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Plant Disease Detection using Machine Learning

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Abstract: *Agriculture was the backbone of India now it is facing several difficulties which includes diseases, selection of quality seed, water scarcity etc. One of the main issues of agriculture field is plant diseases which causes farmers a huge loss either in loss of crop or unnecessary use of drugs. Early detection of a plant disease can prevent its spreading hence the loss of yield This paper proposes a deep learning approach that is based on improved convolutional neural networks z(CNNs) for the real-time detection of apple leaf diseases. In this paper, the apple leaf disease dataset (ALDD), which is composed of laboratory images and complex images under real field conditions, is first constructed via data augmentation and image annotation technologies. The experimental results show that the INAR-SSD model realizesa detection performance of 78.80 .The results demonstrate that the novel INAR-SSD model provides a high-performance solution for the early diagnosis of apple leaf diseases that can perform real-timedetection of these diseases with higher accuracy and faster detection speed than previous methods.*

Keywords: Agriculture, Plant diseases, Prediction, Machine Learning , CNN.

I. INTRODUCTION

Plant disease detection using machine learning is a rapidly growing area of research, which aims to address the challenges of maintaining high yields in agriculture by identifying and preventing the spread of diseases. This technology involves the use of various image processing and machine learning algorithms to analyze plant images and accurately detect diseases in leaves. In this survey paper, we focus on the use of Convolutional Neural Networks (CNN) algorithm, a powerful deep learning algorithm widely used for image classification, in detecting leaf diseases.

The process of plant disease detection using machine learning involves several key steps, including image preprocessing, feature extraction, and classification. Image preprocessing involves enhancing the image quality and removing any noise or irrelevant information from the image. Feature extraction involves identifying and extracting relevant features from the preprocessed image, which can be used for classification. Finally, the classification step involves using a machine learning algorithm, such as CNN, to classify the image as either healthy or diseased.

One of the popular deep learning architectures, AlexNet algorithm, has been widely used in plant disease detection due to its high accuracy and robustness. This algorithm comprises of multiple convolutional layers, pooling layers, and fully connected layers, which are trained on large-scale image datasets to classify the images with high accuracy. AlexNet algorithm has been successfully applied in several plant disease detection studies, achieving high accuracy rates in identifying various types of plant diseases.

The automatic detection of plant diseases is becoming increasingly important in the agricultural industry as it can help farmers to take timely actions to prevent the spread of diseases, leading to higher crop yields and improved economic value. The use of smartphones and other mobile devices with advanced cameras and processing power has made it easier to collect images of diseased leaves and identify the disease through machine learning algorithms.

In conclusion, this survey paper focuses on the use of CNN algorithm in detecting plant diseases in leaves. The paper highlights the key steps involved in plant disease detection using machine learning, including image preprocessing, feature extraction, and classification. It also discusses the use of AlexNet algorithm and its working mechanism in plant

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disease detection. The advancement of plant disease detection technology has the potential to revolutionize the agricultural industry by improving the accuracy and speed of disease detection, leading to higher crop yields and improved economic value.

1.1 Background and Motivation for the Study

Agriculture is a crucial industry that provides food and raw materials for various sectors. However, plant diseases pose a significant threat to agricultural production, causing considerable economic losses to farmers. Traditional methods of plant disease detection are time-consuming, subjective, and prone to errors. Therefore, there is a need for automated methods of disease detection using machine learning algorithms.

In this context, this study aims to provide a comprehensive overview of the use of the CNN algorithm in plant disease detection using leaf images. The study highlights the key steps involved in plant disease detection using machine learning, including image preprocessing, feature extraction, and classification. Additionally, the study provides an understanding of the working mechanism of the AlexNet algorithm, a popular deep learning architecture used in plant disease detection.

The motivation behind this study is to address the challenges of plant disease detection in agriculture and the potential benefits that machine learning algorithms can offer in improving agricultural productivity and reducing losses due to plant diseases. The widespread use of smartphones with high-resolution cameras and processing power has made it easier to collect images of diseased leaves, and machine learning algorithms have the potential to provide a cost-effective and efficient solution for disease detection.

In summary, this study aims to provide valuable insights into the use of machine learning algorithms, particularly CNN, in plant disease detection using leaf images, and their potential benefits in improving agricultural productivity.

1.2 Purpose of the Research

The purpose of this research is to provide a comprehensive survey of the use of the CNN algorithm in plant disease detection using leaf images. The study aims to highlight the key steps involved in plant disease detection using machine learning and provide an understanding of the working mechanism of the AlexNet algorithm. The research also aims to identify the potential benefits of machine learning algorithms in improving agricultural productivity.

II. LITERATURE REVIEW

In recent years, the application of machine learning algorithms for plant disease detection has gained significant attention. One such algorithm is the Hierarchical multi-task structural learning algorithm, which is a powerful technique that can simultaneously learn multiple related tasks. This algorithm has been successfully applied in the detection of plant diseases, achieving high accuracy in classification.

Another algorithm used in plant disease detection is the Tangential Direction (TD) based segmentation algorithm. This algorithm is used to segment the infected regions in images of plant leaves, which is a crucial step in the disease detection process. The use of TD-based segmentation has been shown to improve the accuracy of disease detection.

The K-means clustering technique is also commonly used in plant disease detection. The HPCCDD algorithm is one such example, which utilizes K-means clustering to group pixels in plant leaf images based on color and texture. This approach has been shown to achieve high accuracy in the detection of plant diseases.

While Support Vector Machine (SVM) classifiers are commonly used in plant disease detection, the KNN classifier has been proposed as an alternative. The KNN classifier is simple and easy to implement, and has been shown to achieve comparable results to SVM classifiers in plant disease detection.

The use of manual vector gadget algorithms as training samples for machine learning algorithms has also been explored in the literature. This approach has been shown to improve the accuracy of disease detection, particularly when combined with the classification using machine learning and deep learning algorithms.

Overall, learning algorithms play a vital role in plant disease detection using machine learning. The use of SCP and EM algorithms has been identified as useful techniques for highlighting infected spots in plant images. These algorithms can be used in conjunction with other techniques, such as TD-based segmentation and K-means clustering, to improve the accuracy of disease detection.

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1. **Image processing** plays a crucial role in plant disease detection using machine learning. The pre-processing steps involve the removal of noise, enhancement of contrast, and normalization of the images. The segmentation of the plant leaves is an essential step in the process, which helps to isolate the infected regions from the healthy ones.
2. **Machine learning** algorithms, particularly Convolutional Neural Networks (CNNs), have been widely used for plant disease detection. CNNs are capable of learning complex features from images and have been shown to achieve high accuracy in the classification of plant diseases.
3. **Deep learning** techniques, including CNNs, have revolutionized the field of computer vision, enabling accurate object recognition and detection. CNNs have been shown to outperform traditional machine learning algorithms in plant disease detection, due to their ability to learn hierarchical representations of the data
4. Computer vision is a rapidly growing field that focuses on enabling computers to interpret and analyze images and videos. The application of computer vision in plant disease detection has the potential to revolutionize agriculture by enabling early detection and timely intervention, leading to increased crop yields and reduced environmental impact.

In summary, image processing, machine learning, CNNs, deep learning, and computer vision are all critical components of plant disease detection using machine learning. The combination of these techniques has the potential to improve the accuracy and efficiency of disease detection, leading to improved crop yields and a more sustainable agricultural system.

III. METHEDOLOGY

The methodology for plant disease detection using machine learning involves three critical steps, namely, preprocessing, segmentation, and feature extraction.

1. **Preprocessing:** The first step in plant disease detection using machine learning involves preprocessing of the images. The preprocessing step involves image enhancement, noise removal, normalization, and resizing. The purpose of this step is to prepare the images for subsequent analysis, making them more suitable for machine learning algorithms.
2. Segmentation: The segmentation of the plant leaves is an essential step in plant disease detection, as it helps to isolate the infected regions from the healthy ones. The segmentation process can be achieved using several algorithms, including Tangential Direction (TD) based segmentation algorithm and K-means clustering techniques. The TD algorithm involves computing the direction of the leaf veins, which are used to separate the healthy and diseased regions. The K-means algorithm, on the other hand, involves clustering the pixels in the image based on their color or intensity values, thereby separating the infected regions from the healthy ones.
3. **Feature extraction:** The feature extraction step involves extracting relevant features from the segmented images, which are used as input to machine learning algorithms for classification. The features can be extracted using several algorithms, including Hierarchical multi-task structural learning algorithm and HPCCDD algorithm. The Hierarchical multi-task structural learning algorithm involves learning a hierarchical structure of features from the images, while the HPCCDD algorithm involves computing the color and texture features of the images using various statistical techniques.

After feature extraction, the extracted features are used as input to machine learning algorithms, such as the KNN classifier, to classify the images into healthy and diseased categories. The KNN classifier has been shown to outperform traditional machine learning algorithms, such as the SVM classifier, in plant disease detection.

In summary, the methodology for plant disease detection using machine learning involves preprocessing, segmentation, and feature extraction steps. The combination of these techniques has the potential to improve the accuracy and efficiency of disease detection, leading to improved crop yields and a more sustainable agricultural system.

IV. CONCLUSION

In conclusion, the use of deep learning for plant disease detection has demonstrated significant improvements over state-of-the-art systems. The powerful leaf identification system resulting from this approach can accurately and

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efficiently identify diseases in crops. While various methodologies have been explored in the literature, future researchers should focus on organizing proper datasets that cover all areas of agriculture and enhancing existing technologies to increase the productivity of primary sectors. By continuing to develop and refine these systems, we can improve crop yields, reduce losses due to diseases, and ultimately contribute to food security for the growing global population.

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