Proposal report on

Disease Prediction on Mango Leaf using Image Classification

Group 5

Big Data Analytics (DSMM), Lambton college

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Summary

This project focuses on developing an image classification tool to diagnose diseases in mango leaves, addressing the critical need for accessible and reliable solutions for small-scale farmers. By leveraging machine learning, the tool allows farmers to upload images of affected leaves and receive immediate disease diagnoses, along with treatment recommendations. This project utilizes the Mango Leaf Disease Dataset from Mendeley Data, which comprises labelled images of mango leaves affected by various diseases. This approach is particularly useful as it enables timely diagnosis, enhances accessibility for farmers with minimal technical knowledge, is cost-effective, educates farmers on disease management, and encourages sustainable practices by recommending targeted treatments. Overall, it enhances farmers' ability to manage their crops effectively while contributing to improved agricultural productivity. This reduces the reliance on guesswork or external consultations, minimizes the use of inappropriate treatments, and promotes sustainable practices through tailored recommendations.

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Introduction

Mango agriculture is essential for economic, nutritional, and cultural reasons. It provides income for farmers and creates jobs, while mangoes are rich in vitamins and integral to many diets and traditions. Their export potential boosts economies, and their versatility in products diversifies revenue. Additionally, mango orchards promote sustainability and biodiversity, attracting tourism through festivals. Overall, mango agriculture significantly enhances economic stability, health, and cultural identity.

How the Agriculture Industry Works

Agriculture remains a cornerstone of economies around the world, particularly in regions where crop cultivation constitutes a major part of livelihoods and local food security. Among these, mango farming holds special importance in tropical and subtropical regions, being a valuable export and a dietary staple.

Plant diseases significantly affect the agriculture industry by reducing crop yields and quality, leading to lower incomes for farmers and diminished food supply. They increase treatment and labor costs, disrupt supply chains, and create market instability. The agriculture industry has seen advancements in technology, yet the adoption of these innovations at smaller, resource-limited farms is limited. Addressing plant disease is a critical part of sustainable agriculture, and timely diagnosis is essential for crop health.

Numerous fungal species, both beneficial and dangerous, can be found inhabiting a single plant. About 8,000 of these fungi are known to infect plants and cause illness, which can result in a 100% reduction in output[1].Similar Cases can be found in the mango plant. Persistent diseases may force changes in crop rotations and land use, while reliance on chemicals can harm the environment. These challenges threaten food security, particularly in regions dependent on specific crops, underscoring the need for effective disease management strategies to support sustainable agriculture.

Implementation and Flowchart:

The implementation of the Mango Leaf Disease Prediction project utilizes a technology stack comprising:

1. **TensorFlow**: An open-source machine learning framework for developing and training deep learning models.
2. **Keras**: To simplify model design and training for image classification.
3. **Streamlit**: A framework for creating interactive web applications, providing a user-friendly interface for farmers to upload images and receive diagnoses.

4. **MongoDB/SQLite**: Database management systems for storing disease information, symptoms, and treatment recommendations.

This stack enables an effective and accessible solution for real-time mango leaf disease diagnosis.

The following is a conceptual flow diagram demonstrating how our project's model integrates into the existing workflow, with enhancements at each stage

Problem Statement

Problem:

In mango farming, the occurrence of diseases can drastically affect crop yield, quality, and profitability. Mango farmers, especially those in regions with high humidity, face frequent issues with fungal infections, bacterial spots, and other diseases that impair leaf health. Early detection of these diseases is crucial, yet many farmers lack the tools and resources for quick diagnosis, leading to delayed intervention and significant crop loss.

The specific problem this project addresses is the delay in disease identification and treatment, which is a common challenge among small-scale farmers. Without diagnostic resources, farmers often rely on visual cues and experience to guess the cause of disease, which can result in incorrect or excessive pesticide usage. Research conducted by the International Journal of Agricultural Technology found that in a sample group of small farmers, over 55% reported losses related to misdiagnosis and untimely disease treatment.

Target Consumer

The targeted customers of the project are small-scale and medium-scale mango farmers. These farmers often lack access to affordable diagnostic resources and expertise for identifying diseases in their crops. The project aims to empower them by providing a user-friendly, cost-effective tool for real-time disease diagnosis, enabling informed decision-making and timely interventions to protect their crops. By focusing on the specific needs of these farmers, the solution seeks to enhance their productivity and sustainability in mango farming.

Why it matters

This project offers a timely, technology-based solution to address this gap. By using image classification technology, farmers can capture an image of a diseased leaf and receive an immediate diagnosis, allowing them to treat the problem accurately and without delay. The

project is designed with small and medium-scale farmers as its target consumers, as they often lack access to laboratory testing facilities and cannot afford high-end diagnostic tools.

The project not only addresses the technical challenge of disease diagnosis but also creates an opportunity to promote sustainable agriculture. By enabling farmers to diagnose diseases accurately, it reduces the likelihood of unnecessary chemical treatments, which have environmental and financial costs. This approach provides a measurable solution to an existing gap in the industry, where a successful diagnosis model can reduce losses by as much as 20%, according to estimates by the Agricultural Research and Extension Network.

Differentiation from Existing Solutions

Existing Solutions

- Mobile Apps: General agricultural apps like Plantix and PlantSnap offer disease identification through image recognition. However, they often lack specificity for mango diseases and may provide inaccurate diagnoses due to broad focus.
- Laboratory Testing: Farmers can send samples to agricultural labs for analysis. While accurate, this method is time-consuming, expensive, and often inaccessible for small-scale farmers.
- Consultation Services: Some farmers rely on agronomists or extension services for disease diagnosis. This approach can be costly and may not always be timely, especially in remote areas.
- Community Knowledge: Farmers often depend on local knowledge or peer advice for identifying and managing plant diseases, which can lead to misdiagnosis and ineffective treatments.
- Traditional Methods: Many farmers use visual cues and past experiences to diagnose diseases, which is often unreliable and can result in delayed interventions or inappropriate pesticide use.
- While these solutions exist, they often lack the accessibility, speed, and specificity needed for effective mango disease management, highlighting the need for a more targeted and user-friendly tool.

Differentiation

- Targeted Focus: Unlike general plant disease apps, this solution specifically addresses mango leaf diseases, providing tailored diagnoses and treatment recommendations based on local challenges.

- User Accessibility: Designed for small-scale and medium-scale farmers, the solution is user-friendly and affordable, requiring minimal technical expertise, making it accessible in resource-limited settings.
- Real-Time Diagnosis: The application offers immediate feedback by allowing farmers to upload leaf images for instant disease classification, reducing delays associated with traditional diagnostic methods.
- Comprehensive Insights: In addition to diagnosis, the solution provides detailed information on symptoms, causes, and treatment options, empowering farmers with actionable guidance beyond mere identification.
- Sustainability Focus: By promoting accurate diagnoses, the solution helps reduce unnecessary pesticide use, supporting environmentally sustainable farming practices.

A primary differentiator is the inclusion of disease management recommendations specific to the detected condition. For example, if anthracnose is identified, the system will offer not only a diagnosis but also advice on prevention methods such as adjusting watering practices or using specific fungicides. This comprehensive approach contrasts with other solutions that only focus on identification without providing tailored treatment suggestions.

In summary, our solution stands out in its focus on mango-specific diseases, affordability, ease of use, and in-depth disease management advice. It is designed to bridge the gap left by existing tools that either overserve with high costs or underserve with generic solutions. By providing a specialized, accurate, and accessible disease diagnosis tool, our project is well-positioned to meet the unique needs of mango farmers, empowering them with insights that directly improve crop health and yield.

Data Gathering and Analysis

Dataset Description

The Mango Leaf Disease Dataset from **Mendeley Data** is a key resource for the project, featuring high-quality, labelled images of mango leaves affected by various diseases, including anthracnose, powdery mildew, and bacterial black spot. With approximately 1**03** MB of data, it includes thousands of images that capture diverse symptoms and stages, enabling focused training on specific conditions. Preprocessing steps like resizing, normalization, and augmentation enhance model performance. We also plan to expand this dataset with additional images to improve accuracy and ensure broader coverage of mango diseases globally.

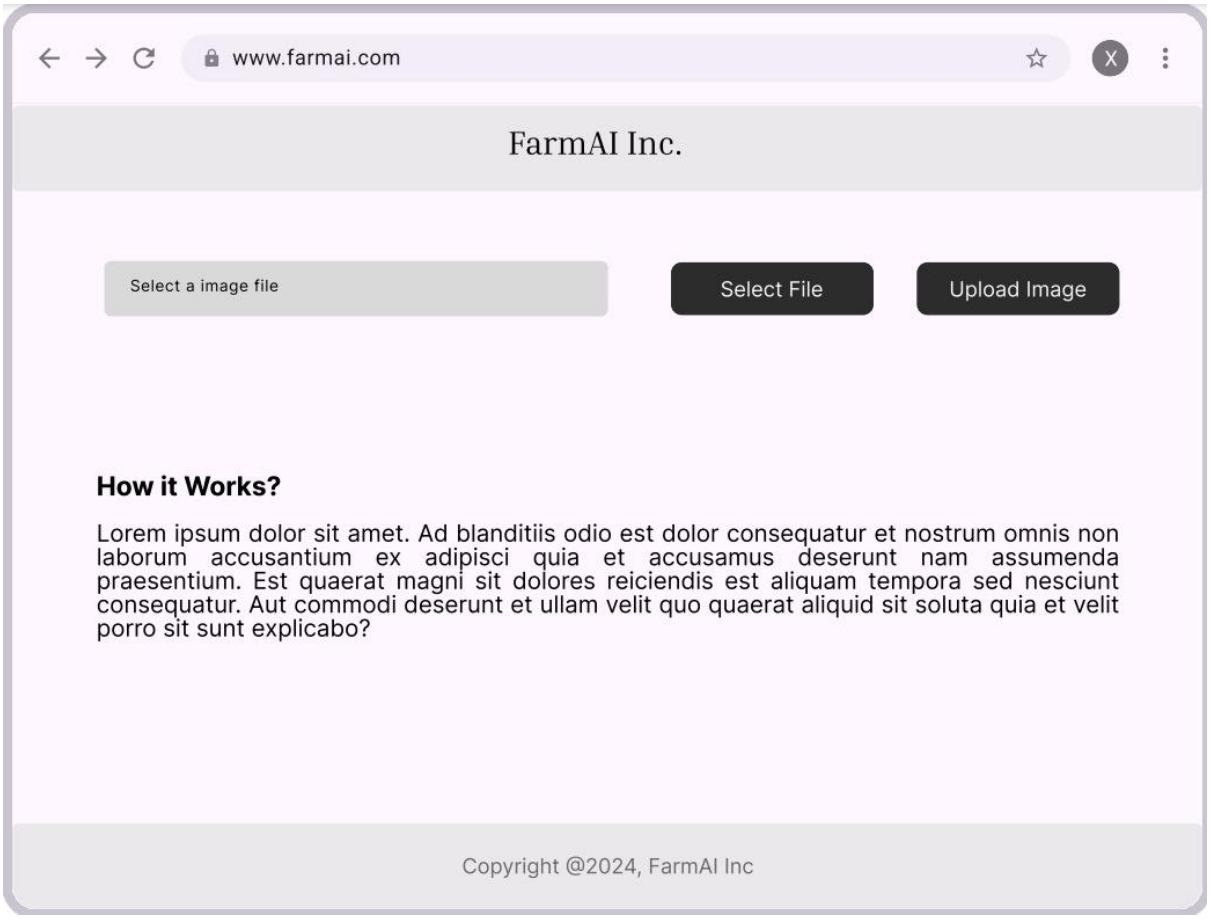
More Dataset Example:

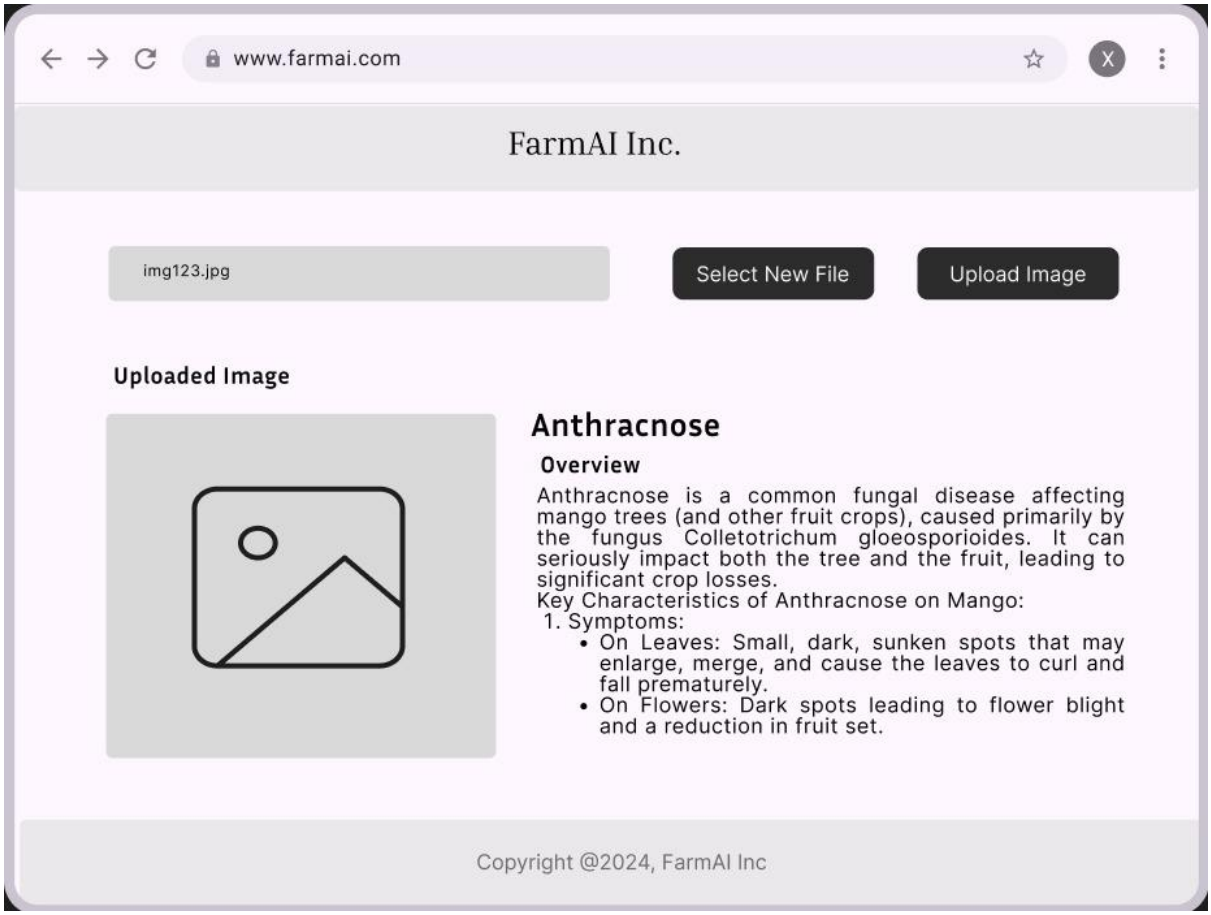
MangoLeafBD: A comprehensive image dataset to classify diseased and healthy mango leaves by National Library of Medicine
https://pmc.ncbi.nlm.nih.gov/articles/PMC9932726/

Data Characteristics

The dataset contains a variety of images of mango leaves, each showcasing distinct symptoms of different diseases. Each disease presents unique visual features—such as dark lesions for anthracnose and white powdery coatings for powdery mildew—that are crucial for identification. By applying machine learning, particularly image classification algorithms, we can train the model to recognize these features from labelled images. This enables the model to analyse new leaf images and provide accurate, real-time diagnoses based on the learned characteristics, facilitating timely disease management for healthier mango crops.

Wireframes





1. Image Upload Module: The process begins with the farmer uploading an image of a mango leaf suspected of having a disease. The image is then processed through the model for disease classification.

2. Model Processing: The uploaded image is analyzed by a TensorFlow Keras Sequential model, which classifies the leaf image based on its features to detect and identify specific diseases.

3. Classification Result: Once the model classifies the disease, the classification result is displayed in the user interface. This result includes the disease name and a confidence score indicating the reliability of the prediction.

4. Database Lookup: The system then queries a MongoDB or SQLite database for further information about the classified disease, such as symptoms, potential causes, and treatment recommendations.

5. Disease Information Display: Upon retrieving relevant data, the system displays detailed information about the disease alongside the classification result. This information helps farmers understand the disease and take appropriate action.

6. User Interface (UI): The UI, built using Streamlit, serves as the main interaction point for the user. It displays the classification result, disease information, and allows farmers to interact with the system.

Conclusion

In conclusion, the Mango Leaf Disease Prediction project leverages image classification techniques to provide small-scale mango farmers with a user-friendly tool for real-time disease diagnosis. By utilizing comprehensive datasets, including images with distinct visual features of various mango diseases, the model aims to improve accuracy and support sustainable farming practices. This innovative solution empowers farmers to make informed decisions, ultimately enhancing crop health and productivity while reducing reliance on chemical treatments.

References

- 1.Ellis SD, Boehm MJ, Mitchell TK. Fungal and fungal-like diseases of plants Fact Sheet, Agriculture and Natural Resources, The Ohio State University; 2008