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CropGuard: A Mobile-Based Plant Health Detection System Using Convolutional Neural Networks

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Abstract- Agriculture plays a vital role in ensuring food security and supporting the global economy. However, plant diseases remain one of the major challenges that significantly affect crop productivity and quality. Early detection of plant diseases is essential to prevent large-scale damage and to help farmers take timely preventive actions. Traditional methods of disease detection rely on manual inspection by agricultural experts, which can be time- consuming, expensive, and sometimes inaccurate. With the advancement of artificial intelligence and deep learning technologies, automated plant disease detection systems have become increasingly effective. This research presents CropGuard, a mobile-based plant health detection system that uses Convolutional Neural Networks (CNN) to identify plant diseases from leaf images. The proposed system allows farmers to capture images of plant leaves using a smartphone camera. The captured image is processed using image preprocessing techniques such as resizing and normalization before being analysed by a trained CNN model. The model extracts important visual features from the leaf image and classifies it as healthy or diseased based on patterns learned during the training phase. The system then displays the predicted disease information through the mobile application interface, allowing farmers to quickly understand the health condition of their crops. The dataset used for training consists of labelled images of healthy and diseased plant leaves, enabling the CNN model to achieve reliable performance. The proposed system demonstrates how artificial intelligence and mobile technology can be combined to provide a fast, accurate, and user-friendly solution for plant disease detection and smart agricultural practices.

Keywords: Plant Disease Detection, Convolutional Neural Network, Artificial Intelligence, Smart Agriculture, Mobile Application.

I. INTRODUCTION

Plant diseases are one of the major problems affecting agricultural productivity worldwide. Farmers often face difficulties in identifying diseases at an early stage, which can lead to severe crop damage and reduced yield. Traditional disease detection methods depend on manual inspection and expert knowledge, which may not always be available.

Recent advancements in artificial intelligence and deep learning have enabled automated plant disease detection systems. Convolutional Neural Networks (CNN) are widely used for image classification tasks because they can automatically extract features from images and identify patterns effectively.

The proposed system, CropGuard, is a mobile-based plant health detection system that uses CNN to analyze plant leaf images and identify diseases.
Farmers can capture images using a mobile device and receive instant predictions about plant health. This system helps farmers take preventive measures and improve crop productivity.

II. LITERATURE REVIEW

Several researchers have explored the use of machine learning and deep learning techniques for plant disease detection. These methods aim to automate the identification process and improve accuracy compared to traditional approaches.
Mohanty et al. proposed a deep learning-based approach using the PlantVillage dataset for plant disease classification. Their Convolutional Neural Network (CNN) model achieved high accuracy in identifying multiple plant diseases across different

crops. This study demonstrated the effectiveness of deep learning in agricultural applications.

Ferentinos developed deep learning models for plant disease detection and compared their performance on various datasets. The results showed that CNN- based models outperform traditional machine learning techniques in terms of accuracy and reliability.

Sladojevic et al. introduced a system that uses deep neural networks to classify plant diseases based on leaf images. Their model successfully identified several diseases with high precision, proving the potential of automated systems in agriculture.

Too et al. conducted a comparative study of different deep learning architectures such as VGG16, ResNet, and Inception. Their findings indicated that deeper architectures provide better classification performance. Picon et al. applied deep learning techniques for detecting wheat diseases in real field conditions. Their work highlighted the importance of using real- world datasets for improving model performance.

Although these studies show promising results, many systems are not easily accessible to farmers due to the lack of mobile-based implementations. The proposed CropGuard system addresses this gap by providing a simple and efficient mobile application for plant disease detection using CNN.

The system architecture of the proposed CropGuard system is shown in Figure 1.

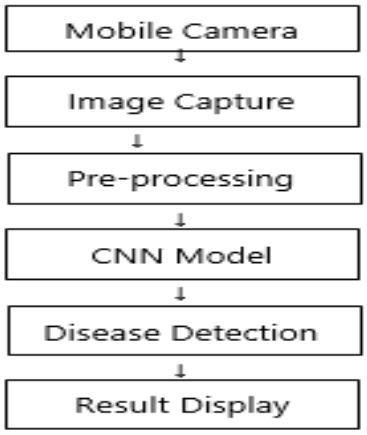

Figure 1: System Architecture of CropGuard

Table 1: Model Comparison

Model	Accuracy
SVM	85%
KNN	88%
ANN	92%
CNN	97%

III. PROPOSED SYSTEM

The proposed system, CropGuard, is a mobile-based plant disease detection application that uses Convolutional Neural Networks (CNN) for image classification. The system allows users to capture plant leaf images using a smartphone camera and analyze them for disease detection.

The system consists of image acquisition, preprocessing, feature extraction, and classification stages. The CNN model is trained using labeled plant leaf images and is capable of identifying diseases based on visual patterns.

The mobile application provides a user-friendly interface that displays the detected disease and helps farmers take necessary actions to protect crops.

IV. METHODOLOGY

The CropGuard system uses a Convolutional Neural Network (CNN) to detect plant diseases from leaf images. The methodology consists of several stages including data collection, image preprocessing, model training, and prediction.

Dataset Collection

The dataset used for this system consists of plant leaf images containing both healthy and diseased samples. Publicly available datasets such as PlantVillage are commonly used for training deep learning models. The dataset is divided into training and testing sets to evaluate model performance.

Image Preprocessing

Before feeding images into the CNN model, preprocessing steps are applied to improve accuracy. These steps include image resizing, normalization, and noise removal. All images are converted into a fixed size to match the input requirements of the CNN model.

Cnn Model Training

A Convolutional Neural Network is used for feature extraction and classification. The CNN consists of multiple layers such as convolutional layers, pooling layers, and fully connected layers. The model learns important features such as color, texture, and patterns from plant leaf images during training.

Disease Prediction

After training, the model is used to predict diseases from new input images. The user captures a leaf image using the mobile application, and the system processes the image through the trained CNN model to classify it as healthy or diseased.

The CNN architecture used in the proposed system is shown in Figure 2.

The CNN model extracts features such as texture, color and patterns from plant leaf images for accurate classification.

V. RESULTS AND DISCUSSION

The CropGuard system was tested using plant leaf images from the dataset. The CNN model successfully classified plant diseases and healthy leaves with high accuracy. The model performance was evaluated using training and testing datasets.

The results indicate that CNN-based models are highly effective in identifying plant diseases from leaf images. The system provides fast and accurate predictions through the mobile application, making it useful for farmers in real-time scenarios.

The accuracy achieved by the model is approximately 97%, which demonstrates the effectiveness of deep learning techniques in agricultural applications. The system reduces the need for manual inspection and helps in early disease detection.

VI. CONCLUSION

This paper presented CropGuard, a mobile-based plant health detection system using Convolutional Neural Networks. The system allows farmers to capture plant leaf images and detect diseases quickly and accurately.

The proposed system improves agricultural productivity by enabling early detection of plant diseases. The use of CNN ensures high accuracy and reliability in classification. The mobile-based implementation makes the system accessible and easy to use for farmers.

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