International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 12 | Dec 2020 www.irjet.net p-ISSN: 2395-0072

A Review Of Different Plant Disease Detection Techniques

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Abstract - *Agricultural productivity highly influences the economy of any country, especially in India where agriculture makes up about 20% of the country's GDP. In such situations, if the plant is affected by diseases and it is not treated properly at the right time, it will lead to economic losses and also increases the global food problem. To prevent this from happening, plant diseases must be detected and treated early so as to prevent serious consequences. The existing manual method of detecting plant diseases is time- consuming and not very pocket-friendly to farmers and may sometimes result in incorrect diagnosis as well. Thus, we can make use of technologies like image processing and deep learning to successfully detect the diseases affecting the plant in the early stages.*

Key Words: **Plant Disease Detection, Image Processing, Review**

1.INTRODUCTION

Since, agriculture powers up-to 50% of the jobs in the world, any disease which affects the plants, takes a huge toll on the income who are dependent on it. Therefore, it is very important to detect and treat the plant diseases in a fast and effective manner. We can use different methods for detection and classification of plant diseases like Convolutional Neural Network, Support Vector Machine, Canny Edge Detector, K-means Clustering etc, which use Image processing. These methods provide varying efficiencies when tested on different plants.

This review paper aims to review different existing techniques for effective detection of plant diseases.

2. LITERATURE SURVEY

N Gobalakrishnan *et al*. [1], uses image processing techniques with machine learning algorithms that are applied in various stages of a plant's life cycle and also come up with treatments for the suitable disease in the plants. In this paper, the author has reviewed several papers with different techniques used for detection and classification of plant diseases.

Sammy V. Militante [2], In this paper, CNN architecture is used for disease classification and identification. The methodology in the study involves three key stages: acquisition of data, pre- processing of data and image classification. Steps used in this methodology are : Input Dataset, Image Acquisition, Image pre-processing and Classification. A 96.5% accuracy rate was achieved using 75 epochs during the training of the model. The model also achieved a maximum accuracy rate of 100% when testing random images of plant varieties and diseases.

Abdul Hafiz Bin Abdul Wahab *et al*. [3], uses K-Means Segmented Support Vector Machine for Detecting diseases in Chilli Plants[3]. In this paper, an Artificial Intelligence based image processing algorithm is proposed to detect diseases on a Chilli plant using its leaves images. The proposed solution focuses on using k- means clustering algorithm for image segmentation and compares different Support Vector Machine (SVM) algorithms for classification. Computed images' features are extracted and used to classify these images into classes. Different parameters and different kernel functions are used to compute different SVM classification algorithms. The results are classified into background, healthy and unhealthy (Cucumber Mosaic) and can differentiate between health and unhealthy plants.

Suma V *et al.* [4], uses CNN with artificial Neural Networks(ANN) and Machine Learning Algorithms (image processing techniques using 5000 datasets). The Network is trained using the images taken in the natural environment and achieved 99.32% classification ability. This shows the ability of CNN to extract important features in the natural environment which is required for plant disease classification. Image classification, Image Categories, Feature Extraction, and Training Data is carried out. The algorithm is implemented with training data and classification of given image dataset. The test input image is compared with the trained data for detection and prediction analysis. From the results, it is clear that the model provides reliable results.

Praveen Kumar Joshi and Anindita Saha [5] proposes the use of Support Vector Machine(SVM) algorithm for plant disease detection and classification. To carry out the process, the entire framework is divided into five sequential steps, namely Image Collection, Image Pre-processing, Image Segmentation using Otsu's method, Feature Extraction using Gray-Level Co-Occurrence Matrix(GLCM) and Classification using SVM. Author was successfully able to detect Bacterial Spot, Septoria Leaf Spot, Leaf Mold and Average Mold with an accuracy of 100%, 60%, 80% and 85% respectively.

Md. Arifur Rahman[6], This paper mainly focuses on implementing an improved segmentation technique using a combination of thresholding and morphological operations. For classification, they have used the deep neural network. This method includes four important stages namely: enhancement, segmentation, feature extraction and classification. Their proposed method has achieved 99.25% accuracy in the Plant Village database.

Sharath D M *et al*. [7], The proposed system uses the canny edge detection technique for detection of the disease affected areas in the fruit after the segmentation of the image using grab cut segmentation. After segmentation the edges of the affected fruit area is calculated in terms of pixels. Based on the number of pixel counts, the percentage of infection in fruits is determined and based on the disease with which the fruit is affected, the preventive measures, biological and chemical solutions are provided.

S.Santhana Hari *et al.* [8], proposes the use of Convolutional Neural Network (CNN)[8] for detection of plant disease by leaf image. Disease identification is done by using a deep learning method. All the classification was done based upon the images of the crop's leaf, which contains both the healthy and affected leaf. This model has produced an accuracy of about 96.3%. Deeper Network architecture is implemented for the grading of plant species. Their result produced an accuracy of 86.2% which is considered to be less accurate.

Santhosh Kumar.S and B.K Raghavendra [9], Literature survey has detailed explanation of the importance of disease detection both to plants and to mankind. To have a meaningful impact of plant diseases & techniques in the area of agriculture, deliberation of proper input is necessary. Research issues addressed here are to develop a systematic approach to detect and recognize the plant diseases that would assist farmers and pathologists in prospect exploration. The paper depicts the importance of image processing in the agriculture field and considering the type of disease for further research work.

Mercelin Francis and C Deisy [10] uses Convolutional Neural Network and deep learning models. (image processing approach). In this paper, Implemented a convolutional neural network to detect and classify whether the leaf is diseased or healthy. Apple and Tomato plant leaves are used to detect whether the plant is healthy or affected by the disease. The achieved accuracy is 88.7 with minimum number of parameters ie. 45K when compared to other existing models. Creating and training a CNN model from scratch is a tedious process when compared to the usage of existing deep learning models for various applications to achieve maximum accuracy. So depending on the application various models can be used or retrained. Therefore in the future work, it is planned to utilize a model efficient than VGG and other existing architectures, such that it gives higher accuracy with minimum size and complexity, so that it can be used in mobile or any other embedded applications.

Endang Suryawati[11] evaluates and compares different CNN architectures with varying depths like CNN baseline(2 convolutional layers), AlexNet(5 convolutional layers), VGGNet(convolutional layers) and GoogleNet(not only deep architecture but also wide). Author makes use of the tomato subset of the Plant Village Dataset for the experiment. After the experiment, the Author states the accuracy rate of each of the tested architectures as 84.58%, 91.52%, 89.68 and 95.24 for Baseline, AlexNet, VGGNet and GoogleNet respectively.

Melike Sardogan[12]: uses CNN with Learn Vector Quantization(LVQ) Algorithm. Tomato plant leaf is used for disease detection and classificationà 500 datasets. Three different input matrices have been obtained for R, G and B channels to start convolution for every image in the dataset. Each input image matrix has been convoluted. reLU activation function and max pooling have been implied to the output matrix. Total 500 feature vectors which obtained from original images have been used for training and testing operations in the LVQ algorithm. It is concluded that the proposed method effectively recognizes four different types of tomato leaf diseases. To improve the recognition rate in the classification process different filters or different sizes of convolutions can also be used.

Huu Quan Cap *et al.* [13], This paper presents a simple and accurate leaf regions detection system with high affinity with other existing disease diagnosis systems. We confirmed that the performance of 78.0% in F1-score is sufficiently acceptable for this task from visual assessment. Precision and recall are trade-off criteria. Considering the practical application of the whole plant diagnosis schema in, it is not necessary to detect exactly the whole full leaf from the images. In the fact that we need to detect some of, or at least one infected leaf per disease in the image. Conversely, we should not pass completely the wrong area to the classifier followed by especially when the following classifier is not so robust. That is, we need a certain level of precision. Therefore, appropriate control of balance between false positive and false negative is required.

Mrs.Divya Unni *et al.* [14], The main approach of this approach is to recognize the diseases. Speed and accuracy are the important characteristics required for disease detection. Hence, the extension of this work will focus on developing the advanced algorithms for fast and accurate detection of leaves with disease. This paper gives the survey on different disease classification techniques that can be used for plant leaf disease detection and an algorithm for image segmentation technique used for automatic detection as well as classification of plant leaf

diseases has been described later. Therefore, related diseases for these plants were taken for identification. Using very less computational efforts the optimum results were obtained which also shows the efficiency of the proposed algorithm in recognition and classification of the leaf diseases.

Halil Durmus *et al.* [15], uses the technique of deep learning to classify the different diseases in the tomato subset of the Plant Village dataset. Author compares two architectures namely AlexNet and SqueezeNet. Author makes use of the supercomputer Nvidia Jetson Tx1 for both training and testing. Accuracy results are obtained from Caffe tests. Even though the SqueezeNet model(2.9Mb) is 80 times smaller than the AlexNet model(227.6Mb), it's accuracy is 94.3% as compared to 95.6% accuracy of AlexNet architecture. Hence, Author concludes that the SqueezeNet model is a good candidate for mobile applications of plant disease detection due to its light-weight property and low computational needs.

Mrunmayee Dhakate[16] proposes a method for diagnosis of pomegranate plant diseases. This method uses the technique of K-means clustering for segmentation of the images, GLCM for feature extraction and multi-perceptron architecture with back-propagation algorithm for classification of the images. The categories used for classification are Good Fruit, Fruit Spot, Bacterial Blight, Fruit Rot, Good Leaf and Leaf Spot. The proposed method works with an accuracy of 100%, 83.33%, 85.71%, 83.33%, 100% and 87.5% for the mentioned categories respectively. Hence, the Author concludes that the proposed method gives a satisfactory average accuracy of 90%.

3. SUMMARY OF LITERATURE SURVEY

Table 1. Tabular Summary of Literature Survey

Author Name	Title & Year of Publishing	Algorithm used	Accuracy
N. Gobalakrishnan *et al.* [1]	"A Systematic Review on Image Processing and Machine Learning Techniques for Detecting Plant Diseases", 28-30 July 2020	-	-
Sammy V. Militante [2]	"Plant Leaf Detection and Disease Recognition using Deep Learning", 3-6 October 2019	Convolutional Neural Networks	96.5%
Abdul Hafiz Bin Abdul Wahab *et al*. [3]	"Detecting diseases in Chilli Plants Using K-means Segmented Support Vector Machine", 27-29 July 2019	K-means clustering and Segmented SVM Image Classification Algorithm	Approx. 90% for chilli plants and 57.1% for cucumber mosaic1
Suma V *et al.* [4]	"CNN Based Leaf Disease Identification and Remedy Recommendation System", 12-14 June 2019	Convolutional Neural Networks	99.32%
Praveen Kumar Joshi, Anindita Saha [5]	"Detection and Classification of Plant Diseases using Soft Computing Techniques", 17-18 May 2019	Support Vector Machine (SVM)	100%, 60%, 80% and 85% respectively to detect Bacterial Spot, Septoria Leaf Spot, Leaf Mold and Average Mold.
Md. Arifur Rahman [6]	"Improved Segmentation Approach for Plant Disease Detection", 3-5 May 2019	Deep neural network	99.25%
Sharath D M *et al.* [7]	"Image based Plant Disease Detection in Pomegranate Plant for Bacterial Blight", 4-6 April 2019	Canny Edge Detection	-
S. Santhana Hari *et al.* [8]	"Detection of plant disease by leaf image processing convolutional neural network", 30-31 March 2019	Convolutional Neural Network	86.2%
Santhosh Kumar.S, B.K Raghavendra [9]	"Diseases Detection of Various Plant Leaf Using Image Processing Techniques", 15-16 March 2019	-	-

Mercelin Francis, C Deisy [10]	"Disease Detection and Classification in Agricultural Plants using Convolutional Neural Networks- A Visual Understanding", 7-8 March 2019	Convolutional Neural Network	88.7%
Endang Suryawati *et al.* [11]	"Deep Structured Convolutional Neural Network for Tomato Disease Detection", 27-28 October 2018	Convolutional Neural Network	84.58%, 91.52%, 89.68 and 95.24 for Baseline, AlexNet, VGGNet and GoogleNet, respectively.
Melike Sardogan *et al.* [12]	"Plant Leaf Disease Detection and Classification based on CNN with LVQ algorithm", 20-23 September 2018	CNN with Learn Vector Quantization (LVQ)	86%
Huu Quan Cap *et al.* [13]	"A Deep Learning approach for On-site Plant Disease Detection", 9-10 March 2018	Convolutional Neural Network	78.0%
Mrs.Divya Unni *et al.* [14]	"Detection of unhealthy plant leaves using image processing and genetic algorithms with Arduino", 6-10 January 2018	-	-
Halil Durmus *et al.* [15]	"Disease Detection on the leaves of the Tomato Leaves by using Deep Learning", 7-10 August 2017	Convolutional Neural Network	95.65% for AlexNet and 94.3 for SqueezeNet
Mrunmayee Dhakate, Ingole A B [16]	"Diagnosis of Pomegranate Plant Disease using Neural Network", 16-19 December 2015	K-means clustering	100%, 83.33%, 85.71%, 83.33%, 100% and 87.5% for Good Fruit, Fruit Spot, Bacterial Blight, Fruit Rot, Good Leaf and Leaf Spot respectively.

4. CONCLUSIONS

Based on the literature survey done in this paper, it can be seen that through the integration of various machine learning algorithms like Convolutional Neural Network, Support Vector Machine, K-means Clustering, etc, diseases on plants can be detected and classified with varying efficiencies. Thus, these methods with some modifications (to increase efficiency) can be put into use in real-life situations.

ACKNOWLEDGEMENT

The authors would like to thank **Asst Prof. Dr. Savita Choudhary** for her continuous motivation and guidance for the development of this paper. Also, we gratefully acknowledge all the journal papers that helped us in the development of this system.

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