add “Days” in it. 8. Update the simulation of design approaches. 9. Add simulation update and explanation in design report.	Task 9: Partially Completed	
17.03.2023 (Group meeting-13)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Make the corrections in logbook. 2. Make the corrections in design report. 3. Add explanation on Data acquisition part in design report under point 6. 4. Update logbook.	**Task 1:** Shabbir **Task 2:** Farhan **Task 3:** Gourab, Jiad **Task 4:** Shabbir **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed	
22.03.2023 (Group meeting-14)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Update the simulation part. 2. Try to make a connection between Blynk and Proteus using com pin. 3. Finding the threshold value and writing the Arduino code for design approach one. 4. Complete and Run the simulation of design approach one.	**Task 1:** Jiad, Farhan, Shabbir, Gourab. **Task 2:** Farhan, Gourab. **Task 3:** Gourab, Farhan, Shabbir. **Task 4:** Jiad, Farhan, Gourab, Shabbir. **Progress:** Task 1: Partially Completed Task 2: Partially Completed Task 3: Completed Task 4: Completed	
24.03.2023 (ATC meeting-6)	**ATC Members:** 1. Prof. Dr. AKM Abdul Malek Azad. 2. Prof. Dr. Touhidur Rahman. **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Add meeting type in logbook (online or offline). 2. Do simulation work in line with Gantt chart. 3. Complete the coding of design approach two. 4. Complete design approach two simulation.	**Task 1:** Shabbir. **Task 2:** Farhan, Gourab, Jiad, Shabbir. **Task 3:** Farhan, Shabbir. **Task 4:** Farhan, Shabbir. **Task5:** Gourab, Jiad. . **Progress:** Task 1: Completed Task 2: Partially	1. New meeting time for Ramadan: Friday at 11 am. 2. We are lagging according to Gantt chart. 3. Divide work among four of us. 4. Farhan and Shabbir complete design approach

		5. Start working on Machine learning part for design approach three.	Completed Task 3: Completed Task 4: Completed Task 5: Partially Completed	two simulation and coding. 5.Gourab and Jiad start working on design approach three.
27.03.2023 (Group meeting-15 Online)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Make the correction and update the logbook. 2. Establish the connection with compim tool between Proteus and Blynk server. 3. Writing the python code in Replit for design approach two simulation. 4. Feed the data set for machine learning algorithm by using Jupyter Notebook.	**Task 1:** Shabbir. **Task 2:** Farhan, Shabbir. **Task 3:** Farhan, Shabbir. **Task 4:** Jiad, Gourab. **Progress:** Task 1: Completed Task 2: Completed Task 3: Partially Completed Task 4: Partially Completed	
29.03.2023 (Group meeting-16 Online)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Make the connection between Replit and Blynk. 2. Create a mobile interface to show the data and suggestions 3. Complete the simulation of design approach two by using Proteus, Blynk and Replit. 4. Split the data set for testing and training purpose in machine learning for design approach three. 5. Use Logistic Regression, Decision Tree Classifier, Light gbm, Random Forrest Classifier algorithms for accuracy testing in machine learning. 6. Send mail with updated logbook and design report.	**Task 1:** Farhan Shabbir. **Task 2:** Farhan, Shabbir. **Task 3:** Farhan, Shabbir. **Task 4:** Jiad, Gourab. **Task 5:** Gourab, Jiad. **Task 6:** Jiad. **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed Task 5: Partially completed. Task 6: Completed.	

31.03.23 (ATC meeting-7)	**ATC Members:** 1. Prof. Dr. AKM Abdul Malek Azad. 2. Prof. Dr. Touhidur Rahman. 3. Mohammed Thushar Imran **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Add the task progress in logbook according to the feedback of FYDP committee during the progress presentation. 2. Revise the write up of design approach one and two. 3. Complete the machine learning coding. 4. Make the connection between proteus and Blynk for design approach-3 5. Complete and add design approach three simulation part in report. 6. Start writing on Design report point 7: Analyze the multiple design solution to find the optimal solution 7. Add data set of machine learning approach in reference. 8. Add all the codes for all design approaches in appendix.	**Task 1:** Shabbir **Task 2:** Shabbir, Farhan **Task 3:** Gourab, Jiad. **Task 4:** Farhan, Shabbir. **Task 5:** Gourab, Jiad **Task 6:** Jiad. **Task 7:** Gourab **Task 8:** Jiad. **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed Task 5: Completed Task 6: Partially Completed Task 7: Completed Task 8: Completed	1. Do not make grammatical mistake in report and Logbook.
03.04.2023 (Group meeting-17 Online)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Revised and make the correction in Logbook. 2. Revised the write up for design approaches one and two. 3. Working on the machine learning code.	**Task 1:** Shabbir **Task 2:** Farhan **Task 3:** Gourab, Jiad. **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed	
05.04.2023 (Group meeting-18 Online)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Build the connection between proteus and Blynk for design approach-3. 2. Completed the design approach three simulation and machine learning part.	**Task 1:** Farhan, Shabbir **Task 2:** Gourab, Jiad. **Task 3:** Gourab. **Task 4:** Jiad, Shabbir. **Task 5:** Gourab. **Task 6:** Jiad.	

		3. Add design approach three part in the Design report. 4. Start writing on Design report point-7: Analyze the multiple design solution to find the optimal solution 5. Add data set on reference. 6. Add all the codes for all three designs.	**Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Partially Completed Task 5: Completed Task 6: Completed	
07.04.23 (ATC meeting-8)	**ATC Members:** 1. Prof. Dr. AKM Abdul Malek Azad. 2. Prof. Dr. Touhidur Rahman. 3. Mohammed Thushar Imran **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Use the appropriate grammar and be specific in logbook. 2. Relocate the comparison table in design report from under multiple design approach to under point-7 (Analyze the multiple design solutions) 3. Add a list of tables and a list of figures in design report. 4. Cite the references in Ethical consideration and Expected impact of the optimal design solution. 5. Revise the overall write up and grammatical mistakes in design report. 6. Revise the budget. 7. Start making the Final presentation Slide. 8. Complete the design report.	**Task 1:** Shabbir **Task 2:** Farhan, Shabbir **Task 3:** Shabbir. **Task 4:** Farhan. **Task 5:** Jiad, Gourab, Farhan, Shabbir. **Task 6:** Gourab **Task 7:** Jiad, Gourab, Farhan, Shabbir. **Task 8:** Gourab, Shabbir, Jiad, Farhan **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed Task 5: Completed Task 6: Completed Task 7: Completed Task 8: Completed	1. Mock presentation on next Friday 14.04.2023. 2. Send the final design report, logbook, and final presentation slides on Wednesday 12.04.2023.
11.04.2023 (Group meeting-19 Online)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Make the corrections and update the logbook. 2. Added the list of tables and list of figures in design report.	**Task 1:** Shabbir. **Task 2:** Shabbir. **Task 3:** Farhan. **Task 4:** Farhan, Shabbir. **Task 5:** Jiad	

		3. Cited the references in Ethical consideration and Expected impact. 4. Relocated the comparison table in design report under point-7 and completed the writing of the point-7. 5. Start making the final presentation slides.	**Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed Task 5: Partially Completed	
12.04.2023 (Group meeting-20 Online)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Completed the writing of point 13 (Report summary). 2. Revised the budget. 3. Revised the overall write up and correct grammatical mistakes in design report. 4. Completed and finalized the design report. 5. Completed the Final presentation slide.	**Task 1:** Farhan, Shabbir. **Task 2:** Gourab **Task 3:** Farhan. **Task 4:** Farhan, Shabbir, Jiad, Gourab **Task 5:** Jiad, Gourab, Farhan, Shabbir. **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed Task 5: Completed	
14.04.23 (ATC meeting-9)	**ATC Members:** 1. Prof. Dr. AKM Abdul Malek Azad. 2. Prof. Dr. Touhidur Rahman. 3. Mohammed Thushar Imran **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Add ATC panel number in title slides. 2. Increase the front size of Kaggle Data set. 3. Correct the term of decision-making algorithm to decision making program. 4. In objectives slides keep point 1 and remove point 4. 5. In terms of land size use potential area in system level specification slide. 6. Add operating time in terms of battery backup in system level specification slide.	**Task 1:** Farhan **Task 2:** Shabbir **Task 3:** Shabbir. **Task 4:** Farhan. **Task 5:** Jiad. **Task 6:** Gourab **Task 7:** Jiad **Task 8:** Gourab. **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed Task 5: Completed Task 6: Completed Task 7: Completed Task 8: Completed	1. Limit the items in slides. 2. Describe all the slides that we added in presentation slides. 3. Spend more times in the three design approaches and comparison part. 4. End the presentation in a smooth and good way. 5. Practice mock presentation among ourselves.

		7. Add appropriate body name in non-functional requirement. 8. Add fertilizer requirement information chart.		
26.04.2023 (Group meeting-21 Online)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Added ATC panel number in title slides and increase the front size of Kaggle Data set. 2. Correct the term of decision-making algorithm to decision making program. 3. Removed point 4 In objectives slides kept point 1. 4. In terms of land size use potential area in system level specification slide. 5. Added operating time in terms of battery backup in system level specification slide. 6. Added appropriate body name in non-functional requirement. 7. Added fertilizer requirement information chart. 8. Send Final Presentation slides, Design Project report and Logbook on April 26, 2023	**Task 1:** Farhan **Task 2:** Shabbir **Task 3:** Gourab **Task 4:** Farhan. **Task 5:** Jiad. **Task 6:** Gourab **Task 7:** Jiad **Task 8:** Shabbir **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed Task 5: Completed Task 6: Completed Task 7: Completed Task 8: Completed	

FYDP (C) Summer 2023 Summary of Log Book/ Journal

Project Title: Design and Implementation of Soil Quality Measurement System to Determine Fertilizer Requirement and Suitable Crop for Farmers

Group-3

Final Year Design Project (C) Summer 2023			
Student Details	**NAME & ID**	**EMAIL ADDRESS**	**PHONE**
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ATC Details			
ATC 3			
Chair	Dr. AKM Abdul Malek Azad, Professor, Department of EEE, Brac University	a.azad@bracu.ac.bd	
Member 1	Dr. Touhidur Rahman, Professor, Department of EEE, Brac University	touhidur.rahman@bracu.ac.bd	
Member 2	Mohammed Thushar Imran, Lecturer, Department of EEE, Brac University	thushar.imran@bracu.ac.bd	

General Notes:

1. In addition to detail journal/logbook fill out the summary/key steps and progress of your work
2. Reflect planning assignments, who has what responsibilities.
3. The logbook should contain all activities performed by the team members (Individual and team activities).

FYDP (C) Summer 2023 Summary of Log Book/ Journal

Date/Time /Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
01.06.2023 (FYDP committee class-1)	**Students:** 1. Shabbir 2. Jiad 3. Gourab [Farhan was absent due to pink eye (conjunctivitis)] **Faculty member:** 1. Abu S.M Mohsin, PhD	1. Introductory Class of FYDP (C) 2. Gave the general guidelines and the tentative time schedules of FYDP-C. 3. Brief us about the course outcome (COs) of FYDP-C. 4. Clarified the Complex Engineering Problem attributes. 5. Suggested us about how we should develop our prototype. 6. Talked about how we should write the Final report. 7. Gave a brief idea about the Poster Presentation		
05.06.2023 (Group meeting-1 Online)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Make the final list of detailed components. 2. Order the components available in Robotics Bd.	**Task 1:** Farhan, Shabbir, Gourab, Jiad. **Task 2:** Gourab **Progress:** Task 1: Completed Task 2: Completed	
10.06.2023 (**ATC Meeting-1**)	**ATC Members:** 1. Prof. Dr. AKM Abdul Malek Azad. 2. Prof. Dr. Touhidur Rahman. **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Start writing the report of FYDP (C). 2. Maintain the logbook. 3. Test all the five Sensors and make the testing videos. 4. Complete the primary stage development of the Prototype. (Connecting all the components)	**Task 1:** Farhan, Shabbir, Gourab, Jiad. **Task 2:** Shabbir. **Task 3:** Shabbir, Gourab, Jiad, Farhan. **Task 4:** Jiad, Farhan, Shabbir, Gourab. **Task 5:** Shabbir. **Progress:** Task 1: Partially Completed	1. Follow the Gantt chart. 2. We are lagging according to the Gantt chart. 3. We have committed that we will developed the Prototype by next Saturday. 4. Buy new components.

		5. Before every meeting send the Updated report and logbook.	Task 2: Completed Task 3: Completed Task 4: Completed Task 5: Completed	
12.06.2023 (Group meeting-2 Offline)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Went to Mirpur-1 to buy pH sensor . 2. Test Moisture sensor and DHT11 (Humidity and Temperature sensor) and make the testing videos.	**Task 1:** Farhan, Jiad. **Task 2:** Gourab, Shabbir. **Progress:** Task 1: Completed Task 2: Completed	
14.06.2023 (Group meeting-3 Offline)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Test NPK sensor and make the testing video. 2. Test pH sensor and make the testing video	**Task 1:** Farhan, Jiad. **Task 2:** Shabbir, Gourab **Progress:** Task 1: Completed Task 2: Completed	
15.06.2023 (Group meeting-4 Offline)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Report writing: a) Ethics statement, Abstract/Executive summary, Acknowledgement b) Chapter-1: Introduction 2. Development the primary stage of the Prototype. (Connecting all the components). 3. Update the logbook and send the updated report and logbook.	**Task 1:** a) Farhan b) Farhan, Jiad **Task 2:** Gourab, Jiad, Shabbir. **Task 3:** Shabbir. **Progress:** Task 1: Partially Completed Task 2: Completed Task 3: Completed	
17.06.2023 (**ATC Meeting-2**)	**ATC Members:** 1. Prof. Dr. AKM Abdul Malek Azad. 2. Prof. Dr. Touhidur Rahman. 3. Mohammed Thushar Imran	1. Make the correction to the report and logbook: a) Specify the Chapter name and number in logbook. b) Add references in Literature Gap point 2. Add Gantt Chart and Budget in report. 3. Complete the hardware (Data acquisition) part of	**Task 1:** a) Jiad b) Farhan **Task 2:** Shabbir. **Task 3:** Jiad, Gourab, Farhan, Shabbir. **Task 4:** Gourab **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed	1. ATC suggested to add Gantt chart and Budget in report. 2. Video demonstration must for sensors working.

	Students: 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	the prototype and collecting all the data through the all combine sensors. 4. Make the video of measuring the all 7 parameters of soil testing through all the sensors.	Task 4: Completed	
20.06.2023 (Group meeting-5 Offline)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Build the circuit of two combine sensors (DHT11 and Soil moisture sensors). 2. Combine DHT11 and Soil moisture sensors code and measure the data	**Task 1:** Jiad, Shabbir. **Task 2:** Gourab, Farhan **Progress:** Task 1: Completed Task 2: Completed	
21.06.2023 (Group meeting-6 Offline)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Build the circuit of connecting all the four sensors (DHT11, pH, NPK , Moisture) with a microcontroller. 2. Combine all the four sensors (DHT11, pH, NPK , Moisture) code and start measuring the data.	**Task 1:** Gourab, Shabbir. **Task 2:** Jiad, Farhan. **Progress:** Task 1: Completed Task 2: Completed	
22.06.2023 (Group meeting-7 Online)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Write the report: a) Relevance to current and future industry (1.1.4), Applicable compliance, standards, and codes (1.2.5). b) Objectives (1.2.1), Functional and nonfunctional requirements (1.2.2). c) Specifications (1.2.3), Technical and non-technical consideration and constraint in design process (1.2.4). d) Use of modern engineering and it tools (3.3.1), Define, plan, and manage engineering project (7.2) , Evaluate	**Task 1:** a) Farhan b) Gourab c) Jiad d) Shabbir **Task 2:** Shabbir **Progress:** Task 1: Completed Task 2: Completed	

		economic and financial aspects (8.4) 2. Update the logbook.		
24.06.2023 (**ATC Meeting-3**)	**ATC Members:** 1. Prof. Dr. AKM Abdul Malek Azad. 2. Prof. Dr. Touhidur Rahman. 3. Mohammed Thushar Imran **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Make the grammatical correction in logbook. 2. Rephrase and add chapters from FYDP-D report. 3. Revise the system level specification. 4. Build the circuit of connecting all the sensors and build the connection with Blynk server. 5. Show the sensors data collection with different soil samples. 6. Make the progress presentation slides.	**Task 1:** Shabbir. **Task 2:** Gourab, Jiad. **Task 3:** Farhan. **Task 4:** Farhan, Shabbir. **Task 5:** Gourab, Shabbir, Farhan **Task 6:** Jiad, Gourab **Progress:** Task 1: Completed Task 2: Partially Completed Task 3: Partially Completed Task 4: Completed Task 5: Completed Task 6: Completed	1. Update more in the report.
25.06.2023 (Group meeting-8 Offline)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Write the report: a) Systematic Overview/Summary of the Proposed Project (1.3), Conclusion (1.4) b) Chapter 2 - Project design approach. 2. Build the circuit of connecting all the sensors and build the connection with Blynk server.	**Task 1:** a) Jiad b) Gourab **Task 2:** Shabbir, Farhan **Progress:** Task 1: Completed Task 2: Completed	
05.06.2023 (Group meeting-9 Offline)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Make a soil bed for different soil samples. 2. Collecting three different soil samples from different locations. 3. Test the different soil samples and verify the sensor's stability.	**Task 1:** Jiad **Task 2:** Shabbir, Jiad. **Task 3:** Gourab, Farhan, Shabbir. **Task 4:** Gourab. **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed	

		4. Make a video of the progress of the system.	Task 4: Completed	
06.07.2023 (Group meeting-10 Online)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Update the logbook. 2. Write the report: a) Chapter 3 - Use of modern engineering and IT tools. b) Optimization of multiple design approach (4.2) 3. Prepare the presentation slides.	**Task 1:** Shabbir. **Task 2:** a) Farhan b) Gourab **Task 3:** Jiad. **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed	
08.07.2023 (**ATC Meeting-4**)	**ATC Members:** 1. Prof. Dr. AKM Abdul Malek Azad. 2. Mohammed Thushar Imran **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Make the corrections in presentation Slide: a) Erase the [CO] part from the slide. b) Correct the grammatical mistake like 'Designing "a" system…' c) Revise objective slide (point two and four) are similar. d) Titles should be in similar font. e) Add conclusion and future impact segment in slide. 2. Add soil samples name tag in the soil bed. 3. Recapture the demonstration video with clear output. 4. Update the report: a) Correct the grammatical and formatting mistakes in report. b) Start writing the chapter -5 and update the test result.	**Task 1:** Shabbir, Farhan, **Task 2:** Jiad. **Task 3:** Gourab. **Task 4:** Farhan, Shabbir, Gourab, Jiad. **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Partially Completed	1. Maintain the report writing format. 2. Write the corrections in bullet point in logbook. 3. Follow the pattern- Objective, problem statement, methodology, findings and conclusion when writing the abstract.

		c) Rewrite the abstract and add key words. d) Start writing the chapters- 4,7,8,9,11 e) Add list of figure and table, table of content.		
11.07.2023 (Group meeting-11 Offline)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab **ATC Members:** 1. Mohammed Thushar Imran	1. Add soil samples tag in soil bed. 2. Take the demonstration video clearly. 3. Show the working progress of the prototype to the ATC member.	**Task 1:** Jiad. **Task 2:** Gourab. **Task 3:** Farhan, Shabbir, Gourab, Jiad. **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed	
12.07.2023 (Group meeting-12 Online)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Update the presentation slide. 2. Practice and give mock presentation among ourselves.	**Task 1:** Shabbir, Farhan **Task 2:** Jiad, Gourab, Farhan, Shabbir. **Progress:** Task 1: Completed Task 2: Completed	
13.07.2023 (FYDP Committee-Progress presentation)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab **Faculty member:** 1.Tashfin Mahmud, Lecturer 2. Saifur Rahman Sobuj, Assistant Professor. 3. Raihana Shams Islam Antara, Lecturer.	ATC Committee suggested: 1. Consider others application rather than Blynk. 2. Revise the Extend of applicable code part. 3. Add data validation for soil samples. 4. Add GSM (mobile text and internet) feature in the prototype. 5. Show samples data collection from outdoor .		

15.07.2023 (**ATC Meeting-5**)	**ATC Members:** 1. Prof. Dr. AKM Abdul Malek Azad. 2. Mohammed Thushar Imran **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Complete the report writing task that was assigned before. 2. Must collect the 4 soil samples data and make a comparative tabular data chart.	**Task 1:** Gourab, Shabbir, Farhan, Jiad. **Task 2:** Jiad, Farhan, Shabbir, Gourab. **Progress:** Task 1: Completed Task 2: Completed	1. Maintain the professionalism.
25.07.2023 (Group meeting-12 Offline)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Take all the soil samples data and make a comparative data table of four different soil samples. 2. Implementation of the machine learning with the collected data.	**Task 1:** Jiad, Shabbir. **Task 2:** Gourab, Farhan. **Progress:** Task 1: Completed Task 2: Partially Completed	
27.07.2023 (Group meeting-13 Online)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Make the corrections in report: a) Add reference for 10 cm or 4-inch depth sensor data collection b) Rewrite reference sequentially in the problem statement. c) Remove the hyperlink in standards and codes d) Correct the formatting error in chapter 7 Gantt chart 2. Rewrite the abstract 3. Add table of content and table of figure. 4. Write the chapters in report: a) Chapter 1.3: Systematic overview, Chapter 10: Conclusion and Future work.	**Task 1:** Shabbir, Jiad. **Task 2:** Gourab. **Task 3:** Shabbir **Task 4:** a) Gourab b) Shabbir c) Farhan d) Jiad **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed	

		b) Chapter 11: Identification of Complex engineering problem and activities. Chapter 6: Impact analysis and project sustainability (6.2, 6.3) c) Chapter 9: Ethics and professional responsibilities, (9.2,9.3.) d) Chapter 5: Completion of final design and validation, (5.1,5.2, 5.3)		
31.07.2023 (Group meeting-14 Offline)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Machine learning implementation for crop suggestion. 2. Machine learning implementation for fertilizer requirement	**Task 1:** Gourab, Farhan. **Task 2:** Jiad, Shabbir. **Progress:** Task 1: Completed Task 2: Partially Completed	
03.08.2023 (Group meeting-15 Online)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Write the chapters in report: a) Chapter 4.1: Introduction (Optimization of multiple designs) Chapter 6.1: Introduction (Impact Analysis and Project Sustainability) b) Chapter 7.1: Introduction (Engineering Project Management) Chapter 8.1: Introduction (Economic Analysis) Chapter 8.3: Cost-Benefit Analysis c) Correct the alignment of the report. d) Chapter 6.3.1: SWOT Analysis for Optimal Design 2. Update the logbook	**Task 1:** a) Gourab b) Jiad c) Farhan d) Shabbir **Task 2:** Shabbir **Progress:** Task 1: Completed Task 2: Completed	

FYDP (C) Summer 2023 Summary of Log Book/ Journal

05.08.2023 (**ATC Meeting-6**)	**ATC Member:** 1. Prof. Dr. AKM Abdul Malek Azad. **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Make correction in report: a) Rewrite abstract 2nd line. Rewrite 10.2: Future work. b) Correct grammatical mistake in report, Remove Gantt chart tables c) Chapter 1.2.4: Differentiate Technical and Non-technical Consideration and Constraint in Design Process, Chapter 1.3:Rewrite the 2nd paragraph, d) Add a paragraph under chapter 2.2, rewrite chapter 2.3 introductory part. 2. Start making the poster.	**Task 1:** a) Gourab b) Jiad c) Farhan d) Shabbir **Task 2:** Jiad, Farhan, Shabbir, Gourab. **Progress:** Task 1: Completed Task 2: Partially Completed	1. Take poster guideline from the FYDP committee. 2.Poster must be sent before next meeting.
08.08.2023 (Group meeting-16 Offline)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Machine learning implementation for fertilizer requirement. 2. Give the power to the prototype with battery.	**Task 1:** Gourab, Farhan. **Task 2:** Jiad, Shabbir. **Progress:** Task 1: Partially Completed Task 2: Partially Completed	
10.08.2023 (Group meeting-17 Offline)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Write the chapters in report: a) Chapter 4.3: Identify optimal design approach, Chapter: 4.5, Chapter 5.4, Chapter 6.4. 2. Making the poster. 3. Update the logbook	**Task 1:** a) Jiad **Task 2:** Gourab, Farhan, Shabbir. **Task 3:** Shabbir **Progress:** Task 1: Completed Task 2: Partially Completed. Task 3: Completed	
13.08.2023 (**ATC Meeting-7**)	**ATC Member:** 1. Prof. Dr. AKM Abdul Malek Azad.	1. Complete the prototype and show the project demonstration in front the ATC member. 2. Test the prototype in the field	**Task 1:** Farhan, Shabbir, Gourab, Jiad. **Task 2:** Shabbir, Gourab **Task 3:** Farhan, Jiad.	1. Gourab Saha is responsible for laptop and video running.

	Students: 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	3. Make the correction in the report and add chapters 4. Complete the poster according to the instruction 5. Make a video of testing the prototype.	**Task 4:** Gourab **Task 5:** Gourab **Progress:** Task 1: Completed Task 2: Completed Task 3: Partially Completed Task 4: Completed Task 5: Completed	
15.08.2023 (Group meeting-18 Offline)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Correction in Poster: a) Add simulation picture and result b) Keep only design approach 3 flowchart c) Write Environmental impact and Conclusion and Future work in bullet point. d) Front size should be maintained according to IEEE format (28-36) 2. Made the prototype frame work. 3. Made the controller circuit for controlling the sensors (turn on and off the sensors when needed).	**Task 1:**Gourab. **Task 2:** Jiad, Farhan. **Task 3:** Shabbir. **Progress:** Task 1: Partially Completed Task 2: Completed Task 3: Completed	
17.08.2023 (Group meeting-19 Offline)	**ATC Member:** 1. Prof. Dr. AKM Abdul Malek Azad. **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Test all the sensors and protype's all function before presents it in front of ATC member. 2. Present the protype in front of Prof. Dr. AKM Abdul Malek Azad sir.	**Task 1:** Farhan, Shabbir, Gourab, Jiad. **Task 2:** Jiad, Farhan, Shabbir, Gourab. **Progress:** Task 1: Completed Task 2: Completed	1. Test the prototype in the outside (field) and make a verification video.
19.08.2023 (Group meeting-20 Offline)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Correction in report: a) Chapter 4.4: Performance evaluation of developed solution. b) Rewrite Chapter 10.2: Future work.	**Task 1:** Farhan, Gourab, Jiad. **Task 2:** Shabbir.	

		c) Chapter 7.2: Define, Plan, and Manage Engineering Project. d) Chapter 7.3, 7.4. e) Chapter 8.2: Economic analysis, 8.5: conclusion. f) Chapter 9.1, 9.4. 2. Update the logbook.	**Progress:** Task 1: Completed Task 2: Completed	
21.08.2023 (**ATC Meeting-8**)	**ATC Members:** 1. Prof. Dr. AKM Abdul Malek Azad. 2. Mohammed Thushar Imran **Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Correction in poster: a) Add soil sample picture. b) Add methodology part c) Revise economic analysis. d) Concise introduction part. e) Add sensor name label in prototype picture of the poster. 2. Take minimum two outdoor field sample data and take videos. 3. Print poster according to the instruction and show poster to the ATC. 4. Complete the report and send it by 25th august.	**Task 1:** Gourab. **Task 2:** Jiad, Farhan, Shabbir, Gourab. **Task 3:** Shabbir, Gourab **Task 4:** Jiad, Farhan, Shabbir, Gourab. **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed	
24.08.2023 (Group meeting-21 Offline)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Print the poster and show it to the ATC. 2. Check the prototype circuit and fixed the connected wire connection.	**Task 1:** Shabbir, Gourab. **Task 2:** Jiad, Farhan, Shabbir, Gourab. **Progress:** Task 1: Completed Task 2: Completed	
25.08.2023 (Group meeting-22 Offline)	**Students:** 1. Shabbir 2. Jiad 3. Farhan 4. Gourab	1. Take the outdoor field data and make the videos. 2. Make and edit the final video for the presentation.	**Task 1:** Farhan, Shabbir, Gourab, Jiad. **Task 2:** Gourab. **Task 3:** Farhan, **Task 4:** Shabbir, Gourab.	

		3. Completed the chapter five in report. 4. Revise and completed all others chapters in the report. 5. Finalize the table of content and table of figure in the report. 6. Submit the Videos and Report to the ATC.	**Task 5:** Jiad, Shabbir, Gourab **Task 6:** Jiad. **Progress:** Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed Task 5: Completed Task 6: Completed	