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A Survey on Leaf Disease Detection Using Deep Learning

Miss. Swati Parab, Prof. Aparna Mote
Department of Computer Engineering Zeal College of Engineering and Research Pune, Maharashtra, India

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ABSTRACT

Plant diseases are the leading cause of financial losses in the agriculture farming industry around the world. It is a critical factor since it reduces both the quality and the capacity of producing crops. As a result, detecting and classifying numerous plant diseases is critical, and it requires the highest attention. Fruits are an important source of nutrients in plants all over the world, but a variety of illnesses have a negative impact on fruit output and quality. As a result, the use of an effective machine vision technology not only detects but also classifies diseases in their early stages. We proposed a new grape leaf disease detection model based on generative adversarial networks. The grape sector is growing in a good way. This research offers a novel model called Leaf GAN, which is based on generative adversarial networks (GANs), to create images of four different grape leaf diseases for training identification models, focusing on the shortage of training photos of grape leaf diseases. The dense connectivity strategy and instance normalisation are fused into an efficient discriminator to identify real and fake disease images by utilising their excellent feature extraction capability on grape leaf lesions. A generator model with digressive channels is first designed to generate grape leaf disease images; then, the dense connectivity strategy and instance normalisation are fused into an efficient discriminator to identify real and fake disease images by utilising their excellent feature extraction capability on grape leaf lesions. The proposed approach is also put to the test in terms of consistency and dependability. The suggested model obtains a classification accuracy of 98.70percent after extensive simulation. The proposed work's accuracy is higher than that of typical machine learning methods.

Keywords - Data augmentation, Grape leaf disease identification, deep learning, real-time detection, convolutional neural networks.

I. INTRODUCTION

One of the most important study areas in precision agriculture is identifying illnesses from photographs of plant leaves. Artificial intelligence, image processing, and graphical processing units (GPUs) can all help to increase and improve plant protection and growth. Most plant diseases produce visible symptoms, therefore learning models should have high observation abilities to be able to recognise the symptoms of any disease. Grapes are one of the most productive types of fruit in the world, with a high nutritional and therapeutic value. However, many diseases affect apple production on a huge scale, resulting in significant economic losses. As a result, prompt and accurate diagnosis of grape leaf diseases is critical for the apple industry's continued growth and has become a research hotspot in the field of agricultural informatics. However, due to subjective perception, there is a chance of inaccuracy. Various spectroscopic and imaging approaches for identifying plant diseases have been investigated in this regard. They do, however, necessitate accurate equipment and large sensors, resulting in high costs and low efficiency. With the widespread adoption of digital cameras and other electronic devices in recent years, automatic plant disease diagnosis via machine learning has become a viable alternative.\par Traditional machine learning algorithms such as support vector machine (SVM) and K-means clustering, on the other hand, typically need complicated image pre-processing and feature extraction stages, which impair disease diagnostic efficiency. Machine learning algorithms are better suited to identifying uniform-background plant photos collected in a controlled laboratory environment. The grape leaf disease dataset was created to provide a strong guarantee of the proposed model's generalisation capacity. To begin, diseased grape photos with homogeneous and complex backgrounds are collected not only in the laboratory but also in the field to improve the resilience of the CNN model. Furthermore, natural diseased grape photos are processed to provide adequate training images via data augmentation technology to tackle the problem of insufficient diseased grape leaf images and prevent overfitting of the CNN-based model during the training process. It is suggested that a Leaf GAN model be used to generate images of grape leaf disease. The generator model is recomposed initially using degressive channel layers to conform to the constraints of training models for image large data. Due to its superior feature extraction capability, the discriminator model is then subjected to the dense connection method and instance normalisation in order to discriminate actual and fake disease images.\par A unique and robust data augmentation method based on the generative adversarial network model termed Leaf Generative Adversarial Networks is proposed in this paper to perform data augmentation for grape leaf disease photos and overcome the identification model's overfitting problem. For various training models, the suggested data augmentation strategy can give enough and high-quality photos of grape leaf disease. The GAN-based hybrid dataset, which contains 8,124 grape leaf disease images, is established using the proposed data augmentation method. The four common classification models demonstrate improved recognition performance when trained with the new dataset. The proposed method can provide a high-quality solution for data augmentation of grape leaf disease images and can increase grape leaf disease image detection accuracy.

II. RELATED WORK

Many literature is available for different plant and leaf and fruit Disease Identification using different techniques. Various papers are suggesting the various implementation ways as illustrated and discussed below.

P. Saleem and M. Arif et.al., proposed the work on Plant Disease Detection and Classification by Deep Learning.In this Paper,A more efficient means of seeing disease spots in plants should be developed because it will save money by reducing the use of fungicides, pesticides, and herbicides that aren't needed. Because the severity of plant diseases varies over time, DL models should be enhanced or adjusted to allow them to identify and categorise illnesses during their entire life cycle.

J. Boulent, S. Foucher, et.al., Convolutional neural networks for the automatic identification of plant diseases.In their research ,recognised some of the significant concerns and flaws in previous work that used CNNs to automatically diagnose agricultural diseases in this publication.The research shows that deep learning techniques can be used to identify agricultural illnesses. Their findings hold a lot of promise for the development of new agricultural tools that could help to make food production more sustainable and secure.

G. G. and A. P. J.et.al.,,proposed the work based on Identification of plant leaf diseases using a nine layer deep convolutional neural network., In this study, the model obtains an average accuracy of 96.46 percent in the classification of the testing set of leaf images, with individual class accuracy ranging from 92 percent to 100 percent. The number of training epochs, batch size, and dropout all had a bigger impact on the outcomes. The maximum pooling method outperforms the average pooling method. The suggested Deep CNN model outperforms other machine learning models in terms of predictive ability and performance.

M. A. Khan,et.al.,proposed the work based on CCDF: Automatic system for segmentation and recognition of fruit crops diseases based on correlation coefficient and deep CNN features.In this study, the researchers employed a method that combines a number of phases such as contrast stretching, illness segmentation, deep feature extraction, and classification. The main goal of contrast stretching is to help the segmentation process reliably detect diseased regions by combining the correlation coefficient method with colour and texture data, as well as H.M and M.D.\par

S. Zhang,et.al.,proposed the work based on TCCNN.in this paper,Instead of laborious preprocessing, lesion segmentation, and hand-crafted feature extraction, TCCNN can extract high-level discriminant characteristics directly from the colour diseased leaf image. The developed method eliminates the need for lesion segmentation and hand-crafted feature creation. The results of the experiments show that multi-channel CNN is both effective and practicable.

P. Jiang, Y. Chen,et.al.,proposed based on Real-time detection of apple leaf diseases using deep learning approach based on improved convolutional neural networks.In this study, a total of 26,377 images with uniform and complex backgrounds were collected in the laboratory and in a real apple field and generated using data augmentation technology to ensure satisfactory generalisation performance of the proposed model and a sufficient apple disease image dataset.

K. P. Ferentinos,proposed based on Deep learning models for plant disease detection and diagnosis.In this study,The deep learning approach has demonstrated its high potential; therefore, it is a matter of increasing the quantity and quality of available data to improve the system and expand the number of plant species and diseases that can be identified, as well as making it more robust in real-world conditions.

S.Wu, G. Deng,Enhancing Triple,et.al.,GAN for semi-supervised conditional instance synthesis and classification.The HEMS, which contains the EWH, AC, CD, EV, PV, CL, and battery, was explored in this paper for half-hour RO. To carry out RO, three ways were investigated: MILP, CR, and FLC. The control methodologies provided in this research for local cost optimization of managed devices integrated in HEMS may provide a viable building block for the formation of ancillary services in the energy reserve market, it is suggested.

C. Ge, I. Y.-H. Gu,et.al., Enlarged training dataset by pairwise GANs for molecular-based brain tumor classification.In this paper,A unique approach for the analysis of remote sensing data based on EFs in this research. An EP constituted of a series of thinning and thickening modifications performed to a grayscale image is proposed. The suggested method is capable of efficiently performing a multilevel decomposition of the input image using EFs. In addition, for the first time in the remote sensing community, we have incorporated a few additional properties, such as volume and height.

Z. Zhong,Gu,et.al.,Random erasing data augmentation.In this study,We saw a significant improvement in object detection and re-identification of people, suggesting that our system is capable of performing well in a variety of recognition tasks. We want to adapt our method to other CNN recognition problems in the future, such as image retrieval, face recognition, and fine-grained categorization.

Gap Analysis

Sr No	Paper Title	Publication Year	Algorithm/ Technique	Description
1	Orchid leaf disease detection using Border Segmentation technique	2014	image segmentation, morphological techniques	This paper presents an image segmentation technique for classify two difference types of orchid leaf disease such as black leaf spot and sun scorch
2	Disease Detection and Severity Estimation in Cotton Plant from Unconstrained Images	2016	genetic algorithm	The proposed work use two cascaded classifiers. Using local statistical features, first classifier segments leaf from the background. Then using hue and luminance from HSV colour space another classifier is trained to detect disease and find its stage.
3	A Survey on Detection and Classification of Cotton Leaf Diseases	2016	Support Vect or Machine	This paper presents a Survey on detection and classification of cotton leaf diseases. It is difficult for human eyes to identify the exact type of leaf disease which occurs on the leaf of plant.
4	Cotton Leaf Disease Identification using Pattern Recognition Techniques	2016	Neural Network	This paper worked on cotton real time Nagpur dataset for disease detection using machine learning.
5	Plant Leaf Disease Detection and Classification based on CNN with LVQ Algorithm	2018	Convolutional Neural Netwo rk (CNN) model and Learning Vector Quantization (LVQ) algorithm	This paper presents a Convolutional Neural Network (CNN) model and Learning Vector Quantization (LVQ) algorithm based method for tomato leaf disease detection and classification.

6	LEAF DISEASE DETECTION AND FERTILIZER SUGGESTION	2019	K-Medoid clustering and Random Forest	The image is first pre-processed and then the clustering method is applied to find the affected area of the leaf.
7	Computer Vision Based Turmeric Leaf Disease Detection and Classification	2019	k-Means image Segmentation, GLCM. SVM classifier	The data base of different leaf images was created and processed using k-Means image segmentation and leaf images textural analysis was carried out using GLCM. SVM classifier is used to classify the feature extracted images
8	Plant Leaf Disease Diagnosis from Color Imagery Using Co-Occurrence Matrix and Artificial Intelligence System	2018	fuzzy ARTM AP neural network	The system is mainly composed of two processes: disease feature Extraction and disease classification. The disease classification process deploys the unsupervised simplified fuzzy ARTMAP neural network to categorize types of disease
9	Real-Time Detection of Apple Leaf Diseases Using Deep Learning Approach Based on Improved Convolutional Neural Networks	2019	Deep-CNN	This paper proposes a deep learning approach that is based on improved convolutional neural networks (CNNs) for the real-time detection of apple leaf diseases
10.	Grape Leaf Spot Identification Under Limited Samples by GAN	2021	R-CNN	The system focused on the features of leaf spot, This paper proposes a deep learning approach that is based on region base convolutional neural networks(CNN)

III. CONCLUSION

In this paper, addressed how the disease analysis is possible for the leaf diseases detection, the analysis of the various diseases present on the leaves can be effectively detected in the early stage before it will damage the whole plant. Here the technique presented can able to detect the disease more accurately, we can say that, we can archive good productivity by preventing the various diseases present on the leaves of plant using weather dataset and image processing. The usage of classification and feature extraction processes has enhanced the performance of the system which provides better results.

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