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A Survey on Plant Disease Detection and Classification Using Different Machine Learning Algorithms

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Abstract— Plant diseases takes place when an organism infects a plant and disrupts its normal growth habits. Diseases have many cause including fungi, bacteria and viruses. Fungi are identified mostly from their morphology, with importance placed on their reproductive structures. Bacteria are measured more primitive than fungi and usually have simpler life cycles. With few exceptions, bacteria are as single cells and increase in numbers by dividing into two cells during a process called binary fission. Viruses are tremendously tiny particles consisting of protein and genetic material with no related protein. The term disease is usually used only for the damage of live plants. Detection of these symptoms with visual aid is matter of time and inconsistent results. Even the experts from related areas have found this visual approach of detection to be erroneous. So by using image processing techniques and machine learning algorithms we can detect and classify diseases of plants.

Keywords— agricultural science, image processing, machine learning, classification, disease detection and classification

I. INTRODUCTION

In agriculture products, diseases are the main cause for the lessening in both quality and production of the agriculture products. So, plant disease diagnosis in early stage is very essential to cure and control them. Farmers puts their great effort in picking best seeds of plant and also provide proper environment for the growth of the plant, although there are lot of diseases that affects plant results. In agriculture it is important to discover the plant disease patches in the early stage which helps us to minimize the damage, reduce production costs, and rise the income. The human eye alone is not that much effective many a times to identify the correct disease. In past farmers used to follow naked eye observation of experts with samples of affected plants or expert used to visit the farm and based on their suggestions farmers were taking the corrective action to cure the plant diseases. In current years, most agricultural plant disease detection systems were established based on image processing. It is very difficult to find trust worthy expert and the solution does not work properly for the large fields, the method takes long time. Also, it is expensive because it requires continuous monitoring of experts. Agriculture is the root for the economy of any country and so the correct and timely identification of agriculture products diseases is very important. So, we need some automatic, fast, accurate and less expensive methods to detect diseases. Modern technological advancement in the field of image processing and machine learning will help farmers in the aspect of cost reduction of pesticides. Insects, bacteria, fungi and viruses come under the category of living agents while temperature changes, excess moisture. The survey on different plant disease detection and classification techniques using image processing and machine learning which is used for fast, spontaneous, automatic and accurate detection as well as classification of plant diseases.

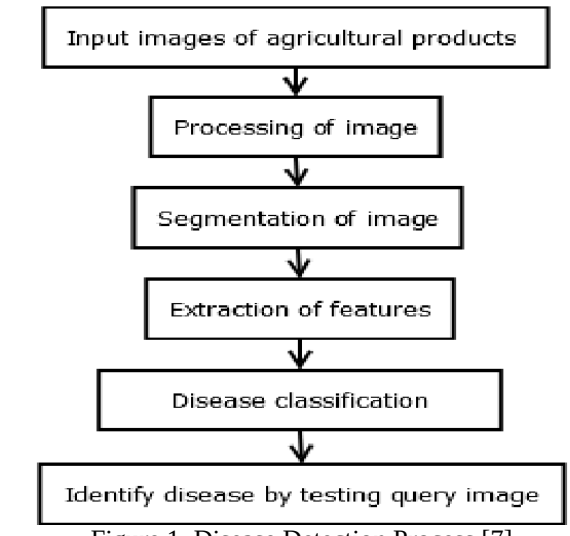

Figure 1. Disease Detection Process [7]

The various stages of disease detection and identification are image acquisition, image pre-processing, image

segmentation, feature extraction and classification are shown in Fig. 1. [7]. System takes large number of infected images of plants. These images are either downloaded from WWW or by captured using good quality of camera. Then these images are going through various steps including pre-processing of input image, segmentation, feature extraction and classification.

Remaining paper contain section 2, which explains various research work carried out on detecting diseases of plants. Section 3, explains comparative analysis of all research papers and finally the section 4 summarizes contribution.

II. LITERATURE REVIEW

Mrunmayee Dhakate et.al in 2015, Diagnosis of Pomegranate Plant Diseases using Neural Network [1] is developed. The plants are infected by various diseases which destroy the entire crop leaving very less product yield. So, the work proposes an image processing and neural network methods to deal with the main issues of phytopathology i.e. disease detection and classification. The Pomegranate fruit as well as the leaves are affected by several diseases affected by fungus, bacteria and the climatic conditions. These diseases are like Bacterial Blight, Fruit Spot, Fruit rot and Leaf spot. The color images are pre-processed and undergo k-means clustering segmentation. The texture features are extracted using GLCM method, and given to the artificial neural network. The overall accuracy of this method is 90%. The results are proved to be accurate and satisfactory in contrast to manual grading and hopefully take a strong rise in establishing itself in the market as one of the most efficient process.

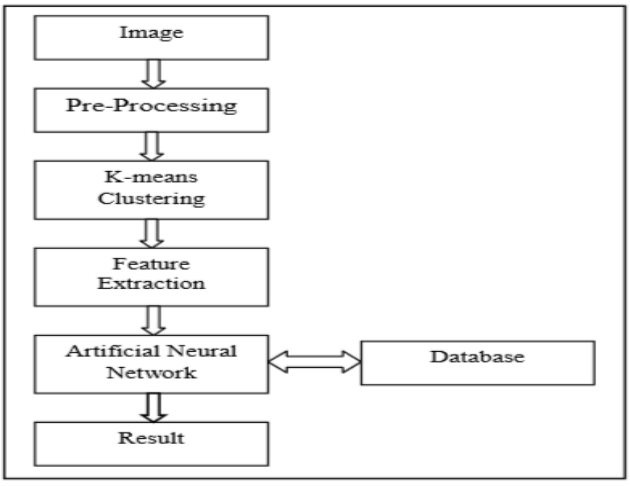

Figure. 2: The Block Diagram [1]

Usama Mokhtar et.al in 2015, is proposed Tomato leaves diseases detection approach based on support vector machines [2]. It consists of a method that applies Gabor wavelet transform technique to extract relevant features related to image of tomato leaf in conjunction with using Support Vector Machines (SVMs) with alternate kernel functions in direction to detect type of disease that infects tomato plant. Initially, real samples of diseased tomato leaves are collected, next each leaf in single image is isolated, wavelet based feature technique has been employed to identify an optimal feature subset.

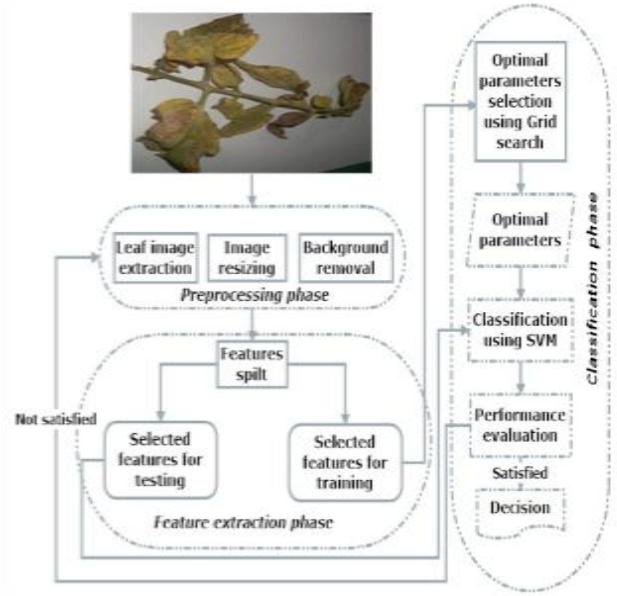

Figure. 3. Layout structure of the proposed SVM-based tomato diseases detection approach [2]

Finally, a support vector machine classier with different kernel functions including Cauchy kernel, Invmult Kernel and Laplacian Kernel was active to evaluate the ability of this approach to detect where tomato leaf infected with Powdery mildew or early blight. It presents test on dataset consisting 100 images of tomato diseases. The proposed method provides excellent annotation with accuracy 99.5 %. Efficient result obtained from the proposed method can lead to tighter connection between agriculture authorities and computer system, yielding more actual and reliable results.

Dhiman Mondal et.al in 2015, Detection and Classification Technique of Yellow Vein Mosaic Virus Disease in Okra Leaf Images using Leaf Vein Extraction and Naive Bayesian Classifier [3] is reported. Okra, is widely grown all over tropical, subtropical and warm temperature regions of the world. The crop is prone to damage by various diseases caused by various insects, fungi, nematodes and viruses. The most common disease of okra is Yellow Vein Mosaic Virus (YVMV), spread by white fly. The efficient technique to detect and classify the presence of YVMV disease in okra leaf with the joint use of image processing, K-means and Naive Bayesian classifier. The proposed technique is experimented on 79 standard diseased and non-diseased okra leaf images.

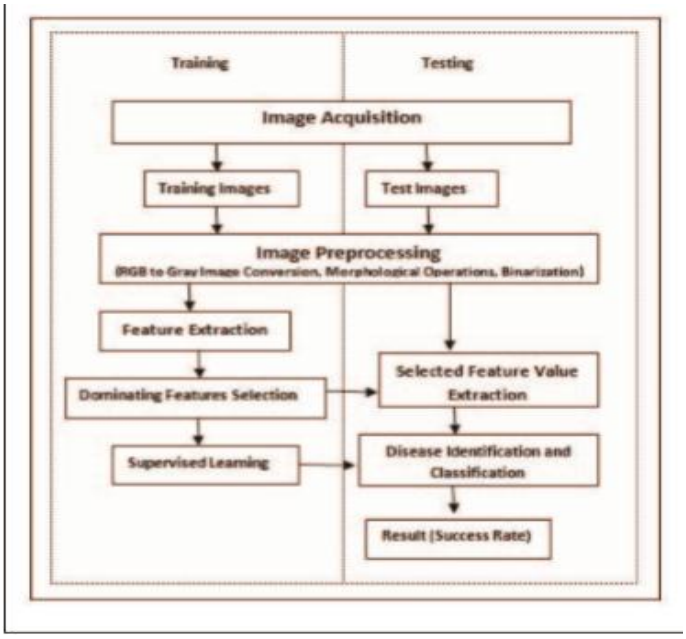

Figure.4. Workflow model for the proposed system for Okra leaf.

[3]

The input leaf images are of four classes, namely Highly Susceptible (HS), Moderately Susceptible (MS), Tolerable (T) and Resistive (R), depending upon the severity of the YVMV infection. The proposed technique achieves 87% success rate using 10 features only.

III. SURVEY AND COMPARATIVE ANALYSIS FOR PLANT DISEASE DETECTION AND CLASSIFICATION

This section describes image processing and machine learning algorithm used in various works on plant disease detection and classification. This section presents a survey of 3 papers of various plant disease detection including criteria such as image dataset, Segmentation, Feature Extraction.

Table.1 presents the analysis of different papers of plant disease detection and classification. Generally to detect the diseases from plant, two tasks are essential. First, image processing task and second machine learning task. At each step of image processing task, different techniques are available. Most authors have mentioned in their works that they had captured images for their experiments from plant fields. After getting the images, image pre-processing step is required, as discussed earlier. Researchers used different techniques of segmentation as per their requirements. Table.1 presents segmentation techniques used in detection of leaf disease. Generally, authors used k- means clustering technique to segment the diseased portion from the plant. K-means clustering groups similar colour pixels into one cluster, while groups different colour pixels into different clusters. K-means clustering can provide accurate result, for plant images, as compared to other segmentation techniques due to its ability to cluster based on distance between two pixels [1] [4]. Feature extraction involves simplifying the number of resources required to describe a large data set accurately. Grey level co-occurrence matrix (GLCM) is expressed to obtain statistical texture features. In this analysis, these texture features are calculated from the statistical distribution of observed intensity combinations at specified positions relative to others [1] [4]. Wavelets are a class of functions used to limit a given signal in both space and scaling domains. The important notion behind wavelets is to analyse the signal at different scales or resolutions, which is called multi-resolution.

Table 1. Comparative Analysis

No.	Contents	Diagnosis of pomegranate plant diseases using Neural Networks.	Tomato leaves diseases detection approach based on support vector machines	Detection and Classification Technique of Yellow Vein Mosaic Virus Disease in Okra Leaf Images using Leaf Vein Extraction and Naive Bayesian Classifier.
1	Plant Name	Pomegranate plant	Tomato plant	Okra plant
2	Dataset	Set of total 500 diseased pomegranate plant images.	Set of total 200 diseased tomato leaf images.	Set of total 79 standard diseased and non-diseased okra leaf images.
3	Segmentation technique	K-means Clustering algorithm	—	—
4	Feature Extraction Technique	Grey level co-occurrence matrix(GLCM)	Gabor wavelet transformation	Grey level co-occurrence matrix(GLCM)
5	Classification Technique	Neural Network	Support Vector Machine	Naïve Bayes Classifier
6	Accuracy	The proposed work gives 90% accuracy.	Using Cauchy 100%, Laplacian function 98%, Invmult kernel 78%.	Using Naive Bayesian Classifier 87% it correctly detects and classify the leaf images.

Among several wavelet bases, Gabor functions provide the optimal resolution in both the time (spatial) and frequency

domains. Gabor transform and Gabor wavelet are generally applied to image processing, computer vision and pattern recognition. [2] This function can provide accurate time-frequency location governed by the Uncertainty Principle, for these reasons, Gabor wavelet transform is used in this research as effective feature extraction technique.
[1] [2] [3] Researchers used different classifiers as per their requirement. Generally, authors use support vector machine, neural network and naïve Bayes classifier for classification of diseases.

IV. CONCLUSION

In this paper we have presented survey on different plant disease detection and classification using various image processing and machine learning techniques. An image processing and Machine Learning Algorithms deal with the main issues of disease detection and classification. Studied different image processing algorithms and machine learning algorithms. SVM is effective in high dimensional spaces so, in comparison with other classification techniques classification accuracy is high. Learning from the initial inputs and their relations, it can infer unseen relations on unseen data as well, thus making the model simplify and predict on unseen data. Naïve Bayes classifier is probabilistic classifier and strong independence assumption theorem. It has been observed that every algorithms having their own features according to respective plant diseases. We have highlighted summary of different segmentation and feature extraction and classification technique. Moreover, we have summarized accuracy of all results.

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