Chapter 10
Plant Disease Classification Using Deep Learning for Agricultural Applications

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ABSTRACT

Agriculture is of paramount importance to human existence, but, the presence of plant diseases poses a significant risk to both food safety and productivity. Although traditional techniques can be used to identify plant diseases, they are frequently time-consuming and ineffective. Thorough research can increase the early detection of problems and boost agriculture by providing accurate diagnosis and preventive solutions. This study supports worldwide efforts to achieve sustainable food pro-

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duction. This study use pre-trained Convolutional Neural Networks (CNN) models to classify numerous plant illnesses concurrently, surpassing the existing constraint of predicting just one disease at a time. The task involves fine-tuning the CNN and DenseNet169 models by training them on the Plant Village dataset. The DenseNet169 architecture was utilized in the proposed approach to obtain an accuracy of 99.61% in identifying and classifying diseases in pepper bell, potato, and tomato. This demonstrates the efficacy of deep learning in the classification of plant diseases.

1. INTRODUCTION

In recent years, there has been a significant rise in agricultural challenges caused by a mix of parameters, such as abrupt climate changes and a lack of crop resistance. This phenomenon devastates agricultural yields on a significant magnitude, undermines societal progress, and leads to financial losses for farmers. As per the Food and Agricultural Organization of the United Nations (FAO) [1], 45% of food that is wasted globally is attributed to plant diseases. This circumstance cost the global economy around 230 billion dollars in lost revenue. Thus, plant diseases depict a significant threat to the world's food security, and early identification is essential to prevent disastrous crop loss.

The identification and treatment of plant diseases have grown increasingly challenging due to the fast expansion of diverse conditions and the limited understanding of farmers [2]. Conventional methods can determine and classify plant diseases, but they can be challenging and costly. The use of deep learning algorithms for autonomous disease classification has grown in popularity in recent years [3]. Deep learning is the process of training artificial neural networks to acquire knowledge from extensive quantities of data. Convolutional Neural Networks (CNNs) are a deep learning technique that has demonstrated remarkable efficacy in image recognition applications, such as the detection of plant diseases. One technique to categorize ailments into distinct groups is to train CNN on massive samplesets of pictures of healthy and ailmented leaves. CNN training can identify fresh leaf images based on the presence or absence of specific ailments. There are several advantages to implementing deep learning techniques for plant disease classification, such as handling large and complex sample sets and achieving precise ailment identification and categorization. Deep learning-based plant disease classification possesses a mandate to improve farming practices and consumer security while revolutionizing plant disease research. Researchers widely employ deep learning techniques like CNN [4], RNN [5], and LSTM [6] to detect bacterial spots. CNN's strong performance on image recognition tasks has led to the creation of accurate plant disease classification systems.