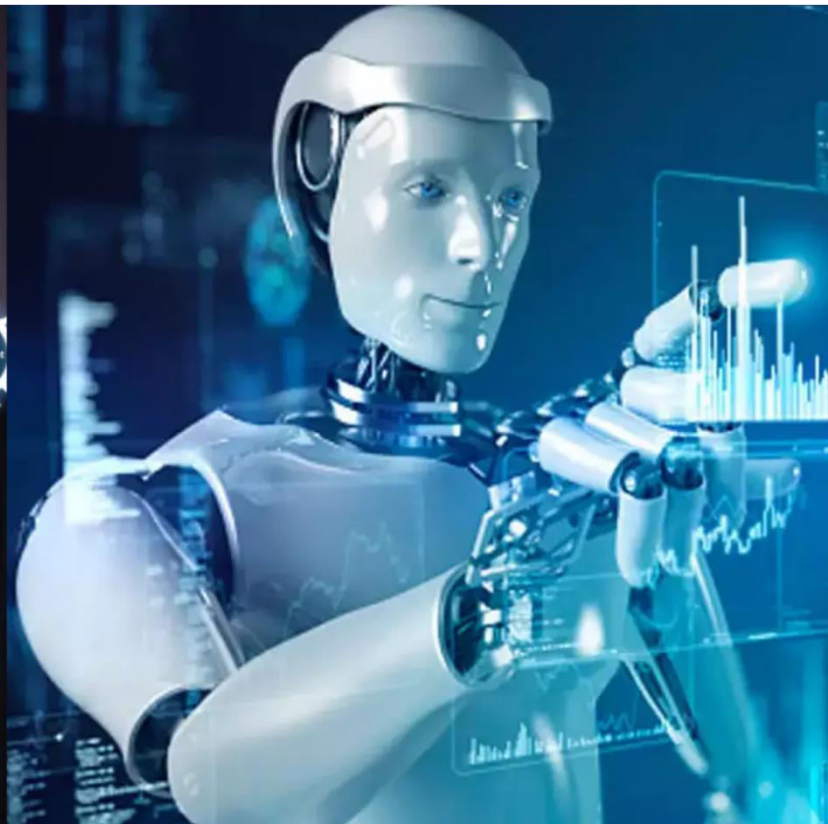




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AI Based Plant Disease Detection using Live Camera Feed

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ABSTRACT: This project presents the development of a smartphone-based, AI-powered system designed to assist farmers in detecting plant diseases in real time. By leveraging deep learning techniques specifically Convolutional Neural Networks (CNN) the system analyzes images captured through a mobile device's live camera feed to accurately identify and classify plant diseases. In addition to CNN, variations such as YOLO (You Only Look Once) for real-time object detection, MobileNetV2 for lightweight and efficient classification, ResNet for deep feature extraction, and Efficient Net for optimized performance are considered to enhance detection speed and accuracy. The mobile application provides farmers with an easy-to-use interface, delivering instant feedback, disease identification, and recommended treatments. Field testing with local farmers demonstrated the system's ability to detect early-stage infections and prevent significant crop loss. This approach addresses the limitations of traditional methods that rely heavily on expert intervention and delayed diagnosis. Furthermore, the project lays the foundation for future enhancements, including IoT integration, cloud-based analytics, and voice support, and impactful solution in the evolution toward AI-driven smart agriculture.

KEYWORDS: Plant Disease Detection, Convolutional Neural Network (CNN), YOLO, MobileNetV2, Res Net, Efficient Net, Real-Time Image Classification, Smartphone Application, Deep Learning, Artificial Intelligence in Agriculture.

I. INTRODUCTION

Plant diseases pose a serious threat to agricultural productivity, often leading to significant crop loss and financial hardship for farmers, especially in rural areas. Traditional methods of disease detection are time-consuming, expensive, and require expert knowledge, making them inaccessible for many small-scale farmers. With the rise of artificial intelligence and mobile technology, there is a growing opportunity to offer accessible and efficient solutions. This project aims to develop a smartphone-based application that uses deep learning particularly Convolutional Neural Networks (CNN) and its variants like YOLO, MobileNetV2, ResNet, and Efficient Net for real-time plant disease detection through a live camera feed. The system provides instant feedback, disease classification, and treatment suggestions through a simple, user-friendly interface. By enabling early detection and action, this AI-powered tool supports smarter farming practices and helps improve crop health and yield, contributing to the advancement of sustainable and technology-driven agriculture.

1.1 Deep Learning for Plant Disease Detection

Deep learning is a powerful subset of artificial intelligence that excels in handling complex image classification tasks, making it highly effective for plant disease detection. In this project, deep learning techniques specifically Convolutional Neural Networks (CNN) were employed to automatically identify and classify diseases from images of plant leaves. The CNN model was trained on a diverse dataset of diseased and healthy leaf images, enabling it to learn critical visual features such as colour, texture, and shape variations associated with specific diseases. By using this model within a smartphone application, the system can analyse real-time images captured through the device's camera and provide instant disease classification along with recommended actions. To further improve performance and adaptability, advanced CNN variants like YOLO for real-time detection, MobileNetV2 for lightweight deployment, Res

Net for deep feature extraction, and Efficient Net for balanced accuracy and speed were also considered. This integration of deep learning into a mobile platform provides an accessible, efficient, and scalable solution for early plant disease detection, helping farmers take timely actions to protect their crops.

II. LITERATURE SURVEY

[1] Machine Learning and Deep Learning for Plant Disease Classification and Detection

Vasileios balafas, Emmanouil karantoumanis, Malamati louta, and Nikolaos ploskas, "Machine Learning and Deep Learning for Plant Disease Classification and Detection", IEEE Access, Volume 11, 2023, PP 114352 - 114377.

Precision agriculture aims to improve agricultural sustainability using advanced technologies, with machine learning and deep learning playing a key role in detecting and classifying plant diseases. This paper reviews recent research in this area, organizing the studies into two main categories: classification and object detection. It also introduces a novel classification scheme and lists publicly available datasets used for plant disease detection. An extensive evaluation was conducted on the PlantDoc dataset using five leading object detection algorithms and eighteen classification models. The results show that YOLOv5 performs best for detecting diseased areas on leaves, while ResNet50 and MobileNetv2 achieve the best balance between accuracy and training time in identifying the presence of disease.

[2] Segment Anything Model and Fully Convolutional Data Description for Plant Multi-Disease Detection on Field Images

Emmanuel moupjou, Florent retrain, Hyppolite tapamo, Marcellin kenlifack, Cheikh kacfah, and Appolinaire tagne, "Segment Anything Model and Fully Convolutional Data Description for Plant Multi-Disease Detection on Field Images", IEEE Access Volume 12, 2024, PP 102592 - 102605.

This study addresses the challenge of low accuracy in plant disease detection models trained on controlled laboratory datasets, like PlantVillage, when applied to real-world field images with complex backgrounds and lighting. To overcome this, the authors propose a model ensemble approach that uses the Segment Anything Model to identify objects in field images, followed by image processing techniques to isolate leaves. A Fully Convolutional Data Description model filters out non-leaf objects, and the selected leaves are classified using a model trained on PlantVillage. This approach improves disease classification accuracy by over 10% on field datasets like PlantDoc, offering a more reliable solution for farmers.

[3] FieldPlant: A Dataset of Field Plant Images for Plant Disease Detection and Classification with Deep Learning

Emmanuel moupjou, Appolinaire tagne, Florent retrain, Anicet tadonkemwa, Dongmo wilfried, Hyppolite tapamo, and Marcellin kenlifack, "FieldPlant: A Dataset of Field Plant Images for Plant Disease Detection and Classification with Deep Learning", IEEE Access Volume 11, 2023, PP 35398 - 35410.

The need for accurate plant disease detection to reduce food waste and meet future food demands. While deep learning models are often trained on datasets like PlantVillage, which contain lab images with simple backgrounds, their performance drops on real-world field images. To address this, the PlantDoc dataset was introduced with 2,569 field images, but it includes some lab images and lacks expert annotations. In response, the authors propose a new dataset, FieldPlant, containing 5,170 field images and 8,629 manually annotated leaves across 27 disease classes, all reviewed by plant pathologists. Benchmark tests show that models perform better on FieldPlant than on PlantDoc, making it more suitable for real-world applications.

[4] Improving Plant Disease Classification with Deep-Learning-Based Prediction Model Using Explainable Artificial Intelligence

Natasha nigar, Hafiz muhammad faisal, Muhammad umer, Olukayode oki, and Jose manappattukunnel lukose, "Improving Plant Disease Classification with Deep-Learning-Based Prediction Model Using Explainable Artificial Intelligence ", IEEE Access Volume 12, 2024, PP 100005 - 100014.

Plant diseases can severely affect crop yield and quality, leading to economic losses on both local and global levels. Deep learning models are effective in detecting these diseases but often lack interpretability, which can reduce user

trust. To address this, the study proposes an explainable AI (XAI)-based plant disease classification system that identifies 38 different plant diseases with high performance achieving 99.69% accuracy, 98.27% precision, and 98.26% recall. To make the model's decisions more transparent, it incorporates the LIME (Local Interpretable Model-Agnostic Explanations) framework, which provides visual explanations for each prediction. This enhances the model's reliability, supports informed agricultural decision-making, and contributes to improved plant health management and global food security.

III. METHODOLOGY

The system captures plant images using a smartphone, preprocesses them to remove noise, and extracts key features. A deep learning model like CNN or its variants classifies the disease in real time. The result is instantly displayed to the user with disease details and suggested actions through a simple mobile interface.

3.1 System Overview

The AI-based plant disease detection system starts by selecting the plant type and capturing or uploading a leaf image via smartphone. A Convolutional Neural Network (CNN) processes the image to detect and identify any plant disease. The system then analyzes the results and provides detailed disease information along with recommended treatments, tips, and pesticides. This efficient and user-friendly process helps farmers detect diseases early and take quick action to protect their crops.

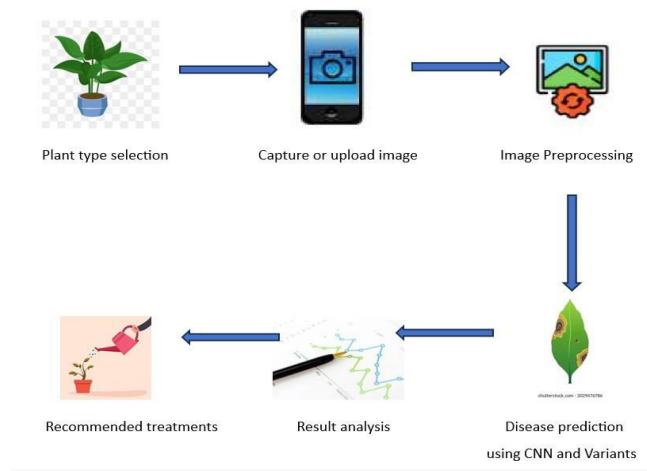


Figure -1: Architecture of the System

As shown in **Figure -1**, illustrates the architecture of the AI-based plant disease detection system. The process begins with plant type selection and capturing or uploading a leaf image. The image is pre-processed and analyzed using Convolutional Neural Network (CNN) analyses the image to detect any disease. Based on the results, the system suggests suitable treatments to help manage the disease effectively.

3.1.1 Plant Type Selection

The user begins by selecting the type of plant from a predefined list. This information helps the AI model narrow down the disease possibilities based on the crop category, enhancing prediction accuracy by providing contextual input.

3.1.2 Capture or Upload Image

The user captures a live leaf image via a smartphone camera or uploads an existing image. At this stage, YOLO (You Only Look Once) can be applied for real-time object detection to locate and crop the relevant leaf area from the image, ensuring focused analysis and reducing background noise.

3.1.3 Image Preprocessing

preprocessing tasks such as resizing to a fixed input shape, normalization for consistent lighting and color intensity, and denoising to remove unwanted artifacts. This step standardizes the input, allowing the model to generalize better and perform more accurate predictions.

3.1.4 Disease Prediction using CNN and Variants

Analysed using a CNN-based classification model, which detects and identifies the disease. Depending on the hardware and deployment environment, model variants such as MobileNetV2 is ideal for mobile-based lightweight applications. Res Net is used for deeper feature extraction in complex cases. Efficient Net offers a balance between speed and accuracy. These models enhance performance and adaptability across different platforms.

3.1.5 Result Analysis

The model outputs a detailed prediction, including the disease name, confidence level, and severity classification. This analysis provides users with insights into how accurate the prediction is, helping them make informed decisions about treatment urgency and resource allocation.

3.1.6 Recommended Treatments

Based on the disease identified, the system recommends actionable treatments such as pesticide application, pruning, watering adjustments, and soil conditioning. It may also include preventive tips to avoid future infections. This guidance empowers farmers or gardeners to take early and effective measures, reducing crop loss and improving yield quality.

3.2 Workflow Overview

The system operates through the following steps:

1. **Plant Type Selection:** The user first selects the type of plant from a predefined list. This step helps the AI model narrow down the potential diseases based on crop type, improving detection precision.
2. **Image Capture or Upload:** A leaf image is either captured using a smartphone camera or uploaded from the gallery. YOLO (You Only Look Once) may be used at this stage for real-time object detection and to focus on the leaf area.
3. **Image Preprocessing:** The image undergoes preprocessing techniques such as resizing, filtering, normalization, and noise reduction to enhance quality and make it suitable for analysis.
4. **Disease Detection using CNN:** The refined image is passed through a Convolutional Neural Network (CNN) or its variants like MobileNetV2, ResNet, or Efficient Net. These models detect and classify the disease with high accuracy.
5. **Result Analysis:** The system displays a comprehensive report, including the disease name, confidence score, severity level, and optionally, heatmaps highlighting the affected regions of the leaf.
6. **Treatment Recommendation:** Based on the diagnosis, the system suggests appropriate treatment measures, such as pesticide use, watering advice, or organic remedies, to help prevent further damage.
7. **User Interface Output:** The results are shown on a simple, user-friendly interface that allows farmers to make informed decisions quickly in real-time field conditions.

IV. SYSTEM IMPLEMENTATION

4.1 List of Modules

- Image Acquisition
- Data Processing & Feature Extraction
- Disease Detection & Classification
- User Interface

4.1.1 Image Acquisition

The image acquisition module serves as the starting point of the system, utilizing the smartphone's built-in camera to capture real-time images of plants. Farmers can either take a still photo or use the live camera feed to continuously scan the leaves for any visible signs of disease. To ensure optimal image quality, the module automatically adjusts focus and lighting conditions when necessary, enabling accurate downstream analysis. This initial step is crucial, as it provides the essential visual data required for the subsequent stages of processing, classification, and disease detection.

4.1.2 Data Processing & Feature Extraction

The system proceeds with a preprocessing phase where the image is resized, filtered, and enhanced to remove noise and irrelevant background elements. Techniques such as normalization and histogram equalization are applied to improve image clarity, contrast, and consistency across different lighting conditions. Once the image is cleaned and standardized, the system extracts key features such as leaf color, shape and size of spots, and texture patterns which are crucial indicators of various plant diseases. These extracted features form the input to the AI classification model and play a vital role in achieving accurate and reliable disease detection results.

4.1.3 Disease Detection & Classification

The image has been processed and relevant features extracted, the data is passed through a trained machine learning model primarily a Convolutional Neural Network (CNN). The model analyzes the input by comparing the extracted features with patterns it has learned from a large dataset of both healthy and diseased plant images. Based on this comparison, the system classifies the plant as either healthy or affected by a specific disease. To improve speed and accuracy, advanced deep learning models such as YOLO, MobileNetV2, or Efficient Net may be utilized, depending on the application requirements. This module serves as the core intelligence of the system, enabling quick, efficient, and highly accurate disease identification, which is critical for timely intervention and effective crop management.

4.1.4 User Interface

The user interface module is designed to be simple, intuitive, and farmer-friendly, ensuring ease of use in real-world agricultural environments. It displays real-time disease alerts, clearly indicating whether a plant is healthy or infected, along with the specific disease name and recommended treatment steps. The interface is accessible via both a mobile application and a web-based dashboard, offering flexibility and convenience for farmers. Additionally, it supports manual image uploads for further analysis, allowing users to recheck or analyze saved images. This module plays a crucial role in translating complex AI-driven insights into practical, easy-to-understand information, making the technology highly accessible and useful for local farmers with varying levels of digital literacy.

V. RESULT AND DISCUSSION

The proposed system was tested on real-world plant leaves to evaluate its accuracy and efficiency in assisting local farmers. The results demonstrate that the system successfully detects plant diseases and provides appropriate recommended treatments.

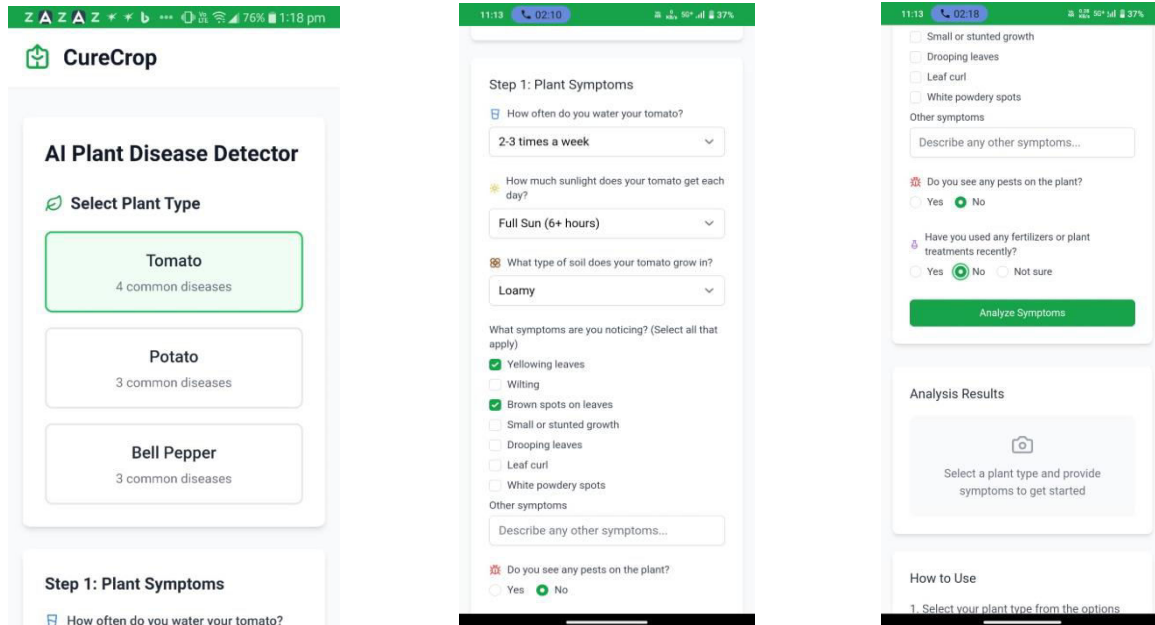


Figure 1: User Guided Plant and Plant Health Assessment

Cure Crop offers an easy-to-use interface for detecting plant diseases with AI. Farmers start by selecting a plant type, then enter key details like watering frequency, sunlight, soil type, and visible symptoms. They can also note pest presence and recent treatments. After submitting the information, the app activates the mobile camera to scan the leaf and detect the disease.

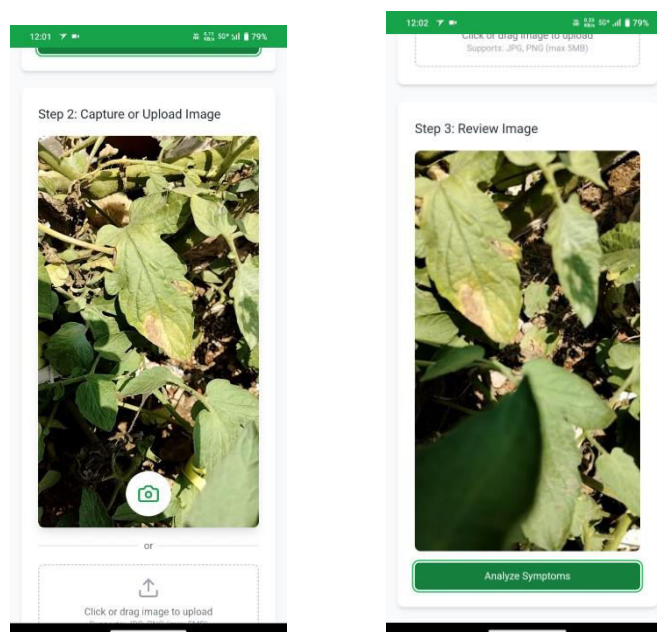


Figure 2: Real-Time Leaf Detection for Disease Analysis

Leaf captured by the mobile camera for disease analysis. YOLO is used to detect and isolate the leaf from the background in real time. After detection, the image is sent to a CNN-based model to identify any visible disease based on leaf symptoms. This process ensures quick and accurate results, helping farmers take timely action.

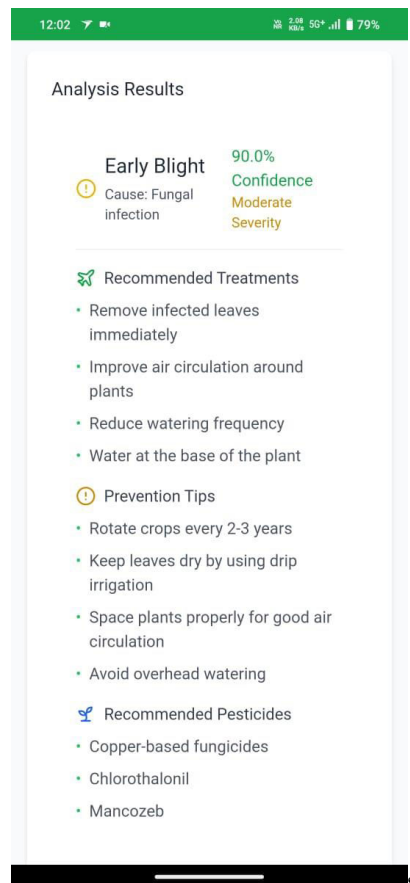


Figure -3: Disease Detection Result and Treatment Suggestions

Final disease diagnosis result, identifying the leaf as affected by Early Blight with a 90% accuracy. It also provides treatment recommendations such as removing infected leaves, improving air circulation, and reducing watering frequency. Additionally, it suggests preventive tips like crop rotation and using drip irrigation, along with recommended pesticides including copper-based fungicides, Chlorothalonil, and Mancozeb to manage the disease effectively.

VI. CONCLUSION

The AI-based plant disease detection system developed in this project offers real-time analysis using a live camera feed and advanced machine learning techniques. By leveraging Convolutional Neural Networks (CNN) along with other efficient deep learning models, the system accurately classifies plant diseases from leaf images, enabling immediate diagnosis and action. Field testing has validated its effectiveness, showing that early detection significantly helps farmers reduce crop loss and increase productivity. The mobile application is designed with a simple and user-friendly interface, making it accessible even to farmers with limited technical experience. Beyond its immediate benefits, the project establishes a strong foundation for future enhancements, including the integration of IoT devices for automated crop monitoring and cloud-based platforms for large-scale data analysis. These improvements could greatly expand the system's capabilities and reach. With ongoing development, the solution holds great promise for

research, commercialization, and startup innovation. Overall, this project represents a significant step toward revolutionizing precision agriculture and promoting smarter, technology-driven farming practices on a broader scale.

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