

Chapter 1

A Machine Learning–Based Crop Diseases Detection and Management System

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ABSTRACT

This work proposes an innovative solution to address crop diseases. The objectives include developing a machine-learning model for rapid disease identification and designing a user-friendly mobile application. The machine learning model, employing convolutional neural networks and transfer learning, is integrated into the mobile app for on-the-go disease diagnosis. Key features include image analysis, disease identification, and real-time treatment recommendations. This work termed CropGuard aims to empower farmers, regardless of technical proficiency, through accessible and efficient crop disease management. This aligns with the broader goal of sustainable agriculture by enabling timely interventions, reducing crop losses, and promoting increased productivity.

INTRODUCTION

Agriculture is always a major factor in food security and enhancing the GDP of any country. In the context of India Considering the latest data for the year 2020-2021, Agriculture is contributing 20.2% of the country's GDP. India secures second position for producing large quantities of agricultural outputs in the world. 50% of the job market in India is dependent upon Agriculture. Considering the population of India, there is an imbalance between the demand and supply. Demand is always high compared to the Supply of food products. In this situation, Crop diseases (Mondal,B., et al., 2023) have a major role in declining the rate of food production.

Crop diseases are those diseases (Rohilla. N., & Rai,M., 2021)that degrade the quality, as well as quantity of our crops like Rice paddy, wheat leaves, Cucumber leaves, tomato leaves, Strawberry leaves, and banana plants, and almost every crop production is (Harika, M., et al., 2023)affected by diseases. The common diseases are leaf spots, Bacterial leaf blight, Black rust, Blight, Charcoal rot, Fusarium, Sheath blight of rice, Brown rust, Powdery mildew, anthracnose, wilt, scab, gall, canker, dieback, and

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so on. Several researchers have studied various crops and classified them as some harmful diseases that infect plants due to biological reasons Bacterial Diseases, Viral Diseases, Fungal Diseases, and so on. Some of the common diseases we can see are Leaf Smut and Brown spots on the Paddy leaf. There can be several reasons for crop diseases such as inappropriate Moisture and temperature differences because different crops require different levels of temperature and moisture. Wind, Frequent as well delays for rain, floods, and Chemicals such as pesticides affect soil quality, Deficiency of nutrients, and hazards.

Farmers who are the backbone of our country got troubled a lot because of such diseases. The production yield are only income source of their family. To troubleshoot these crop diseases, technologies like Machine Learning(ML) and Deep Learning(DL) is introduced. K-Clustering, and Support Vector Machine (SVM) techniques are used in classifying the diseases. At first the plant or leaves images are tested with Image Processing and Computer Vision techniques. Deep learning (Sangeevan, 2021) helps to recognize the image in detail and Machine learning classifies the different diseases into different categories for easy identification of their proper solutions, treatment, and recommendations to prevent such diseases.

PROBLEM STATEMENT

CropGuard aims to address the pressing issue of crop diseases through the development of a sophisticated Machine Learning-Based Crop Diseases Detection and Management System. The problem statement revolves around the prevalent challenges faced by farmers worldwide due to the devastating impact of plant diseases (Balafas,V., et al., 2023) on agricultural yields. Despite various existing methods, the timely and accurate identification of these diseases remains a significant hurdle, leading to substantial crop losses. CropGuard endeavors to fill this crucial gap by employing advanced machine learning algorithms to swiftly and precisely detect and manage crop diseases. The system intends to provide farmers with an intuitive tool that can identify diseases (Praveena, M., et al., 2023) early, enabling prompt and targeted interventions to mitigate their spread, thereby safeguarding crop health and ensuring optimal agricultural productivity.

SIGNIFICANCE

A Machine Learning-Based Crop disease detection (Ekanayake & Nawarathna, R. D., 2021) and Management System holds several significant advantages and benefits for agriculture and farmers:

Early Detection: One of the primary advantages is the system's ability to detect diseases in crops at an early stage. Machine learning models can analyze large amounts of data, including images of plants, to identify subtle signs of diseases that might not be easily noticeable to the human eye. Early detection permits for prompt intervention, preventing the range of diseases propagated and decreases crop damage.

Precision and Accuracy: Machine learning algorithms, when trained on diverse datasets, can achieve high levels of accuracy in disease identification. They can differentiate between various diseases and even distinguish them from other stressors like nutrient deficiencies or pest attacks. This precision ensures targeted and effective management strategies.

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