International Journal of Software Innovation
Volume 11 • Issue 1

A Systematic Review on the Detection and Classification of Plant Diseases Using Machine Learning

Deepkiran Munjal, Dept. of Computer Science and Technology, Manav Rachna University, Faridabad, India

Laxman Singh, Dept. of Electronics and Communication Engineering, Noida Institute of Engineering & Technology, Greater Noida, India*

Mrinal Pandey, Dept. of Computer Science and Technology, Manav Rachna University, Faridabad, India

Sachin Lakra, Dept. of Computer Science and Technology, Manav Rachna University, Faridabad, India

ABSTRACT

The occurrence of disease in plants might affect the crop production at a large scale, resulting into decline of the economic growth rate of the country. The disease in plants can be detected and treated at an early stage. Machine learning (ML), deep learning (DL), and computer vision-based techniques could play a pivotal role in detecting and classifying the diseases at an early stage. These approaches have even surpassed the human performance, as well as image processing based traditional approaches in the analysis and classification of plant diseases. Over the years, numerous authors have applied various image processing ML and DL techniques for the diagnosis of different ailments in plants that gives great hope to the farmers and landlords to cure the disease at an early stage. In this study, the authors addressed and evaluated the various currently existing state of art methods and techniques based on machine and deep learning. Besides, the authors have also focused on various limitations and challenges of these approaches that can explore greater possibly of these methods about their usability for disease detection in plants.

KEYWORDS

Agriculture, classification, Deep learning, Image Processing, Machine learning, segmented image

1. INTRODUCTION

Crops and plants suffering from disease can have a major influence on crop quality and measure. This can adversely affect the country's economy, especially if agriculture is the primary source of income and occupation (Jiawei et al., 2016). Hence, detection and identification of disease in the crops at an early stage is crucial to avoid crop damage and improve its quality. As per the reports, about 70% of

DOI: 10.4018/IJSI.315657 *Corresponding Author

India's population is dependent on agriculture, either directly or indirectly, and contributes around 17% of the country's GDP.

Diseases and infections among crops are caused by a variety of reasons; some of them are based on environment and aging such as a lack of quality land manures, the selection of inappropriate crops, climatic fluctuations, and rodents etc. Pest infections alone account for roughly 30-33% of the overall output loss in India. Infections in plants are caused by fungus, viruses, and bacteria. Owning to these numerous diseases and variables, farmers face significant hurdles in transition from one infection control method to another to prevent these infections, which has high impact on total output and crop quality.

Agriculturalists are still using the traditional and ancient methods to discern crop diseases and substantially studying the crops with their judgments, even in this technologically advanced era, where high tech instruments are available to discern any disease prevailing in the plant at any point of time. This age-old method of monitoring and analyzing crops with the naked eye based on the farmer's experience has several flaws and drawbacks. An agriculturalist may be intelligent to detect some crop contagions and diseases with this method, however it is not effective in detecting new or unknown crop infections. As a result, the crop's infection is usually ignored, or sometimes inappropriate control plan is used to detect them.

Advanced and in-depth investigation is required in such circumstances. To avoid contagions in the crops, farmers must be an expert and have a thorough understanding of all the crop diseases, and their corresponding solutions of diagnosis particularly in current scenario, when new contaminations are venting due to current climatic disruptions. Easy and precise detection of plant ailments is known as the pillar of the productive and effective agriculture strategies.

Detection of diseases from the plant images is considered most critical research field due to high similarity of diseases in appearance, however they need the different treatment and care. Hence, different image processing, machine learning, and computer vision algorithms are needed to outline and identify the disease in plant leaves.

Over the centuries, the basic stages in farming, such as identifying diseases and selecting effective medicines for controlling such diseases, have been practiced by farmers to avoid crop loss and to maintain crop quality. However, owning to the global climatic changes, dramatic rise in many crop diseases may take place. Farmers must be familiar with these crop diseases to recognize and control them. However, due to vast number of diseases, it's difficult for farmers to be familiar with all of them. In addition, it is both economically and physically impossible for a farmer to monitor large-scale production.

As a result, different plant diseases and infections often go unnoticed, affecting total crop output and quality. As a result, automatic identification and classification of crop disease is required and is the need of the hour to cope with such difficulties. Farmers and researchers all around the world are already using Machine Learning and Computer Vision in agriculture for a variety of applications. Machine Learning-based techniques can be used to detect and classify diseases in crops in real time, increasing crop yield and quality while reducing labor, expense, and improving farmer accuracy in crop cultivation.

To prevent crop loss due to disease, a variety of strategies have been devised. Integrated pest management (IPM) slants have progressively complemented historical ways of extensive pesticide application in the last decade (Ehler et al., 2006). Regardless of the method used, correctly identifying an illness on first sight is vital for optimal disease management. Farmers have started using mobile phone-based tools nowadays across the globe.

2. CATEGORIES OF PLANT DISEASES

Plants might be caught by many diseases, which can affect the whole crop. These diseases can be further categorized into different classes. In general, plant diseases are categorized into abiotic and