SMART STSTEM FOR OPTIMIZED ORGANIC CROP ROTATION USING PRECISION AGRICULTURE DATA

TMP-23-113

Project Proposal Report

Samarakoon S.M.A.D

B.Sc. (Hons) Degree in Information TechnologySpecializing in Software Engineering

Department of Software Engineering

Sri Lanka Institute of Information TechnologySri Lanka

March 2023

SMART STSTEM FOR OPTIMIZED ORGANIC CROP ROTATION USING PRECISION AGRICULTURE DATA

TMP-23-113

Project Proposal Report

B.Sc. (Hons) Degree in Information TechnologySpecializing in Software Engineering

Department of Software Engineering

Sri Lanka Institute of Information TechnologySri Lanka

March 2023

DECLARATION

We declare that this is our own work, and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Name	Student ID	Signature
Samarakoon S. M. A. D	IT20233808	

The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

03/20/2023

Signature of the supervisor: Date

ABSTRACT

The proposed approach is an Internet of Things-based solution that attempts to help farmers increase crop productivity while using less fertilizer by predicting the most optimal crop for a specific soil sample. A multi objective optimization technique is used by the system to determine the best crop for a given soil sample after collecting data from soil sensors using a range of hardware and software components. The gathered data is then used with a machine learning model to improve its crop recommendation algorithms through historical data analysis and trend identification, leading to best crop growth and yields with little fertilizer use. This IoT-based solution offers farmers a more efficient and effective method of managing their crops, as they can make informed decisions on fertilizer selection based on real-time data. By leveraging the power of IoT technology and algorithmic based processing, this system can potentially help farmers to increase their crop yields with low fertilizers and contribute to the growth of the agricultural sector.

Keywords -NPK, IOT, Soil Sensors, Algorithms, Optimization Algorithm, Fertilizer, Crop Growth

Table of Contents

LIST OF ABBREVIATIONS

Abbreviation	Description
SLIIT	Sri Lanka Institute of Information Technology
NPK	Nitrogen, Phosphorus, Potassium
FE	Frontend
BE	Backend
DB	Database

1. INTRODUCTION

1.1. Background Study

Agriculture plays a crucial role in the global economy by providing food, fiber, and raw materials to various industries. However, conventional or artificial farming methods have been found to have negative impacts on the environment, such as soil degradation, water pollution, and a loss of biodiversity [1]. As a result, there is a growing demand for agricultural practices that prioritize social fairness, economic viability, and environmental protection.

Organic farming, which focuses on natural inputs and the preservation of soil health, is a promising alternative. Organic crop rotation, which involves rotating crops to improve soil fertility, reduce soil erosion, and control pests and diseases, is a critical part of organic farming. Additionally, soil analytics, which uses advanced technologies to monitor soil properties such as moisture, temperature, and nutrient levels, is another essential aspect of organic farming. With the help of organic crop rotation and soil analytics, farmers can make informed decisions about crop selection and management, which can increase output and profitability while minimizing negative environmental impacts.

To further enhance sustainable agricultural practices, we propose the development of a software program that integrates soil analytics with organic crop rotation. This software program will use IoT sensors to collect real-time data on soil parameters, crop growth, and environmental variables. These data will be processed with an optimization algorithm to determine the most optimized crop for the given soil sample. Furthermore, the software program will integrate a knowledge base covering top techniques for pest management, soil health management, and organic crop rotation.

In addition to the optimization algorithm, we suggest incorporating machine learning models to enhance the software's analytical capabilities. By using machine learning, the software program can learn from data collected from previous farming seasons to offer more accurate predictions and recommendations for future crop rotations.

Our project aims to promote the adoption of sustainable and resilient agricultural practices that benefit both the environment and farming communities. By providing farmers with access to advanced technologies and knowledge sources, we hope to help build a more resilient and sustainable food system for future generations.

1.2. Literature survey

People use external nitrogen, phosphorus, and potassium (NPK) fertilizers to soil to provide additional nutrients that are necessary for plant growth and development. Nitrogen is an essential element for the formation of amino acids, the building blocks of proteins, which are necessary for cell division and growth. Phosphorus is essential for energy transfer within the plant and is a key component of nucleic acids, the genetic material of the cell. Potassium plays a role in plant growth and development by regulating water balance, facilitating the movement of nutrients.

While these nutrients are naturally present in soil, they may not be present in sufficient quantities or in a form that is easily accessible to plants. This is especially true in agricultural settings where crops are grown in large quantities and may require additional nutrients to support their growth. External NPK fertilizers can be applied to the soil to provide these additional nutrients and improve the growth and yield of crops.

However, use of this external NPK fertilizers have many negative effects on soil health and the environment.In the research paper “Impact of long-term N, P, K, and NPK fertilization on the composition and potential functions of the bacterial community in grassland soil” by Yao Pan, Noriko Cassman, Mattias de Hollander, Lucas W. Mendes, Hein Korevaar, Rob H.E.M. Geerts, Johannes A. van Veen, Eiko E. Kuramae [2] they have mention that there are major disadvantages from using external fertilizers like Nitrogen, phosphorus, Potassium as mentioned bellow

- Polluting groundwater by adding nitrates
- Harming aquatic ecosystems
- Soil salinization
- Soil degradation

[2]They are showing that nitrogen fertilizers can lead to polluting groundwater by adding nitrates to the underground water sources, which can result in contamination of drinking water sources also they are showing that phosphorus fertilizers can lead can result in harming aquatic ecosystems. Application of potassium fertilizers can also lead to soil salinization, which can negatively impact plant growth also they are showing that frequent use of external fertilizers can lead to soil degradation, making it harder for plants to absorb nutrients and water. In the research paper “Effects of Organic and Inorganic Fertilizer Application on Growth, Yield, and Grain Quality of Rice” by Kifayatullah Kakar, Tran Dang Xuan, Zubair Noori, Shafiullah Aryan and Gulbuddin Gulab [3] they are mentioning the importance of carefully managing the use of external NPK fertilizers to avoid negative impacts on soil health and the environment while also ensuring that crops receive the necessary nutrients for

optimal growth and yield. Which requires an understanding of the nutrient requirements of different crops and the nutrient content of the soil, as well as the use of appropriate fertilizer application methods and timing [4]. This is where the importance of crop rotation comes into the picture.In the research paper "Conventional Agricultural production systems and soil functions by Francisco J Arriaga , Jose Guzman and Birl Lowery" [4] [6] they are mentioning Crop Rotation as the agricultural practice of planting different crops in rotation in a single field.Use of crop rotational plans instead of external fertilizers has several benefits for agricultural and soil systems, including a decrease in weed, insect, and plant disease occurrence as well as an improvement in the physical, chemical, and biological characteristics of the soil. Better water retaining capacity and aggregate stability are also mentioned [4]. They claim that greenhouse gas emissions are reduced when crops are cultivated in rotation because less nitrogen fertilizer is supplied. Because it takes atmospheric N and returns it to the soil, rhizobacteria, for example, can fix atmospheric N via the leguminous crops.[7] [8] [9]

In the research paper "IoT based Soil Nutrients Analysis and Monitoring System for Smart Agriculture" by Pyingkodi Maran, Thenmozhi Karunanithi, M. Karthikeyan, T. Kalpana, Suresh Palarimath and G. Bala Ajith Kumar [5] they are saying that Plants rely on both macronutrients and micronutrients in the soil to grow. Macronutrients, such as nitrogen, potassium, and phosphorus (NPK), are required in larger amounts compared to micronutrients. Efficient management of available nutrients and determination of optimal doses for maximum yield are the main goals of soil testing and Nitrogen, potassium, and phosphorus are crucial elements for plant growth and development in the paper [5] they are saying that as nitrogen being the most significant, when plants lack nitrogen, they tend to appear unhealthy, with yellow leaves, weak stems, and reduced fruit yield. Also, [5]they have discussed about what if plants don't get enough phosphorus as well. According to their paper what happens is their stems become weak and thin, and their growth is affected. The older leaves may also turn dark bluish green. Also, they have mentioned what happens when plants don't get enough potassium, their leaves may turn yellow or have yellowed tissue around the edges. In severe cases, the whole leaf may become lighter in color.

As my component goal in the research project is to provide a software solution that provide soil analytics and a crop rotation plan to the end user based on soil composition in a provided agricultural field the IOT devices plays a major role in it as in the research paper “IoT based Soil Nutrients Analysis and Monitoring System for Smart Agriculture” by Pyingkodi Maran, Thenmozhi Karunanithi, M. Karthikeyan, T. Kalpana, Suresh Palarimath and G. Bala Ajith Kumar they are saying that To address the challenges face by farmers modern science and technology must be applied to boost the yields, also according to their research paper the use of automation and IoT technology, such as wireless sensor networks, can provide farmers with real-time data on soil conditions. In the mentioned paper the authors saying that by leveraging IoT-related automation, farmers can improve the effectiveness of their work, increase production, and meet the needs of the growing population. In their research paper they have provided a diagram for the implementation of a IOT system that can gather the soil nutrients as shown below in Figure 1

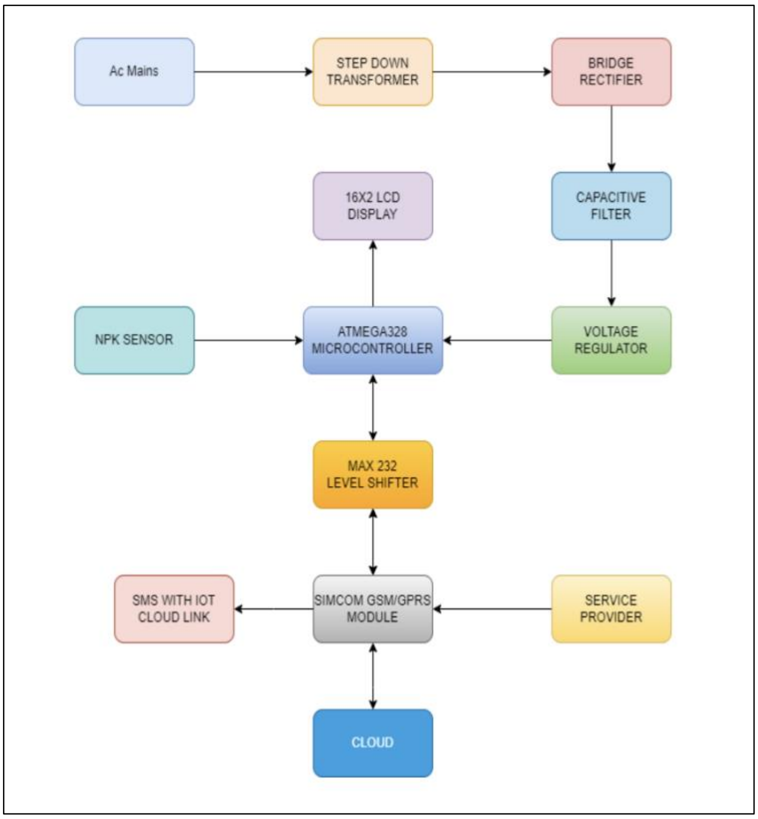


Figure 1. Soil Nutrients System using IoT System

In here the NPK sensor is used to gather the soil nutrients. NPK stands for Nitrogen, phosphorus and potassium. As in the research paper the system included above is a system a that uses both hardware and software to measure the levels of nitrogen, phosphorus, and potassium in the soil in real-time. It then suggests the appropriate number of fertilizers to be used. This will help farmers make better decisions about fertilizers and improve crop growth and production.

2. RESEARCH GAP

A significant research gap in the area of sustainable agriculture is the absence of integrated software that includes both organic crop rotation and soil analytics, with an optimization algorithm and machine learning model to find the most optimized crop. Although there are currently tools that focus on a single component of sustainable agriculture, such as crop rotation or soil analytics, there is a need to create software programs that can give farmers a more comprehensive approach to farm management. For example, in the journal paper “ROTOR, a tool for generating and evaluating crop rotations for organic farming systems” by Johann Bachinger and Peter Zander, the authors only focus on crop rotation planning. More research is also required to determine the best methods for integrating IoT sensors and knowledge resources into such software solutions, as well as to evaluate the effectiveness of the software application in various farming situations. Our suggested software application could assist in the development of more effective and environmentally friendly farming techniques by filling this research gap. Our software will be unique in its capacity to offer farmers real-time data regarding crop growth and soil health, empowering them to choose and manage crops intelligently for a crop rotation plan using an optimization algorithm and machine learning model. Our software application will also give farmers personalized recommendations that can help them optimize their yields while reducing the use of synthetic fertilizers and pesticides by incorporating a knowledge base that includes best practices for organic crop rotation, soil health management. In the end, our software program can increase farm output and profitability while also preserving soil health and lowering environmental pollution.

3. RESEARCH PROBLEM

An important research problem in sustainable agriculture is the lack of integrated software solutions that combine organic crop rotation and soil analytics, including the utilization of gathered soil data with an optimization algorithm, potentially powered by a machine learning model, to find the most optimized crop. Existing methods that target only one aspect of sustainable agriculture do not provide farmers with a comprehensive approach to managing their farms, leading to poor yields and environmental damage. The main challenge in creating an integrated software solution is developing a user-friendly platform that combines real-time information about soil health, crop growth, and environmental variables, and incorporates best practices for organic crop rotation and soil health management. To achieve this, it is crucial to simplify the integration of IoT sensors and knowledge sources into a single platform that can be customized to meet the specific needs of different farming communities. Additionally, it is essential to evaluate the efficacy of such a software program in different farming situations to ensure that it can enhance farm productivity and profitability while promoting sustainable and environmentally friendly practices.

Therefore, the research goal is to develop and test an integrated software system that combines organic crop rotation with soil analytics, optimization algorithm potentially powered by a machine learning model, and incorporates the use of gathered soil data to find the most optimized crop. Our proposed software solution could help promote more effective and sustainable agricultural practices while enhancing farm productivity and profitability, addressing this critical research topic.

4. OBJECTIVES

4.1. Main Objectives

The main objective of this research is to develop an integrated software system that provides an organic crop rotation plan and soil analytics to support environmentally friendly and sustainable farming practices while also improving farm productivity and profitability. By utilizing IoT sensors to collect real-time data on soil parameters and crop growth and using an optimization algorithm, the software will determine the most optimized crop for a given soil sample. Farmers will be able to choose and manage crops more effectively because of the software application's real-time data on crop growth and soil health. Including best practices for organic crop rotation, soil health management, and pest control, it will also contain a knowledge base that will offer farmers personalized suggestions to enhance yields while reducing the use of synthetic fertilizers. The software will be made to be customizable to the specific needs of different farming communities. We want to offer farmers a complete approach to farm management that advances the development of more resilient and sustainable farming practices while also enhancing farm production and profitability by creating and testing this software solution.

4.2. Specific Objectives

4.2.1. Finding soil chemical composition using IOT device

This study explores the feasibility of using IoT devices to evaluate the chemical composition of the soil. This technology can help farmers make smart decisions to improve soil health, decrease chemical inputs, and raise crop output in a sustainable way by gathering real-time data on soil parameters and using crop rotation strategies.

4.2.2. Use the gathered data with an optimization algorithm

The soil NPK data gathered from the IoT devices is further processed using an optimization algorithm to determine the most suitable crop for that specific soil sample. The algorithm takes into consideration various factors, such as the nutrient composition of the soil and crop's nutrient requirements to provide recommendations on the most optimized crop to be grown in that particular soil. By utilizing this approach, farmers can make informed decisions about which crops to plant, ensuring that they are taking advantage of the soil's natural resources while also minimizing the use of synthetic fertilizers and pesticides. This ultimately leads to the sustainable use of resources and the enhancement of agricultural productivity.

4.2.3. Use the outputs of the optimization algorithm with a machine learning model

Once the optimization algorithm processes the gathered soil data, it will provide recommendations for the most optimized crop for that specific soil sample. These recommendations can be used to train a machine learning model to predict the most suitable crop for future soil samples. The machine learning model can also take into account other relevant factors, such as weather patterns and historical crop yields, to make more accurate predictions. By incorporating both the output of the optimization algorithm and machine learning, farmers can make informed decisions about which crops to grow to maximize yields while promoting sustainable agricultural practices

5. METHODOLOGY

5.1. System Overview

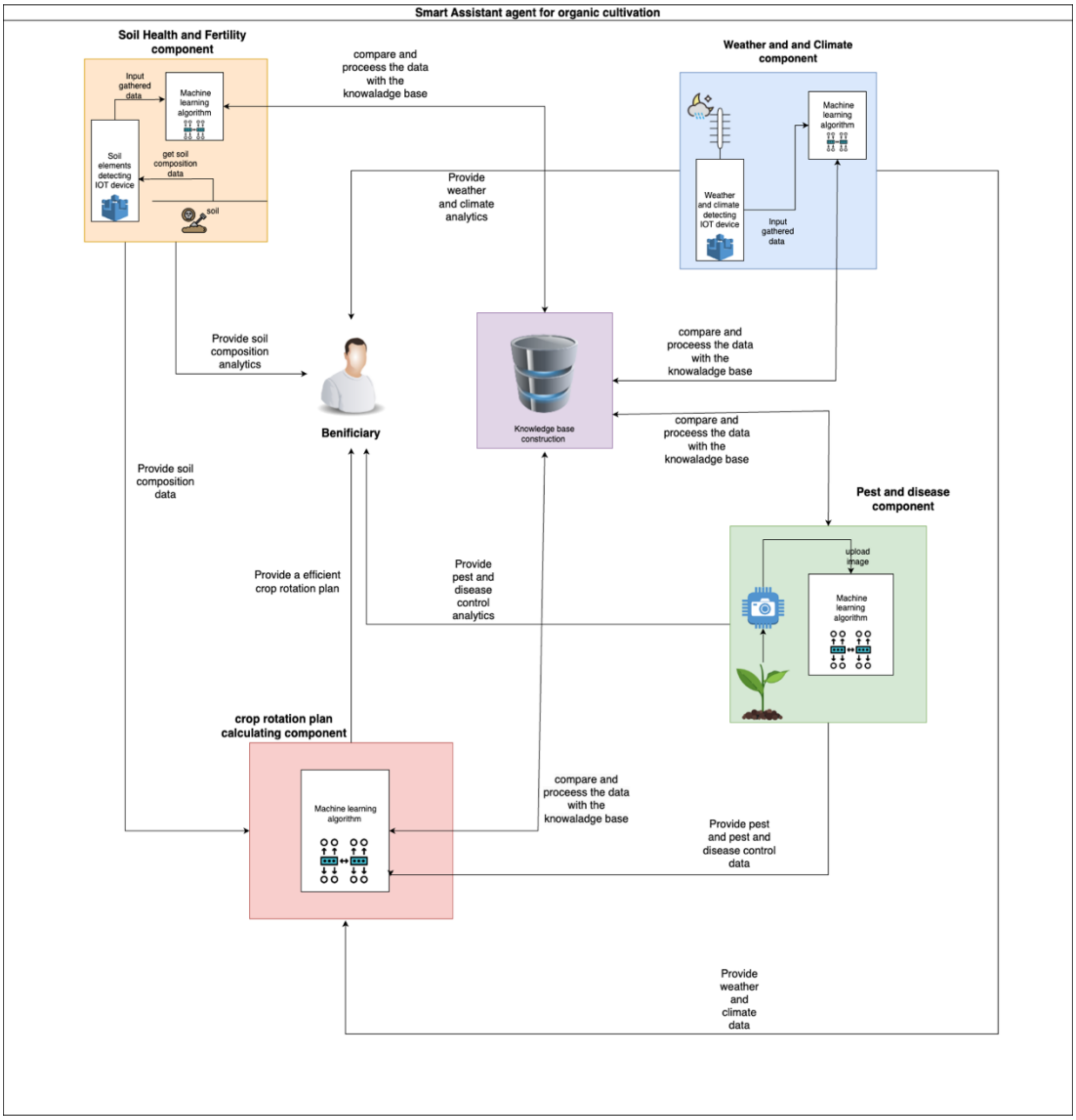


Figure 5.1 System overview

The high-level architecture diagram of the proposed software is shown in the above diagram(figure 5.1). our software system is divided into four major parts with each of the team member. In the overview of the system there are four major components as listed below

- Soil health and fertility component
- Weather and climate component
- Pest and disease control component
- Crop rotation planning component

In our research project my component is the soil health and fertility component. The front end (FE) components will be implemented by using react and react native in my component and material UI will be used as a UI library for the FE. One of the key advantages of using React is that it offers a component-based approach to UI development. As a result, it can be easier to divide the user interface into more simple, reusable parts that can be coded to communicate with the Arduino hardware.

The back end (BE) will be implemented by using python language Django will be used as a backend framework. Python offers an excellent ecosystem of libraries and tools, including PySerial and PyFirmata, that can be used for interacting with Arduino hardware. Because of this, creating type of software that can interact with the Arduino board and manage its sensors and actuators is made simpler. Also, as the requirements node JS also can come into the picture

For the soil data collection part Arduino will be used with IOT sensors. To get the soil data about its Nitrogen, Phosphorus and Potassium, which are the most important nutrients for plant growth, a sensor called JXCT Soil NPK sensor [11] is used. For getting the data about the PH level of the soil RS-PH-N01-TR-1 sensor is used

Figure 2.2 JXCT Soil NPK sensor

Figure 5.3 RS-PH-N01-TR-1 sensor

In the Soil health and fertility component Firebase will be used to process real time data Firebase allows for real-time data synchronization between the Arduino device and the cloud database, making it easy to update and retrieve data as needed. Mongo DB will also be used depending on the condition

5.2. Component Structure

5.2.1 Soil data gathering component

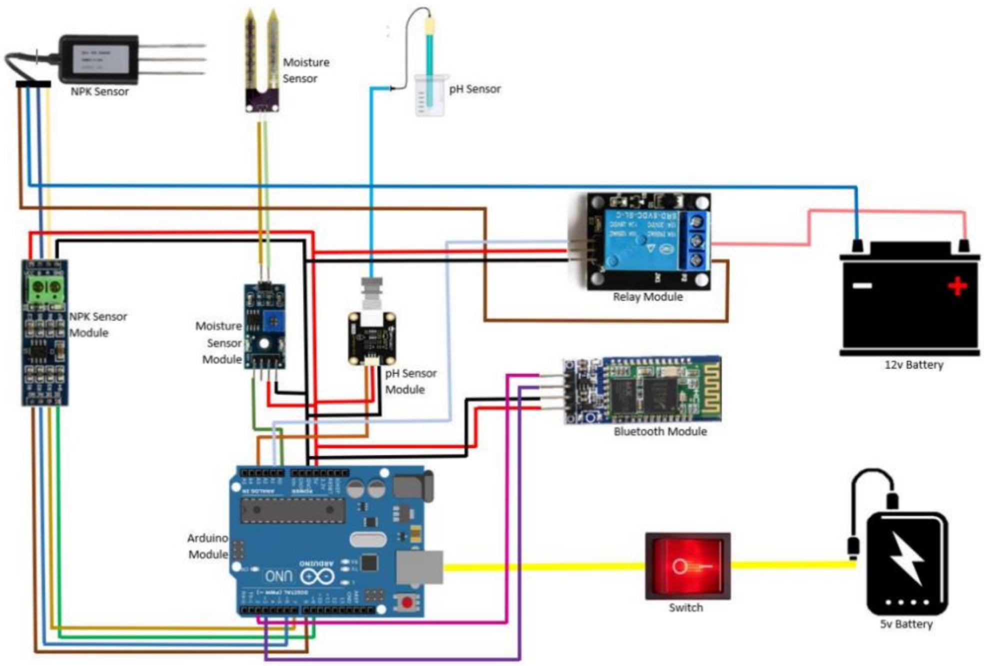


Figure 5.4 Circuit Diagram of the soil sample

The diagram presented in Figure 5.4 illustrates the wiring connections between all the electronic components in the device. Each component is connected using wires that facilitate data transfer and the flow of electricity. The power source for the device comes from a 5v power bank, while a separate 12v power supply is used to power the NPK sensor. All the electronic parts are connected to the Arduino board, which enables the transfer of data to an Android device through a Bluetooth module.

5.3 Software Methodology

Selecting the best software development process is one of the most important decisions to be made while creating any system. The project's success can be hugely affected by the technique that is used, particularly when it comes to controlling the project's scope and time frame. Choosing the appropriate approach is essential for the proposed system since it has a huge scope that spans the entire year and incorporates sophisticated algorithms in its software components. The Agile software development technique has been selected as the best and most appropriate option for this project after careful consideration. The suggested system is exactly the kind of complex, dynamic project that the agile methodology is designed to handle. Agile development is characterized by an incremental, incremental way that gives the development process more flexibility and adaptability. This is crucial when creating a system with a broad scope that might need to be adjusted and changed over time. For this project, the Agile technique Scrum has been chosen specifically. Scrum is a useful management and control method for incremental and iterative projects. The success of a project with a broad scope depends on the team members' ability to communicate, collaborate, and be transparent with one another. The team can use Scrum to divide the project into smaller, easier-to-manage tasks and prioritize them according to their significance and degree of difficulty. This makes it possible to use time and resources more effectively while also ensuring that the project will be completed on schedule and within budget.

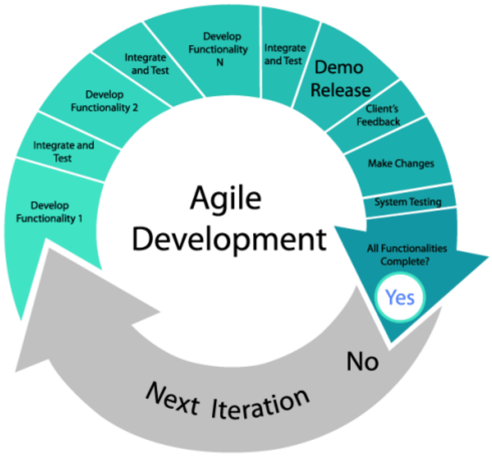


Figure 3 Agile Methodology

- **Requirement gathering:** The requirements are mainly gathered by interviewing the resource persons.
- **Design and development:** Before the development high level diagram is made then diagrams like use case diagrams are planned make to get a clear idea of the system.

- **Implementation**: During this phase,implementation of the software solution is happening.

- **Testing**:After the implementation phase all the components are tested out to find the components are working as expected.

5.4 Functional requirements

- Data Collection: The software must have the ability to collect data from IoT sensors.

- Optimization Algorithm: The software should include an optimization algorithm that uses gathered soil data to identify the best crop to plant in a specific field or area.

- Machine Learning: The software should utilize machine learning to improve its crop recommendation algorithms by analyzing historical data and identifying trends.

5.5 Non-functional requirements

- **Reliability**: The soil analytics should be very accurate
- **Availability**-The system should be available when end users, needs to use the application.
- **Usability**: The UI’s must be clear and interactive to the end user
- **Performance**: system must be process the input date quikly and accurately to provide meaningful information

5.6 Project Technology Stack

Table 1 Technologies

Library	React, Material UI
Language	JavaScript, Python
Database	Firebase, MongoDB
Editor	Vs Code, PyCharm
Packages	NumPy, Pandas, deap

5.7 Feasibility study

5.7.1 Technical Feasibility

The proposed system for an integrated software solution that gather soil data and use with an optimization algorithm to find the most optimized crop appears to be technically feasible.The development of such a software solution will require the use of multiple technologies, including IoT sensors, machine learning, and optimization algorithms.

However, each of these technologies is well established and widely used in the agriculture industry, making the technical feasibility of the proposed system relatively straightforward.

To ensure technical feasibility, it will be essential to choose appropriate hardware and software components and ensure their compatibility with each other. Additionally, the software should be designed to be user-friendly and accessible to farmers with varying levels of technical expertise. This could be achieved by creating an easy-to-use interface that provides clear instructions for using the software.

Overall, based on the current technologies and the requirements of the proposed system, it appears that the is technicaly feasible to develop a integrated software solution.

5.8 Hardware Requirements

- JXCT Soil NPK sensor
- RS-PH-N01-TR-1 sensor
- Arduino circuit

6. DESCRIPTIONS OF PERSONAL AND FACILITIES

6.1 Commercialization

The proposed system for soil data gathering and crop optimization using IoT sensors and machine learning will have broad commercialization potential for various stakeholders in the agricultural sector. This software solution can be utilized by small-scale farmers, agriculture professionals, and enterprise-level users to access real-time information about soil health and crop growth patterns, which can help to optimize crop rotations and reduce the use of synthetic fertilizers and pesticides. The optimization algorithm will assist farmers in identifying the most optimized crop for a given plot of land based on data gathered by IoT sensors, while the machine learning model will be trained using this data to provide personalized recommendations to users. To achieve this, cloud computing concepts and machine learning algorithms will be used to provide accurate and valuable information to users. The user interface will be designed to be intuitive and user-friendly, enabling even those without technical expertise to utilize the software easily. Overall, the proposed system has the potential to revolutionize sustainable agriculture practices and increase farm output and profitability while preserving soil health and reducing environmental pollution.

Target audience -

- Farmers
- Domestic people
- Agricultural officers
- Agricultural Researches
- Stakeholders

7. BUDGET AND BUDGET JUSTIFICATION

Table 2 Estimated budget plan

Description	Cost
IOT sensors and Arduino items	Rs.35000.00
Database	Free
Cloud environment	Using student account credits in azure
Stationary items	Rs.3000.00
Other	Rs.2000.00
Total	Rs.40000.00

References

[1] J. A. ,. J. D. P. E. A. M. I. Valeria Piñeiro, "A scoping review on incentives for adoption of sustainable agricultural practices and their outcomes," *nature sustainability,* 2020.

[2] N. C. M. d. H. L. W. M. H. K. R. H. G. J. A. v. V. E. E. K. Yao Pan, "Impact of long-term N, P, K, and NPK fertilization on the composition and potential functions of the bacterial community in grassland soil," *FEMS Microbiology Ecology,* vol. 90, no. 1, 2014.

[3] T. D. X. ,. N. ,. A. G. Kifayatullah Kakar, "Effects of Organic and Inorganic Fertilizer Application on Growth, Yield, and Grain Quality of Rice," *Agriculture 2020,* vol. 10, no. 11, 2020.

[4] B. M. ,. I. M. F. A. Abubaker, "Analysis Of Soil NPK, Ph And Electrical Conductivity At Adham Area-Renk, Upper Nile State," in *Research Gate*, 2020.

[5] J. G. L. Francisco J. Arriaga, "Conventional Agricultural Production Systems and Soil Functions," in *Soil Health and Intensification of Agroecosytems* , 2017, pp. 109-125.

[6] K. B. K. Aarti Abhijit Chavan, "Analysis of Soil Nitrogen (N), Phosphorus (P) and Potassium (K) Estimation Methods," *IJRT,* vol. 8, no. 3, 2021.

[7] L. X. A. A. H. P. Q. V. N. T. T. Hong, "The impact of NPK fertilizer on growth and nutrient accumulation in juniper (Juniperus procera) trees grown on fire-damaged and intact soils," *Reserchgate,* vol. 5, no. 2, 2020.

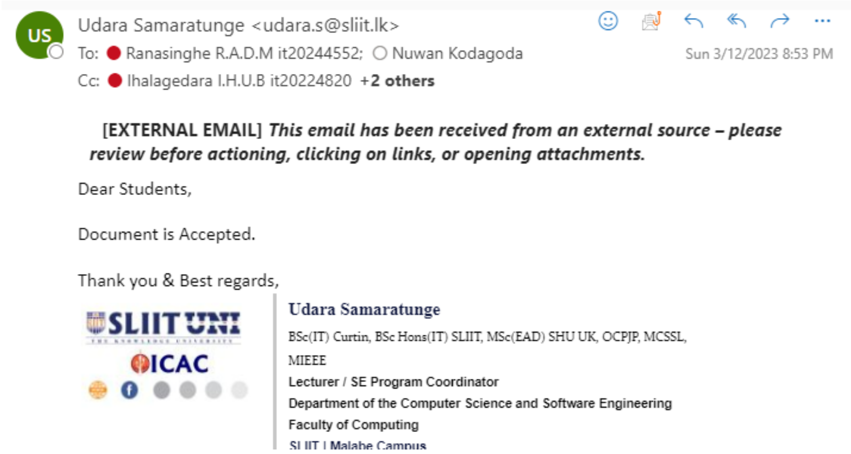
[8] J.-w. L. ,. F. C. ,. X.-k. L. Wen-xi LI, "Effect of NPK Application on Yield, Nutrients and Water Utilization Under Sudangrass and Ryegrass Rotation Regime," *ELSEVIER*, vol. 9, no. 7, 2010.

[9] T. B. M. Ş. T. 2. H. Ü. Z. F. T. B. B. Ş. T. Harran Üniversitesi, "Research on the Effects of NPK (Chemical fertilizer) and Organic Fertilizers Used for Some Cotton Species (Gossypium hirsutum L.) Grown In Semi-arid Climate Conditions on Growing Crops, Growing Crop Elements and Sustainable Agriculture," *Derigpark,* vol. 10, no. 6, 2021.

[10] T. K. M. K. T. K. Pyingkodi Maran, "IoT based Soil Nutrients Analysis and Monitoring System for Smart Agriculture," in *ResearchGate*, 2022.

[11] M. S. A. R. R. S. a. Z. J. Marianah Masrie*, "Detection of nitrogen, phosphorus, and potassium (NPK) nutrients of soil using optical transducer," in *Reaserchgate*, 2017.

APPENDIX



Udara Samaratunge <udara.s@sliit.lk>
To: Ranasinghe R.A.D.M it20244552; Nuwan Kodagoda
Cc: Ihalagedara I.H.U.B it20224820 +2 others
Sun 3/12/2023 8:53 PM

[EXTERNAL EMAIL] *This email has been received from an external source – please review before actioning, clicking on links, or opening attachments.*

Dear Students,

Document is Accepted.

Thank you & Best regards,

Udara Samaratunge
BSc(IT) Curtin, BSc Hons(IT) SLIIT, MSc(EAD) SHU UK, OCPJP, MCSSL, MIEEE
Lecturer / SE Program Coordinator
Department of the Computer Science and Software Engineering
Faculty of Computing
SLIIT | Malabe Campus

ABSTRACT

The proposed approach is an Internet of Things-based solution that attempts to help farmers increase crop productivity while using less fertilizer by predicting the most optimal crop for a specific soil sample. A multi objective optimization technique is used by the system to determine the best crop for a given soil sample after collecting data from soil sensors using a range of hardware and software components. The gathered data is then used with a machine learning model to improve its crop recommendation algorithms through historical data analysis and trend identification, leading to best crop growth and yields with little fertilizer use. This IoT-based solution offers farmers a more efficient and effective method of managing their crops, as they can make informed decisions on fertilizer selection based on real-time data. By leveraging the power of IoT technology and algorithmic based processing, this system can potentially help farmers to increase their crop yields with low fertilizers and contribute to the growth of the agricultural sector.

Keywords -NPK, IOT, Soil Sensors, Algorithms, Optimization Algorithm,

Assignment Inbox: RP-2023-Regular

Assignment Title	Info	Dates	Similarity	Actions
Project Proposal Report	ⓘ	Start 02-Mar-2023 6:22PM Due 31-May-2023 11:59PM Post 10-Mar-2023 12:00AM	7%	Resubmit View