PapayaBuddy 

Enhancing Papaya Cultivation through Advanced Monitoring

Introduction

- Papaya is a vital crop in tropical agriculture, contributing significantly to both the economy and nutrition. It covers extensive cultivation areas and provides essential income for many farmers.

- The high incidence of pests and diseases poses significant threats to papaya production and farm productivity. Early detection and management of these diseases are critical to sustaining healthy crops and maximizing yields.

- A smart agricultural solution with automated plant disease detection and classification tools offers a valuable resource for supporting farm decision-making. Our system integrates advanced AI technologies to diagnose papaya plant diseases accurately and efficiently, even those undetectable by the untrained human eye.

Research Question

- Many diseases are difficult to detect in their early stages, leading to severe outbreaks and significant crop losses.
- Most farmers are not aware of the specific diseases and pests affecting papaya cultivation. They only recognize that their plants are diseased without understanding the exact nature of the problem.
- Due to this lack of knowledge, farmers often resort to using any available chemical treatments or removing affected plants entirely, leading to reduced income and yield.

Main & Sub Objectives

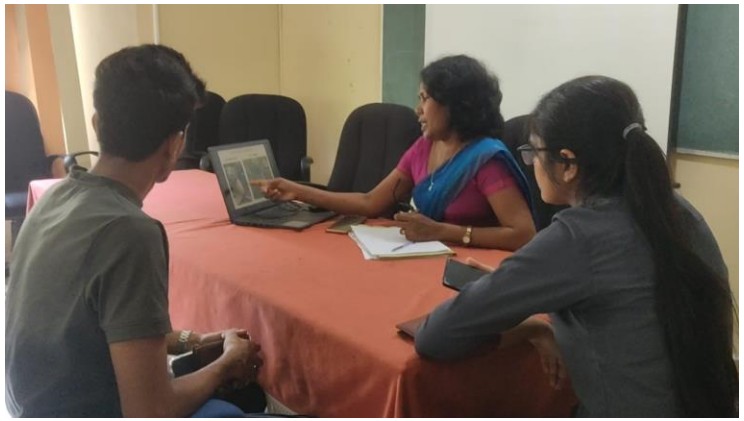
Main Objective

Advanced Monitoring system for disease and pest controlling for papaya cultivation.

Sub Objectives

1. Identification and classification of Papaya Mosaic and Cercospora leaf disease.
2. Identification and classification of Papaya Ringspot Virus and Powdery Mildew.
3. Identification and classification of Mite and Mealy Bug.
4. Identification of progress level of cercospora and Identification of Diseases Using Customized GPT.

Field Visit



System Diagram

IT21161056 | Peiris M. M. A. E

Software Engineering

Introduction

- Papaya (Carica papaya) is a crucial fruit crop in tropical and subtropical regions worldwide.
- In Sri Lanka, papaya is grown in various provinces, including Western, North Western, Central, and Southern provinces, with a total production of around 30,000 tonnes annually [1].
- The productivity and quality of papaya are severely impacted by various diseases, including the Papaya mosaic virus (PapMV) and Cercospora leaf spot.
- Mosaic virus reported the widespread occurrence of papaya mosaic virus in Sri Lanka, highlighting the need for effective management strategies.[2]
- Fernando et al. (2015) [3] emphasized the importance of early detection and management of Cercospora leaf spot to prevent significant yield losses.
- A study in the Central Province of Sri Lanka found that 75% of papaya samples were infected with Papaya Cercospora Virus (PCV) [4]

Research Gap

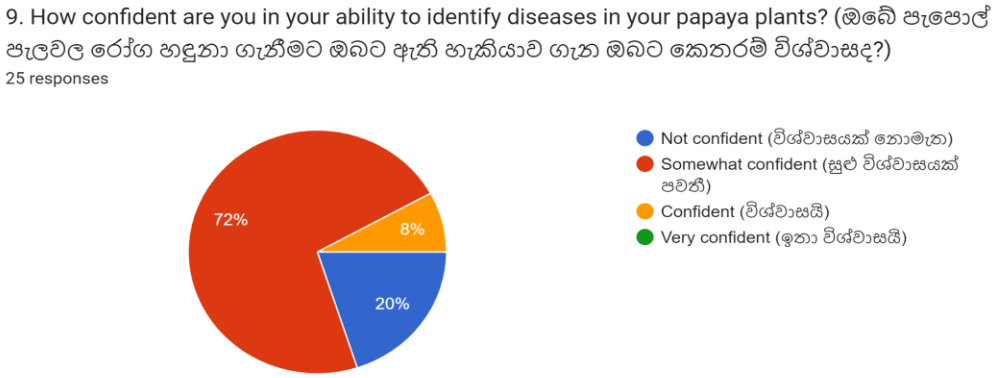
Application Reference	Mobile App	EffientNet	Vision Transformer	CNN	Mosaic Virus	Cercospora	Remedy Suggestion	Accuracy
Research 1	✓	✗	✗	✓	✗	✗	✗	82.0%(MobileNet)
Research 2	✗	✗	✗	✓	✗	✗	✗	81.48%
Research 3	✗	✗	✗	✓	✗	✗	✗	80%
Proposed System	✓	✓	✓	✓	✓	✓	✓	

Research 1 - Enhanced Plant Disease Detection Using Deep Learning and Mobile-Based Application.
Research 2 - A Comparative Study of Deep Learning Models for Plant Disease Detection.
Research 3 - Deep Learning Techniques for Plant Disease Detection: A Review.

"How can we revolutionize papaya farming in Sri Lanka?"

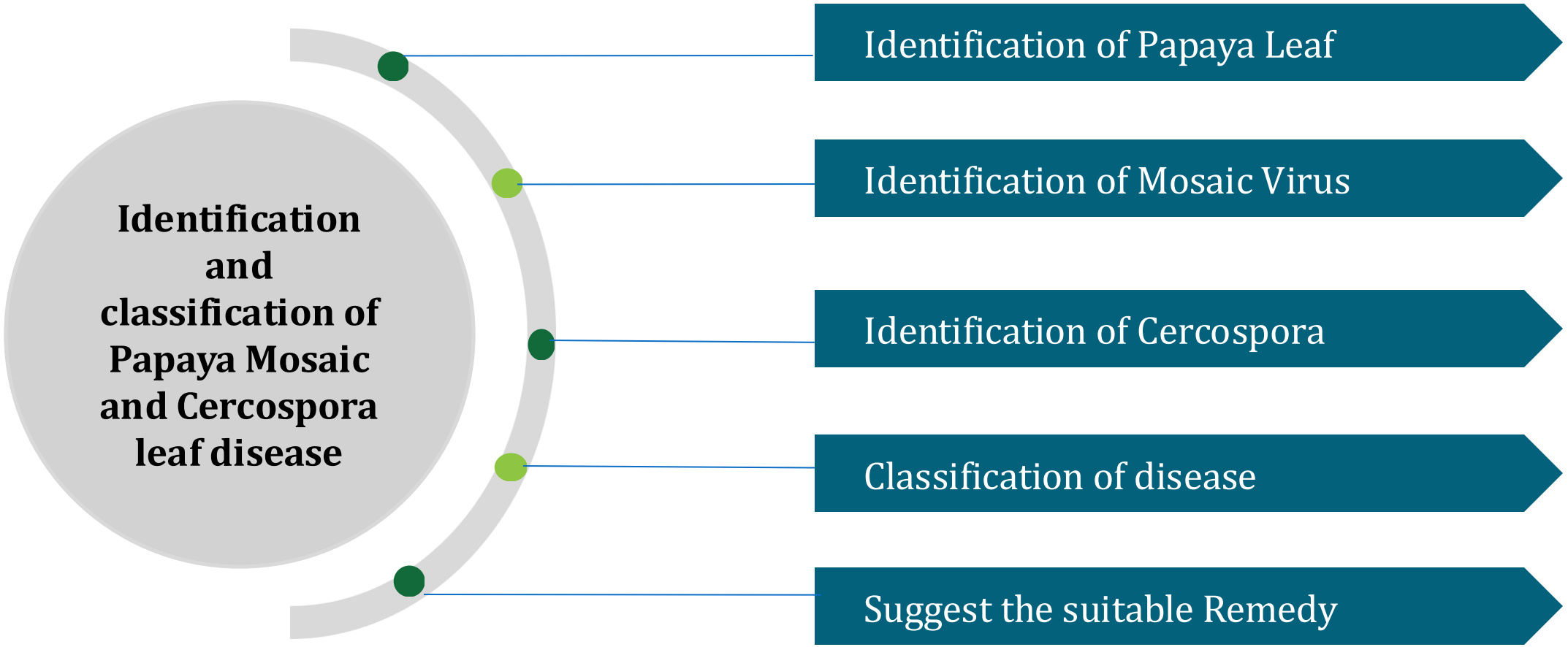
Leveraging cutting-edge mobile technology and machine learning,
to precisely detect and manage:

- Papaya Mosaic Virus
- Cercospora Leaf Spot

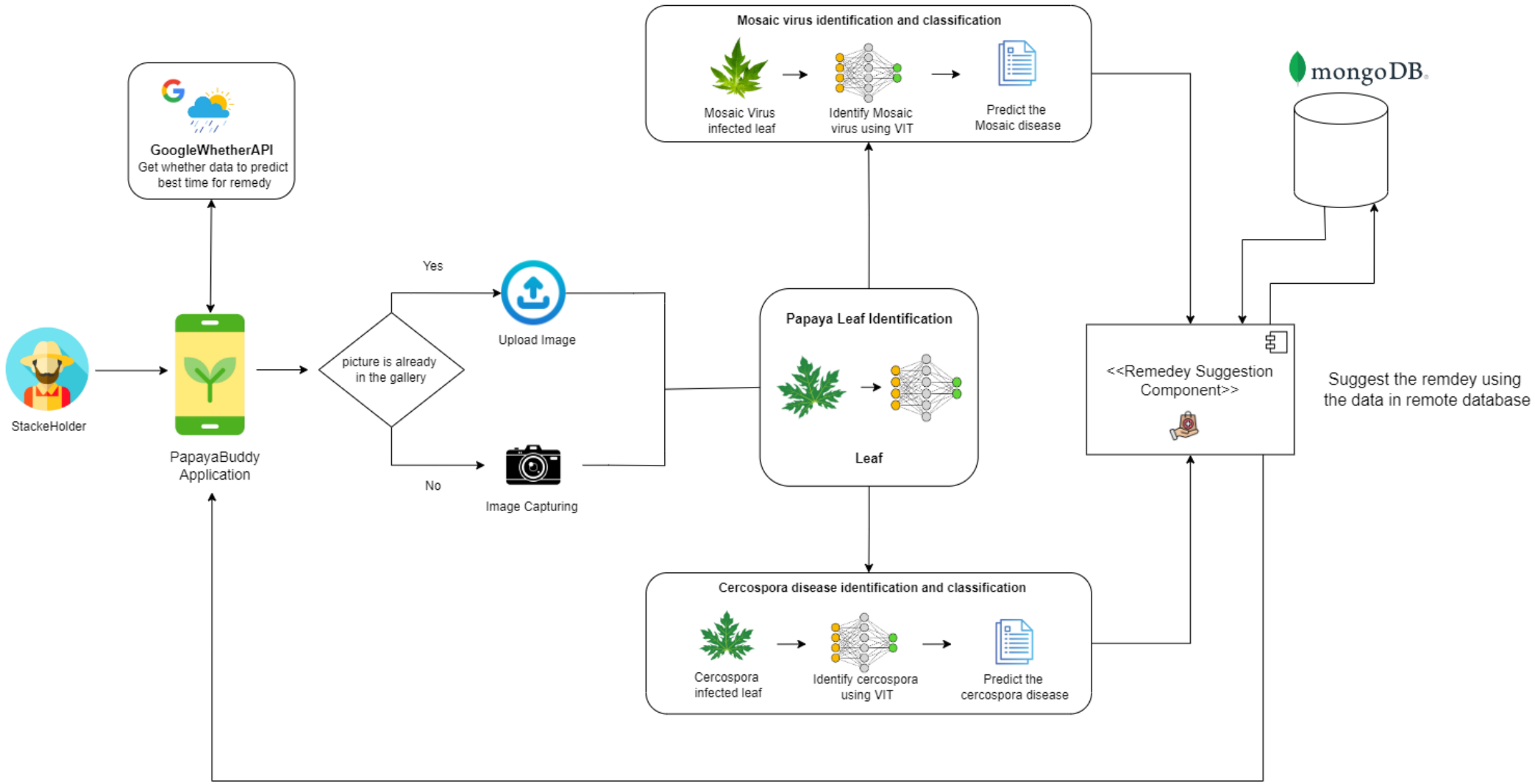


Can this innovation empower rural farmers with real-time, accurate disease diagnosis and effective management strategies?

Specific and Sub Objectives



System Diagram



Requirements

Functional Requirements

- **Data Collection**: Gather and annotate a diverse papaya leaf image dataset for mosaic and Cercospora diseases.
- **Data Preprocessing**: Resize, augment, and normalize images.
- **Model Development**: Implement EfficientNet and Vision Transformers, combine them into a hybrid model, and train on the dataset.
- **Model Evaluation**: Evaluate using accuracy, precision, recall, F1-score, AUC-ROC, and compare models.
- **Deployment**: Deploy the model in an app for automated disease diagnosis from uploaded leaf images.

Non – Functional Requirements

- **Usability**: User-friendly interface, clear instructions.
- **Availability** – Should be able to use, when needed.
- **Reliability** - There should never be a glitch or deadlock in the system during the operation and user interaction.
- **Higher Accuracy** - The accuracy of results needs to be high.
- **Performance**: Should be able to process images in real-time (less than 1 second per image)
- **Scalability**: Should be able to handle large datasets and be scalable for deployment on cloud platforms.

Software Requirements

- Flutter
- Python
- MongoDB
- OpenCV
- TensorFlow
- Github
- Git
- PyCharm

Personal Requirements

Resources and data set of Papaya Cercospora virus and Mosaic virus.

- Fruit Research and Development Institute (FRDI) - Horana
- Mrs. Thilini Anuradha (RA – Research Assistance)
- Papaya landowners near Diwulapitiya

Requirements

Techniques

- Image Data Collection and Annotation
- Image pre-processing
- Image augmentation
- Transfer Learning
- Model Ensembling
- Explainability Tools (e.g. LIME, SHAP)

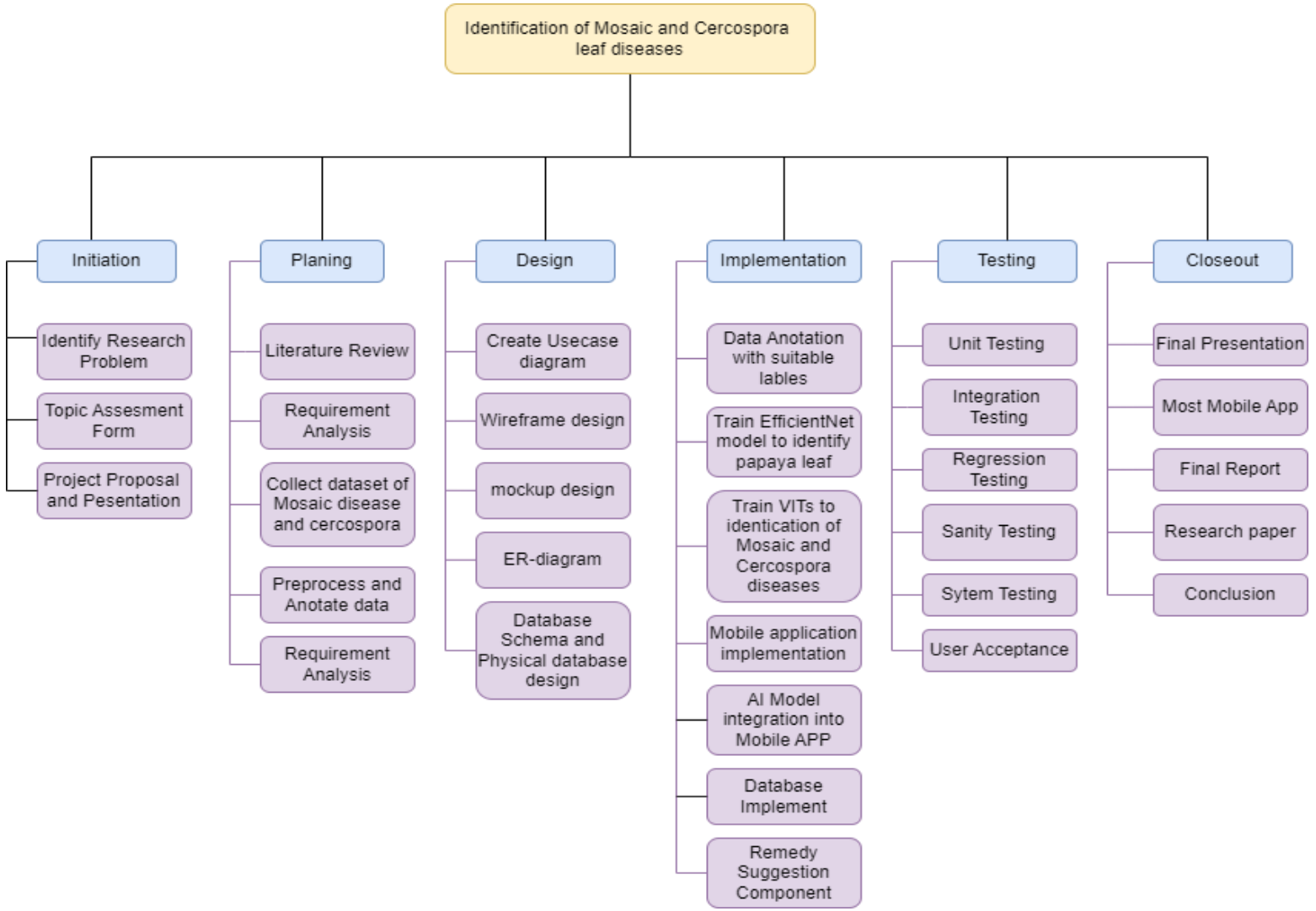
Technologies

- Flutter
- Python
- OpenCV
- TensorFlow
- FastAPI
- MongoDB
- Azure/AWS

Algorithms

- EfficientNet
- Vision Transformers (VITs)

Work breakdown Chart



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IT21160066 | K.K.P. Perakum

Software Engineering

Introduction

- Papaya crop in Sri Lanka are significantly affected by various diseases, such as ringspot, powdery mildew, anthracnose, black spot and phytophthora, which were identified as common and detrimental in research conducted in 2019. [1]

- The Ringspot disease affects papaya plants at all stages of growth and naturally spreads very quickly, leading to infection of the whole orchard within 3–7 months with severe yield losses of up to 100%. [4]

- Reduce the yield.
  Reduce the fruit quality.

- No such research found in Sri Lanka for implementing a mobile app for this work.

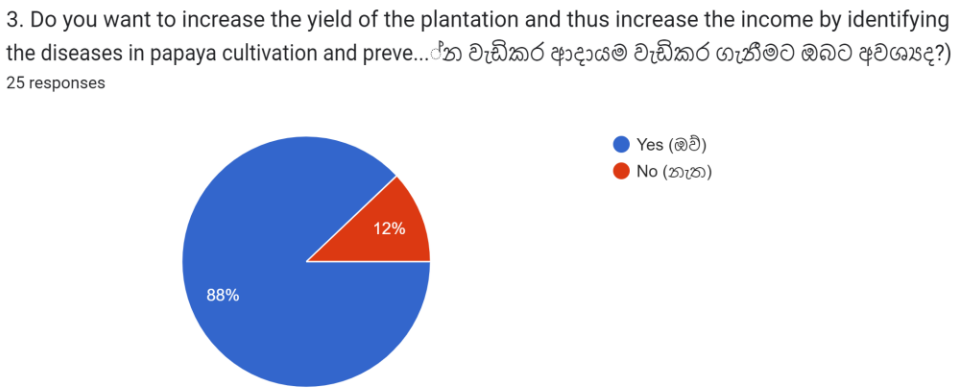
- Also, No such research found in Sri Lanka which is done for remedy suggestion for Ringpsot virus and Powdery mildew.

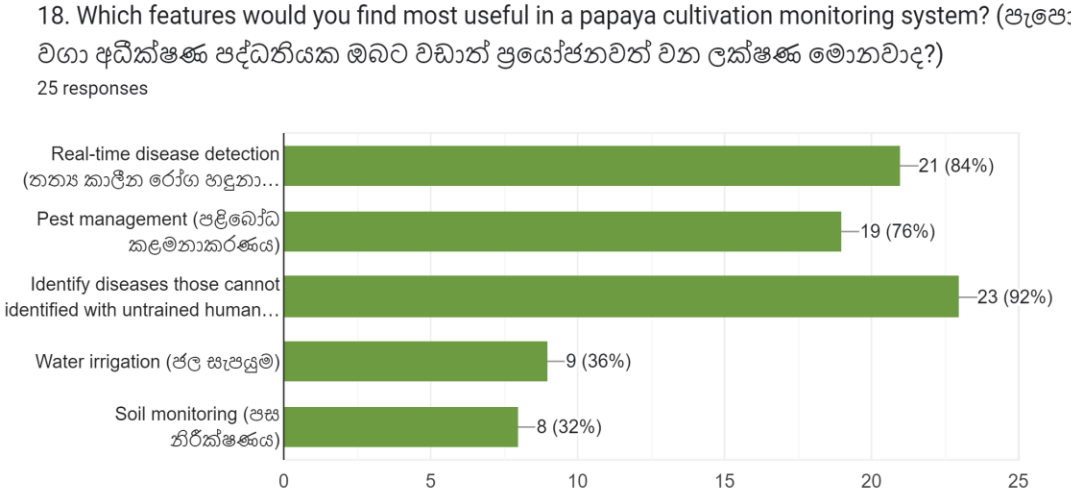
Research Gap

Application Reference	Ringspot Virus identification	Powdery Mildew identification	Mobile application	Remedy Suggestion	Yolov5	Used Technology
Research 1	✗	✓	✓	✗	✗	K-means Support VM
Research 2	✓	✓	✗	✗	✗	Efficientnet
Research 3	✓	✓	✗	✗	✗	CNN
Proposed System	✓	✓	✓	✓	✓	Yolov5

Research 1 - Machine Vision Based Papaya Disease Recognition [1]
Research 2 - A Deep Ensemble Approach for Recognition of Papaya Diseases using EfficientNet Models [2]
Research 3 - Identification of Papaya Fruit Diseases using Deep Learning Approach [3]

Research Question

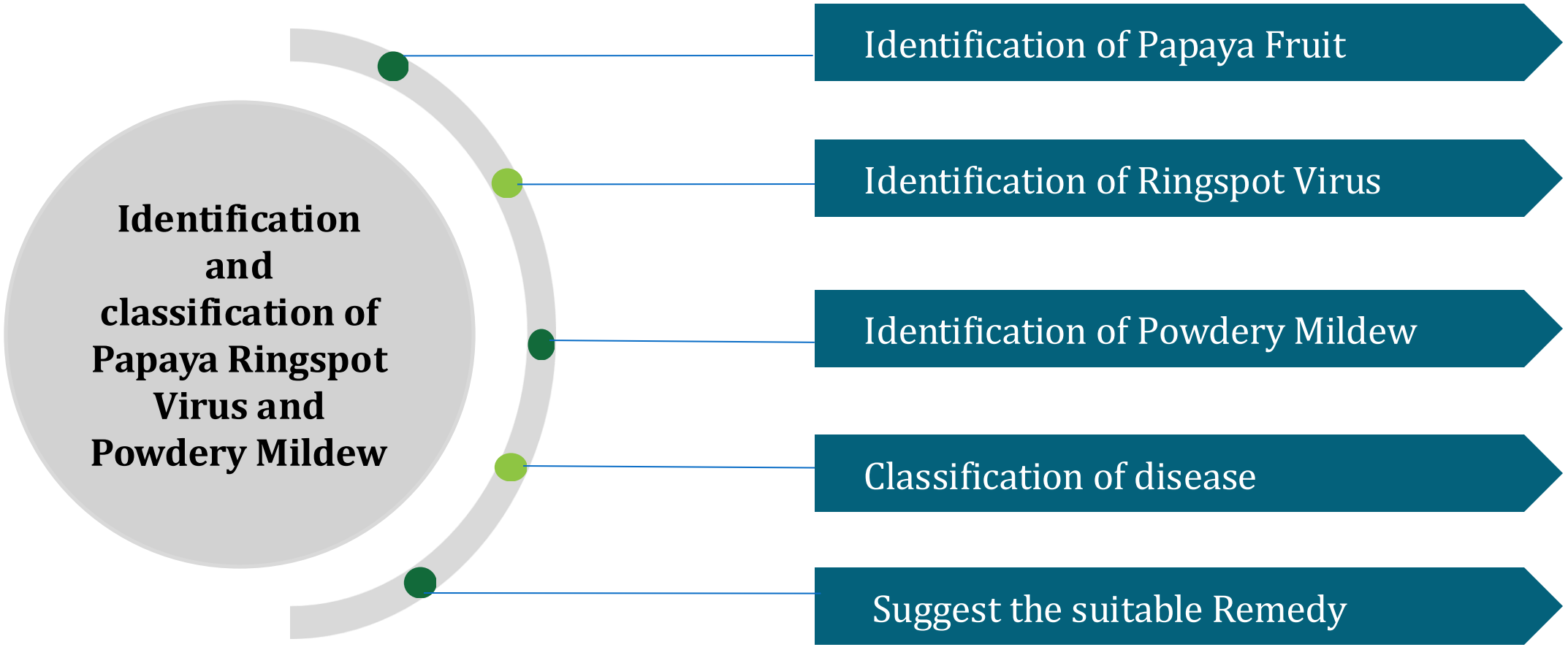




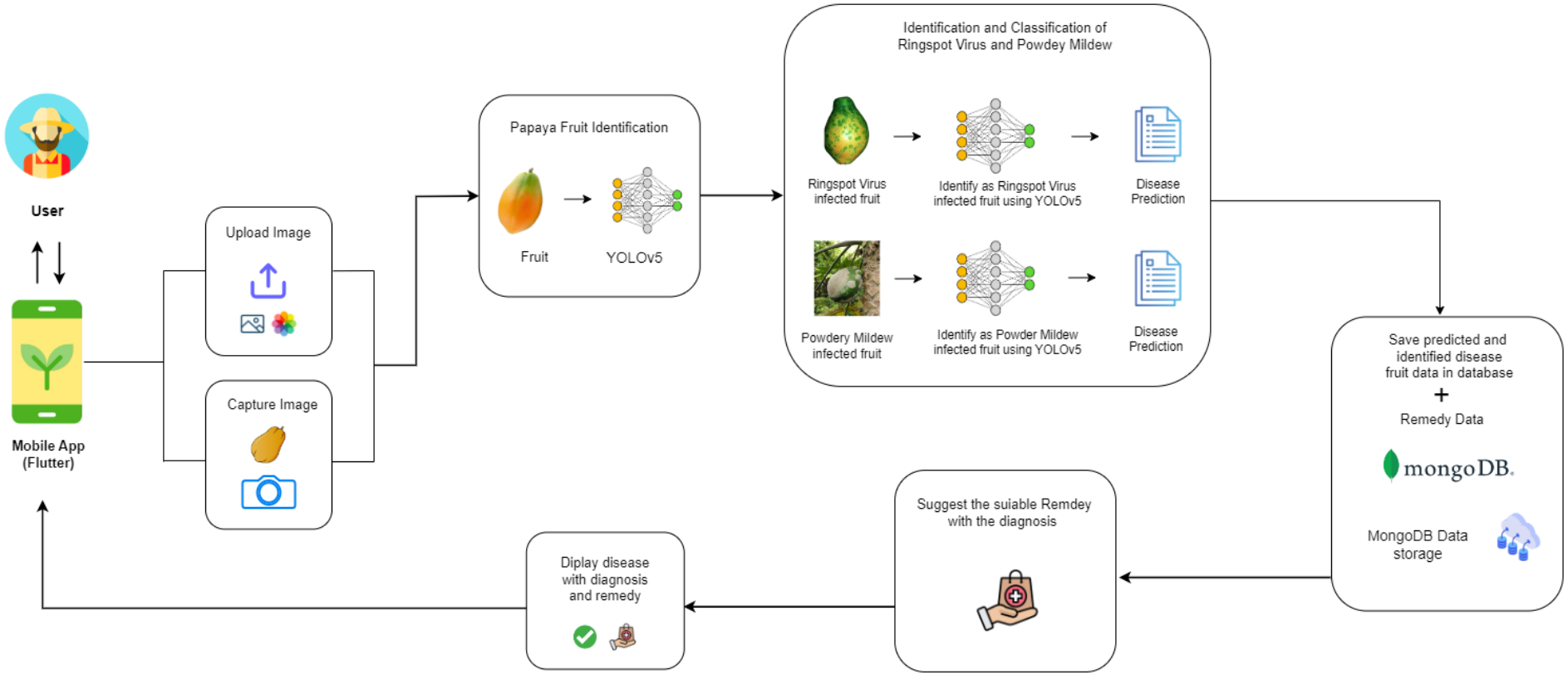
How to identify Papaya Ringspot Virus?

How to identify Powdery Mildew?

Specific and Sub Objectives



System Diagram



Requirements

Functional Requirements

- The system should be able to identify ringspot virus disease.
- Powdery mildew disease detection should be possible using the system.
- The system should be able to suggest the correct remedy for the identified disease.
- The diagnosis and the remedy details should be accurately shown by the system.

Non – Functional Requirements

- User friendliness
- Availability – System should be able to use, when needed
- Reliability - There should never be a glitch or deadlock in the system during the operation and user interaction.
- The accuracy of results needs to be high.
- The system should work fast to achieve a task.

Software Requirements

- Flutter
- Python
- MongoDB
- OpenCV
- OpenWeatherAPI
- Github
- Git
- YOLOv5
- Labelimg

Personal Requirements

Resources and data set of Papaya ringspot virus and Powdery Mildew

- Fruit Research and Development Institute (FRDI) - Horana
- Mrs. Thilini Anuradha (RA – Research Assistance)
- Papaya landowners near Diwulapitiya

Requirements

Techniques

- Object Detection
- Image pre-processing
  - ✓ Image resizing
  - ✓ Image normalization
- Image augmentation
  - ✓ Rotation
  - ✓ Flipping
  - ✓ Scaling
- Bounding box transformation
- Image Classification

Technologies

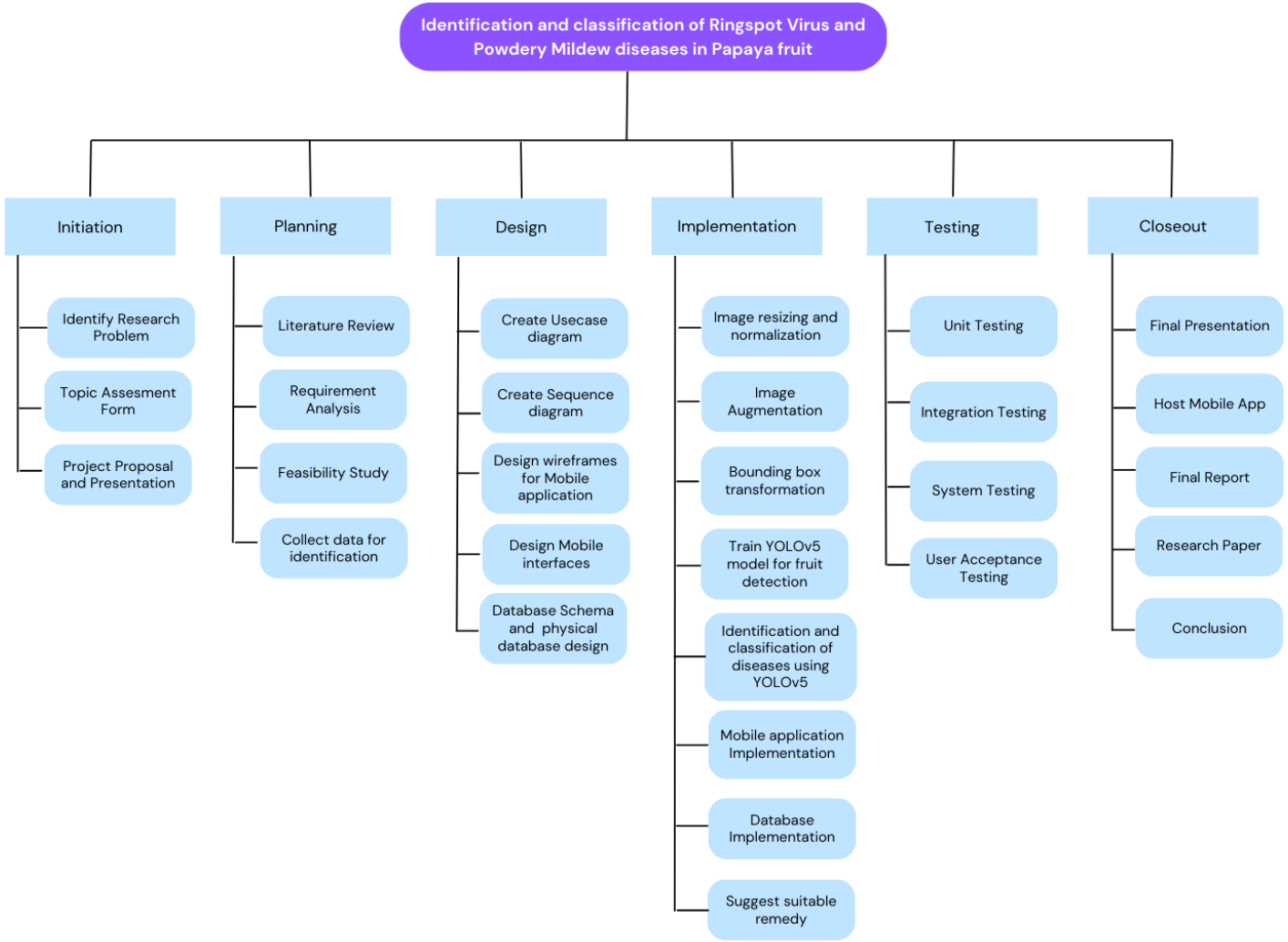
- Flutter
- Python
- OpenCV
- Flask Server
- MongoDB
- Labelimg

Algorithms

- YOLOv5

Completion of the project

Methodology



References

[1] R. H. Hridoy and M. R. A. Tuli, "A Deep Ensemble Approach for Recognition of Papaya Diseases using EfficientNet Models," 2021 5th International Conference on Electrical Engineering and Information Communication Technology (ICEEICT), Dhaka, Bangladesh, 2021, pp. 1-6, doi: 10.1109/ICEEICT53905.2021.9667825.

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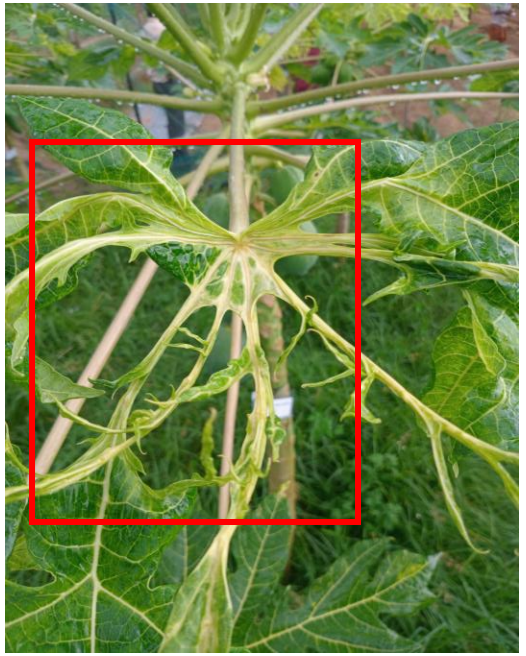
IT21161810 | Mangchanayaka M.V.V

Software Engineering

Introduction

- Papaya crop is affected by Mealy Bug (Paracoccus marginatus) was discovered in early 2008 in the western provincial district Colombo and Gampaha[1]
- The mealybug attacked more than 40 host plants in Sri Lanka, but papaya and Plumeria were its most favored hosts
- Mite bug infestations cause papaya leaves to curl and discolor, leading to significant lower yields.
- Awareness, early detection of invasive species and immediate control methods could minimize the economic losses caused by pests



Mite Bug

Mealy Bug

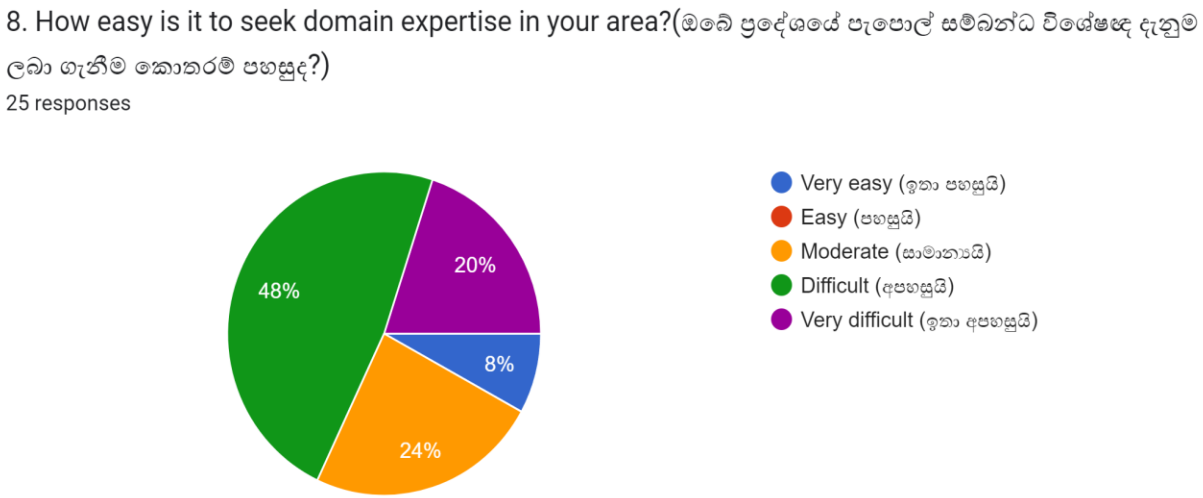
Research Gap

Application Reference	Mite Bug Identification	Mealy Bug Identification	Remedy Suggestion	Use DenseNet to Identify Mite and Mealy Bug	Mobile Application	Used Technology
Research 1	✗	✗	✗	✗	✗	EfficentNet
Research 2	✓	✗	✗	✗	✓	Random Forest,SVC
Research 3	✗	✓	✗	✗	✓	Naïve Bayes Classifier
Proposed System	✓	✓	✓	✓	✓	DenseNet

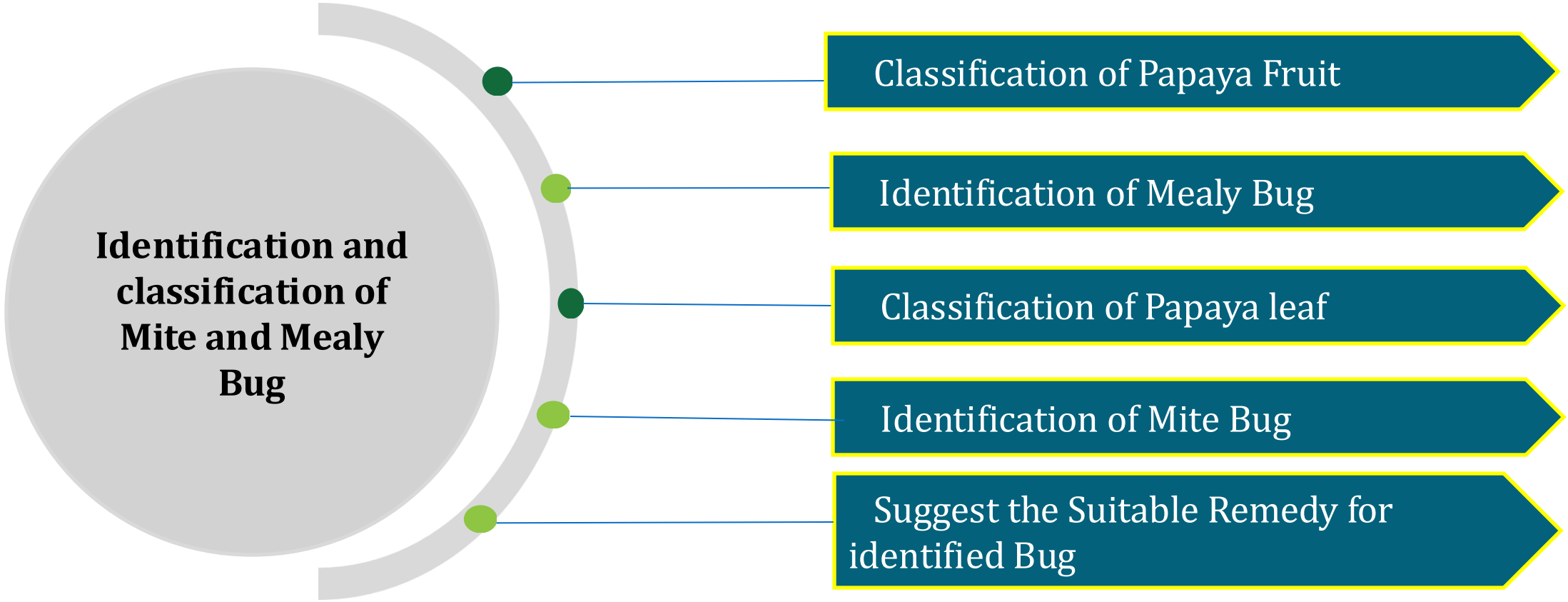
Research 1 - A Deep Ensemble Approach for Recognition of Papaya Diseases using EfficientNet Models [2]
Research 2 - Machine Learning based Image Classification of Papaya Disease Recognition [3]
Research 3 - Papaya Disease Detection Using Fuzzy Naïve Bayes Classifier [4]

Research Problem

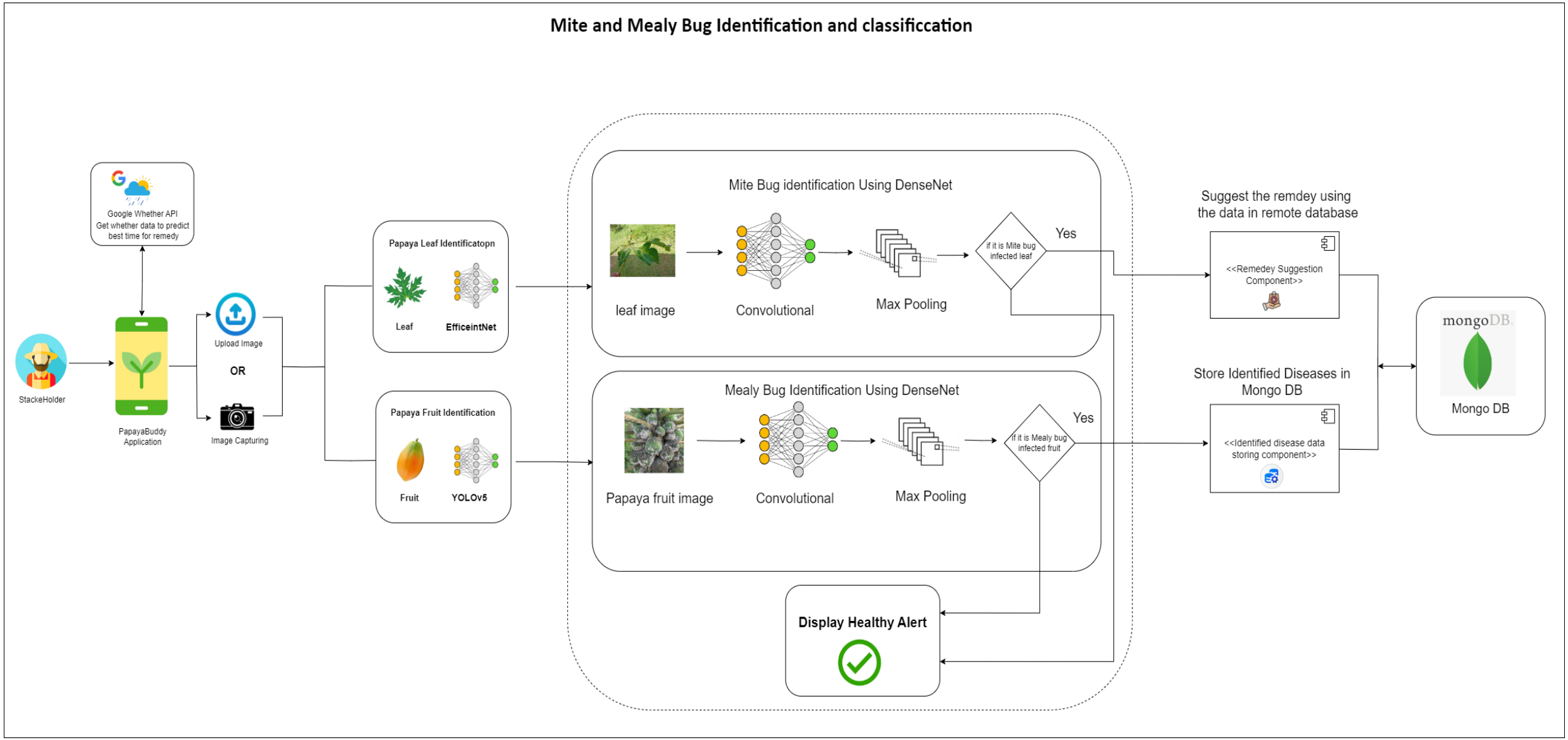
- Mite and mealy bug infestations severely damage papaya crops financial losses for farmers
- Early detection and effective management of these pests are essential
- Current systems do not provide personalized and severity-specific remedy suggestions for pest infestations
- Lack of expert knowledge identifying pest diseases
- Existing systems may not be optimized for real-time pest identifications



Specific and Sub Objectives



Methodology System Diagram



Technologies, Techniques and Algorithms

Technologies

- Flutter
- Python
- Keras
- Tenserflow
- Google Collab
- Node

Techniques

- Data Preprocessing
- Transfer Learning
- Data Augmentation
- Confusion Matrix

Algorithms

- DenseNet

Requirements

Functional Requirements

- The system should be able to identify Mite Bug
- The System should be able to identify Mealy Bug correctly
- The system should be able to identify healthy papaya fruit.
- The system should be able to suggest the correct remedy for the identified pest disease.
- The diagnosis details should be accurately shown by the system.

Non – Functional Requirements

- User friendliness
- Availability – System should be able to use, when needed
- Reliability - There should never be downtime during the operation and user interaction.
- The accuracy of results needs to be high.

Requirements

Software Requirements

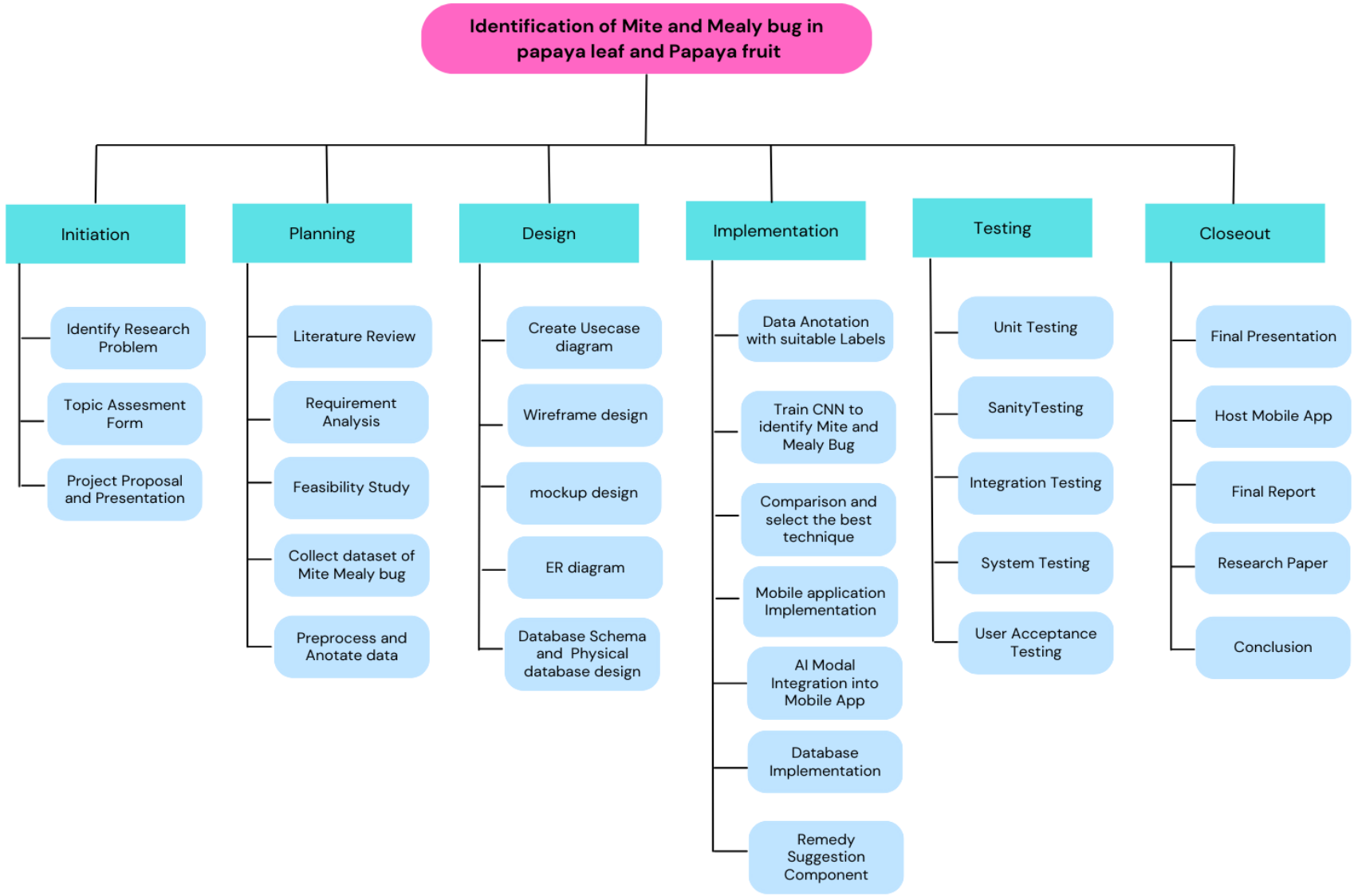
- Flutter
- Python
- MongoDB
- OpenCV
- OpenWeatherAPI
- Github
- Git
- VS Code
- Jupyter
- Google Collab

Personal Requirements

Resources and data set of Mite and Mealy Bug

- Fruit Research and Development Institute (FRDI) - Horana
- Mrs. Thilini Anuradha (RA – Research Assistance)
- Papaya landowners near Diwulapitiya

Work Breakdown Chart



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IT21386022 | Senevirathne U.W.H. N

Software Engineering

Introduction

- There are many diseases in papaya cultivation such as root rot , anthracnose, black spot, powdery mildew, phytophthora and etc . [1]
- It is better to identify diseases early at the disease.
- The Cercospora virus primarily affects the **leaves**, but it can also spread to the **fruit** and **stem** of the papaya plant.
- The virus first appears as small, water-soaked spots on the leaves, which then develop into dark brown or black lesions.
- Identifying the virus at the initial stage, when it affects the leaves, is crucial for preventing further spread to the fruit and stem.

Research Problem

- Most of the farmers can't identify diseases from their untrained human eyes.
- At the same time, if Cercospora Virus spread after leaves, Farmers have to remove the whole plant.
- But most of the farmers can't identify this virus at initial stage of the leaves.

Solution

•Utilizing deep learning models to detect the progress level of Cercospora disease at an early stage.

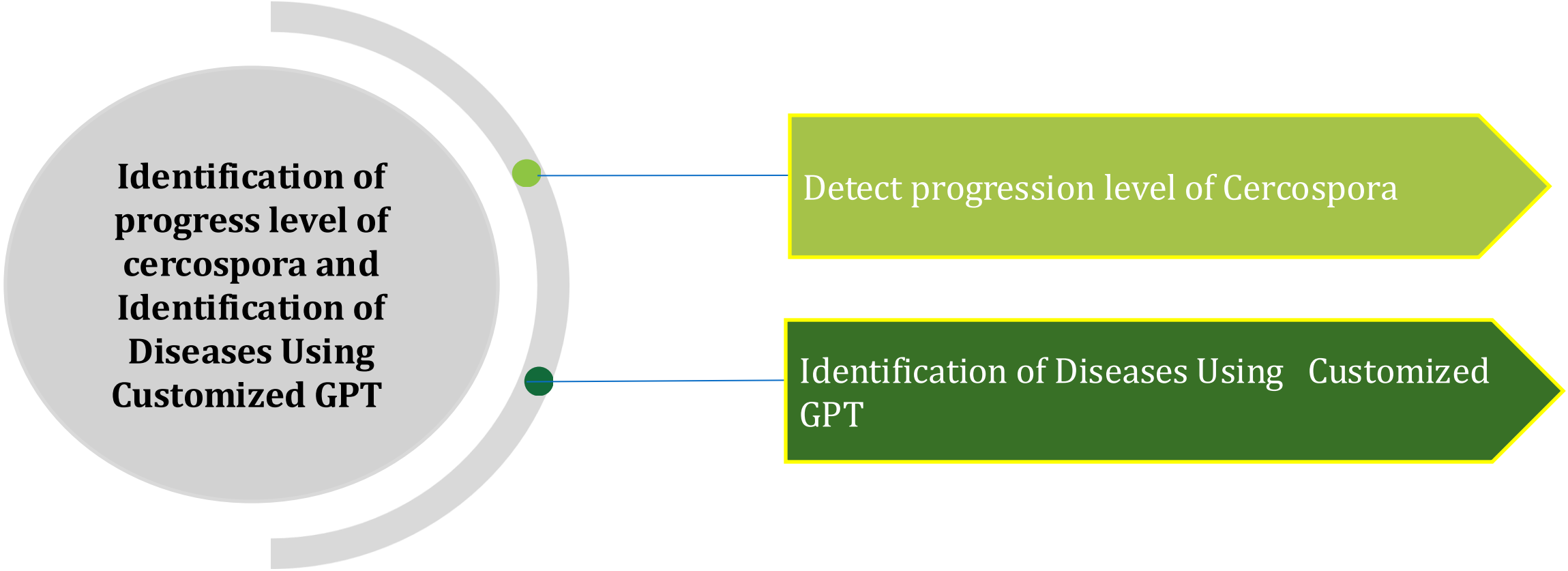
•Customized GPT model to identify diseases from user-input symptoms that are not easily visible to the untrained eye.

Reseach Gap

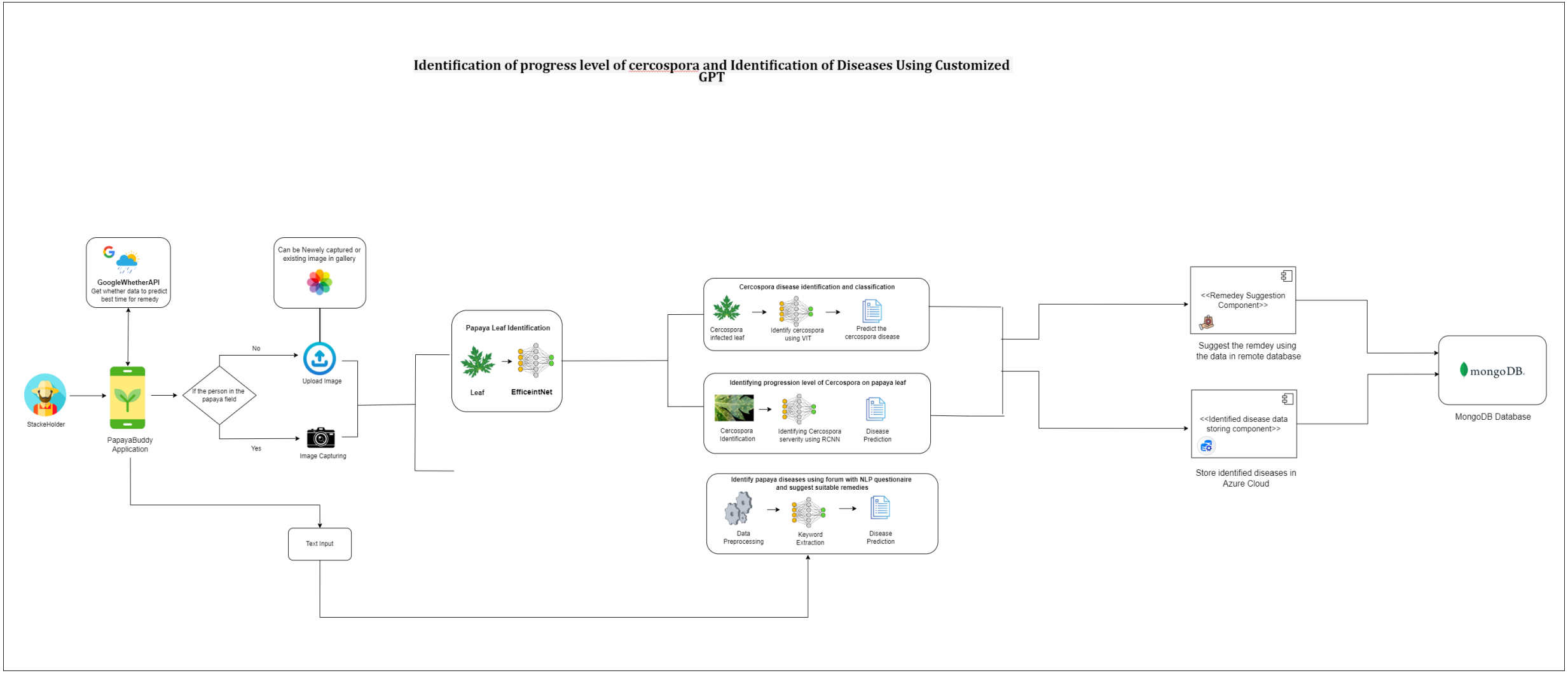
Aspect	Research A	Research B	Research C	Research D	Proposed system
Use R-CNN Model for getting progression level	✗	✓	✗	✗	✓
Use R-CNN Model for getting progression level of circospora virus of papaya leaf.	✗	✗	✗	✗	✓
Use customized gpt for NLP-based text identification	✗	✗	✓	✗	✓
Use customized gpt for NLP-based text identification for papaya plant	✗	✗	✗	✗	✓

Research A - A Hybrid Deep Learning Approach for Severity Classification of Pepper Leaf Mosaic Virus
Research B - Deep Learning-Based Surveillance System for Coconut Disease and Pest Infestation Identification
Research C - Fine-Tuning GPT on Biomedical NLP Tasks: An Empirical Evaluation
Research D - Detection of Diseases and Nutrition in Bell Pepper

Specific and Sub Objectives



Methodology System Diagram



Requirements

Personal Requirements

- Resources and data set of diseases
- Fruit Research and Development Institute (FRDI) - Horana
- Mrs. Thilini Anuradha (RA – Research Assistance)
- Papaya landowners near Diwulapitiya

Software Requirements

- Code Editor/IDE: Visual Studio Code
- Mobile Development: Flutter
- UI/UX Design: Figma
- Server-Side Framework: Django (Python)
- Database: MongoDB
- OpenAI API: For integrating the customized ChatGPT model

Requirements

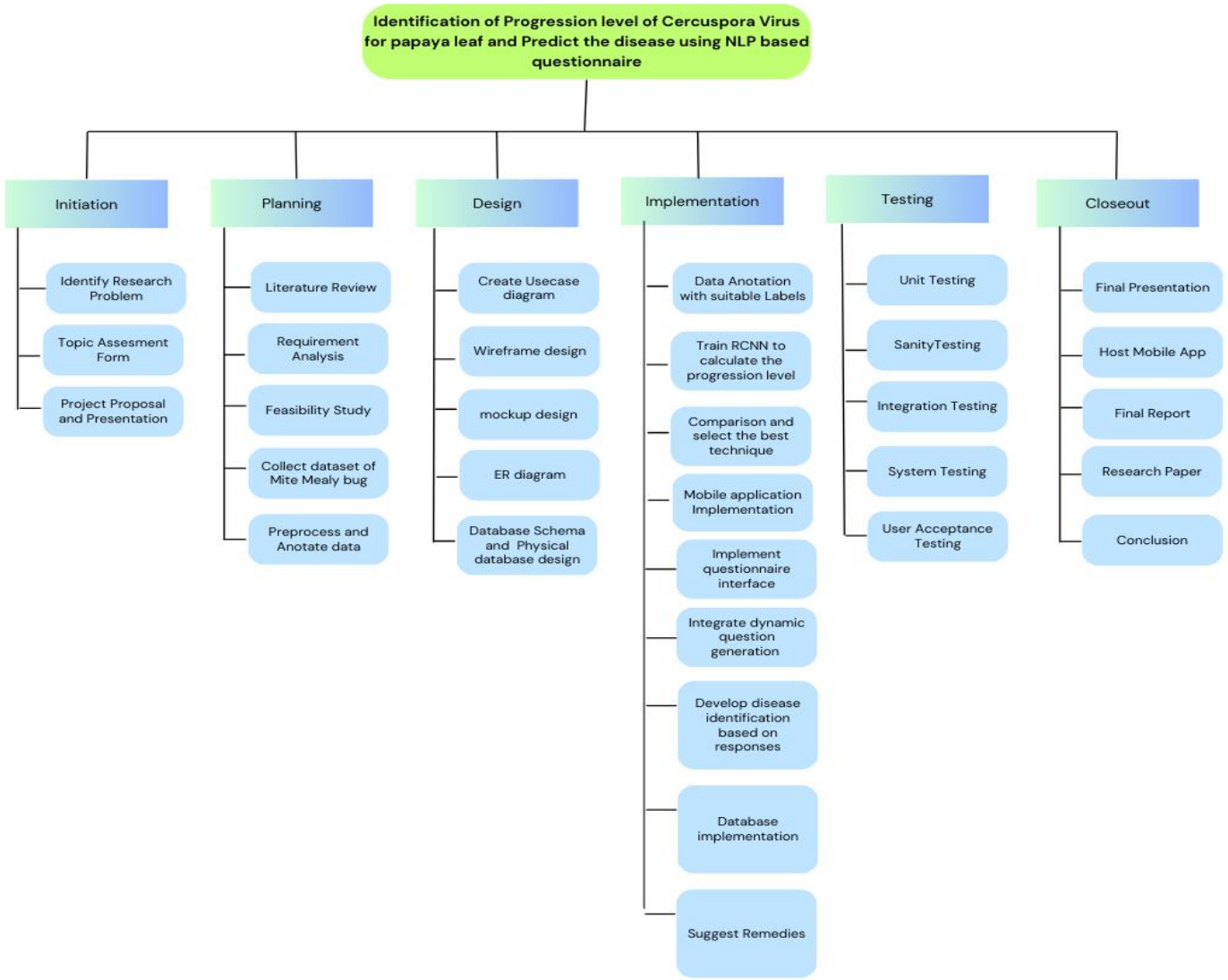
Functional Requirements

- System should calculate the percentage of the leaf area affected by the virus and determine the progression level.
- System should display the calculated progression level of the virus (e.g., Mild, Moderate, Severe).
- System should predict the correct disease using keywords and suggest remedies

Non - Functional Requirements

- User friendliness
- Availability – System should be able to use, when needed
- Reliability - There should never be a glitch or deadlock in the system during the operation and user interaction.
- The accuracy of results needs to be high.

Work Breakdown Chart



Requirements

Techniques

- Image Data Collection and Annotation
- Image pre-processing
- Image augmentation
- Progression level calculation
- ChatGPT Customization and Fine-Tuning

Technologies

- Flutter
- Python
- OpenCV
- TensorFlow
- Flask
- Django
- MongoDB
- OpenAI API

Algorithms

- R-CNN

RCNNs are designed for detecting objects within images by generating bounding boxes around the regions of interest. It can help in identifying the areas affected by the virus.

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[5] A. Dissanayake, I. Rajapaksha, R. Gunarathna, S. Jayasinghe, H. De Silva and S. Hettiarachchi, "Detection of Diseases and Nutrition in Bell Pepper," 2023 5th International Conference on Advancements in Computing (ICAC), Colombo, Sri Lanka, 2023, pp. 286-291.

Commercialization

- We aim to promote our product among papaya farmers and garden enthusiasts who grow papayas at home.

- To commercialize our mobile app, we will partner with Govijana Sewa Centers to conduct sessions that introduce farmers to our mobile app. These sessions will demonstrate the app’s disease detection capabilities and highlight its benefits for improving papaya cultivation.

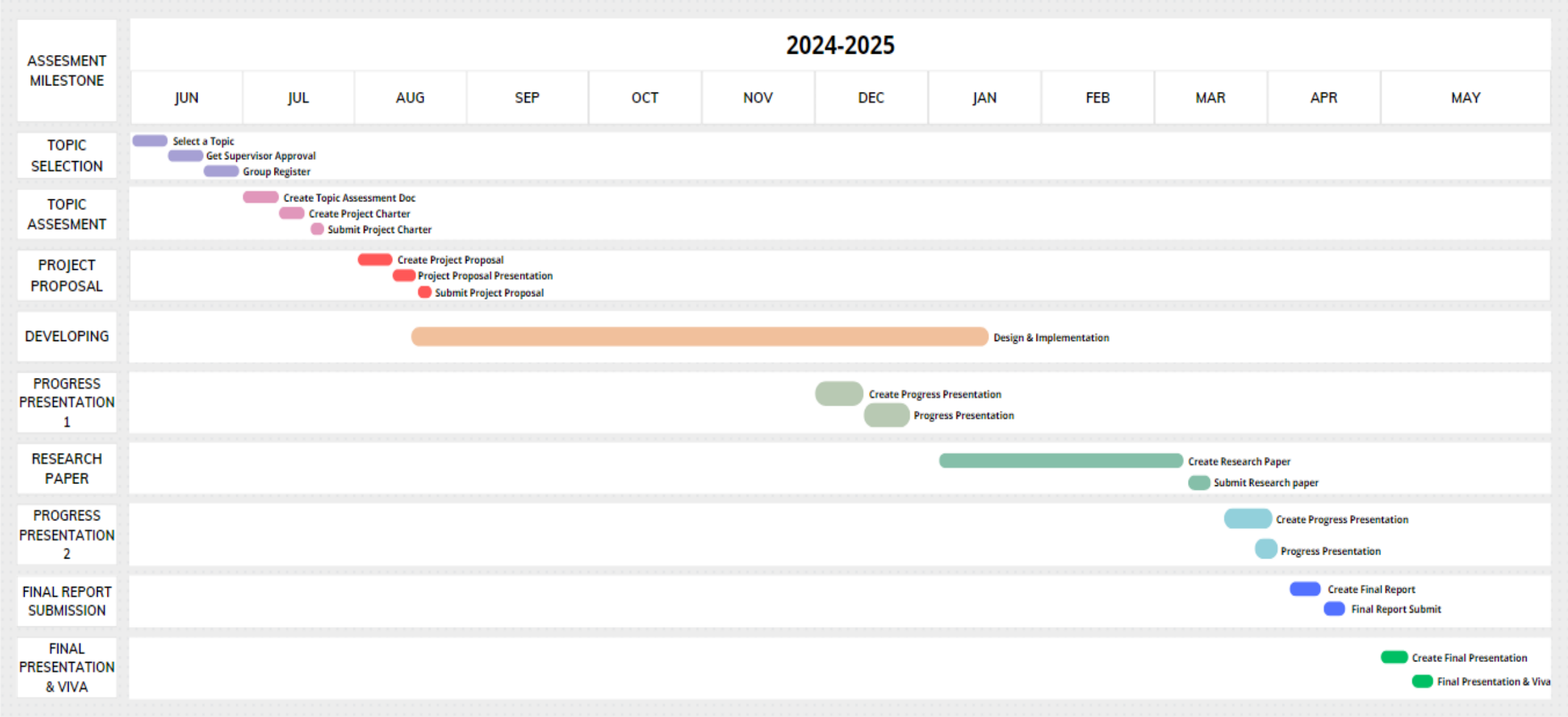
- To further promote our mobile app, we will launch a Facebook Boost campaign targeting farmers and agricultural communities. This campaign will raise awareness about the app's features and benefits, driving engagement and encouraging adoption among the target audience.

- Wish to Commercialize,
  - ✓ Via Youtube and Social media
  - ✓ Host App in Google Store
  - ✓ Via Organization (Horana Agronomy Center)

Budget

Resources	Price (Rs)
Identification and classification of Papaya Mosaic and Cercospora leaf disease.	Travelling Cost - 5000
Identification and classification of Papaya Ringspot Virus and Powdery Mildew.	Travelling Cost - 5000
Identification and classification of Mite and Mealy Bug.	Travelling Cost - 5000
Identification of progress level of cercospora and Identification of Diseases Using Customized GPT.	Travelling Cost - 5000
MongoDB Paid Cluster	
Dataset Drive Upload	10GB
OpenWeatherMap API	Free
Mobile App -Hosting on Play Store	
Mobile App -Hosting on App Store	
Buy Chatgpt	1000

Gantt Chart


ASSESMENT MILESTONE
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JUN
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TOPIC SELECTION
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Create Project Charter
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Thank You !

PapayaBuddy