IJITCE

ISSN 2347- 3657

International Journal of
Information Technology & Computer Engineering

Email : ijitce.editor@gmail.com or editor@ijitce.com

International Journal of Information Technology & Computer Engineering
ISSN 2347–3657
Volume 13, Issue 2, 2025

PLANT DISEASE DETECTION AND FERTILIIZER RECOMMENDATION USING ML AND DL

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ABSTACT

Agriculture remains a cornerstone of the global economy and food security, but it faces major challenges due to crop diseases and imbalanced fertilizer usage. These issues can lead to significant yield losses and long-term soil degradation. Early detection of plant diseases and the application of appropriate fertilizers are vital to improving agricultural productivity. This paper proposes a dual-purpose system leveraging machine learning (ML) and deep learning (DL) to assist farmers in identifying plant diseases and recommending suitable fertilizers.

The plant disease detection module uses Convolutional Neural Networks (CNNs), a class of deep learning models known for their high performance in image classification tasks. Leaf images are processed and classified into healthy or diseased categories, with further identification of specific disease types. This approach reduces the need for manual inspection and expert intervention, providing farmers with instant diagnostic capabilities. Transfer learning with pre-trained models such as VGG16 or ResNet is applied to enhance accuracy and reduce training time.

1. INTRODUCTION

Agriculture plays a vital role in global food security and economic development, providing sustenance and livelihood to millions of people. However, the productivity and quality of agricultural output are constantly threatened by various factors, including plant diseases. These diseases can lead to significant yield losses, affecting food availability and increasing economic burdens on farmers. Early and accurate detection of plant diseases is essential for effective disease management and control.

Traditional disease identification methods primarily rely on manual inspection by farmers or agricultural experts. This approach is not only time-consuming but also prone to human errors due to the variability in disease symptoms, environmental conditions, and the expertise of the observer. With advancements in technology, machine learning and deep learning have emerged as powerful tools for automating plant disease classification and detection, offering more efficient and precise solutions.

In contrast, modern approaches utilizing machine learning and deep learning techniques offer several advantages. These models are trained on large datasets containing images of healthy and diseased plants, allowing them to learn distinguishing features and classify diseases with high accuracy.

2. LITERATURE REVIEW

In recent years, the application of machine learning (ML) and deep learning (DL) in agriculture has gained significant momentum, particularly in the areas of plant disease detectio n and fertilizer recommendation. Numerous studies have explored these domains to enhance crop management and ensure sustainable agricultural practices. Plant disease detection has predominantly focused on the use of image-based analysis, leveraging the power of convolutional neural networks (CNNs) for accurate classification. For instance, Mohanty et al. (2016) utilized a deep CNN model to classify 38 classes of plant diseases using over 50,000 leaf images, achieving a high accuracy of over 99% on the training dataset. Similarly, Sladojevic et al. (2016) demonstrated the effectiveness of deep learning in identifying plant diseases through a model trained on a publicly available dataset of diseased and healthy plant leaves.

2.1 Existing system

Plant disease detection has traditionally relied on conventional methods, primarily involving manual inspection, laboratory testing, and expert consultation. Farmers and agricultural specialists visually inspect plants for symptoms such as leaf discoloration, spots, wilting, and fungal growth. While these methods have been used for centuries, they come with limitations that hinder timely and accurate disease identification. With the advancement of technology, several computational techniques have been introduced to assist in disease detection. However, the existing systems still have challenges, including reliance on handcrafted features, limited dataset diversity, and difficulties in real-world implementation. This section explores the various approaches used in the existing plant disease detection systems, their methodologies, and their limitations.

3. Proposed System

The proposed system for plant disease classification and detection using machine learning and deep learning aims to provide an efficient, accurate, and user-friendly solution to assist farmers, agricultural researchers, and policymakers. The system leverages advanced artificial intelligence techniques to identify plant diseases from images, enabling early detection and timely intervention. By integrating cloud-based processing, mobile accessibility, and a

International Journal of Information Technology & Computer Engineering

ISSN 2347–3657

Volume 13, Issue 2, 2025

user- friendly interface, the system addresses the limitations of traditional manual inspection methods and existing automated systems. This section outlines the core components, architecture, and functionalities of the proposed system.

3.1 System Architecture

The proposed system follows a structured architecture that includes multiple layers to ensure efficiency and reliability. It consists of the following components:

1. **User Interface Layer**: This layer includes a web-based and mobile application interface that allows users to capture and upload plant images. The interface provides an intuitive experience with real-time feedback.

2. **Data Preprocessing Layer**: Once an image is uploaded, this layer enhances the image quality through operations such as noise removal, contrast adjustment, and segmentation to isolate the leaf from the background.

3. **Feature Extraction Layer**: Deep learning models, such as convolutional neural networks (CNNs), extract relevant features from the image to distinguish between healthy and diseased plants.

4. **Classification Layer**: The extracted features are processed by a trained deep learning model that categorizes the disease and provides a confidence score.

5. **Recommendation Layer**: Based on the classification results, the system provides treatment suggestions, preventive measures, and expert recommendations.

4. RESULTS

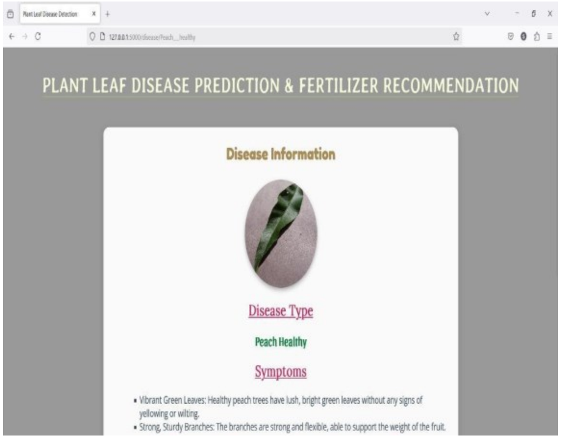

Fig 1: Healthy peach

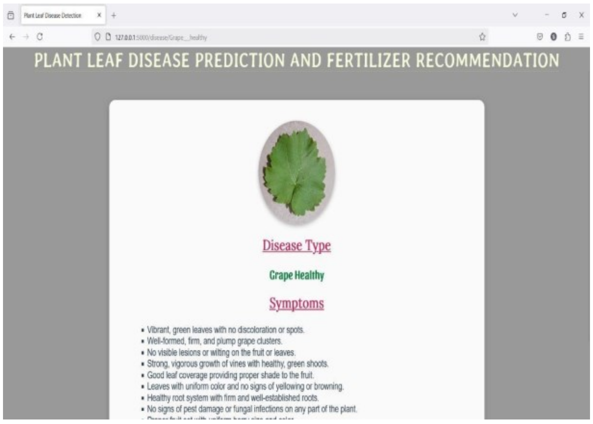

Fig 2: Healthy Grape detected

CONCLUSION

The implementation of the plant disease detection system using deep learning, as demonstrated in the provided code, represents a significant step forward in the application of AI technologies in agriculture. Leveraging a pre-trained deep

ISSN 2347–3657
Volume 13, Issue 2, 2025

learning model (PlantDNet.h5) and a simple web interface built with Flask, this system enables users specifically farmers or agricultural technicians to upload images of crop leaves and receive accurate predictions about potential diseases. The model processes these images in real-time, normalizes them for consistency, and outputs a classification based on a predefined list of plant diseases, which is critical in facilitating timely and informed crop management decisions.

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