Chapter 15
Crop Disease Prediction Using Deep Learning Algorithms

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ABSTRACT

Good crops yield good food which in turn nourishes the human body and mind. But these crops across the globe face the threat of various diseases that remain unidentified, leading to poorer quality and quantity of crops. But, in recent times, the increasing adoption of smartphones worldwide and current developments in image processing of computers enabled by deep models of learning have made smartphone-based disease detection possible. In this chapter, the authors train a deep convolutional neural network (CNN) model to recognize 18 crop species and 28 diseases by feeding it a pre-available dataset of 70,296 photographs of unhealthy and healthy crop leaves taken under control. On a sustained test set, the trained model shows up to 99% accuracy, proving the feasibility of the method.

1. INTRODUCTION

Crop diseases pose a significant threat to global food security, exerting adverse effects on agricultural productivity and food sustainability. Ensuring timely and accurate detection of these diseases becomes

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imperative for effective disease management and the mitigation of potential losses. In recent years, the emergence of deep learning, specifically Convolutional Neural Networks (CNNs) employing the Residual Network (ResNet) architecture, has shown remarkable potential in automating crop disease detection through computer vision.

This research paper endeavours to explore the application of deep learning techniques in crop disease detection, specifically focusing on CNNs with the ResNet architecture. Deep learning algorithms have demonstrated exceptional proficiency in recognizing intricate patterns and features within images, rendering them highly suitable for identifying disease symptoms present in crops (Patil & Manohar, 2023). The primary objectives of this study encompass the development of a precise and efficient crop disease detection model using deep learning, along with a thorough evaluation of its performance when compared against conventional methods and established benchmark datasets (Sumathi et al., 2022). By harnessing the capabilities of deep learning, this research aims to streamline the disease detection process, thereby facilitating early intervention and minimizing potential crop damage.

Through its contributions to precision agriculture, this research seeks to empower farmers, researchers, and policymakers with an advanced tool for effective disease monitoring and management (Vaishali et al., 2022). By bridging the gap between deep learning methodologies and crop disease detection, this investigation anticipates substantial advancements in safeguarding global food security against the emergence of crop diseases and potential environmental challenges.

2. RELATED WORK

Many initiatives have been established to combat crop loss caused by diseases. Integrated pest management (IPM) methods have gained prominence over traditional insecticide usage in the past decade (Sumathi et al., 2022). Regardless of the approach, accurate disease identification at an early stage is crucial for effective plant disease management. Indigenous crop clinics, agricultural institutions, and associated agencies have historically played a role in disease identification. In recent times, the progress of such initiatives has been further augmented by the abundance of online resources and the easy accessibility of data for disease detection, capitalizing on the global surge in data consumption. Additionally, Android application-based tools have flourished, leveraging the widespread adoption of Android applications and their associated technologies (Sharma et al., 2020).

Smartphones, equipped with powerful high-resolution cameras and supported by efficient computing capabilities and fast processing speeds, present a distinctive platform for disease detection technology. Their inherent features, including high-resolution displays and built-in functionalities, enable innovative applications in the field of disease detection. The widespread adoption of smartphones worldwide has facilitated the potential reach of automated picture identification for disease diagnosis (S. Das et al., 2021). High-definition cameras, high-performance processors, and broad smartphone adoption are factors that contribute to the technical feasibility of such disease detection methods. In recent years, object identification and computer vision have made significant strides, with large-scale image recognition challenges based on the ImageNet dataset serving as a standard for various image recognition-related tasks, including object classification.

Advancements in deep convolutional neural networks have significantly reduced the error rate in image recognition tasks, reaching nearly 3.58 percent within the next three years (Saeed et al., 2021). Deep neural networks have been extensively employed for one-end-to-another-end learning across various