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An Artificial Intelligence and Cloud Based Collaborative Platform for Plant Disease Identification, Tracking and Forecasting for Farmers

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Abstract: Plant diseases have a significant impact on crop yield and agricultural productivity. Early detection and continuous monitoring of plant diseases are important for helping farmers manage crops effectively. This paper proposes an Artificial Intelligence (AI) and cloud-based collaborative platform for plant disease identification, tracking, and forecasting. The system employs deep learning techniques, particularly Convolutional Neural Networks (CNN), to detect plant diseases from leaf images captured through mobile devices. The identified disease data is stored and processed in a cloud environment, enabling real-time data sharing and large-scale monitoring. In addition, the platform tracks disease occurrences and utilizes historical information to forecast potential outbreaks. By integrating AI with cloud computing, the proposed system improves the accuracy, scalability, and accessibility of disease diagnosis while assisting farmers in taking timely preventive actions.

Keywords: Artificial Intelligence, Plant Disease Detection, Convolutional Neural Networks (CNN), Cloud Computing, Disease Forecasting, Smart Agriculture.

I. INTRODUCTION

Agriculture plays a crucial role in ensuring food security and supporting the global economy. However, plant diseases significantly affect crop yield and quality, leading to economic losses for farmers. Traditional disease detection methods usually depend on manual inspection by agricultural experts. This process can be time-consuming and often inaccessible to farmers, especially in rural areas, resulting in delayed diagnosis and increased crop damage.

Recent advancements in Artificial Intelligence (AI) and machine learning have provided effective solutions for agricultural monitoring. Deep learning techniques, particularly Convolutional Neural Networks (CNN), have shown strong performance in image recognition tasks such as plant disease detection from leaf images. These technologies enable faster and more accurate identification of plant diseases compared to traditional approaches.

In addition, cloud computing offers scalable storage and real-time data processing capabilities. Integrating AI with cloud-based platforms enables efficient data sharing and collaboration between farmers and agricultural experts. Such systems also support continuous data collection and large-scale monitoring of crop health across different geographical locations.

This paper proposes an AI and cloud-based collaborative platform for plant disease identification, tracking, and forecasting. The system allows farmers to capture images of infected plants using mobile devices, which are analyzed using deep learning models. The detected information is stored on a cloud platform for monitoring disease occurrences and predicting potential outbreaks. The proposed system aims to assist farmers in making timely decisions and improving sustainable agricultural practices.

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II. RELATED WORK

Several studies have explored the use of image processing and machine learning techniques for plant disease detection. Earlier approaches mainly relied on traditional image processing methods such as color analysis, texture extraction, and pattern recognition to identify disease symptoms on plant leaves. Although these methods provided useful results, they often required manual feature extraction and had limitations in handling complex disease patterns.

With recent advancements in Artificial Intelligence, deep learning models such as Convolutional Neural Networks (CNN) have been widely used for plant disease classification. CNN-based models can automatically learn important features from leaf images and have shown improved accuracy compared to conventional machine learning techniques. Many studies have demonstrated the effectiveness of these models in detecting plant diseases from images captured under different environmental conditions.

Researchers have also investigated the use of cloud computing in agricultural applications. Cloud platforms enable efficient storage, processing, and sharing of large volumes of agricultural data.

Despite these advancements, most existing systems focus mainly on disease detection without providing integrated solutions for tracking and forecasting disease spread. Therefore, there is a need for a collaborative platform that combines automated disease detection with cloud-based monitoring and predictive analysis. The proposed system aims to address this limitation by integrating AI-based diagnosis with tracking and forecasting capabilities.

III. PROPOSED SYSTEM

The proposed system is an Artificial Intelligence and cloud-based collaborative platform designed to assist farmers in identifying, tracking, and forecasting plant diseases. The system enables farmers to capture images of infected plant leaves using a mobile application. These images are uploaded to a cloud server where they are analyzed using a deep learning model, specifically a Convolutional Neural Network (CNN). The CNN model is trained on large datasets of plant images and is capable of identifying different types of plant diseases based on visual symptoms.

Once the image is processed, the system provides the farmer with the predicted disease name along with basic recommendations for treatment or prevention. The cloud platform stores the uploaded images and diagnostic results in a centralized database. This data can be used to monitor disease occurrences across different geographical regions.

In addition, the stored historical data and environmental information can be analyzed to detect patterns and forecast possible disease outbreaks. By integrating AI-based image analysis with cloud computing and collaborative features, the proposed system provides a scalable and accessible solution for plant disease management.

IV. SYSTEM ARCHITECTURE

The system architecture of the proposed platform integrates mobile devices, cloud computing, and AI- based image analysis to provide automated plant disease detection, tracking, and forecasting. The architecture consists of the following main components:

Mobile Application:

Farmers capture images of plant leaves using the mobile app and submit them for analysis. The app also receives diagnostic results and recommendations.

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Cloud Server:

All uploaded images are transmitted to a cloud server. The server handles image preprocessing such as resizing, normalization, and noise reduction to prepare the images for analysis.

Disease Detection Module (CNN Model):

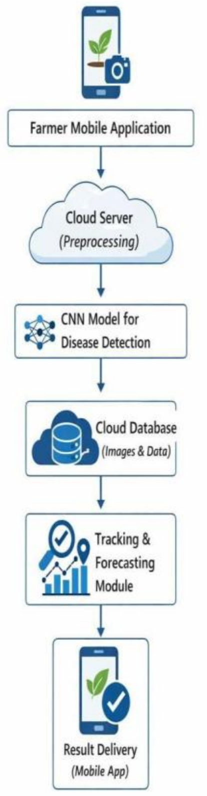
A trained Convolutional Neural Network (CNN) model analyzes the processed images and identifies the type of plant disease. The model is trained on a large dataset of annotated plant images to ensure accurate classification.

Database Module:

The system stores images, diagnostic results, and geographical information in a centralized cloud database. This enables monitoring of disease occurrences across regions.

Tracking and Forecasting Module:

Historical data and environmental parameters are analyzed to identify patterns and forecast possible disease outbreaks.



Result Delivery:

Diagnostic results and preventive recommendations are sent back to the farmer via the mobile application.

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V. DATA FLOW DIAGRAM

The Data Flow Diagram (DFD) represents the flow of information within the AI and cloud-based plant disease detection system. The system works as follows:

The farmer captures an image of an infected plant leaf using the mobile application.

The image is uploaded to the cloud server for processing.

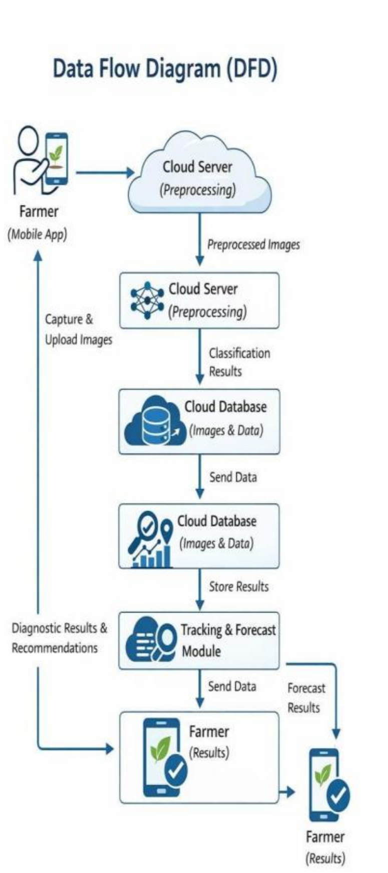
The cloud server performs image preprocessing, including resizing, normalization, and noise removal.

The preprocessed image is sent to the CNN-based disease detection module for classification.

The classification results are returned to the cloud server and stored in a centralized cloud database along with the image and geographical information.

The tracking and forecasting module analyzes the stored data to predict possible disease outbreaks based on historical and environmental information.

The final diagnostic results and preventive recommendations are delivered back to the farmer's mobile application.



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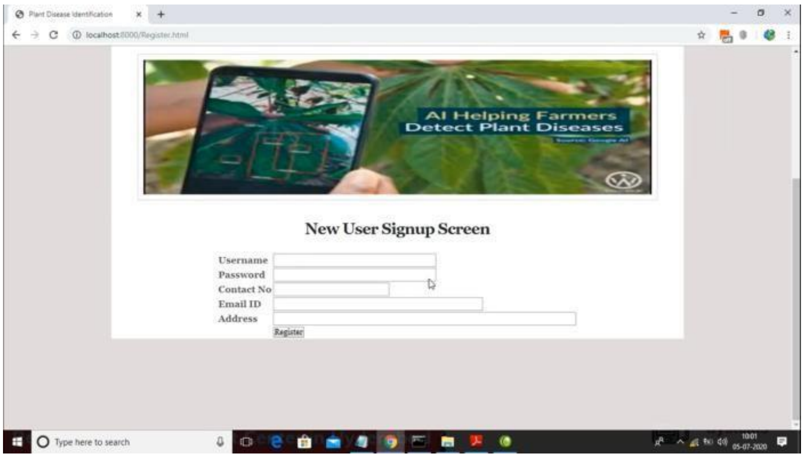
The DFD can be visualized with the farmer’s mobile app at the start, connected to the cloud server, which forwards the image to the CNN model for disease detection. The results are stored in the cloud database, which feeds the tracking and forecasting module. The final output is sent back to the farmer’s mobile application.

VI. IMPLEMENTATION

The proposed AI and cloud-based plant disease detection system is implemented as a modular and scalable platform. The system integrates a mobile application, cloud computing infrastructure, and a deep learning-based disease detection model to provide real-time diagnosis and forecasting.

The system is divided into several functional modules:

1. Registration Module: This module allows farmers to create accounts and securely access the platform. Users provide basic information such as name, contact details, and location to enable personalized disease tracking.



2. Login Module: Users authenticate themselves using registered credentials to ensure secure access and maintain data privacy.

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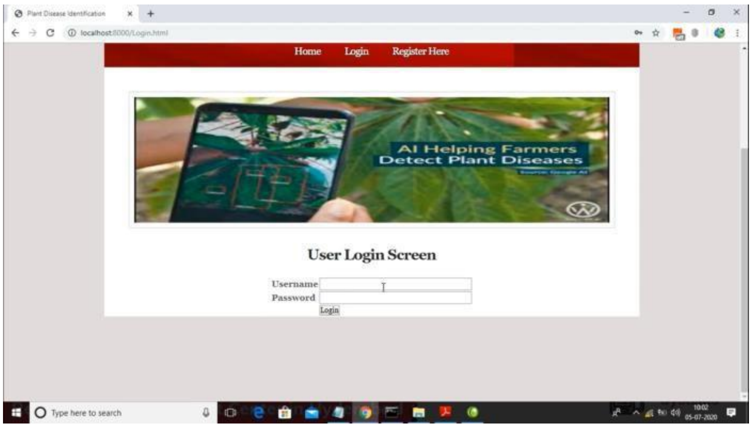
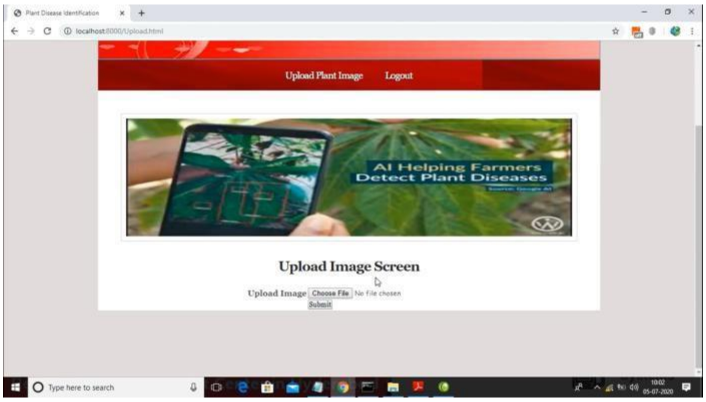


3. Upload Plant Image Module: Farmers capture images of infected plant leaves using the mobile application and upload them to the cloud server. The system ensures proper image quality and resolution for accurate analysis.



4. Disease Detection Module: The cloud server preprocesses uploaded images, including resizing, normalization, and noise reduction. The processed images are then analyzed by a Convolutional Neural Network (CNN) model, which classifies the disease based on visual symptoms. The CNN model is trained on a large dataset of annotated plant images covering multiple crops and disease types.

5. Result Delivery Module: Once the disease is classified, the system returns the diagnosis along with preventive or treatment

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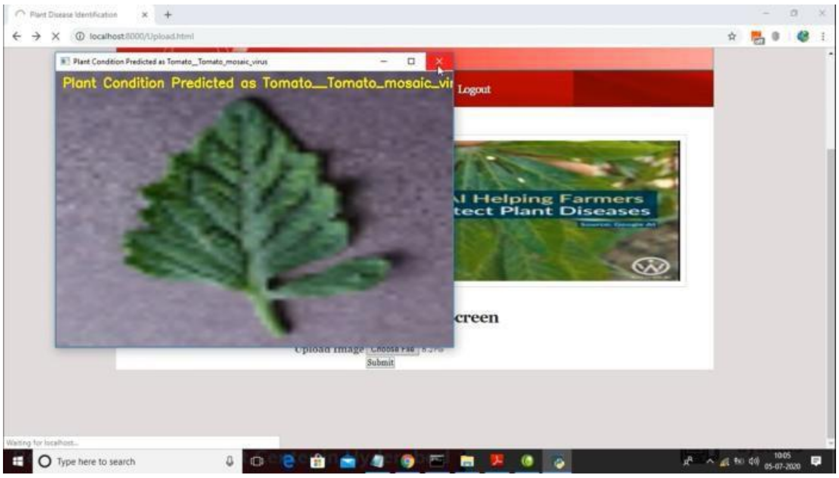
recommendations to the farmer via the mobile application.



6. Tracking and Forecasting Module: All uploaded images, diagnostic results, and geographical data are stored in a cloud database. Historical data is analyzed along with environmental parameters to track disease spread and forecast potential outbreaks. This module helps farmers anticipate risks and take preventive measures.

7. Logout Module: Users can securely end their session to maintain account security.

Technologies Used

The system is implemented using open-source and widely available technologies. The mobile application is developed for smartphones to capture and transmit plant images. The cloud server handles image preprocessing, execution of the CNN model, and database management.

The CNN model is implemented using TensorFlow/Keras and trained on a custom dataset collected over several months from multiple farms. It analyzes the uploaded plant images to identify the most likely disease class. All images, diagnostic results, and geotagged data are stored in the cloud database to support disease tracking, monitoring, and forecasting.

Workflow

The AI-driven workflow of the system is as follows:

Image Capture: The farmer captures a plant image and uploads it via the mobile application.

Preprocessing: The cloud server preprocesses the image, including resizing, normalization, and augmentation, to prepare it for analysis.

Disease Classification: The CNN model extracts relevant features from the preprocessed images and predicts the plant disease.

Data Storage & Analysis: The classification results are stored in the cloud database. The tracking and forecasting module analyzes trends in disease occurrence to provide insights.

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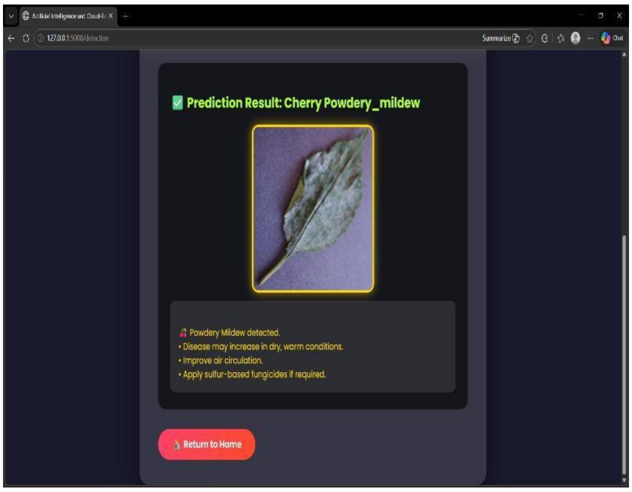
Result Delivery: The diagnostic results, along with preventive recommendations, are delivered to the farmer through the mobile application, completing a seamless AI-based workflow.

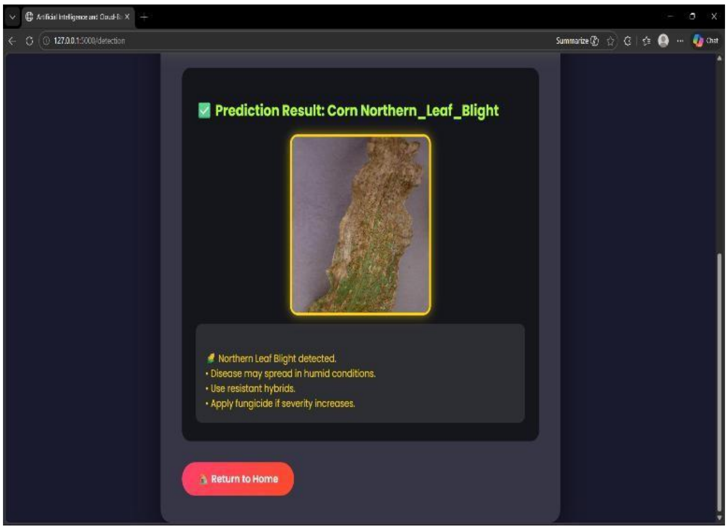
This workflow ensures automated, accurate, and real-time plant disease identification, enabling data- driven decision-making for farmers and supporting proactive disease management.

VII. RESULTS

The proposed AI and cloud-based platform was evaluated for its ability to accurately identify plant diseases using leaf images collected from farmers. A Convolutional Neural Network (CNN) model was trained on a diverse dataset of plant images obtained from multiple farms over seven months. The dataset included both healthy leaves and leaves affected by various diseases.



Cherry Powdery Mildew



Corn Northern Leaf Blight

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The system was evaluated using accuracy, precision, recall, and F1-score as performance metrics. The test results indicated an overall disease identification accuracy of over 95%. Precision and recall values for major crop diseases exceeded 93%, demonstrating that the model effectively minimized false positives and false negatives.

System performance was further validated by comparing the automated diagnostic results with assessments conducted by plant pathologists. The evaluation confirmed that the automated system provided consistent and reliable disease identification.

The cloud-based architecture enabled real-time diagnosis and storage of disease occurrences, facilitating continuous monitoring of crop health across regions. Disease density maps and predictive forecasting models were generated from geo-tagged images and environmental data, providing actionable insights for preventive measures.

These results demonstrate that the proposed system is scalable, robust, and capable of assisting farmers in managing plant health efficiently, reducing reliance on manual expert inspections.

VIII. CONCLUSION

This paper presents an AI and cloud-based platform for automated plant disease identification, tracking, and forecasting. Farmers can capture images of infected leaves via a mobile app, and diseases are classified using a CNN trained on a large dataset. The cloud-based system enables real-time diagnosis, centralized storage, and analysis of geo-tagged data for monitoring and forecasting. Experimental results show over 95% accuracy, with precision and recall exceeding 93% for major crop diseases, validated against expert assessments. By combining AI and cloud computing, the system provides a scalable solution for timely disease management. Future work may expand the dataset to more crops and diseases, incorporate multi-spectral imaging, and enhance early warning predictive analytics.

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