Project Reference Number: 46S_MCA_001

Project Title: Design and Development of an Android based Classification model for Arecaunut Leaf Disease Detection using Deep learning Techniques

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Introduction

Arecanut, also known as betel nut or supari, holds significant cultural, social, and economic importance in India. India is one of the largest producers and consumers of arecanut in the world. Arecanut cultivation in India is predominantly concentrated in the southern and north-eastern states. The major arecanut-growing states include Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, and Assam. These regions provide suitable climatic conditions, such as high humidity and rainfall, for the growth of arecanut palms.

Arecanut cultivation faces several challenges in India. One major concern is the occurrence of diseases that affect the arecanut palms and reduce their productivity. Common diseases include Areca nut Leaf Spot (ALS), Mahali disease, Steam bleeding and various fungal and bacterial infections.

Traditional methods of disease detection in Areca nut leaves involve manual inspection by experts, which is time-consuming, subjective, and often prone to errors. Therefore, this project proposes the development of an Android-based classification model that utilizes deep learning techniques to automate the process of disease detection in Areca nut leaves.

Deep learning, a subfield of artificial intelligence, has shown remarkable success in image recognition and classification tasks. By leveraging deep learning algorithms, we can train a model to accurately identify and classify different diseases affecting Areca nut leaves. The Android platform offers a convenient and widely accessible medium to deploy the trained model, allowing farmers and agricultural experts to easily detect and diagnose diseases using their smartphones.

The papers [1-10] focus on simple CNN architectures were used to classify the diseased and healthy plants. Total 3 types of diseases were identified in different parts of the plant. The authors propose a methodology using CNN to accurately identify and classify different diseases affecting arecanut crops. The research contributes to the field of agricultural technology by offering a potential solution for automated disease detection in arecanut plants, which can assist in timely interventions and effective crop management strategies.

The papers [11-20] on different aspects of plant disease detection and classification using various techniques and technologies. Deep learning architectures, such as CNN architectures, are employed for accurate detection and classification of plant diseases. The papers highlight the importance of leveraging machine learning and computer vision techniques to improve efficiency and effectiveness in plant disease management. The studies emphasize the application of advanced technologies and algorithms to assist farmers and agricultural experts in monitoring and mitigating plant diseases, thus reducing crop losses and ensuring sustainable agriculture.

In conclusion, arecanut plays a significant role in India's agricultural sector and cultural traditions. Its cultivation and consumption patterns are deeply rooted in the country's heritage. However, challenges such as disease management and environmental sustainability need to be addressed to ensure the long-term viability of arecanut cultivation.

The successful implementation of this project will provide a valuable tool for farmers and agricultural experts to detect and manage diseases affecting Areca nut plants at the earlier stages. By utilizing the power of deep learning and the convenience of Android devices, the proposed solution aims to improve disease diagnosis accuracy, reduce manual efforts, and enhance the overall productivity and sustainability of Areca nut cultivation.

Scope and Objectives

Scope:

The scope of this project is to develop an android application that allows user to capture an image of arecanut plant and identify whether plant is diseased or not using a deep learning model. If disease is identified, the application displays the type of the disease. The application will provide educational resources and information about arecanut plants.

Objectives:

(i) **Collect real time data of Arecanut leaves and create a dataset**: Images were captured using digital and mobile cameras from the arecanut plantation located at Sirsi, Karnataka. The images were labelled based on the classifications like diseased / healthy and stored in a database. The collected leaf images will be used for training the deep learning model.

(ii) **Apply image preprocessing techniques and preprocess the dataset**: Image pre processes such as resizing, converting the image to grayscale, and removing noise were applied over the dataset to have uniformity.

(iii) **Build a CNN model to train and validate the data set for classification of health and diseased leaf and identify the type of leaf disease if the leaf is diseased.** CNN Architectures like VGG19, ResNet, MobiNet were used to evaluate the model for the training set out of which VGG19 has the highest accuracy for the dataset.

(iv) **Optimize and deploy the model in an android device:** The model is optimized using activation and loss functions and deployed in android device for real time application.

(v) **Test and evaluate the model real time leaves and communicate to the authorities:** The leaves are captured real time and tested. The output of the application is visible to be farmer immediately.

Methodology

The project will be implemented in three phases:

1. **Phase I: Data Collection and Pre-processing**

Data collection and pre-processing of the dataset were carried out in phase I. Images were captured using digital and mobile cameras from the arecanut plantation and sorted based on healthy or diseased categories for easy classification. Pre-processing involved enhancing the quality of the images to remove noise and improve contrast. At the end of the first phase, the dataset was divided into a training set (60%), a validation set (15%), and a test set (15%).

2. **Phase II: Building and evaluating the Model.**

A classification model was built using the training data using Convolutional Neural Network (CNN). Different CNN architectures, including ResNet with 76% accuracy, MobiNet with 72% accuracy, and VGG19 with 87% accuracy, were implemented to classify the leaves as (i) diseased and (ii) healthy. Among the diseased leaves, further classification was performed to identify the type of disease. The model was then evaluated based on the test dataset and optimized to improve accuracy. VGG19 model was selected based on accuracy level, computational power, loss value, and other relevant factors.

3. **Phase III: Model Deployment and Management**

The best model identified in the previous phase i.e., VGG19 was used to be deployed on android devices. The user can take real time pictures of the leaves and know about the plant health (diseased or not diseased). The user will also be aware of the disease that has attacked the leaf if it is diseased and measures to cure or prevent the same.

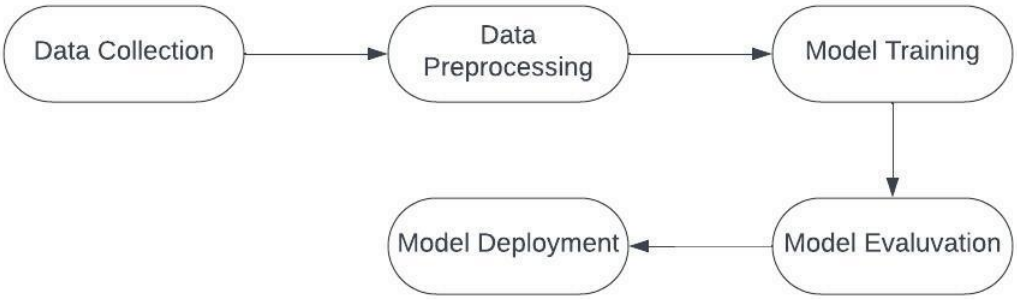


Fig. 1.1 Architecture diagram

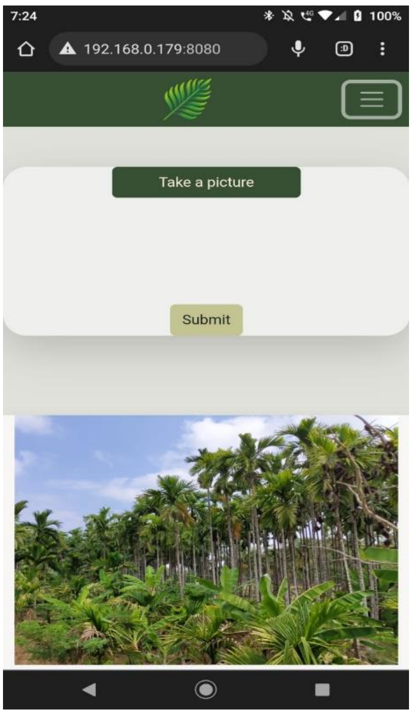
Results and Conclusion

The result of the project is the development of Mobile application that detects arecanut disease.

The Arecanut Disease Detection Application results in accurately identifying and classifying diseases. The deep learning model trained on the dataset achieved a high level of accuracy in differentiating between various diseases. Different CNN architectures like VGGNet, ResNet, MobiNet were tested among which VGGNet had the highest accuracy so VGGNet was deployed in the application. The Android-based application provides a user-friendly interface for farmers to capture leaf images, process them using the classification model, and receive the real time diagnosis results. The application provides users to take a live picture of the arecanut plant or upload an existing image from the device to detect if the plant is diseased.

Furthermore, the additional information regarding the preventive measures of the disease detected provides a pocket friendly helping hand in preventing or curing the diseased plants and hence increasing the productivity of the crops.

The following figure 1 shows the application user interface where the user can choose to upload or take a real time picture of the plant.



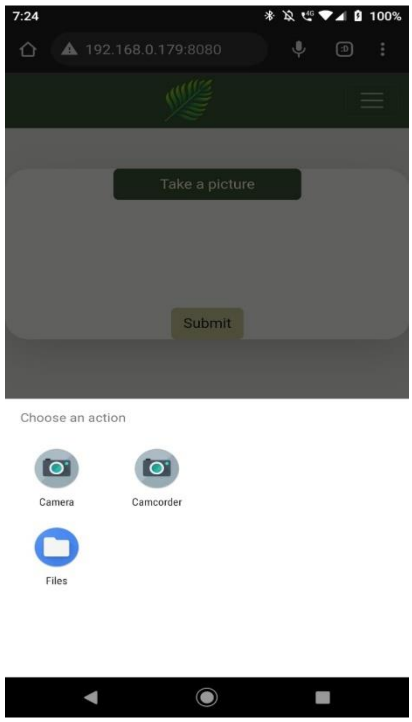
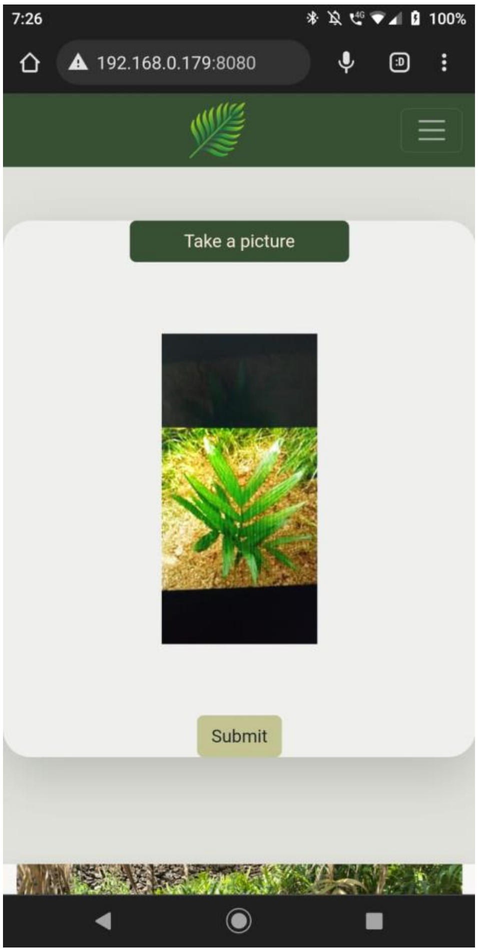
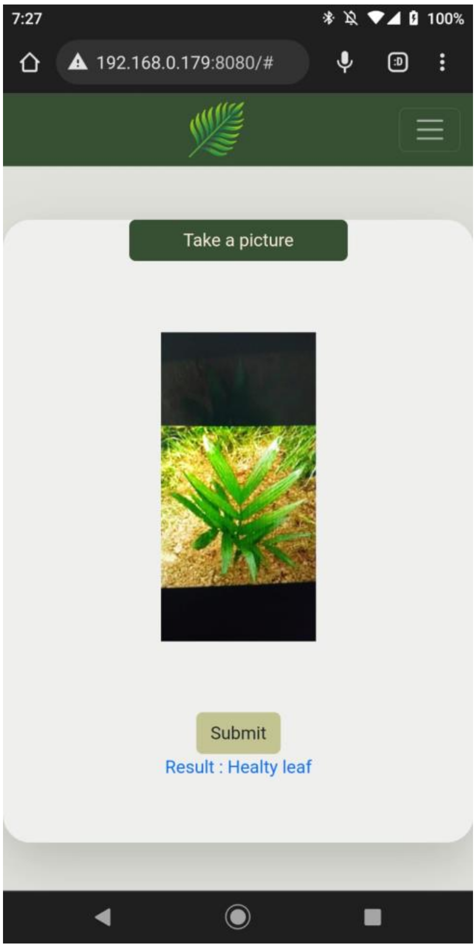


Figure 2 shows the results predicted by the model





Innovation in the Project

- Along with the leaves the project can detect diseases in other part of the plant. Diseases like: Steam bleeding and Mahali disease. Including images of other parts of the plant in the dataset to identify and classify the disease.
- Real time image input from the user is available for the farmers to click pictures of the plant at any time and understand the health of the plant.

Scope for future work

- Expansion of the application with other crops:
  The application currently focuses on arecanut plants, including other crops can be a valuable step in broadening its utility and catering to a wider range of users.
- Incorporation of smart agricultural technologies:

  The model with smart farming systems that leverage IoT devices, sensors, and data analytics. This integration would bring numerous benefits to arecanut farmers by enabling real-time monitoring of their plantations, data-driven decision-making, and automated disease detection and management.

- Training the model on a wider range of diseases:

The model was trained on a specific set of diseases. It may not be able to accurately detect diseases that are not included in the dataset. The model should be trained on a wider range of diseases to improve its accuracy.

- Include farming research institutions

  The project can collaborate with agricultural research institutions and organizations to refine and validate the classification model, benefiting from their expertise, domain knowledge, and access to diverse datasets for improved accuracy and reliability.

- Satellite based systems to monitor large areas