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Review On Leaf Disease Detection Using Image Processing Techniques

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Abstract - *This paper holds a survey on leaf disease detection using various image processing technique. Digital image processing is fast, reliable and accurate technique for detection of diseases also various algorithms can be used for identification and classification of leaf diseases in plant. This paper presents techniques used by different author to identify disease such as clustering method, color base image analysis method, classifier and artificial neural network for classification of diseases. The main focus of our work is on the analysis of different leaf disease detection techniques and also provides an overview of different image processing techniques.*

***Key Words*: Leaf diseases, SVM, segmentation, morphological processing, features extraction, neural networks, clustering, fuzzy logic.**

1. INTRODUCTION

India is agricultural country and most of population depends on agriculture. Farmers have wide range of selection in Fruit and Vegetable crops. The cultivation can be improved by technological support. Disease is caused by pathogen in plant at any environmental condition. In most of the cases diseases are seen on the leaves, fruits and stems of the plant, therefore detection of disease plays an important role in successful cultivation of crops. In most of cases plant diseases are caused by pathogens, microorganism, fungi, bacteria, viruses, etc. Sometimes unhealthy environment include soil and water is also responsible for diseases in plants.

There are lots of techniques to detect the different types of diseases in plants in its early stages. Conventional method of plant disease detection is naked eye observation methods and it is non effective for large crop. Using digital image processing method, the disease detection in plant is efficient, less time consuming and accurate. This technique saves time, efforts, labors and use of pesticides. Different authors propose different techniques with the help of digital image processing for accurate plants disease identification. Lots of algorithms have developed by different researchers for image processing. This paper is survey on different types of image processing techniques for detection and classification various leaf diseases. Section 1 gives an introduction of leaf disease detection. Section 2 gives brief literature survey which includes all techniques used by all authors. Section 3 presents a review table for quick information about techniques used by all authors for different papers. Section 4 provides conclusions for this paper.

2. LITERATURE REVIEW

In paper [1] authors present image processing technique for Rice disease identification and considered the two most common diseases in the north east India, namely Leaf Blast (Magnaporthe Grisea) and Brown Spot (Cochiobolus Miyabeanus). Image acquisition is basic step, after that author use segmentation, boundary detection and spot detection method for feature extraction of the infected parts of the leave. In this paper author introduces zooming algorithm in which SOM (Self Organising Map) neural network is used for classification diseased rice images. There are two methods to make input vector in SOM. First method is the padding of zeros and the second method is the interpolation of missing points. For fractional zooming to normalize the spots size, interpolation method is applied. Image transformation in frequency domain does not give better classification. For testing purposes, four different types of images are applied; the zooming algorithm gives satisfactory results of classification for test images.

In paper [2] authors present image-processing technique for Leaf & stem disease detection. The author used a set of leaf images from Jordan's Al-Ghor area. The five plant diseases namely: Early scorch, Ashen mold, Late scorch, Cottony mold and Tiny whiteness is tested by image processing technique. In this technique at starting, image acquisition is obtained and then K-Means clustering method is used for segmentation. After that in feature extraction, CCM (Colour Co-occurrence Method) is used for texture analysis of infected leaf and stem. Lastly paper presents Back propagation algorithm for neural network in classification of plant diseases. Result of this image processing technique shows accurate detection and classification of plant diseases with high precision around 93%.

In paper [3] authors used both LABVIEW and MATLAB software for image processing to detect chili plant disease. This combined technique detects disease through leaf inspection in early stage. The Image is captured using LABVIEW IMAQ Vision and MATLAB is used for further

operations of image processing. Image pre-processing operations are Fourier filtering, edge detection and morphological operations. In feature extractions, the color clustering is used to distinguish between chili and non-chili leaves. Then image recognition and classification determine the healthiness of each chili plant. This technique results in reducing use of harmful chemicals for chili plant which reduces production cost and increases high quality of chili.

In paper [4] authors present image processing technique for detecting the Malus Domestica leaves disease. Intensity values of grayscale images are obtained by histogram equalization method. In image segmentation, Co-occurrence matrix method algorithm is used for texture analysis and K-means clustering algorithm is used for color analysis. Texture analysis is characterization of regions in an image by texture content. Color analysis refers to minimizing the sum of squares of distance between objects and class centroid or corresponding cluster. In threshold matching process individual pixels value is compared with threshold value, if value is greater than threshold then it is marked as object pixel. The texture and color analysis images are compared with the previous images for detection of plant diseases. Author will use Bayes and K-means clustering in future.

In paper [5] authors present image processing techniques for detecting the Bacterial infection in plant. Common infection seen on plant is Bacterial leaf scorch and early detection of this helps in improvement of plant growth. The image processing starts with image acquisition which involves basic steps such as capturing of image and converting it to computer readable format. Then clustering is done to separate foreground and background image with help of K-means clustering method in image segmentation. Clustering is based on intensity mapping and leaf area highlighting is done by subtracting the clustered leaf images from base images. Compared to Fuzzy logic, K-means clustering algorithm is simple and effective in detecting the infected area with reduced manual cluster selection requirement. With ADSP target boards and FPGA tools, further implementation is possible.

In paper [6] authors present image processing technique for detection of unhealthy region of Citrus leaf. There are four types of citrus diseases namely: (i) Citrus canker, (ii) Anthracnose, (iii) Overwatering, (iv) Citrus greening. Author proposed methodology in which image acquisition is first step for capturing image by digital camera in high resolution to create database. Color space conversion and image enhancement is done in image pre-processing. Discrete cosine transform domain is used for color image enhancement. YCbCr color system and L*a*b* color space are chosen for color space conversion. In feature extraction author present statistical method, using Gray-Level Co-Occurrence Matrix (GLCM) to see statistics such as contrast, energy, homogeneity and entropy using graycoprops function. Two types support vector machine (SVM) classifiers: SVMRBF and SVMPOLY are used for differentiating citrus leaf diseases.

In paper [7] authors present image processing technique for Orchid leaf disease detection. Black leaf spot and Sun scorch are two types of orchid leaf diseases mostly found. The basic step of image processing is image acquisition for capturing images and stores it in computer for further operation. Image pre-processing involves histogram equalization, intensity adjustment and filtering for enhancing or modifying the image. Three morphological processes are used in border segmentation technique for remove small object and preserve large object in image. Thresholding in segmentation is used for start and stop point of line to trace edges. Author added ROI (region of interest) in GUI. After the border segmentation process a classification is done by calculating white pixels in image. This system gives high accuracy and low percentage of error in result.

In paper [8] authors present image processing technique for Tomato leaves diseases detection. In image acquisition phase, digital images of infected tomato leaves are collected which include two types of tomato diseases namely: Early blight and Powdery mildew. In pre-processing phase some techniques are techniques are applied for image enhancement, smoothness; remove noise, image resizing, image isolation, and background removing. Author introduced Gabor wavelet transformation and Support vector machine for identification and classification of tomato diseases. In feature extraction phase with the help of Gabor wavelet transform feature vectors are obtained for next classification phase. In classification phase, support vector machine (SVM) is trained for identifying the category of tomato diseases. The inputs of SVM are feature vectors and corresponding classes, whereas the outputs are the decision that detect tomato's leaf disease. SVM is employed using Invmult Kernel, Cauchy Kernel and Laplacian Kernel functions. Grid search and N-fold cross-validation techniques are used for performance evaluation.

In paper [9] authors described disease detection, in which image processing is first step for obtaining image in digital form and pre-processing to remove noise and other object from image. Pre-processing also convert RGB images into grey images using equation $f(x) = 0.2989*R + 0.5870*G + 0.114*B$ and makes histogram equalization. Image segmentation is done using boundary and spot detection algorithms for finding infected part of leaf. Classifications of objects are done using K-means clustering method. Otsu threshold algorithm is used for thresholding which creates binary images from grey images. With the help of feature extraction color, texture, morphology, edges are used in plant disease detection. Leaf color extraction using H & B components and Color co-occurrence method are feature extraction methods in image processing. Classifications of diseases are done using artificial neural network (ANN) and Back propagation network.

In paper [10] authors present image processing technique to detect Scorch and Spot diseases of plant. First step is RGB image acquisition of plant. Then in pre processing color transformation structure is created and color values in RGB are converted to the space. The masking of green-pixels is done after applying K-means clustering. This removes masked cells inside the boundaries of infected clusters. Image segmentation is done to obtain the useful segments in image. In feature extraction, color, texture and edge features are computed using color co-occurrence methodology. Neural Networks is configured for recognition and classification of diseases. Future work will include analyzing citrus trees disease conditions in outdoor environment.

In paper [11] authors present image processing technique for Groundnut plant disease detection. Groundnut plant has two major diseases namely: Early leaf spot (Cercospora) and Late leaf spot (Cercosporidium personatum). After obtaining leaf images in RGB are converted to HSV color images. Green colored pixels in image are found out to reduce processing time. In color and texture feature extraction analysis, co-occurrence matrices technique is used. In texture feature extraction there are two ways to analyze the texture images. First method is structured approach and second method is statistical approach. Author used statistical approach in this paper. Back propagation algorithm is applied for classification and recognition of groundnut diseases. In back propagation two type of phase are there namely: 1) propagation and 2) weight update. Authors classified four different diseases with 97 % of efficiency.

In paper [12] authors described plant disease recognition technique, in which first phase is to create color transformation structure for the RGB leaf image and convert color values from RGB to the space specified in that structure. Then apply color space transformation and image is segmented using the K-means technique. In the second phase called as Masking of green pixels, the unnecessary part such as green area within leaf area is removed. In third phase authors calculate the texture features for the segmented infected object also remove masked cells inside the boundaries of the infected cluster. Infected cluster are converted from RGB to HSI and SGDM matrix is generated for H and S. In the fourth phase GLCM function is used to calculate the features and compute of texture statistics. Finally, the extracted features are passed through pre-trained neural network for disease recognition.

In paper [13] authors present image processing technique for detecting disease of Sugarcane leaf. Authors choose 6 type of disease for experiment, they are: Brown Spot, Downy mildew, Sugarcane Mosaic, Red stripe, Red rot and Downy Fungal. In image acquisition, images are captured in better quality resolutions with format such as TIF, PNG, JPEG and BMP for image-analysis. In pre processing RGB images are converted to grayscale and unwanted part of data from the images is removed. Segmentation locates healthy area of given image which contains green pixels and potentially infected area. Three algorithms namely: Linear SVM, Non linear SVM and Multiclass SVM are used in feature extraction for disease detection.

3. REVIEW TABLE

Paper	Techniques Used
[1] Rice Disease identification using Pattern Recognition Techniques	Zooming algorithm, SOM neural network
[2] A Framework for Detection and Classification of Plant Leaf and Stem Diseases	K-Means clustering, Back propagation algorithm, CCM
[3] Feasibility Study on Plant Chili Disease Detection Using Image Processing Techniques	Morphological processing, Color clustering, LABVIEW IMAQ Vision
[4] Remote Area Plant Disease Detection Using Image Processing	CCM, K-Means clustering
[5] A Novel Algorithm for Detecting Bacterial Leaf Scorch (BLS) of Shade Trees Using Image Processing	K-means clustering algorithm, Intensity mapping
[6] Unhealthy Region of Citrus Leaf Detection Using Image Processing Techniques	GLCM, SF-CES, SVMRBF & SVMPOLY classifier
[7] Orchid Leaf Disease Detection using Border Segmentation Techniques	Border segmentation, Pattern classification
[8] Tomato leaves diseases detection approach based on support vector machines	SVM, Gabor wavelet transform
[9] Plant Disease Detection Using Image Processing	Otsu thresholding, ANN, SVM, Back propagation network
[10] Advance in Image Processing for Detection of Plant Diseases	CCM, Neural network
[11] Groundnut Leaf Disease Detection and Classification by using Back Probagation Algorithm	CCM, Back propagation algorithm
[12] Plant Leaf Disease Detection and Classification Using Image Processing Techniques	RGB to HSI, K-means clustering, SGDM Matrix, GLCM
[13] Leaf Disease Detection and Prevention Using Image processing using Matlab	Linear SVM, Non Linear SVM and Multiclass SVM

4. CONCLUSIONS

This paper gives the survey on leaf disease detection and classification techniques using image processing. Different authors used different algorithms for accurate detection of diseases. Advantage of using image processing method is that the leaf diseases can be identified at its early stage. For improving recognition rate, most of researchers used artificial neural networks and classifiers like ANN, SVM, etc. All methods in this paper save time and provide efficient result.

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