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Current Trends In Plant Disease Detection

Kiran S M, Dr. Chandrappa D N

Abstract : Plant diseases causes the major loss in the field of agriculture worldwide. The diseases affect the stem, root, leaves and fruits. Detecting the diseases in early stages and taking proper actions can reduce the disease spreading. DNA –based, serological and texture bases methods provide essential tool for accurate plant disease diagnosis. This paper provides the review of different methods used in plant disease detection based on features extracted from the plant parts. These extracted features are useful in the classification of plant diseases.

Key Words: Agriculture, Plant diseases, DNA, Texture features.

1. INTRODUCTION

Agriculture is the backbone of Indian economy, In India, almost two third of the population depending on the agriculture for their livelihood. Agricultural yield depends on: the environmental conditions, soil quality and also on the plant diseases. The farmers suffer a major economic loss due to the plant diseases [1]. Most of the plant diseases affect steam, leaf and fruits. One of the traditional methods following for identification of plant diseases is simple naked eye observation of parts of plant by experts. This method is time consuming and also constant and continuous observation by experts is necessary, which may be more expensive in large fields. In remote areas farmers may have to travel long distances, to get touch with the experts. Therefore a serious challenge exists for researchers to implement the techniques for detection of the disease. The plant diseases are may be due to biotic and abiotic factors. Diseases caused by living things such as bacteria, fungi and virus belong to biotic. The diseases caused by nutritional deficiencies like poor light, poor soil pH and extreme weather belongs to abiotic factors [2]. Plant diseases can be divided into three groups bases on the cause for the disease: fungal, bacterial and viral diseases. Fungus causes the maximum diseases in plants. Some of the basic fungal diseases are Downy mildew, Wilt, Powdery mildew, Alternia, Anthracnose, leaf spot, Grey mildew, Cankers, Rots, Molds etc. On time usage of fungicides can control the fungal diseases. When the bacteria get a favorable environments to multiply themselves quickly, causes a disease in plants. Very Small number of bacteria species can cause the disease in plants. Most common bacterial diseases are Crown gall, Soft spots, Bacterial blight, Wilts etc. These diseases are recognized by pale green spots on the leaves. [3]. Viral diseases are caused by virus that is very difficult to identify. Some of the viral diseases are Leaf curl, Leaf crumple, Leaf roll etc.[4]. The leaves infected by viral diseases may be frizzed and furrowed [5]. Most of the plant diseases affect steam, leaf and fruits. To prevent these diseases, different pesticides and costly methods are used in the agriculture. Continuous use of chemicals harms the plant health, soil quality, human health and also affects the environment negatively. Hence, it is very important to detect the plant diseases in the beginning stages so that proper preventive measures can be taken to avoid the crop loss.

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2. LITERATURE REVIEW

The plant diseases can be detected automatically by analyzing the DNA structures as well as the volatile organic compounds emitted from the plant parts and also analysis of the textures formed on the plant parts like leaf, stem and fruit useful in plant disease detection. Different diseases form the different colour, texture and shape using which a disease can be detected. With the help of Wireless Multimedia Sensor Networks (WMSN) and image processing techniques cultivation yield can be increases by developing a decision support system to identify and classify the diseases. Plant disease detection methods based on DNA structure are reviewed by Ward E et al [6]. When the plant is affected by disease the structure of the DNA or the nucleic acids chain in the DNA will change. The changes in the structures are analyzed for disease detection. This method requires high resolution microscopes and lab facilities and also the procedure takes lot of time detection and it is not applicable real time. Shaoqing Cui et al [7], reviews an artificial intelligent noses (E-noses) for the detection of fungal, bacterial and viral infections and also insect damage in fruit and vegetable plants. Plants emits the volatile organic compounds (VOCs) through the leaves, these VOCs provides the basic information about the plant's health. E-noses are easy to operate, provides real-time analysis and portable but they are extremely sensitive. There are challenges regarding the sensitivity of a sensor as well as interference from surrounding atmosphere. There sensors are not applicable in open field disease analysis, which require further improvements. There exist many techniques for plant disease detection using the extracted texture features from the plant parts like leaf, fruit stem and root. Grey level co-occurrence matrix (GLCM) is one of the simple and efficient approaches for texture analysis. Grey level co-occurrence matrix depicts the spatial distribution of gray values and frequency of one gray value appearing with another gray value in a specified angle and distance. Number of texture features of an image can be evaluated from the matrix given by GLCM. By adding some more features along with GLCM efficiency of diagnosis of disease can be improved [8]. Khirade et al [9], developed a system for disease detection in plants using image processing technique. Various operations applied on the plant images include: pre-processing to remove the noise and other unwanted objects, Image clipping to select a required image part. Image smoothing using smoothing filters. Image enhancement for increasing the contrast. Pre-processed images are segmented using K-means and Otsu threshold algorithms. When a disease attacked to a plant, change in its leaf colour gives the information about the diseases. Therefore, the greenness of leaf image is used for identification of infected part. Three colour components (R, G and B) are extracted from the image. Otsu's method is used to calculate the threshold. If the intensity of green pixels is lower than the computed threshold, then those

pixels are masked and removed. The image features are extracted using (GLCM). Finally images are classified using ANN. Nivedita et al [10], developed a system for automatic disease detection in grape leaves. Here the system is tested on 5 plant diseases, they are: Downy mildew, Powdery mildew, Black rot, normal and leaf roll. In this approach the leaf images used are captured using high resolution camera. The image colour conversion, histogram, histogram equalization techniques are applied on the images to improve quality and clarity before feature extraction. Later the images are segmented using canny edge detection methods. The Grey co-occurrence Matrix (GLCM) method is used for feature extraction, finally back propagation neural network is used to classify the images for different diseases. This approach consumes more time because for complex computations in canny edge detection, hence it fails in real time response. Halil Durmu et al [11], use deep learning for disease detection from the leaves of tomato plants. The aim of this work is to develop a robot to detect the diseases using deep learning algorithm in real time. The robot will be wandering automatically or manually in the greenhouse or on the field. AlexNet and SqueezeNet deep learning network architectures were used. Using Nvidia Jetson TX1, the training and validation were done for the network architectures. The tomato leaf image dataset for training are taken from PlantVillage Trained networks are also tested on the images from the internet. Patil Sanjay B et al [12], detects the fungi-caused diseases in sugar cane. Leaf areas are segmented using Simple threshold method and triangle threshold method is used to segment lesion region. Quotient of lesion area and leaf area are calculated for the classification of diseases. This method is fast and gives accuracy of 98.6%. Choudary Piyush et al [13], segmented the diseased spots in plant leaf images using image processing techniques. In this work, effects of HIS, YCbCr colour space and CIELAB are used for disease spot detection. Images are smoothened using Median filters and then Otsu threshold algorithm is applied on colour component for the calculation of threshold. . Yogesh Dandawate et al [14], focuses on disease detection in soybean plants. Algorithm proposed here divides the images of soybean leaf into diseased and healthy images. The algorithm having four important steps: Image acquisition, background removal, statistical analysis and classification. Using the colour cameras with resolution greater than 2 mega pixels the soybean leaf images are captured then the captured RGB images are converted to HIS colour space, and then multi-thresholding is used to extract the region of interest from the leaf. Colour based segmentation methods are used for image segmentation and then the images are classified using SVM classifier. Experimental results shows 93.79% accuracy in disease classification. Bhange et al. [15], developed a web based technique for the detection of diseases in Pomegranate fruit. This work mainly focused on Bacterial Blight disease. Farmers can make use of this system for disease detection, the fruit images taken from mobile cameras can directly upload to the web and the system identifies the disease and results given to farmers directly. The uploaded images undergo several processing steps and results are compared with the trained database available in web. The system resizes the uploaded images to a standard value then the features are extracted on various parameters such as CCV, Morphology and Colour. Then, using K-means clustering algorithm the image clusters are formed. The images are classified as infected and non-infected using SVM classifier. The morphological features gives best results among the three features extracted. The experimental result gives 82% of accuracy in identifying diseases in pomegranate. Shiv Ram Dubey et al [16], presented an adaptive scheme for detecting diseases in apple fruit. Using RGB and HSV colour space, image colour as well as texture features are extracted. Then, K-means clustering technique is used for segmentation. Using multi-class support vector machine the images are classified as diseased and healthy. The system gives approximately 93% of accuracy. Savita N. Ghaiwat et al [17], presents survey on different techniques used in plant disease identification and classification. There exist many classification algorithms for plant diseases some of them are: SVM, K-nearest neighbor classifier, Principal component analysis (PCA), parabolic neural networks, artificial neural networks and fuzzy logic. Selection of classifier is a complex task, because the results vary for different input data set. K-Nearest neighbor clustering is simple of all the algorithms. In neural networks the algorithms are complex and difficult to understand. SVM performs better in classifying high dimensional data set, but it is difficult to calculate optimal parameters in Support Vector Machine if the training data is not linearly separable. Kulkarni et al [18], implemented a plant disease detection system using various image processing techniques along with artificial neural network (ANN) for early and accurate plant diseases identification and detection. In this proposed approach, image features are extracted using Gabor filter and using ANN images are classified as healthy and diseased. The system gives the better results with 91% of recognition rate. An ANN based classifier uses the color as well as textures features to recognize and classify the diseases. There are many issues arising during plant disease detection because of colour, shape or other image features. To resolve these issues B S Ullagaddi et al [19], presented a directional feature extraction scheme based on Modified Rotation Kernel Transformation (MRKT). This scheme is used to calculate histograms as well as directional features for the plant parts like fruits and leaves. Along with directional features and histograms calculated using MRKT, artificial neural network is used to detect Anthracnose disease in mango. Using directional features set and histograms along with Artificial Neural Networks lead to a better recognition technique of Anthracnose disease.

Table -1: *Analysis of different algorithms*

Author and year	Goal	Algorithms used	Future perspective
Ward, E. et al [6], 2004	Disease detection in rubber plant	Analyzing DNA structure of the plant.	Require special equipments and more time consuming.
Shaoqing Cui et al [7], 2018	detection of fungal, bacterial and viral infections in fruit and vegetable plants	Designing artificial nose to inspect Volatile organic compounds (VOCs) emitted from plants leaves.	Sensor are very sensitive, interference from the surrounding atmosphere may change the performance and the difficulty of detection in open fields.
Shriroop C. M et. al [8], 2017	Anthracnose and leaf spot detection in mango plants.	Image feature are extracted using Gray Level Co-occurrence Matrix (GLCM) and Image classification using	SVM classifier is too slow and need to use better classifier.

		Support Vector Machine (SVM) classifier	
Khirade et al [9], 2015	Detection on winter wheat disease.	Image feature are extracted using Gray Level Co-occurrence Matrix (GLCM) and Image classification using ANN	Disease classification can be done using Fuzzy logic with other soft computing technique.
Nivedita et al [10], 2015	Disease detection using grape leaves.	Edge detection followed by Gray Level Co-occurrence Matrix followed by back propagation neural networks.	Proper edge detection methods to be used to reduce the time consumption.
Halil Durmu et al [11], 2012	Disease detection in tomato plants	Standard feature extraction methods and deep learning.	Issue in deep learning architecture selection for the implementation.
Patil Sanjay B. et al [12], 2013	Detection of fungus diseases in sugar cane.	Vision-based disease identification algorithm with masking the green-pixels and colour co-occurrence method.	Recognition rate of classification process can be increased using Neural Network's.
Piyush Chaudhary et al [13], 2012	Detection of disease Spot on monocot and dicot Plant Leaf	Image smoothing using median filter and Otsu method for threshold for threshold calculation	Detection of disease spot area is useful for the assessment of loss in crops. By calculating the dimensions of disease spot diseases can be classified
Dandawate et al [14], 2015	Disease detection in soybean images	Colour based segmentation and Support Vector Machine classifier	Database extension is needed to increase accuracy
Manisha Bhange et al [15], 2015	Detection of Fruit Spot, Bacterial Blight, and Leaf Spot in pomegranate	k-means clustering and SVM classifier.	Accuracy obtained is 82%, it is to be improved
Savita N. Ghaiwat et al [17], 2014	Survey of disease classification using plant leaves	Review of different classifiers such as: SVM, PNN, ANN, fuzzy logic and SELF ORG MAPS	Understanding the structure of algorithm is difficult in neural network and difficult to calculate optimal parameters when training data is not linearly separable
Kulkarni et al [18], 2012	Disease detection in pomegranate	Gabor filter is used for feature extraction and ANN for Classification	Recognition rate can be increased
S.B. Ullagaddi et al [19], 2017	Disease detection in Mango Crop	Modified Rotational Kernel Transforms and ANN	Only Anthracnose disease is detected. Need to detect other mango diseases.

3. CONCLUSION

This paper provides a review of different algorithms used in plant disease detection and classification. Out of all the reviewed algorithms 98.76% is the highest accuracy of disease classification using image texture features. The methods like DNA analysis and E-nose are not better suited in the field of agriculture as they require special labs and also their output parameters vary with the environmental conditions. Methods using texture features extracted from plant parts gives better results. Also from the results it is observed that SVM classifier is best suited for plant disease detection and classification. Future work can be done by adapting new algorithms to improve the accuracy by increasing the number of samples. More number of plants as well as plant diseases can also be included and further tested.

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