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SMART DETECTION OF FRUIT DISEASES AND FERTILIZER RECOMMENDATION USING CNN

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ABSTRACT

This project focuses on leveraging technology to enhance agricultural productivity by accurately detecting fruit diseases and providing corresponding fertilizer recommendations. Traditional disease detection methods are manual and require expert intervention, which can be inaccessible for many farmers, especially those in remote regions. This system employs Convolutional Neural Networks (CNNs) to identify diseases in fruit crops using image-based data. Upon detection, it offers customized recommendations for corrective measures, including fertilizer application. By integrating real-time analysis and a user-friendly interface, this system empowers farmers with precise, actionable insights, promoting timely intervention and improving crop health.

Keywords: Agricultural Productivity, Fruit Disease Detection, Fertilizer Recommendations, Traditional Disease Detection, Remote Regions, Convolutional Neural Networks (Cnns), Image-Based Data, Customized Recommendations, Corrective Measures.

I. INTRODUCTION

Crop diseases are a persistent challenge in agriculture, threatening food security and farmer livelihoods. Accurate and timely detection of such diseases can mitigate significant losses. This project explores the role of image processing and machine learning in modernizing agricultural practices. Using CNNs for disease identification and integrating a recommendation engine for fertilizer suggestions creates a holistic crop management solution. The system aims to make disease detection accessible, scalable, and effective, offering real-time insights via a mobile application.

II. LITERATURE SUREVY

- Deep Learning for Disease Detection: Previous research has explored various deep learning models, such as Convolutional Neural Networks (CNNs), for detecting plant diseases from images. However, most solutions lack integrated recommendations for treatment or further corrective measures
- Vision Transformers: Advanced models like Vision Transformers have shown promise for specific applications, such as detecting diseases in particular crops (e.g., Java Plum), achieving high accuracy but limited by their focus on detection without recommendations
- Hybrid Models: Some studies have explored hybrid approaches, combining different deep learning techniques for improved detection accuracy. While effective, they often lack real-time capabilities and usability for non-technical users
- Gap Analysis: Existing systems often excel at disease detection but fall short of offering practical, actionable guidance to farmers. There is a clear need for a solution that combines high-accuracy detection with specific, data-driven recommendations for disease management

III. EXISTING SYSTEMS AND GAP ANALYSIS

Current Solutions: Most existing systems focus on detecting crop diseases using image processing and machine learning models, such as CNNs and hybrid networks. However, these systems often do not provide recommendations for treatment, limiting their practical utility for farmers

Gaps Identified:

- Limited real-time processing capabilities.
- Lack of user-friendly interfaces, making them difficult for non-technical users.
- No integration of fertilizer recommendations based on detected diseases.
- Minimal location-based alert mechanisms for collaborative agricultural management

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IV. PROPOSED SYSTEM

The proposed system aims to overcome existing limitations by offering a comprehensive approach that combines accurate disease detection with actionable recommendations. Key components include:

- Data Collection: Creation of a dataset containing labeled images of healthy and diseased fruits.
- Model Training: Training CNN models to recognize and classify various fruit diseases based on visual characteristics.
- Disease Detection and Recommendation Engine: The system uses a pre-trained CNN model to detect diseases and, upon confirmation, references a database to provide specific fertilizer recommendations tailored to the detected disease.
- User Interaction: Farmers interact with the system through a mobile application, receiving real-time disease detection results, fertilizer suggestions, and location-based alerts

V. SYSTEM ARCHITECTURE AND DESIGN

- System Architecture: Consists of multiple layers, including data collection, preprocessing, disease detection using CNN, recommendation generation, and a user interaction layer for real-time communication with farmers.
- Structural Diagrams: Include class diagrams, object diagrams, and component diagrams to represent system components and their interactions.
- Behavioral Diagrams: Use-case diagrams, sequence diagrams, and activity diagrams to illustrate user interactions, disease detection workflows, and recommendation processes

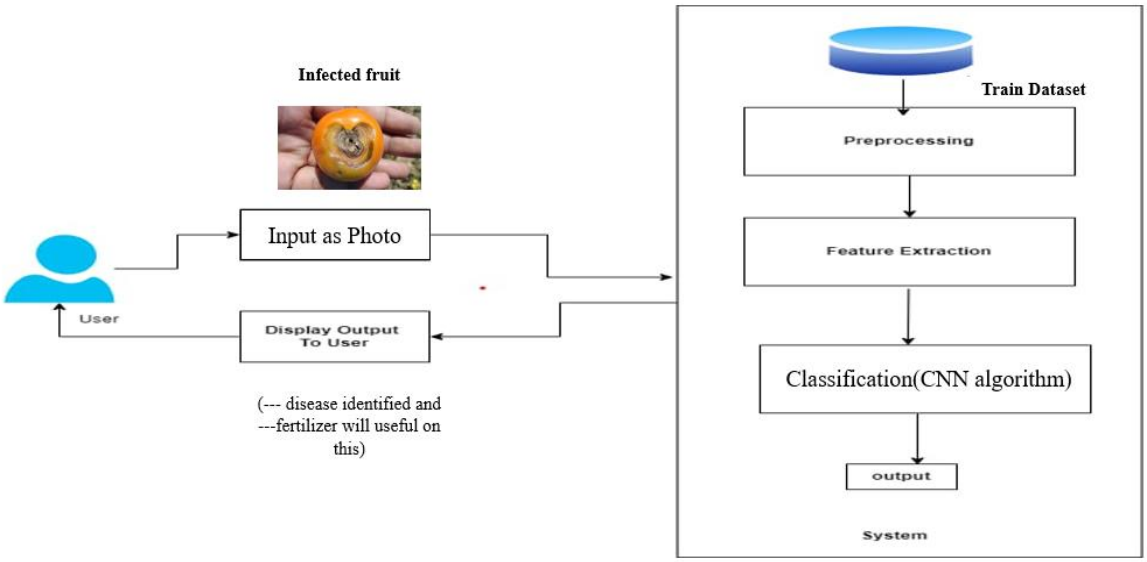

Figure 1: System Architecture.

VI. METHODOLOGY

1. Convolutional Neural Network (CNN): The core algorithm used for disease detection, capable of learning spatial hierarchies and distinguishing disease symptoms from fruit images.
2. Data Preprocessing: Data augmentation techniques, such as resizing and normalization, enhance model generalization and improve accuracy.
3. Model Training and Evaluation: Training a CNN model using labeled datasets, followed by validation to assess model accuracy.
4. Fertilizer Recommendation System: A rule-based or decision-tree engine that provides treatment recommendations based on detected diseases.
5. Mobile Application: Development of a cross-platform mobile app to enable farmers to upload crop images and receive real-time feedback

VII. TOOLS AND TECHNOLOGIES

- Languages: Python for developing and training the CNN model.
- Libraries and Frameworks: TensorFlow/Keras for deep learning, OpenCV for image preprocessing.

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- Database: Firebase for storing disease data, user profiles, and recommendation data.
- Platforms: React Native for mobile applications, enabling cross-platform support

VIII. SYSTEM IMPLEMENTATION AND FEATURES

- Real-Time Disease Detection: Identifying diseases from uploaded images using a trained CNN model.
- Fertilizer Recommendations: Customized recommendations based on disease type, crop, and environmental data.
- User Interaction: Farmers can access the system via a mobile app for disease detection, treatment recommendations, and location-based alerts.
- Notification System: Provides timely alerts and updates, fostering community collaboration and proactive management

IX. CONCLUSION

This project presents a novel system for intelligent disease detection and management in agriculture, using advanced deep learning techniques to identify fruit diseases and provide actionable insights. By integrating real-time notifications, a user-friendly interface, and tailored recommendations, it aims to revolutionize traditional agricultural practices. Future enhancements could include expanding to pest detection and incorporating weather-based recommendations, ensuring comprehensive support for farmers in diverse regions.

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