RICEgenie

Predicting and Enhancing Paddy Crop Success

Crop yield prediction using machine learning – Paddy Harvest Prediction

24-25J-125

Team Members

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3. Objectives
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6. Gantt Chart
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8. Budget

Overall Project Description

- Sri Lanka is experiencing an economic crisis due to unsustainable debt and persistent deficits, leading to a severe shortage of foreign currency. Agriculture, a vital sector, plays a crucial role in the economy and provides livelihoods for a significant portion of the population.

- Our research project aims to enhance paddy cultivation by leveraging advanced machine learning and image processing techniques. This includes predicting paddy yield, recommending optimal paddy varieties, and managing pests and weeds efficiently.

- By providing real-time, data-driven recommendations, the platform will help farmers optimize their practices, reduce losses, and promote sustainable farming, contributing to the economic stability and growth of Sri Lanka's agricultural sector.

Research Problem

Importance:

- Paddy crop yield is vital for food security and economic stability in Sri Lanka.
- Accurate yield prediction helps farmers and policymakers improve agricultural practices and resource management.

Challenges with Traditional Methods:

- Struggle with complex factors like weather, soil health, diseases, weeds, and pests.
- Inability to model nonlinear relationships effectively.

Research Objectives

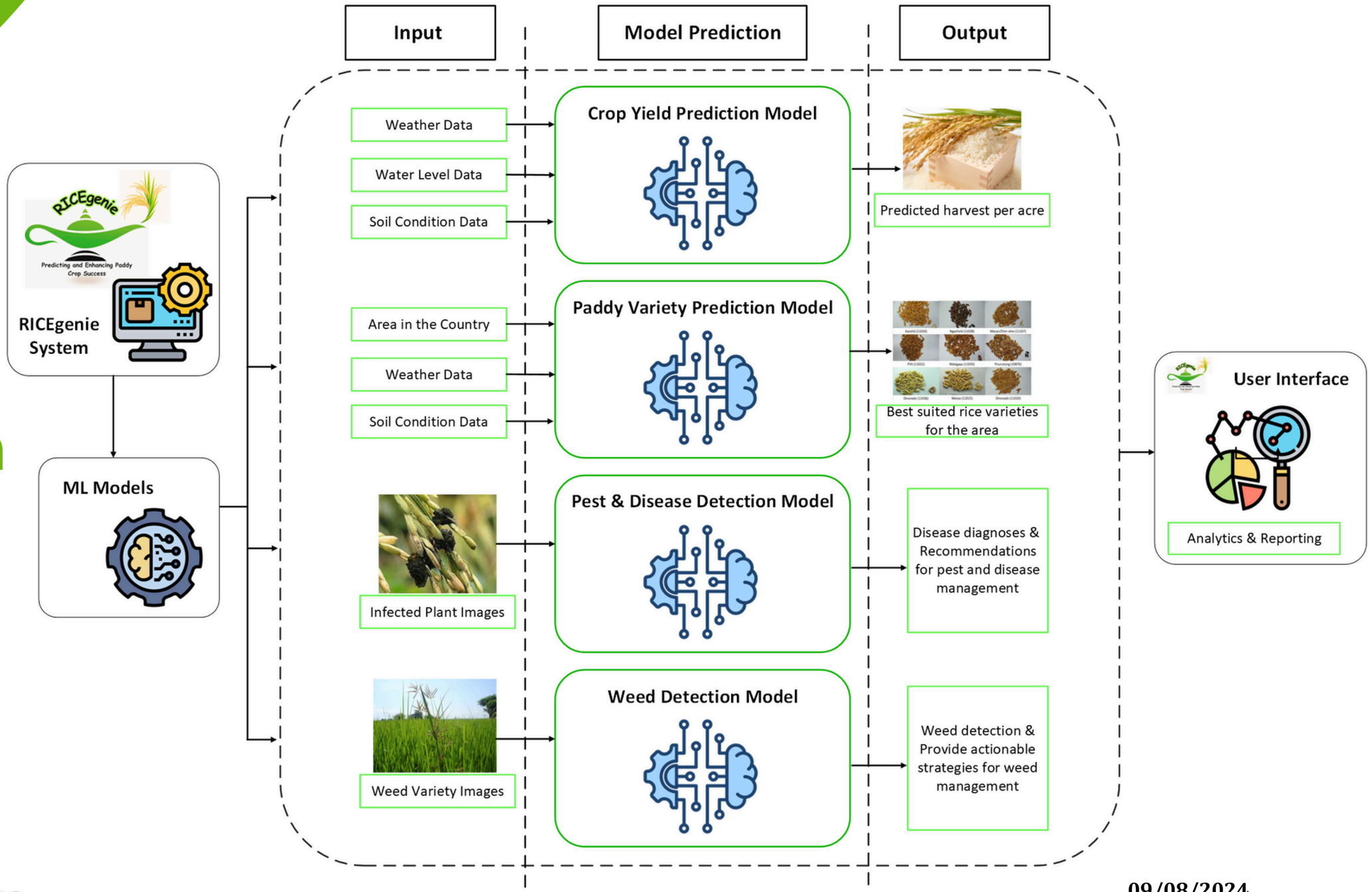
Main Objective:

- Develop an comprehensive platform to Enhance paddy cultivation in Sri Lanka by leveraging predictive models and image processing techniques.

Sub Objectives:

1. **Predict Harvest Yield:** Forecast paddy yields under varying conditions.
2. **Recommend Optimal Paddy Varieties:** Suggest suitable paddy types based on local conditions.
3. **Detect and Manage Pests and Diseases:** Use image processing for timely identification and treatment.
4. **Identify and Control Weeds:** Detect weed varieties and offer control strategies.

Overall System Diagram



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3. APSIM - https://www.apsim.info/
4. CERES - https://ceresglobalagcorp.com/about/who-we-are/

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Crop Yield Prediction System

Information Technology

SLIIT FACULTY OF COMPUTING

INTRODUCTION

- **Objective**: Develop a robust crop yield prediction model for paddy crops using machine learning.
- **Data Integration**: Analyze a comprehensive dataset, including historical yield data, weather conditions, soil health, and irrigation patterns.
- **Decision Support**: Incorporate a decision support framework to provide actionable insights and recommendations.
- **Benefits**: Enhance yield predictions, optimize agricultural practices, and improve resource management for increased productivity.

Research Gap

- **Lack of Integration in Existing Models :**Current models do not integrate critical factors such as weather, water, and soil conditions effectively.

- **Model Accuracy:** This lack of comprehensive data integration leads to inaccuracies in yield predictions.

- **Objective:** To create a robust prediction model that integrates these factors and provides actionable insights for optimizing paddy yield predictions.

- **Impact:** This approach aims to significantly enhance the accuracy of yield forecasts and offer practical recommendations for farmers.

Research Gap

	Research A [1]	Research B [2]	Research C [3]	Proposed solution
Incorporate localized weather patterns	NO	NO	YES	YES
combine soil health variation	YES	NO	NO	YES
provide robust decision support system	NO	YES	NO	YES
Develop predictive models	YES	YES	YES	YES

Research Problem

How can integrating advanced machine learning with diverse data sources improve the accuracy of paddy yield predictions and provide actionable insights for farmers?

Specific and Sub Objectives

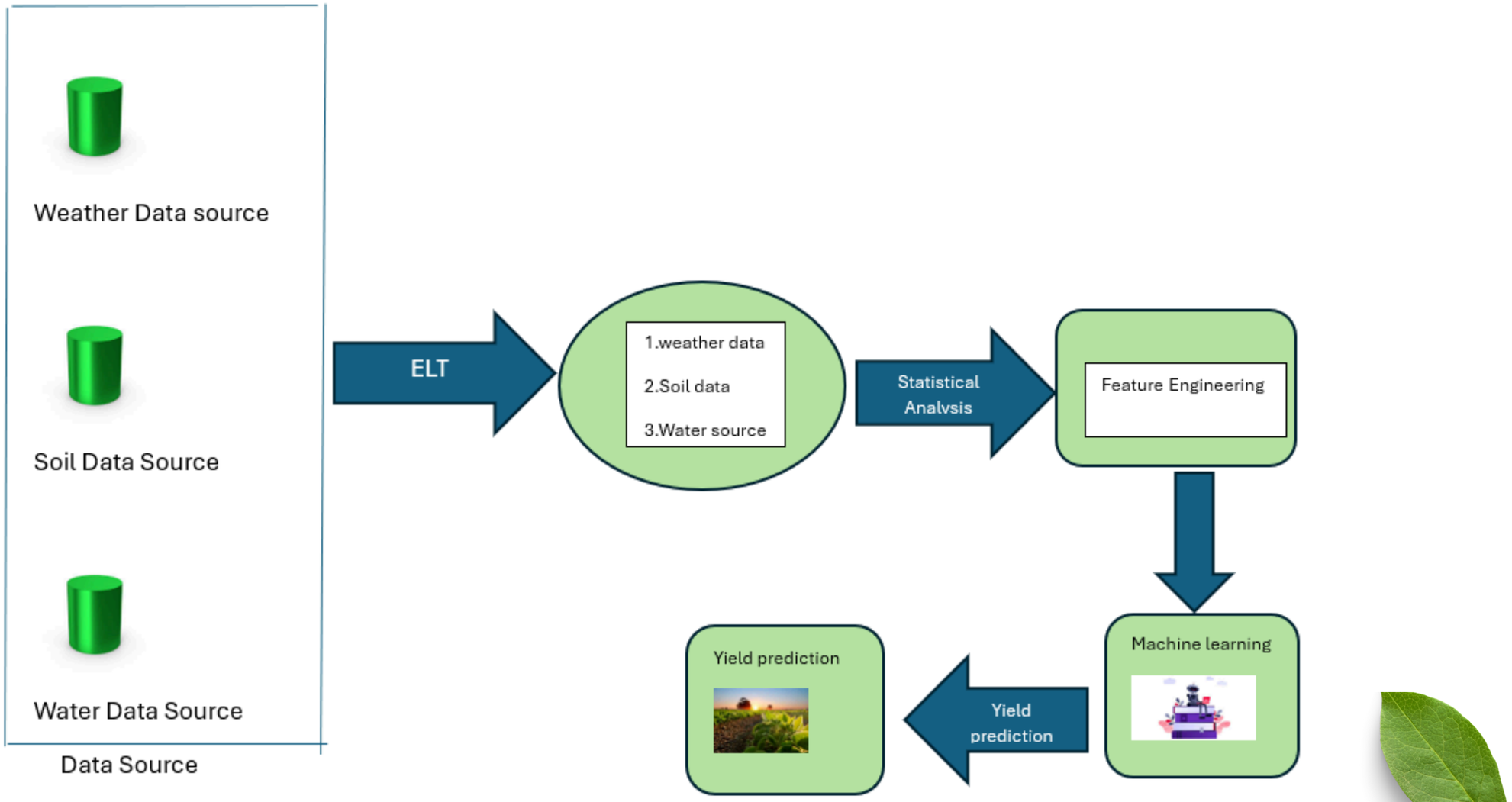
- **Specific Objectives :**
  - Utilize factors such as weather patterns, soil conditions, and water availability to accurately forecast paddy yields per acre.
  - Develop a decision support system that provides actionable insights and recommendations based on the yield predictions to optimize agricultural practices and resource allocation.

- **Sub Objectives :**
  - Collect historical data on paddy crop yields from Rice Research and Development Institute Bathalagoda.
  - Develop key features and train a machine learning model for accurate yield predictions.
  - Integrate the model into a decision support system with a user-friendly interface for farmers.

Methodology

- **Data Collection:** Gather historical data on paddy yields, weather conditions, soil health, and irrigation patterns from reliable sources.
- **Pre-processing :** Clean, normalize, and augment the data to ensure it is suitable for model training.
- **Model Training :**Train a machine learning model using the processed dataset and fine-tune it for optimal performance.
- **Model Validation :** Split the dataset into training, validation, and test sets. Evaluate model performance using metrics like RMSE, MAE, and R^2.
- **Integration with Decision Support System :** Develop an algorithm to integrate yield predictions with actionable insights, providing recommendations for planting times, irrigation schedules, and fertilization strategies.

System Diagram



Technologies

- Python (Back end)
- Tensor Flow (Framework)
- ML (Classifications)
- ReactJS (Front end)
- HTML (Front end)
- CSS (Front end)
- Bootstrap (Front end)
- Google colab
- Git Hub (Version control system)
- Trello (Project Management)

Requirements

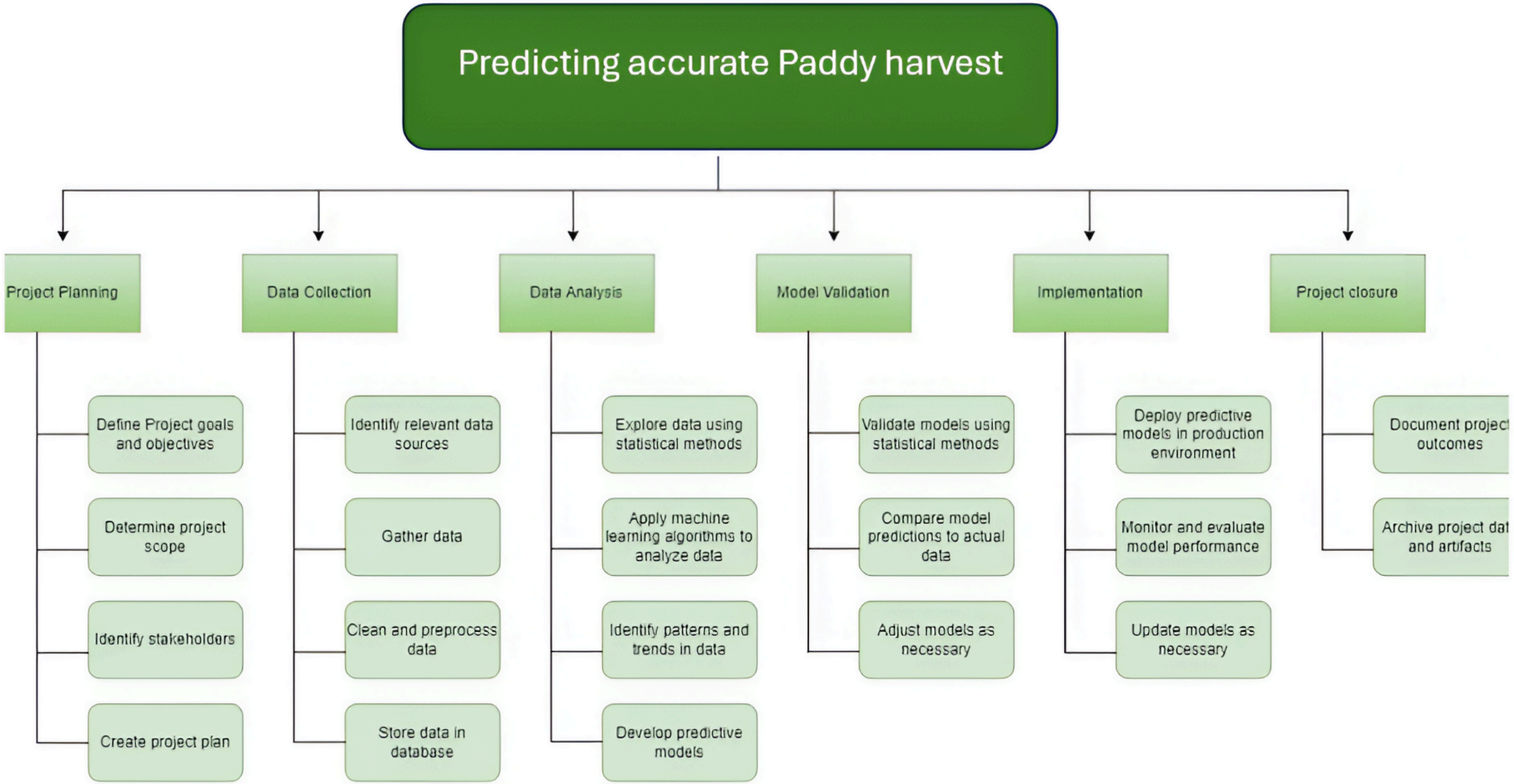
Non-functional requirements

- Availability
- Usability
- Performance
- Accuracy

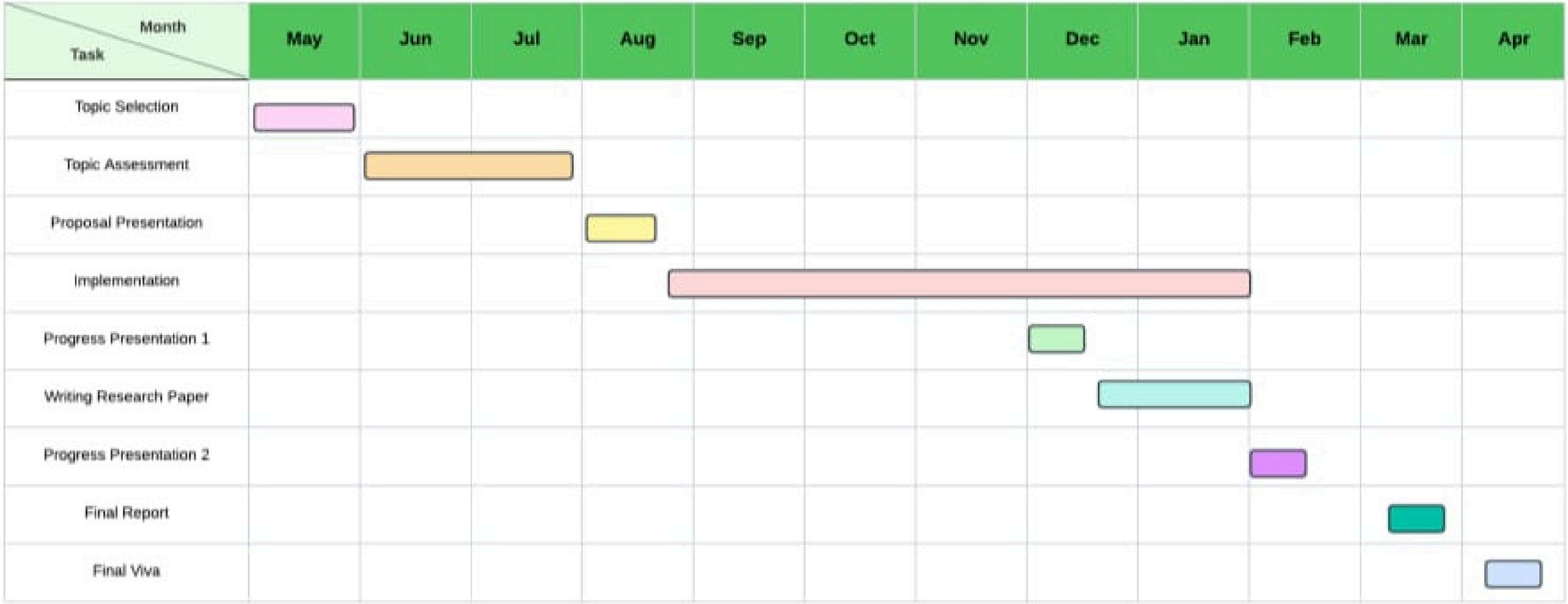
Functional requirements

- Yield Prediction
- Decision Support

Work Breakdown Structure



Gantt chart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Paddy Variety Prediction System

Information Technology

INTRODUCTION

This Research component which The Paddy Variety Prediction Model aims to ,

- **Identify the most suitable paddy varieties for specific regions in Sri Lanka**

- Based on local soil and weather conditions. By leveraging data analytics and machine learning techniques, this model seeks to optimize paddy cultivation, enhance crop yield, and improve economic outcomes for farmers.

Research Gap

- Currently, there is a lack of integrated systems that consider local soil and climatic conditions for predicting the best-suited paddy varieties. While various studies have explored crop yield prediction, specific focus on paddy variety suitability under diverse environmental conditions is limited. This project fills this gap by providing a comprehensive model that aids farmers in selecting the optimal paddy variety for their fields.

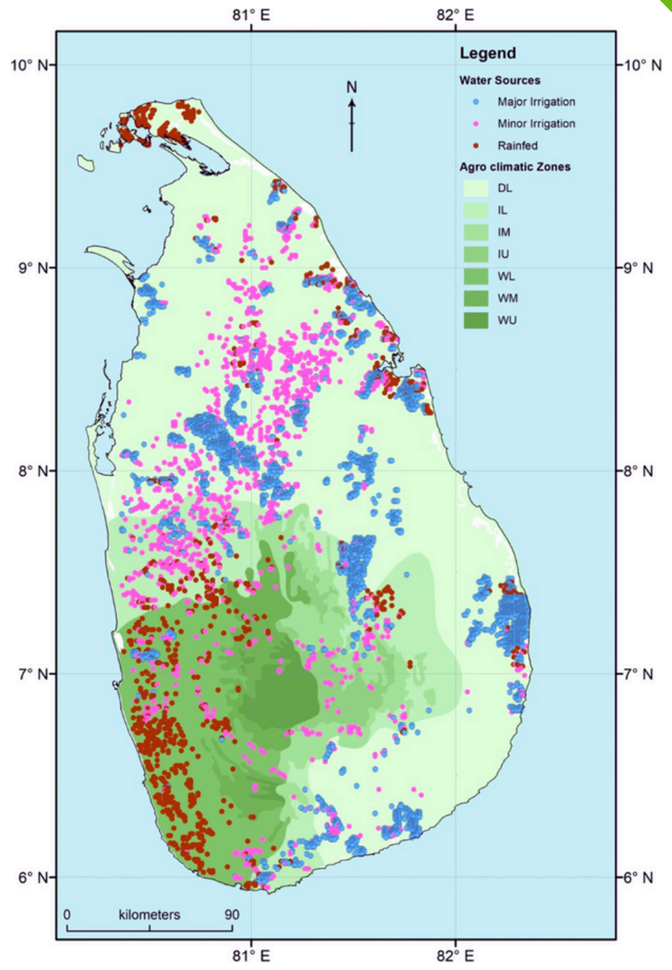
Research Problem

- The primary research problem is to establish a predictive relationship between different paddy varieties and the local environmental conditions, such as soil type, pH, moisture, temperature, and nutrient levels. The challenge lies in accurately predicting which paddy varieties can thrive in specific conditions to maximize yield and resilience to environmental stressors.

Specific and Sub Objectives

- **Specific Objectives :**
  - To develop a predictive model for determining the suitability of paddy varieties based on soil and climatic data.

- **Sub Objectives :**
  - Collect and analyze data on paady varieties, various soil parameters (pH, moisture, nutrient content) and weather conditions (temperature, rainfall).
  - Identify the key factors influencing the growth and yield of different paddy varieties.
  - Develop a machine learning model to predict the most suitable paddy variety for an area of the country under given set of environmental conditions.



Mapping Productivity-related Spatial Characteristics in Rice-based Cropping Systems in Sri Lanka

Methodology

- **Data Collection:**Gather data on soil properties (pH, NPK levels, soil moisture), and climatic conditions (temperature, humidity, rainfall) from relevant agricultural departments and field studies.

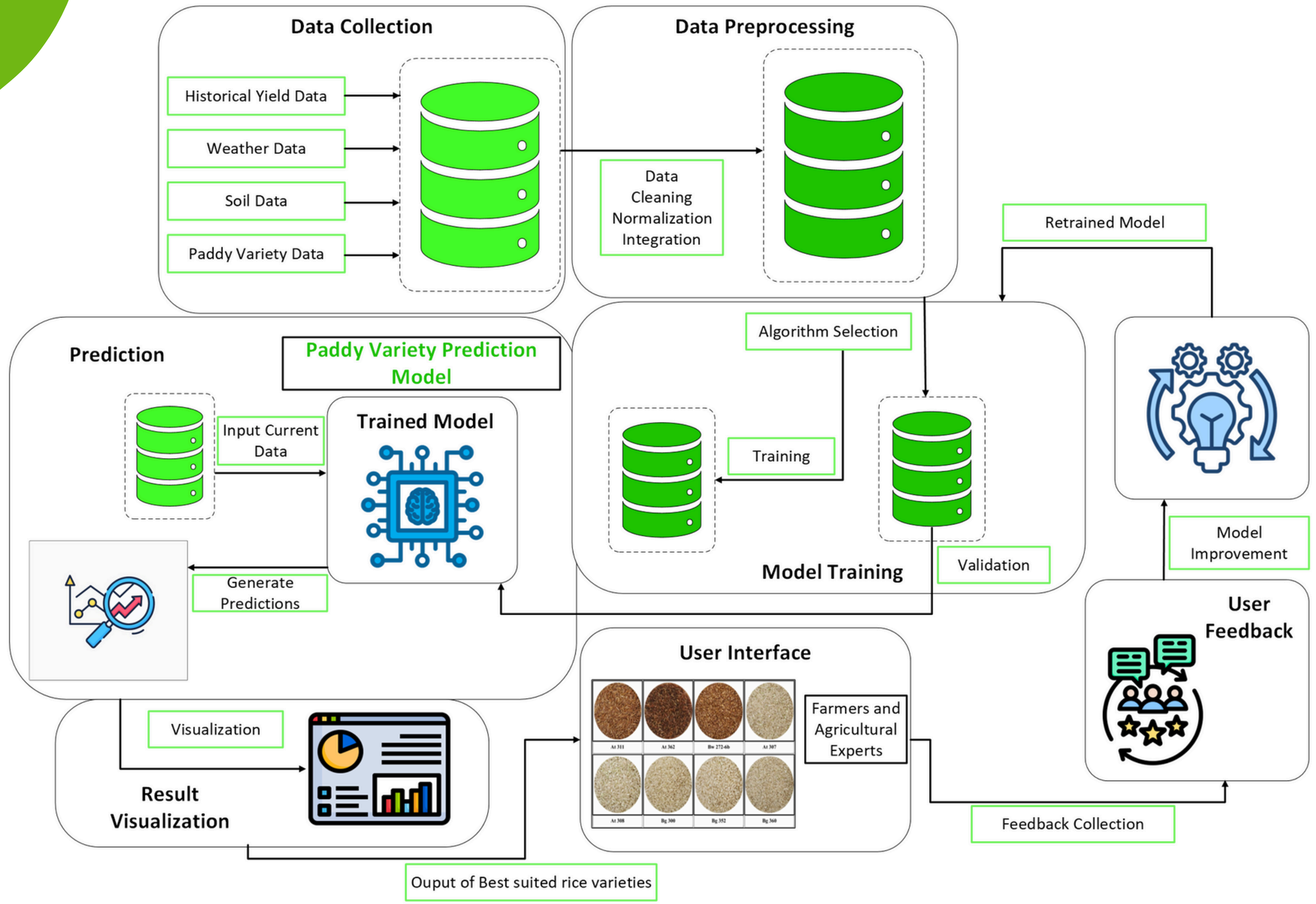
- **Data Analysis:**Analyze the collected data to identify patterns and relationships between soil/climatic factors and paddy variety performance.

- **Model Development:**Use machine learning techniques, such as decision trees, support vector machines, or neural networks, to develop a predictive model.
- Train the model on historical data to learn the relationship between environmental conditions and paddy variety yield.

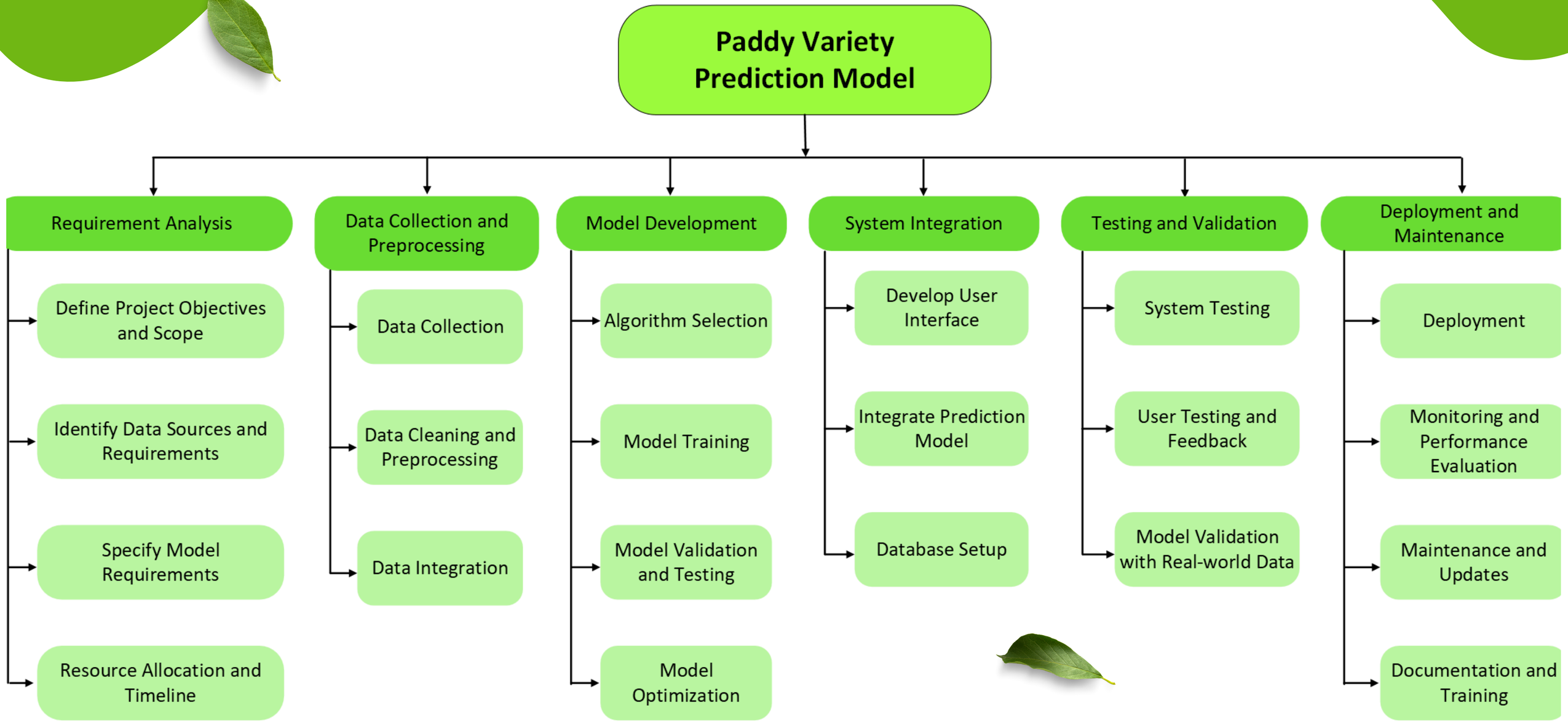
- **Model Validation:**Validate the model using a separate dataset to assess its accuracy and reliability in predicting suitable paddy varieties.

- **Implementation:**Develop a user-friendly interface for farmers to input their local conditions and receive recommendations on the best-suited paddy varieties.

System Diagram



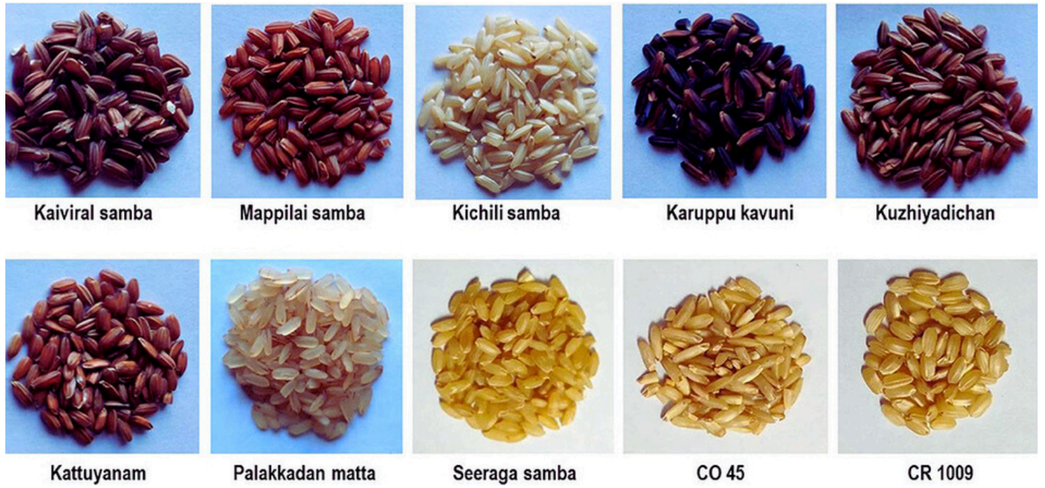
Work Breakdown Structure



Requirements

Non-functional requirements

- Accessibility: Ensure the system is accessible to all users, including farmers with limited technical expertise.
- Reliability: The model should provide consistent and accurate predictions.
- Performance: The system should deliver predictions promptly.
- Usability: The interface should be intuitive and easy to use.



Functional requirements

- Ability to analyze environmental data.
- Ability to predict the best paddy variety for specific conditions.

Technologies

- Python (Back end)
- Tensor Flow (Framework)
- ML (Classifications)
- ReactJS (Front end)
- HTML (Front end)
- CSS (Front end)
- Bootstrap (Front end)
- Jupitor notebook
- Google colab
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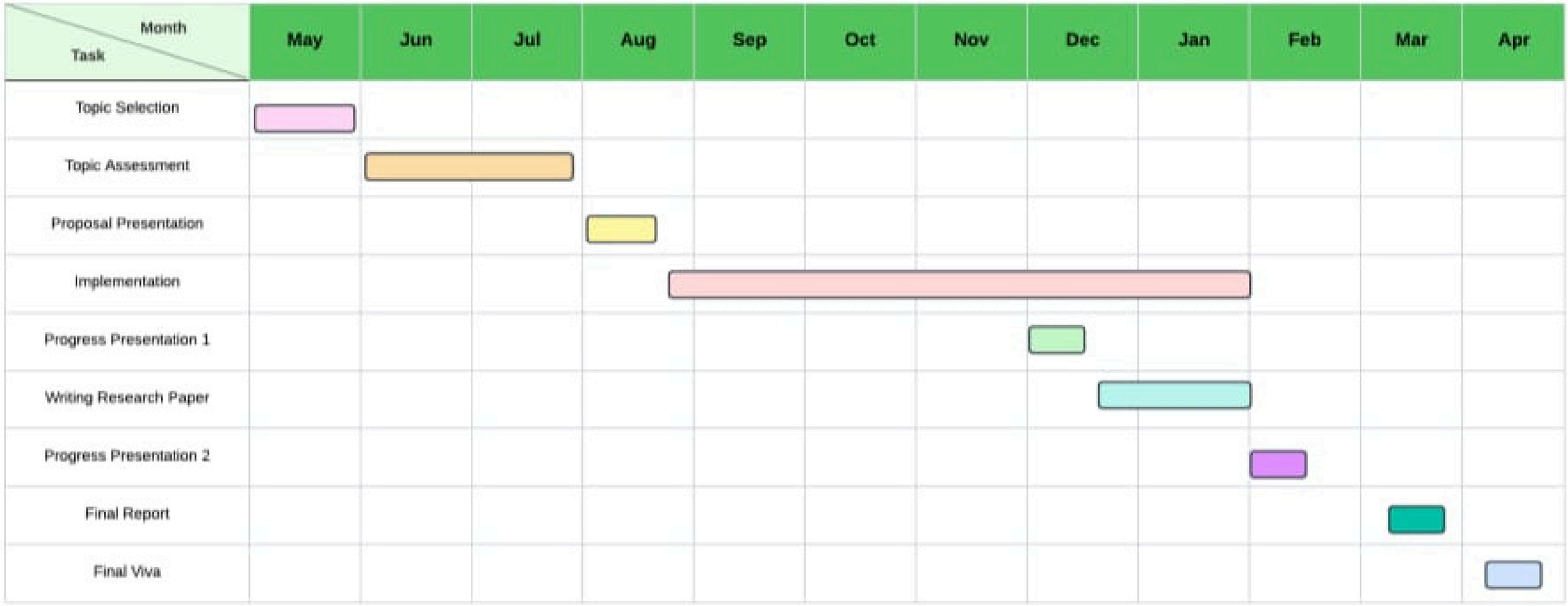
Gantt chart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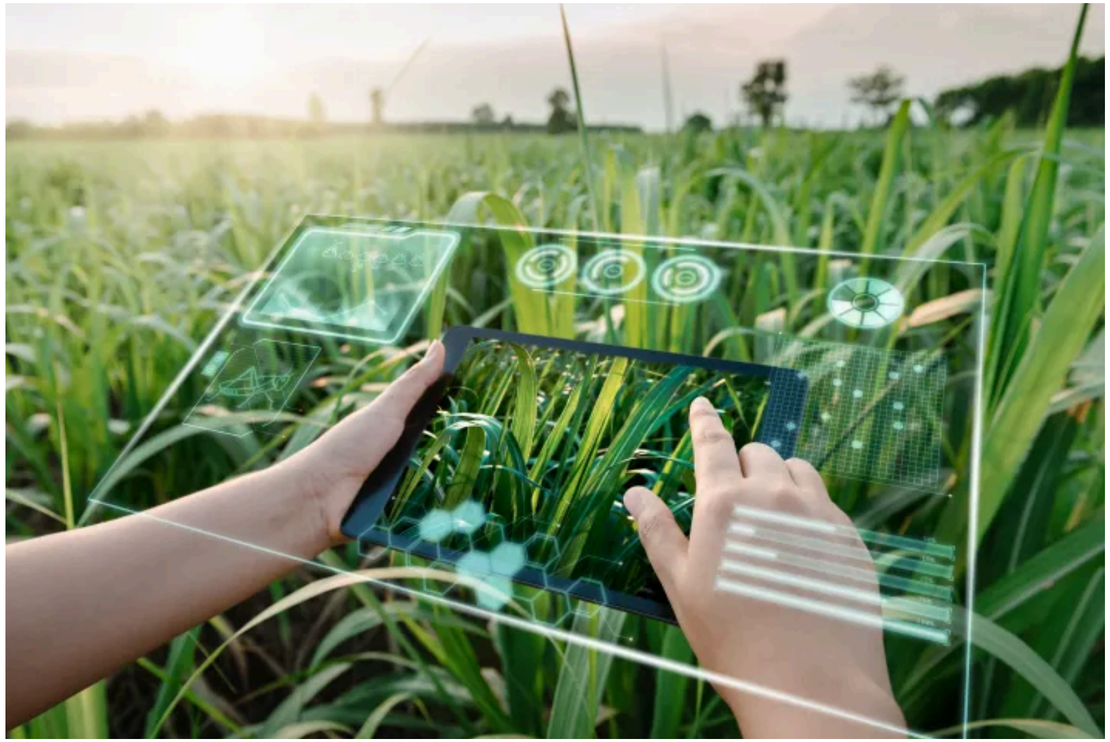
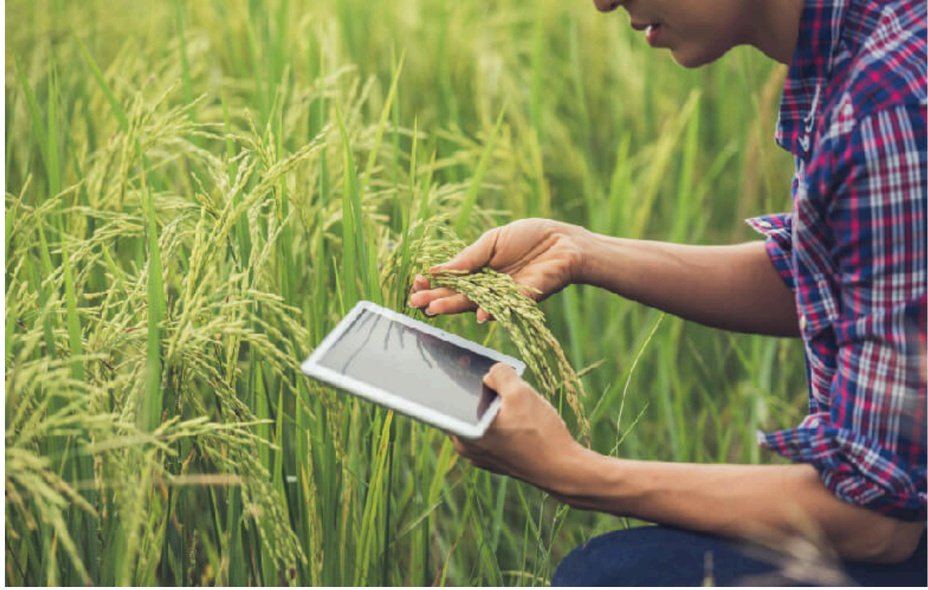
Pest & Disease Detection & Mitigation System



Information Technology

INTRODUCTION



This Research component is about paddy disease identification,

- Paddy diseases can have a significant impact on crop yield and quality.
- It is important to identify the paddy diseases at an **early stage to prevent their spread and minimize** damage.
- I**mage processing techniques** can be used to analyze digital images of plants and identify signs of disease.
- Image processing offers a promising approach for rapid and accurate detection of plant diseases, which can help to support more effective disease management and control strategies.

Research Gap

1. Limited focus on integrated solutions: Most existing studies focus only on disease detection, not on providing treatment recommendations.

2. Lack of real-time processing: Many methods do not offer real-time disease detection and treatment suggestions.

3.Insufficient accuracy: Current systems may not be accurate enough in identifying specific paddy diseases.

4. Scalability issues: Many approaches do not scale well for large agricultural fields.

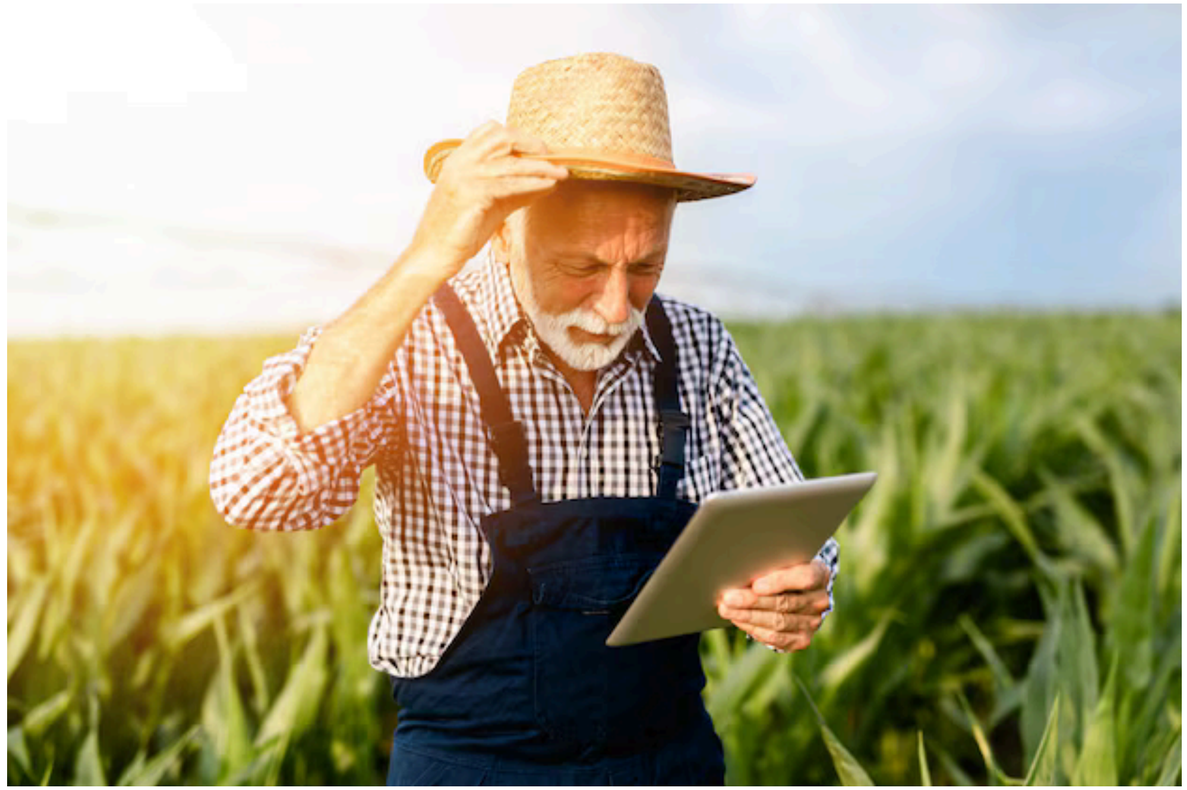
5. Lack of user-friendly interfaces: There is a need for more emotionally and easy-to-use interfaces for farmers.

Research Gap

Features	Research A [1]	Research B [2]	Research C [3]	Proposed solution
Provide sustainable solutions to paddy diseases	NO	NO	No	YES
Identify diseases in commercially viable plants	NO	NO	Yes	YES
Report Generation	NO	NO	NO	YES
ML techniques	YES	YES	YES	YES
Image processing techniques	YES	YES	YES	YES

Research Problem

- Reduced crop yield
- Quality degradation and low marketability
- Higher production costs
- Crop loss due to reduced shelf life
- Economic losses



Specific and Sub Objectives

Specific Objectives :

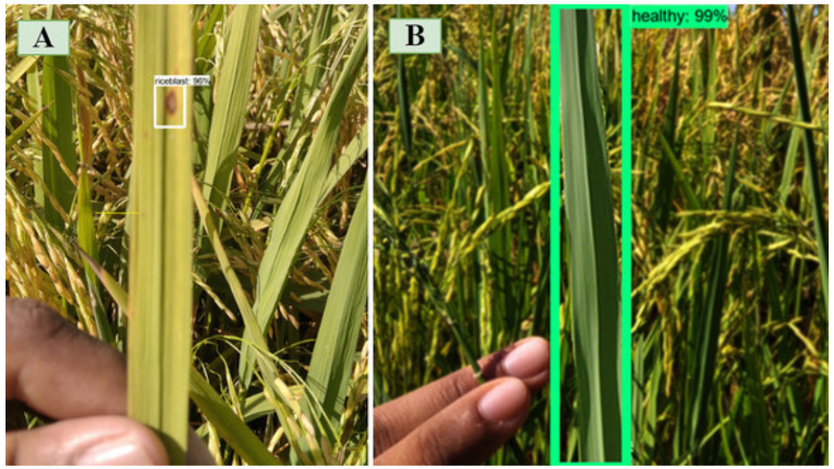
a. **Monitor and maintain healthy growth** of commercially viable paddies by paddy
b. I**ntegrated Disease Detection and Treatment System**: While many systems focus solely on disease detection, our project stands out by integrating both detection and treatment recommendations in a single platform.

Sub Objectives :

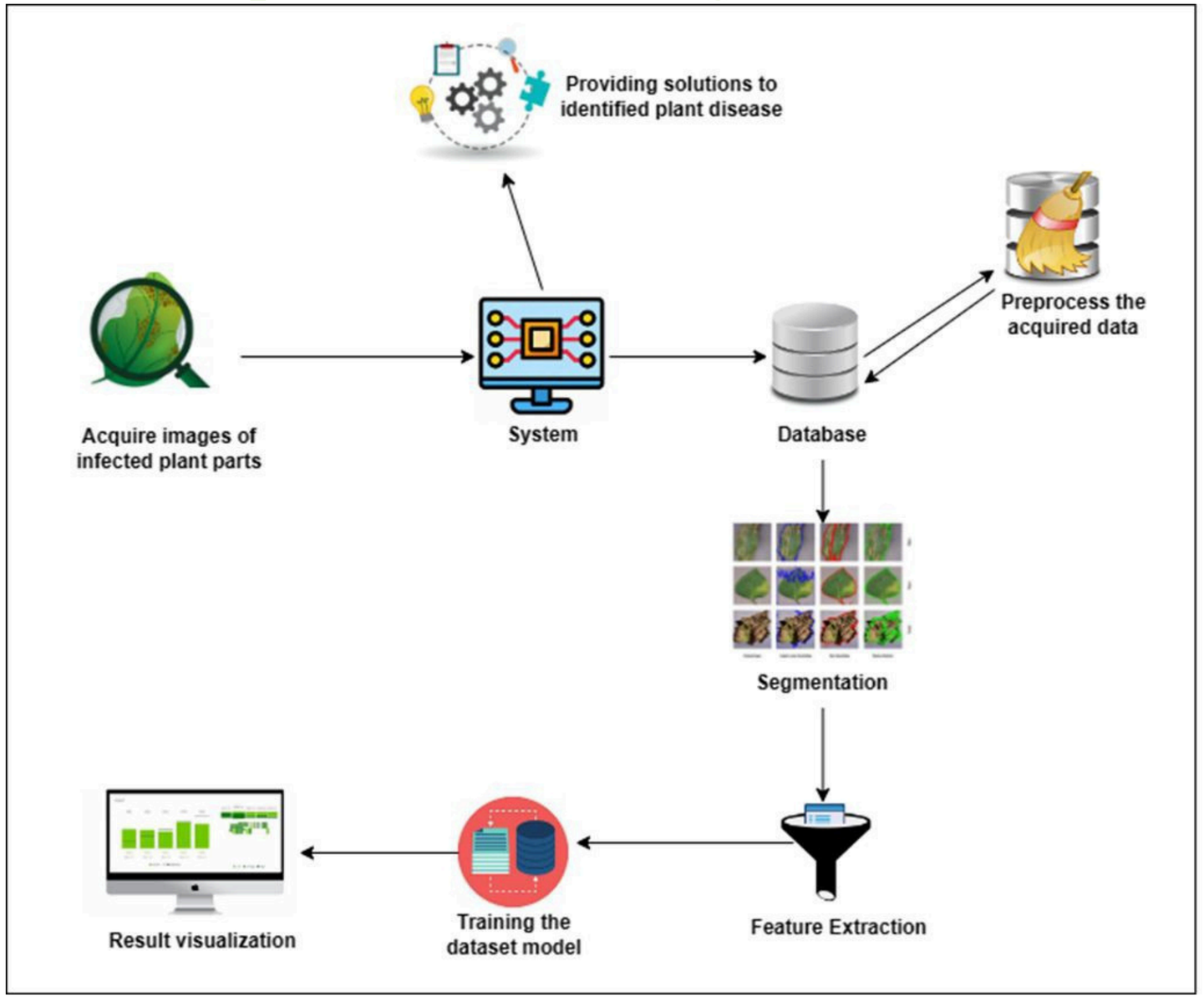
- Provide **sustainable treatments** for paddy diseases
- **Generate report** of plant diseases
- **Customized Treatment Recommendations**: The treatment suggestions are tailored to the specific disease detected, considering factors like severity and local agricultural practices.

Methodology

- **Image Acquisition:** capturing high quality images of plants using digital cameras.
- **Pre-processing :** captured images are preprocessed to improve image quality
- **Segmentation:** separating the plant parts from the background and isolating the region of interest.
- **Feature Extraction :** Features are extracted from image ,these features may include color, texture, shape, or any other relevant features that can help distinguish between healthy and diseased plants.
- **Classification :** classifying 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.
- **Visualization:** The results are visualized to provide a clear and concise output to the user. This includes highlighting the infected area in the image.
- **Diagnosis :** The system identifies the type of plant disease and suggests appropriate treatment measures, Based on the classification results.



System Diagram



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- Google Colab
- Git Hub (Version control system)
- Trello(Project Management)

Requirements

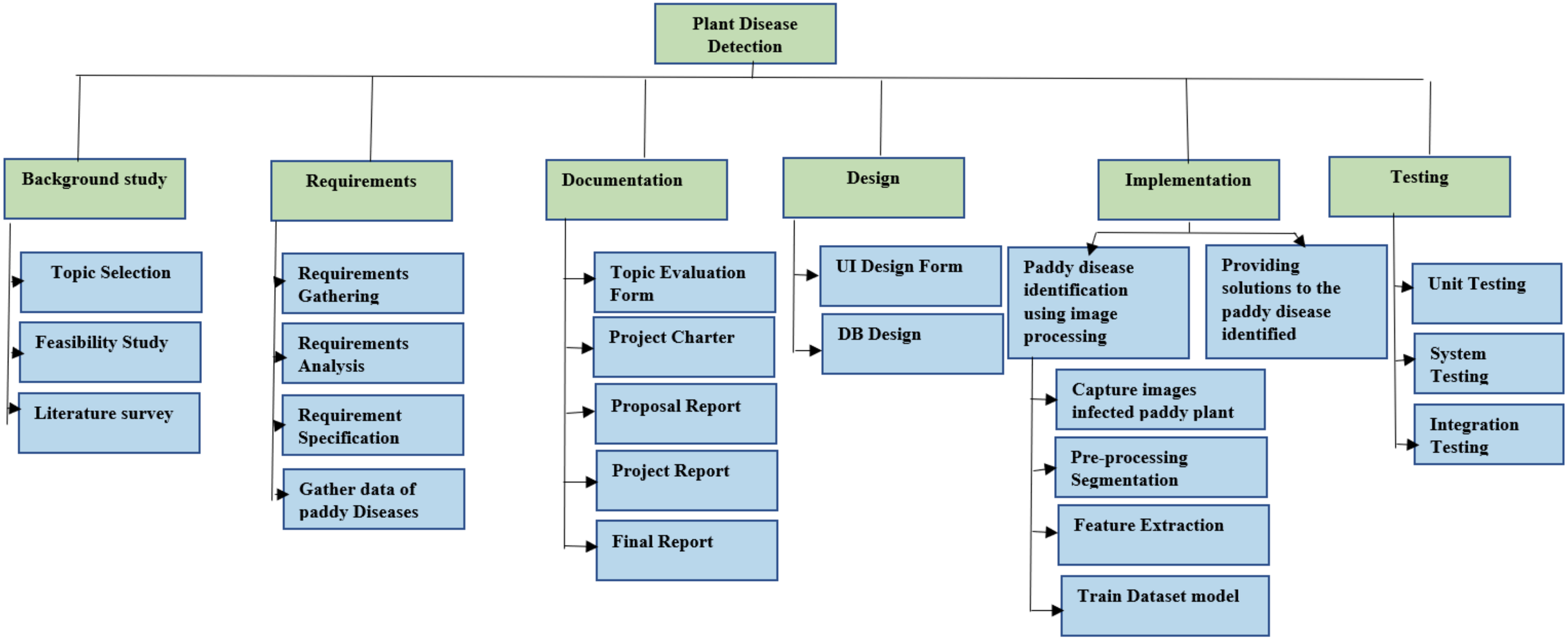
Non-functional requirements

- Availability - Accessible
- Reliability - perform without Errors
- Performance - quickly
- Usability - easy to use

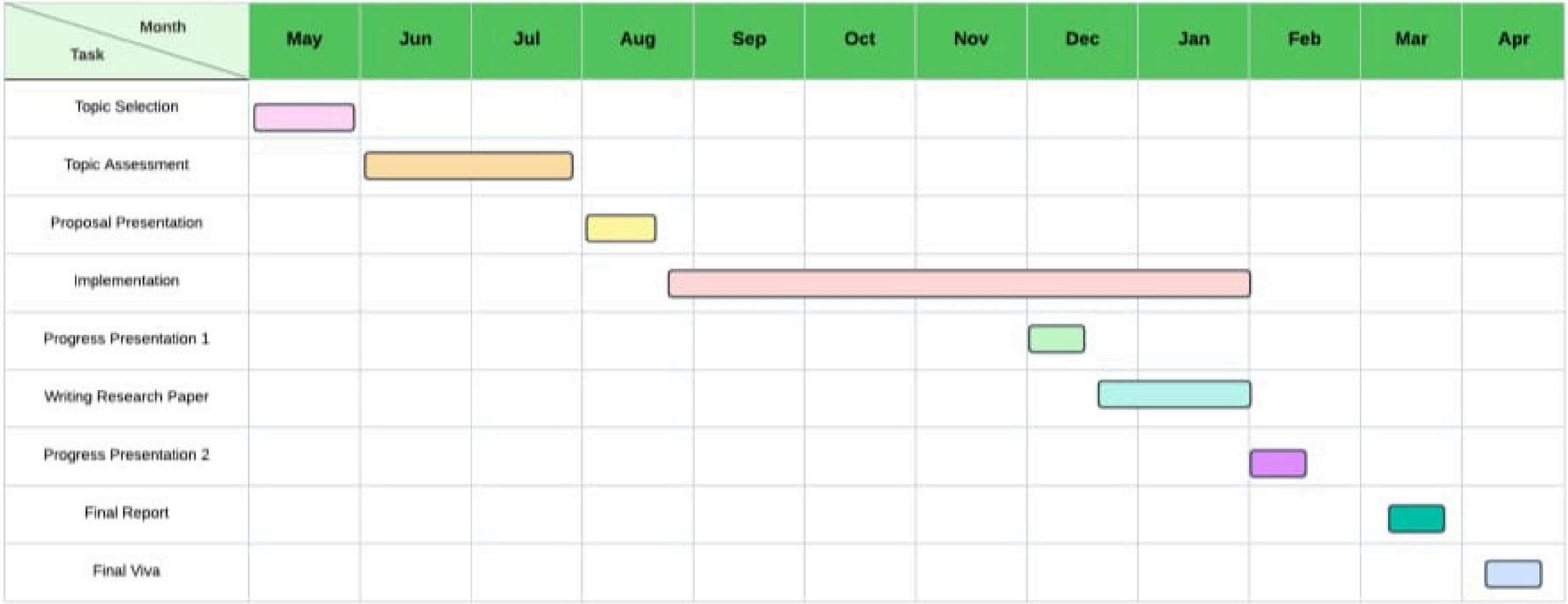
Functional requirements

- Ability to identify plant diseases
- Ability to suggest treatment to diseases

Work Breakdown Structure



Gantt chart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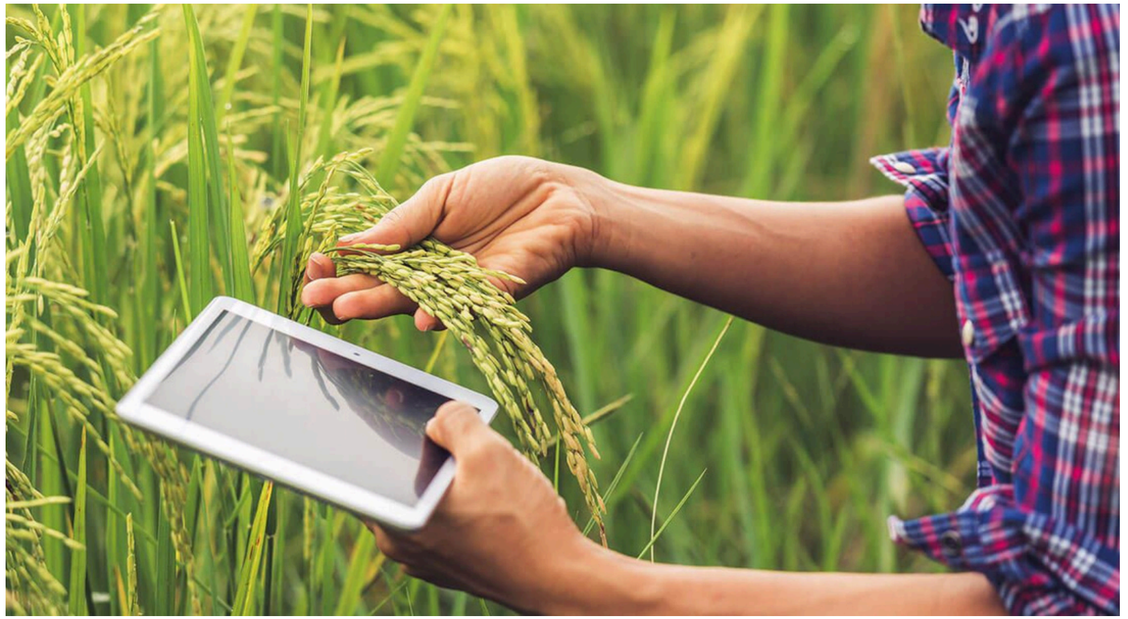
Weed Detection & Mitigation System



Information Technology

INTRODUCTION

- **This Research component is about,**
  - Identify and mitigate weed varieties in paddy fields
- **Machine learning and image processing offer innovative solutions for real-time weed management.**
- **An Accurate weed detection and mitigation system can enhance productivity and reduce losses.**

RESEARCH GAP

- Traditional weed detection relies on manual identification, which is time-consuming and less accurate.
- Bad mitigation strategies can cause huge negative impacts not only on paddy yield but also on properties like soil and water !!
- Lack of integrated solutions that provide both detection and mitigation recommendations.

RESEARCH PROBLEM

Building a system that offers accurate mitigation strategies based on detected weed species is needed.

- Build an automated system to detect and classify weed species accurately and recommend mitigation strategies with a user-friendly user interface.

SPECIFIC AND SUB OBJECTIVES

- **Specific Objectives :**
  - Enhance paddy crop yield by developing a robust weed detection and mitigation system using machine learning.

- **Sub Objectives :**
  - Develop an Image Classification Model for Weed Detection: Train a model to identify and classify weeds.
  - Implement a Weed Mitigation Recommendation System: Suggest effective control strategies for detected weeds.

METHODOLOGY

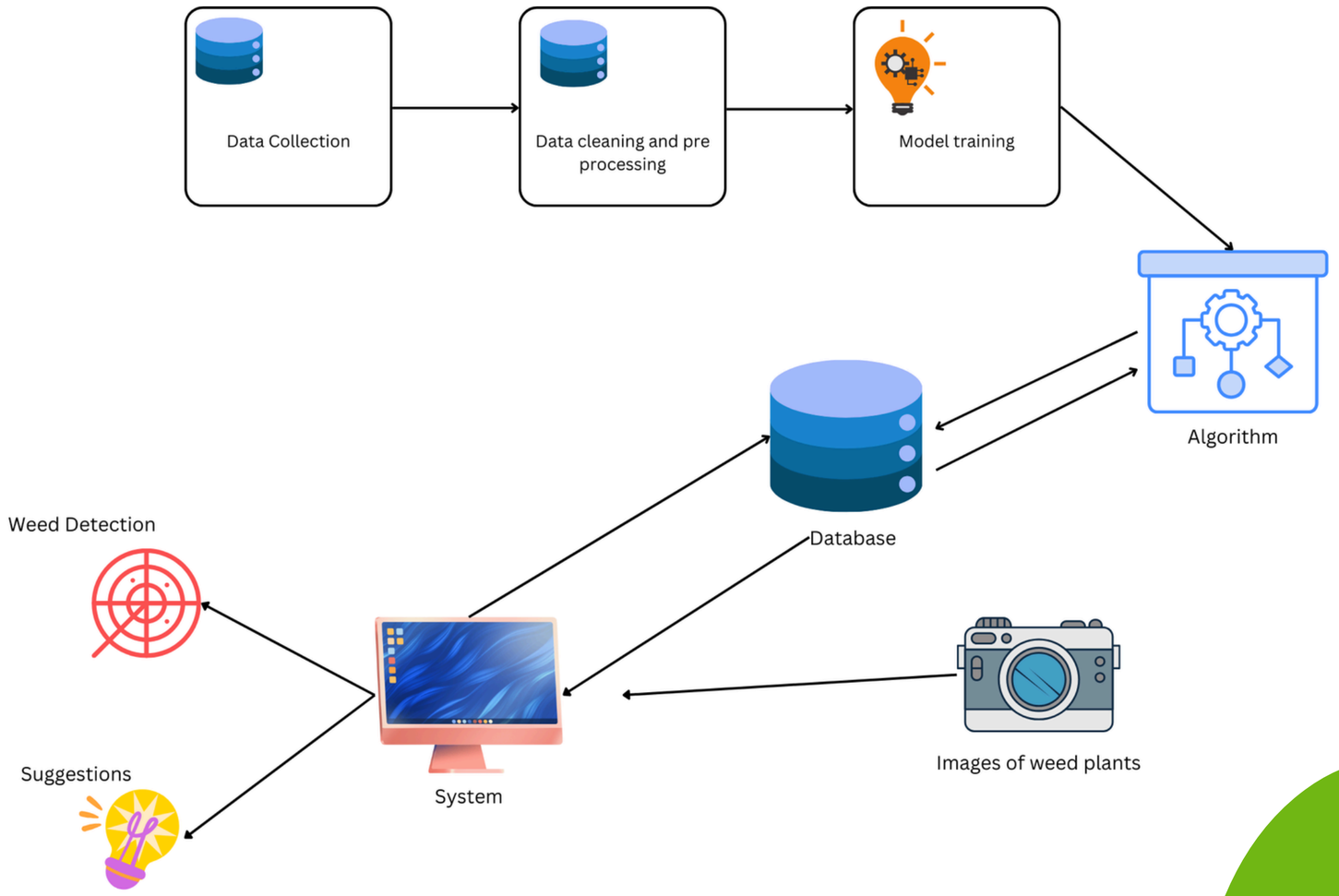
- **Dataset Collection and Preprocessing**
  - Collect Images
  - Preprocess Images

- **Model Training and Validation**
  - Split Dataset: Divide into training, validation, and test sets.
  - Choose Model: Select and train a CNN for image classification.
  - Evaluate Model: Assess performance

- **Development and Integration**
  - Document Details(DB) : Include methods, techniques, and dosages.
  - Develop Algorithm: Link detected weeds to mitigation strategies.
  - User Interface Development: Design an interface to upload images and receive mitigation methods.

- **Field Testing and Feedback Collection**

SYSTEM DIAGRAM



TECHNOLOGIES

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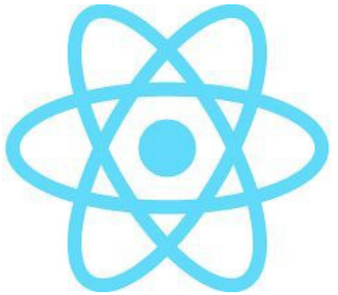
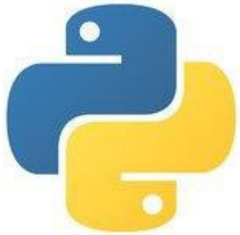
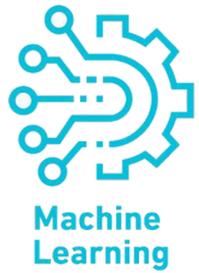






Requirements

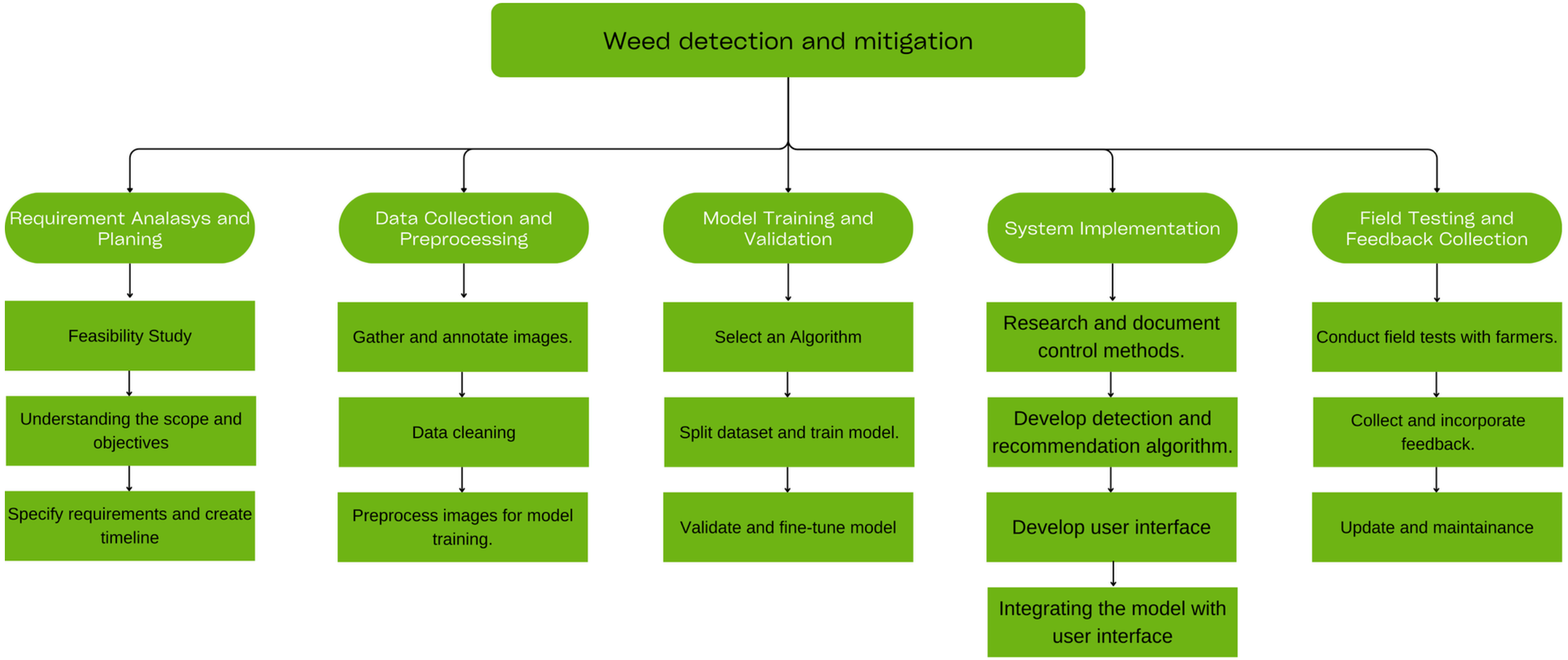
Non-functional requirements

- Availability
- Reliability
- Performance
- Usability

Functional requirements

- Ability to identify weed varieties
- Ability to suggest treatments to mitigate weed plants

Work Breakdown Structure



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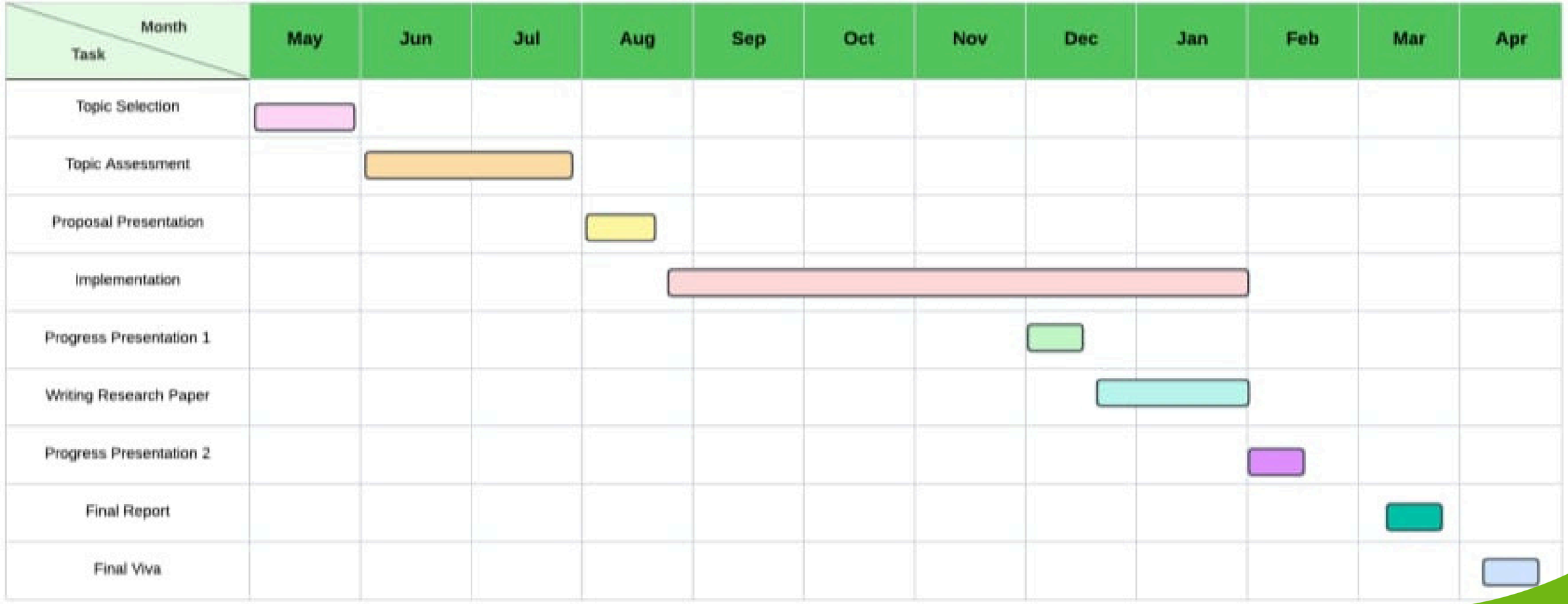
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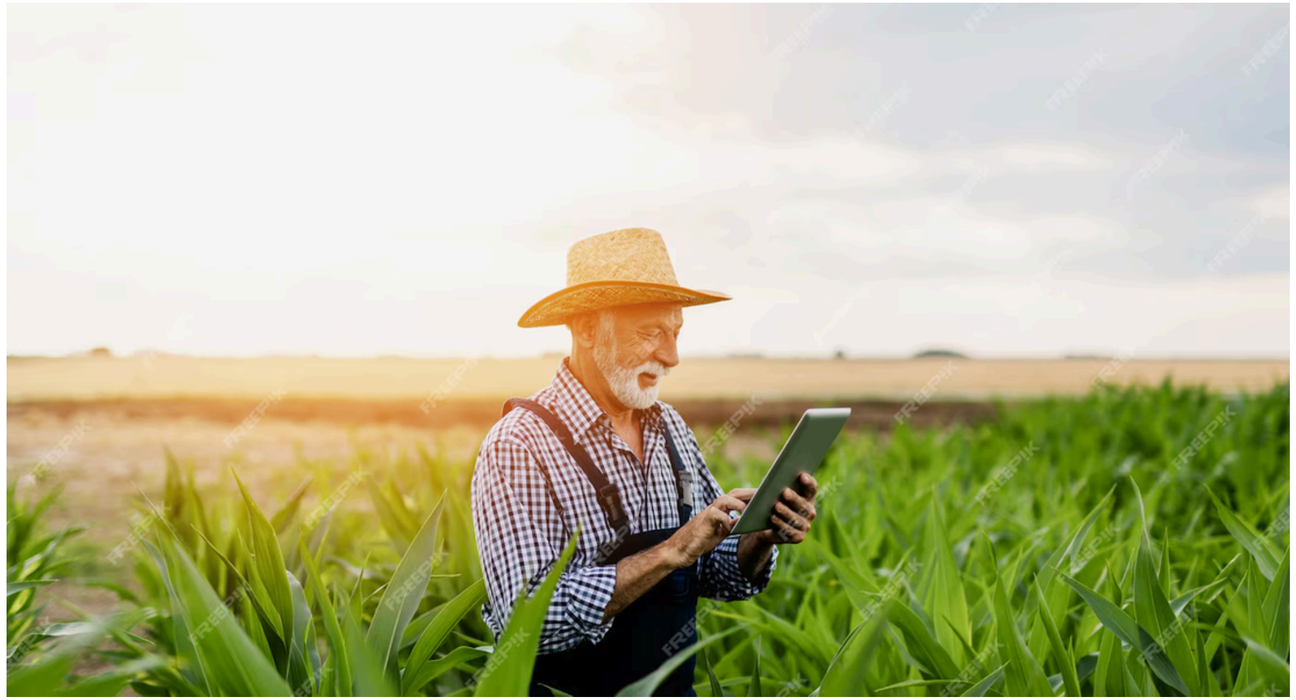
[3] Radhika Kamath, Mamatha Balachandra, Amodini Vardhan & Ujjwal Maheshwari | (2022) Classification of paddy crop and weeds using semantic segmentation, https://doi.org/10.1080/23311916.2021.2018791

Supportive information



Commercialization

- **Target Market Sectors:**
  - Farmers, agricultural extension officers, and other stakeholders involved in the agriculture industry.
  - Government agencies responsible for agriculture policies.

- **Marketing Plan :**
  - Developing and maintaining a website to showcase features, benefits, and usage guidelines
  - Conducting live demonstrations and training workshops for farmers and agricultural extension officers.

Budget

	Cost (in LKR)
Domain Hosting space (If needed per month) Travelling cost	7500 2000 * 4* 11
Total	95,500.00

- The budget mentioned is a rough estimate and may vary according to the purpose when developing the system.


THANKS FOR
Your Attention