A Review Paper on Automated Plant Leaf Disease Detection Techniques

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Abstract - *Agriculture accounts for 17% of the GDP in the Indian economy. Many types of diseases are present in plants such as blight, rot, bacterial wilt, etc. Some of these diseases cannot be detected by the human eye. The wide variety of diseases causes serious economic effects, resulting in production losses and market declines. Plant disease detection by implementing Machine Learning algorithms, Convolutional Neural Networks, Image Processing, and Deep learning models can be quite beneficial as it reduces a large work of monitoring in big farms of crops, and can detect the symptoms of diseases at an early stage. In this paper, studies based on various techniques of plant disease detection are reviewed.*

***Key Words*: Convolutional Neural Networks, Machine Learning Algorithms, Image Processing, SVM, RF, Plant Disease, etc**

1. INTRODUCTION

Agriculture has been a primary economy for many countries in the world. Agriculture techniques and practices have evolved to meet the need of the large population of a particular country and the World population too, but the field has always been cornered regarding techniques to identify plant disease. Climatic changes have affected crops in many ways because of which different techniques are being implemented to overcome these difficulties. Moreover, recent trends have shifted to using natural products rather than chemically compounded products, which has created more pressure on the production of agricultural products. This demand has given rise to the use of modern technology such as AI, ML, and DL that has helped farmers in many ways. Implementing techniques such as SVM, RF, VGC-19, and CNN can efficiently detect diseases in plants.

2. LITERATURE SURVEY

2.1 Leaf Disease Detection using Support Vector Machine, Debasish Das, Mahinderpal Singh, Sarthak Swaroop Mohanty, and S. Chakravarty, IEEE 2020

The authors have developed an automatic leaf detection model which helps in the early detection of diseases. They have focused mainly on tomato leaves. The proposed model includes six steps. Firstly the datasets are collected and stored. Then the pre-processing of the image is done by reducing the dimension of the image. Then the image goes through the process of masking which is a technique for separating features in an image. To extract the features of the image, the Haralick algorithm is used, and the mean and the standard deviation are calculated and stored. The authors have used three different classifiers namely Random Forest, Logistic regression, and support vector machine, and found out that SVM produces the best results.

2.2 Plant Disease Detection Using Machine Learning, Mr. Ramachandra Hebbar, Niveditha M, Pooja R, Prasad Bhat N, Shashank N, Mr. P V Vinod, IEEE2018

In this paper, the authors have used a random forest machine-learning algorithm to classify healthy and disease images. Firstly, the RGB image is converted to a grayscale image to calculate the histogram of the image. The feature vectors are generated using a Histogram of oriented gradients (HoG). HoG is an element descriptor that is used for object detection. The authors have made use of three descriptors namely Hu moments, Haralick texture, and color histogram. These generated features are saved and trained under the random forest classifier for the prediction of the results. The main aim of this project is to classify whether the plant leaf is diseased or healthy using Random Forest Algorithm as this algorithm provides the best accuracy as compared to the other machine learning algorithms.

2.3 Application of Image Processing Techniques in Plant Disease Recognition, K. Renugambal, B. Senthilraja, IJERT 2015

Image processing techniques are being put to use which helps to classify and recognize the diseases in the sugarcane crop. Sugarcane mainly is affected by diseases like Sugarcane Mosaic Virus which forms a pattern of dark and light green patches which run parallel to the midrib of a leaf or the Leaf spot which is the formation of dark red to brown color spots on leaves which may further affect photosynthesis. The image processing techniques are used to detect the above diseases and are done in the following steps. The first step is image acquisition in which the images of the affected sugarcane leaves are taken and stored in a JPEG format in which the leaf is placed on a white background and the leaf is zoomed. Then comes the Image pre-processing step in which the techniques used help to bring out details that are hidden and highlight the features which we want to study in an image. one such technique is histogram equalization which distributes the intensities of the image which increases the quality and visibility of the image. The third step is a color transformation which is the comparison of the grayscale

image to color image in terms of luminance. The last step is Image segmentation in which the image is segmented or separated into different parts of special significance. This helps to look further into the image which helps to find affected areas more quickly.

2.4 Plant Disease Detection Using CNN, Emma Harte, ResearchGate 2020

In the current era, where computers have been developed and technology has advanced manyfold, the traditional methods of finding crop diseases by humans are no longer feasible. Convolutional Neural Networks (CNN) facilitate an accurate diagnosis of plant diseases. The CNN classification starts with data acquisition. The images used are captured in a very controlled environment to avoid any errors while detecting the underlying disease. The images have information about plant anatomy and data about different stages of the disease. Once the data needed to work on is acquired then it is pre-processed and divided into two parts of 80% and 20% for training and validation respectively. after that the images are resized and normalized. after this classification by CNN is carried out.it starts by trailing the image size so that the size of the image that has an accurate performance is found. This is also called the model image. Further, the model image changes brightness and warp.

2.5 Identification of Plant-Leaf Diseases Using CNN and Transfer-Learning Approach, Sk Mahmudul Hassan, Arnab Kumar Maji, Michal Jasiński, Zbigniew Leonowicz, and Elzbieta Jasińskia, Electronics 2021

CNN and the transfer learning approach to detect plant leaf diseases are discussed in this paper. Transfer learning can train the network with a small amount of data and high accuracy. In this, a computer uses information obtained from previous work to increase generalization to a new one. The authors have used four deep learning models that are InceptionV3, InceptionResnetV2, MobileNetV2, and EfficientNetB0 for the detection of plant diseases. InceptionV3 is used for assisting in image analysis and object detection. The InceptionResNetV2 architecture is the combination of residual connection and the Inception architecture. It combines the benefits of a residual network with the unique characteristics of the Inception network's multi-convolutional core. The reason authors made use of MobileNetV2 architecture is because of the convolutional layer which is cheaper compared to normal convolutions. In the MobileNetV2 architecture, depth-wise separable convolution is used for better efficiency. PlantVillage dataset which consists of more than 50,000 images was used for the training and testing purpose of the model. 80% of the dataset was used for training purposes and the remaining 20% was used for testing. Compared to other models, the EfficientNetB0 model achieved an accuracy rate of 99.56% and the time required to train the images in the MobileNetV2 and EfficientNetB0 architectures was much less than that of other machine-learning approaches.

2.6 A novel computer vision-based neutrosophic approach for leaf disease identification and classification, Dhingra, G., Kumar, V., & Joshi, H. D., Measurement 2019

The authors have designed modern segmenting systems with a new set of features. All of the cycles are defined, from photo selection to segmentation and finally classification. The main aim of doing segmentation is to discover the unhealthy areas of plant leaf to diagnose the disease. Based on segmentation, new features were extracted. Nine classifiers are supplied to test the precision of the suggested functions. This model was created to distinguish between healthy leaves and diseased leaves. When it came to data presentation, RF outperformed other versions with 98.4 percent precision.

2.7 Using Deep Learning for Image-Based Plant Disease Detection, Sharada P. Mohanty, David P. Hughes, and Marcel Salathé, Frontier in Plant Science 2016

The authors in this paper demonstrated the use of the deep learning method where they demonstrated the technical viability and success rate of using technology in detecting plant leaf disease so it can be implemented in smartphones. Researchers used online free available datasets through the PlantVillage organization which comprises in total 54,306 images of different plants leaf. They first experimented with different formats of the dataset, and eventually proceeded with a gray-scaled version. This approach eliminates the unnecessary data collected during the regularization of data collection. Outlining that in the repository, they identified 38 class labels where random guessing might lead to an average accuracy of 2.68%. The model with the highest F1 score was able to predict the outcome of a test with a 99.35% accuracy. They made use of two different technology which were AlexNet and GoogLeNet as this technology are excellent models to execute the project.

2.8 Performance of deep learning vs machine learning in plant leaf disease detection, R. Sujatha, Jyotir Moy Chatterjee, NZ Jhanjhi, Sarfraz Nawaz Brohi, Elsevier 2021

Authors targeted to classify citrus plant leaf disease using both methods Machine Learning and Deep Learning to find out which one of these performs better in detecting disease. A total of 609 image samples were taken which comprised of healthy as well as the diseased leaf. Researchers executed the different techniques for which they initially started with procurement of datasets and Multiclass Classification was carried out in which each sample was mapped into 5 class labels based on the structures of the images that get classified into different concepts for determining the training, testing the data, were random sampling methods and k-fold cross-validation methods are used. Further, the Squeezenet method is used which ensures that input given is an inappropriate format for ML and DL to understand. Moreover, now different techniques from Machine Learning

and Deep Learning were applied to analyze the accuracy of the predictions made. It was observed that Deep Learning techniques were more prominent and had higher-order accuracy as compared to Machine Learning techniques. Observed accuracy for Machine Learning was RF (76.8%), SGD (86.5%), SVM (87%) and for Deep Learning it was VGG-19(87.4%), Inception-v3(89%), VGG-16(89.5%). Hence, it was proven that Deep Learning techniques dominate in addressing complex issues in a sensibly short amount of time and provide great classification Accuracy.

3. CONCLUSION

The primary purpose of reading this paper is to obtain a better comprehension of the various research methods and techniques used in the detection of plant leaf diseases, such as machine learning, image processing, and Convolutional Neural Network techniques. Another goal of this study is to develop an effective approach to identify and recognize plant illnesses, which will aid farmers and pathologists in prospect investigation.

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