Chapter 9
Hybrid Approaches for Plant Disease Recognition: A Comprehensive Review

S. Hemalatha
School of Computer Science Engineering and Information Systems, Vellore Institute of Technology, India

Athira P. Shaji
School of Computer Science Engineering and Information Systems, Vellore Institute of Technology, India

ABSTRACT

Plant diseases pose a significant threat to agriculture, leading to yield and quality losses. Traditional manual methods for disease identification are time-consuming and often yield inaccurate results. Automated systems leveraging image processing and machine learning techniques have emerged to improve accuracy and efficiency. Integrating these approaches allows image preprocessing and feature extraction to be combined with machine learning algorithms for pattern recognition and classification. Deep learning, particularly convolutional neural networks (CNNs), has revolutionized computer vision tasks, enabling hierarchical feature extraction. Hybrid methods offer advantages such as improved accuracy, faster identification, cost reduction, and increased agricultural productivity. This survey explores the significance and potential of hybrid approaches in plant disease identification, addressing the growing need for early detection and management in agriculture.

1. INTRODUCTION

Agriculture is one of the biggest contributions to a country's economy. The plant diseases can cause severe negative influence on the quantity and quality of agricultural

DOI: 10.4018/978-1-6684-7659-8.ch009

products. Thus, it is very important to identify them in the early-stage and control the spread over its neighborhood. Early disease detection is essential for getting better yield in the agricultural domain. The lag or failure in identification can lead to low production and loss of economy to the farmers. In the beginning, the detection of plant diseases had been done manually by monitoring plants, collecting the specimen of diseases in plants and consulting the agricultural experts. This process was more time consuming and expensive as the farmers would have to travel a long distance to meet the experts. Moreover, continuous monitoring of plant is cumbersome in case of long plantations (Tucker CC & Chakraborty, 1997).

A solution arrived to solve these issues in terms of image processing approaches (Bock et al.,2010; Lee and Chung,2005). The plant diseases occur mostly due to microorganisms like bacteria, fungus, virus and protozoa. These organisms can turn the plant leaves into yellowish, wilted and molted. Some of the diseases make the leaves with black spot, downy mildew, bacterial built etc. (Mesquita,2011). Thus, it has become possible to apply image acquisition and image processing appropriately to identify damaged leaves in plants (Al-Hiary et al.,2011; Sena et al.,2003). Fundamental Image processing methods such as edge detection and thresholding segmentation (Raji & Alamutu,2005; Zhang et al., 2005) were employed around a decade back for plant disease detection. Furthermore, color image processing (Camargo& Smith, 2009; Bama et al.,2011; Gocławski et al.,2009) techniques were used to identify plant diseases.

With advancements in computer vision and pattern recognition, several studies for plant disease diagnosis have been proposed, with the goal of identifying the diseases through affected leaves. Pattern classification methods helped to identify disease causing agents in plants (Camargo & Smith,2009). It was thought that image processing methods along with machine learning based algorithms could be utilized for the identification and classification of plant diseases. Because the inclusion of machine learning concept for the purpose could help to discriminate appropriate targets when fed with suitable information. Machine learning techniques such as naïve Bayes classifier, Decision tree classifier and perceptron models were used for training the model (Jamuna et al., 2010; Korada et al.,2012; Revathi et al..2011). Various feature selection and rule generation techniques (Phadikar et al..2013) have been proposed and improvised the results. Multi disease identification is done by

proposing a Leaf doctor algorithm (Pethybridge S J&Nelson,2015) that was deployed on a real smartphone application and validated under real field conditions. The computer vision system detects and classifies the crop diseases through image acquisition, feature extraction, feature selection and classification (DeCost BL& Holm; Han et al., in 2015).