IT4010 – Research Project - 2023

Topic Assessment Form

Project ID : TMP-23-236

1. Topic (12 words max)

An integrated platform for identification of suitable lands and soil conditions for remunerative crops in Sri Lanka.

2. Research group the project belongs to

Machine Learning and Soft Computing (MLSC)

3. Research area the project belongs to

ICT for Development (ICTD)

4. If a continuation of a previous project:

Project ID	
Year	

5. Team member details

Student Name	Student ID	Specialization
Leader: Manchalee R.R.N.	IT20096748	IT
Member 2: Madhushika A.H.D.	IT20122928	IT
Member 3: Janadeepa W.H.G.	IT19045290	IT
Member 4: Arachchige P.D.A.M.	IT20121556	IT

6. Brief description of the research problem including references (200 – 300 words max)

The COVID-19 pandemic has brought unprecedented disruption to our agriculture and food systems, increasing pressure on farmers and agribusinesses in our country and around the world. Historically, agriculture has been the most important sector of the Sri Lankan economy. Even though its contribution to the gross domestic product declined substantially during the past three decades (from 30% in 1970 to 7.3% in 2020), it is the most important source of employment for the majority of the Sri Lankan workforce. Sri Lanka is experiencing an economic crisis stemming from an unsustainable debt load and perennial deficits on both the international balance of payments and government budget, resulting in a severe shortage of foreign currency exchange. The Ministry of Agriculture itself has identified issues in Sri Lanka's present agricultural landscape such as Low productivity of crop and animal products for which demand is rising, Inadequate attention to agricultural diversification in favor of crops that have better income prospects and many more. These issues have serious consequences not only on the profitability of Sri Lanka's agricultural industry, but also on national food security. High percentage of land today are unused or underutilized. Bare land indicates the land not covered by vegetation, water, buildings, or roads. There is a high percentage of bare land that is not utilized properly in Sri Lanka which can be used for commercial purposes like agriculture.

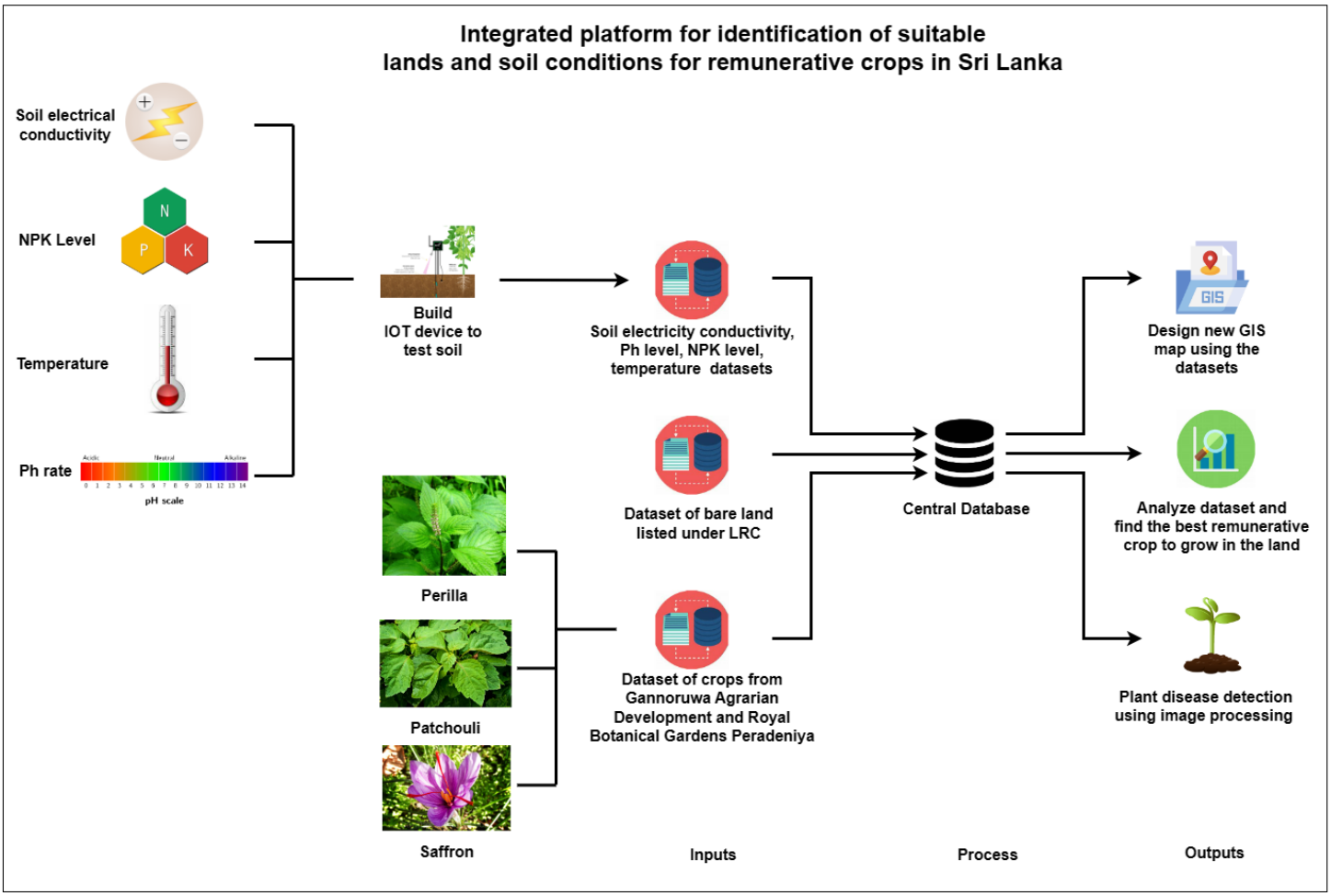
References:

[1]"Sri Lanka: Issues and priority for the agriculture sector | Daily FT," www.ft.lk. https://www.ft.lk/columns/Sri-Lanka-Issues-and-priority-for-the-agriculture-sector/4-713634

[2]"Are Sri Lanka's agricultural policies starving our farmers?," Advocata Institute | Sri Lanka | Independent Policy Think Tank. https://www.advocata.org/commentary-archives/2019/10/20/are-sri-lankas-agricultural-policies-starving-our-farmers#:~:text=The%20Ministry%20of%20Agriculture%20itself%20has%20identified%20the (accessed Feb. 13, 2023).

7. Brief description of the nature of the solution (150 words max)

Our research project fundamentally focuses on import and export of commercially demanding crops such as perilla patchouli and saffron. The aim of the project is to develop an integrated platform for identification of suitable lands and soil conditions for remunerative crops in Sri Lanka. Initially, we develop GIS map using remote sensing to identify the bare lands in Sri Lanka listed under LRC (Land reform commission). NPK level (The NPK ratio refers to the three numbers that indicate the percentage of nitrogen, phosphorus, and potassium in an NPK fertilizer.), PH rate(pH stands for "potential of hydrogen", it is a scale used to specify the acidity or basicity of an aqueous solution.), EC(electrical conductivity refers to the degree to which a specified material conducts electricity, calculated as the ratio of the current density in the material to the electric field which causes the flow of current), temperature of the soil is collected using a IOT device. The dataset of commercially viable plants is collected from Gannoruwa department of agrarian development, after the soil is tested, an analysis is done to check if it is suitable to grow the particular crop. Finally, the crop is grown in the bare land and the GIS map is updated. A system to detect for fungus and diseases in the plant is also developed using image processing to monitor and ensure healthy growth of plants.



8. Brief description of specialized domain expertise, knowledge and data requirements (200 words max)

The dataset of bare land is collected from LRC and the crop dataset is collected from department of agrarian development, Gannoruwa. We selected commercially viable plants like patchouli, perilla and saffron to grow in the appropriate soil conditions. Initially the GIS map is developed from the gathered dataset of bare land using remote sensing methods. IOT device is built to measure the NPK level (The NPK ratio refers to the three numbers that indicate the percentage of nitrogen, phosphorus, and potassium in an NPK fertilizer.), PH rate (pH stands for "potential of hydrogen", it is a scale used to specify the acidity or basicity of an aqueous solution.), EC(electrical conductivity refers to the degree to which a specified material conducts electricity, calculated as the ratio of the current density in the material to the electric field which causes the flow of current), temperature. Using the dataset collected from Gannoruwa department of agrarian development and royal botanical garden, Peradeniya prediction and analysis is done to select the best remunerative crop that can be grown in the given soil conditions. To maintain the healthy growth of plants we are developing a system to detect diseases and fungus in plants using image processing by identifying the diseases and training a model for common diseases in patchouli, perilla and saffron.

9. Objectives and Novelty

Main Objective Develop an integrated platform for identification of suitable lands and soil conditions for growing remunerative crops in Sri Lanka.			
Member Name	Sub Objective	Tasks	Novelty
Manchalee R.R.N.	Monitor and maintain healthy growth of crops by plant disease detection.	1. Identify plant diseases: The first step is to acquire images of the plant parts that might be infected by a diseases or fungus. This can be done using digital cameras or smartphones with high-resolution cameras. 2. Preprocessing: The acquired images needs to be preprocessed to enhance the quality of the image and to remove any noise or unwanted features. This includes adjusting the brightness, contrast, and color balance of the image, and removing any background noise. 3. Segmentation: Segmentation involves separating the plant parts from the background and isolating the region of interest. 4. Feature Extraction: Once the region of interest has been identified, features need to be extracted from the image. These features may include color, texture, shape, or any other relevant	This system mainly focuses on detecting diseases and fungus on commercially viable crops like perilla and patchouli.

		features that can help distinguish between healthy and diseased plants. 5. Train dataset model: The extracted features are then used to classify the plant as either healthy or diseased. This involves using machine learning algorithms to train a model that can accurately predict the presence of disease in each plant. 6. Visualization: Finally, the results are visualized to provide a clear and concise output to the user. This may include highlighting the infected area in the image or providing a diagnosis of the disease based on the classification result.	
Madhushika A.H.D.	Prediction and analysis to determine whether the selected can be grown in given soil condition.	1. Collect dataset from Gannoruwa department of agrarian development - The main plants that we selected are perilla, pachouli and saffron. We need to collect dataset of the temperature, NPK, PH, EC suitable for the growth of the plants. 2. Analyze the dataset and the measured soil conditions of land. Identify the soil type: Different types of plants require different types of soil. Some plants prefer sandy soil, while others prefer	We mainly focus on growing plants like perilla and Patchouli in bare lands, since those plants can be grown in Sri Lanka but a proper research has not be done till now. Growing such plants will be economically beneficial for Sri Lanka.

		clay or loam. Therefore, it is important to determine the type of soil present in the area where the plant will be grown. Determine the soil pH: The pH of the soil is a measure of its acidity or alkalinity. Different plants thrive in different pH ranges. For example, blueberries require acidic soil, while vegetables such as tomatoes and peppers prefer slightly acidic to neutral soil. Soil pH can be determined by using a pH meter or a soil test kit. Test soil nutrient levels: Soil nutrient levels are essential for plant growth and development. A soil test can provide information about the levels of essential nutrients such as nitrogen, phosphorus, and potassium. Based on the results, it can be determined whether the soil has sufficient nutrients to support the growth of the selected plant. Assess soil moisture: The amount of moisture in the soil can impact plant growth. Some plants require well-draining soil, while others thrive in moist soil. It is important to assess the	

		moisture level of the soil and determine whether it is suitable for the selected plant. Based on the above factors, a prediction and analysis can be made about whether the selected plant can be grown in the given soil condition. If the soil type, pH, nutrient levels, moisture content, and texture are suitable for the plant, then it is likely that the plant will grow well. However, if the soil condition is not suitable, then it may be necessary to amend the soil or select a different plant that is better suited for the soil condition. 3. Find the best remunerative crop to grow in land.	
Janadeepa W.H.G.	Soil testing and identification of soil conditions using IOT device.	1. Build IOT device: The first step is to design and build an IOT device that can measure soil conditions such as moisture, temperature, pH level, and nutrient content. The device can be designed using sensors, microcontrollers, and wireless communication modules. 2. Measure soil conditions: Once the IOT device is built, it can be deployed in the	The accuracy of this soil testing device reading is higher compared to other IOT devices built until now.

		soil to measure the soil conditions continuously. The sensors on the device can collect data on soil moisture, temperature, pH level, and nutrient content at regular intervals. 3. Test the accuracy of the data by lab testing: To ensure the accuracy of the data collected by the IOT device, samples of the soil can be collected and tested in a laboratory using standard soil testing procedures. The laboratory testing can provide a reference for comparing the accuracy of the data collected by the IOT device. 4. Store data in cloud storage: The data collected by the IOT device can be transmitted wirelessly to cloud storage for storage and analysis. Cloud storage provides a secure and scalable solution for storing large amounts of data collected over time. 5. Get those data into a dashboard and visualization: The data stored in the cloud can be accessed through a dashboard and visualized using graphs and charts. The dashboard can provide	

		real-time information on soil conditions, trends over time, and alerts for any critical values. This information can be used to make data-driven decisions regarding irrigation, fertilization, and other management practices to optimize crop yields and soil health. Additionally, machine learning algorithms can be applied to the data to predict future soil conditions and provide recommendations for crop management.	
Arachchige P.D.A.M.	Identification of bare lands using GIS map and remote sensing approach.	1. Select a specific area as pilot: The first step is to identify a specific area of interest to be studied. This could be a region with significant agricultural activity, 2. Classify satellite image and identify land cover: Once the pilot area has been selected, the next step is to obtain high-resolution satellite images for the area. These images can be obtained from various sources such as Landsat, Sentinel or MODIS. Once the satellite images have been obtained, they are processed using Geographic Information Systems (GIS) software to create a land cover map. The land cover map is created by	Till now there is no proper ML technology used for creating and identify the bare lands using GIS mapping technique. In this scenario we will first identify the proper land covers for soil testing and planting based on current data we collected. Then we will again generate and obtain high resolution satellite images for the area based on properly tested and calculated data upon other scenarios in this research. For obtain

		identifying and classifying different types of land cover, such as forests, grasslands, water bodies, and barren lands. The classification process involves using a combination of spectral bands, indices, and algorithms to distinguish between different land cover types. 3. Select bare land and verify if it is bare land or not: After the land cover map has been created, the next step is to identify and select the areas that are classified as barren or bare lands. These areas could be identified based on their spectral reflectance, which is a measure of the amount of light reflected by the earth's surface at different wavelengths. Once the barren lands have been identified, ground truthing can be done to verify if the areas are indeed bare lands. Ground truthing involves physically visiting the area and verifying the land cover type using visual observations, field measurements, and other relevant data. The ground truthing data is then used to validate the remote sensing classification results.	this requirement and concerns we will be using proper and popular tech stack which will related to ML with GIS mapping and will be testing results based on soil & plant conditions. Also, this technique will implement based on remote sensing after the lab tests for final detailed output.

10. Supervisor checklist (supervisors should fill sections 10 and 11)

a) Is this research problem valid?

Yes	✓	No	

b) Is the proposed research group correct?

Yes	✓	No	

c) Is the proposed research area correct?

Yes	✓	No	

d) Do the proposed sub-objectives match the students' specialization?

Yes	✓	No	

e) Is the required domain expertise, knowledge and the data available?

Yes	✓	No	

f) Is the scope of the solution practical?

Yes	✓	No	

g) Do all sub-objectives have sufficient novelty?

Yes	✓	No	

11. Supervisor details

	Title	First Name	Last Name	Signature
Supervisor	Ms.	Devanshi	Ganegoda	
Co-Supervisor	Mr.	Sathira	Hettiarchchi	Sathira
External Supervisor	Mr.	K.H.L	Sanjeewa	

Mr. K.H.L Sanjeewa has completed his degree in Bachelor of Science in Agriculture. He is currently the Assistant regional manager and has also been in the post of research and development scientist of Link Natural Products Pvt. Ltd in 2012 ,Assistant project manager in Green leaves Pvt. Ltd in 2014 , Assistant Farm Manager in 2015 and Environment Officer in Mahaweli Authority of Sri Lanka. Empowering agriculture extension team to deliver exceptional agriculture extension service.

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Topic Assessment Form

Summary Sheet

The topic evaluation panel will use the summary sheet to evaluate the suitability of the project

1. Brief description of research problem including references (200 – 300 words max)

The COVID-19 pandemic has brought unprecedented disruption to our agriculture and food systems, increasing pressure on farmers and agribusinesses in our country and around the world. Historically, agriculture has been the most important sector of the Sri Lankan economy. Even though its contribution to the gross domestic product declined substantially during the past three decades (from 30% in 1970 to 7.3% in 2020), it is the most important source of employment for the majority of the Sri Lankan workforce. Sri Lanka is experiencing an economic crisis stemming from an unsustainable debt load and perennial deficits on both the international balance of payments and government budget, resulting in a severe shortage of foreign currency exchange. The Ministry of Agriculture itself has identified issues in Sri Lanka's present agricultural landscape such as Low productivity of crop and animal products for which demand is rising, Inadequate attention to agricultural diversification in favor of crops that have better income prospects and many more. These issues have serious consequences not only on the profitability of Sri Lanka's agricultural industry, but also on national food security. High percentage of land today are unused or underutilized. Bare land indicates the land not covered by vegetation, water, buildings, or roads. There is a high percentage of bare land that is not utilized properly in Sri Lanka which can be used for commercial purposes like agriculture .

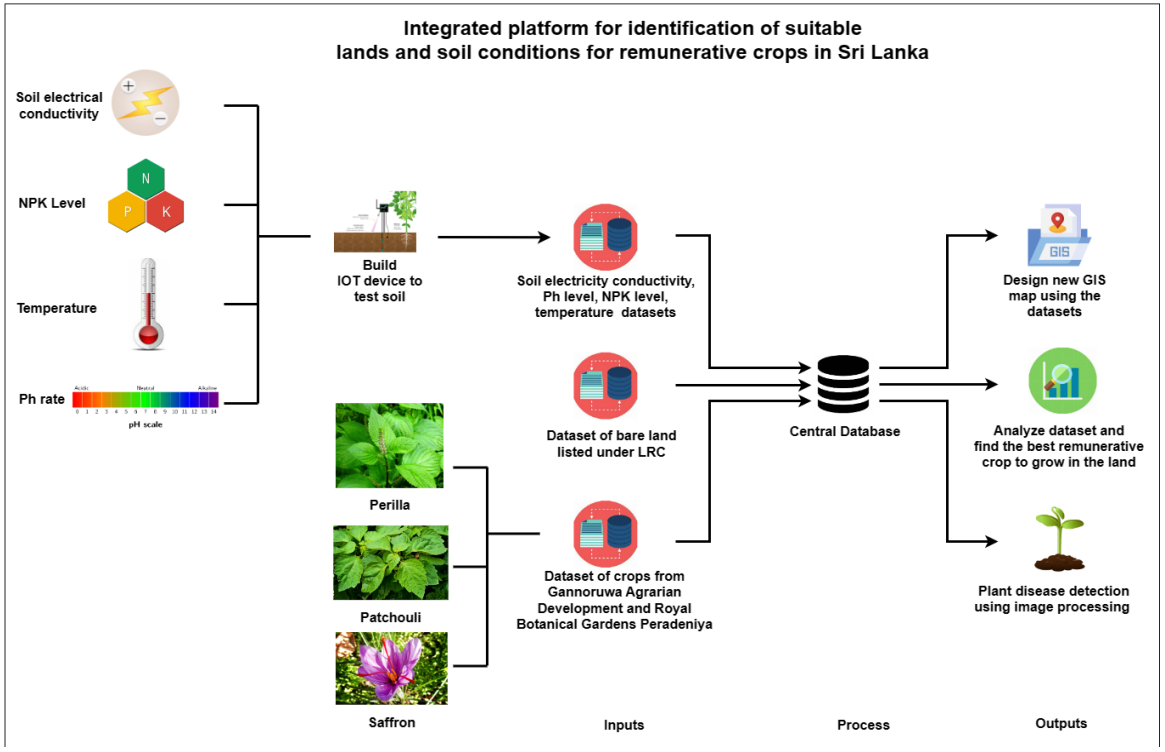
References:

[1]"Sri Lanka: Issues and priority for the agriculture sector | Daily FT," www.ft.lk. https://www.ft.lk/columns/Sri-Lanka-Issues-and-priority-for-the-agriculture-sector/4-713634

[2]"Are Sri Lanka's agricultural policies starving our farmers?," Advocata Institute | Sri Lanka | Independent Policy Think Tank. https://www.advocata.org/commentary-archives/2019/10/20/are-sri-lankas-agricultural-policies-starving-our-farmers#:~:text=The%20Ministry%20of%20Agriculture%20itself%20has%20identified%20the (accessed Feb. 13, 2023).

2. Brief description of the nature of the solution (150 words max)

Our research project fundamentally focuses on import and export of commercially demanding crops such as perilla patchouli and saffron. The aim of the project is to develop an integrated platform for identification of suitable lands and soil conditions for remunerative crops in Sri Lanka. Initially, we use GIS technology to identify the bare lands in Sri Lanka listed under LRC (Land reform commission). NPK level (The NPK ratio refers to the three numbers that indicate the percentage of nitrogen, phosphorus, and potassium in an NPK fertilizer.), PH rate(pH stands for "potential of hydrogen", it is a scale used to specify the acidity or basicity of an aqueous solution.), EC(electrical conductivity refers to the degree to which a specified material conducts electricity, calculated as the ratio of the current density in the material to the electric field which causes the flow of current), temperature of the soil is collected using a IOT device. The dataset of commercially viable plants is collected from Gannoruwa department of agrarian development, after the soil is tested, an analysis is done to check if it is suitable to grow the particular crop. Finally, the crop is grown in the bare land and the GIS map is updated. A system to detect for fungus and diseases in the plant is also developed using image processing to ensure healthy growth of plants.



3. Objectives and novelty

Main Objective Develop an integrated platform for identification of suitable lands and soil conditions for growing remunerative crops in Sri Lanka.			
Member Name	Sub Objective	Tasks	Novelty
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		distinguish between healthy and diseased plants. 5. Train dataset model: The extracted features are then used to classify the plant as either healthy or diseased. This involves using machine learning algorithms to train a model that can accurately predict the presence of disease in a given plant. 6. Visualization: Finally, the results are visualized to provide a clear and concise output to the user. This may include highlighting the infected area in the image or providing a diagnosis of the disease based on the classification result.	
Madhushika A.H.D.	Prediction and analysis to determine whether the selected can be grown in given soil condition.	1. Collect dataset from Gannoruwa department of agrarian development - The main plants that we selected are perilla, pachouli and saffron. We need to collect dataset of the temperature, NPK, PH, EC suitable for the growth of the plants. 2. Analyze the dataset and the measured soil conditions of land.- • Identify the soil type: Different types of plants require different types of soil. Some plants prefer sandy soil, while others prefer clay or loam. Therefore, it is important to determine the type of soil present in the area where the plant will be grown.	We mainly focus on growing plants like perilla and Patchouli in bare lands, since those plants can be grown in Sri Lanka, but proper research has not be done till now. Growing such plants will be economically beneficial for Sri Lanka.

		• Determine the soil pH: The pH of the soil is a measure of its acidity or alkalinity. Different plants thrive in different pH ranges. For example, blueberries require acidic soil, while vegetables such as tomatoes and peppers prefer slightly acidic to neutral soil. Soil pH can be determined by using a pH meter or a soil test kit. • Test soil nutrient levels: Soil nutrient levels are essential for plant growth and development. A soil test can provide information about the levels of essential nutrients such as nitrogen, phosphorus, and potassium. Based on the results, it can be determined whether the soil has sufficient nutrients to support the growth of the selected plant. • Assess soil moisture: The amount of moisture in the soil can impact plant growth. Some plants require well-draining soil, while others thrive in moist soil. It is important to assess the moisture level of the soil and determine whether it is suitable for the selected plant. • Based on the above factors, a prediction and analysis can be made about whether the selected plant can be grown in the given soil condition. If the soil type, pH, nutrient levels, moisture content, and texture are suitable for the plant, then it is	

		likely that the plant will grow well. However, if the soil condition is not suitable, then it may be necessary to amend the soil or select a different plant that is better suited for the soil condition. 3. Find the best remunerative crop to grow in land.	
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		4. Store data in cloud storage: The data collected by the IOT device can be transmitted wirelessly to cloud storage for storage and analysis. Cloud storage provides a secure and scalable solution for storing large amounts of data collected over time. 5. Get those data into a dashboard and visualization: The data stored in the cloud can be accessed through a dashboard and visualized using graphs and charts. The dashboard can provide real-time information on soil conditions, trends over time, and alerts for any critical values. This information can be used to make data-driven decisions regarding irrigation, fertilization, and other management practices to optimize crop yields and soil health. Additionally, machine learning algorithms can be applied to the data to predict future soil conditions and provide recommendations for crop management.	
Arachchige P.D.A.M.	Identification of bare lands using GIS map and remote sensing approach.	1. . Select a specific area as pilot: The first step is to identify a specific area of interest to be studied. This could be a region with significant agricultural activity, 2. Classify satellite image and identify land cover: Once the pilot area has been selected, the next step is to obtain high-	Till now there is no proper ML technology used for creating and identify the bare lands using GIS mapping technique. In this scenario we will first identify the proper land covers for soil testing and planting based on current data we

		resolution satellite images for the area. These images can be obtained from various sources such as Landsat, Sentinel or MODIS. Once the satellite images have been obtained, they are processed using Geographic Information Systems (GIS) software to create a land cover map. The land cover map is created by identifying and classifying different types of land cover, such as forests, grasslands, water bodies, and barren lands. The classification process involves using a combination of spectral bands, indices, and algorithms to distinguish between different land cover types. 3. Select bare land and verify if it is bare land or not: After the land cover map has been created, the next step is to identify and select the areas that are classified as barren or bare lands. These areas could be identified based on their spectral reflectance, which is a measure of the amount of light reflected by the earth's surface at different wavelengths. Once the barren lands have been identified, ground truthing can be done to verify if the areas are indeed bare lands. Ground truthing involves physically visiting the area and verifying the land cover type using visual observations, field measurements, and	collected. Then we will again generate and obtain high resolution satellite images for the area based on properly tested and calculated data upon other scenarios in this research. For obtain this requirement and concerns we will be using proper and popular tech stack which will related to ML with GIS mapping and will be testing results based on soil & plant conditions. Also, this technique will implement based on remote sensing after the lab tests for final detailed output.

		other relevant data. The ground truthing data is then used to validate the remote sensing classification results.	

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Topic Assessment Form

<u>This part to be filled by the Topic Screening Panel members</u>

Acceptable: Mark/Select as necessary

Topic Assessment Accepted	
Topic Assessment Accepted with minor changes (should be followed up by the supervisor)*	
Topic Assessment to be Resubmitted with major changes*	
Topic Assessment Rejected. Topic must be changed	

* Detailed comments given below

Comments

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Topic Assessment Form

The Review Panel Details

Member's Name	Signature

Important:

1. According to the comments given by the panel, do the necessary modifications and get the approval by the **Supervisor** or the **Same Panel**.
2. If the project topic is rejected, identify a new topic, and request the RP Team for a new topic assessment.
3. The form approved by the panel must be attached to the **Project Charter Form**.