A Review paper On Fruit/Leaf/Plant Disease Detection Using various Image Processing Approaches

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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. This paper also discuss about Fruit disease cause a calamitous problem and results in economic and agricultural industry loss. Earlier detection of infected fruit had done manually but now with the advancement in technology image processing techniques was developed. There are two phases; first is for training and the other is for testing. In training phases, all the data related to the infected and non-infected fruit is stored and in testing phase, it is analyzed that whether the fruit is infected or not and if yes then by which disease. In this paper, the different existing techniques used to detect the infected fruit are discussed. These techniques are proved to be beneficial for the farmers as they help in detection of fruit disease in early stages.

***Key Words*: Leaf diseases, SVM, segmentation, morphological processing, features extraction, clustering, fuzzy logic. Back Propagation Neural Network, CCV, K-means Clustering, LBP, SVM**

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 and also fruit disease. Earlier the detection and identification of disease is done by experts. Depending upon the observation of experts farmers take further steps to control the disease. In developing countries consulting experts is quite costly and time consuming, that's why automated disease detection techniques were developed. Agricultural industry is using technological solutions for improving fruit production and quality. By using this system economical loss of farmers can be avoided. Automatic detection of fruit disease is important as it detects the symptoms on fruit at very growing stage which results in reducing the economic loss per year and this will also help the farmers in taking preventive measures for next year by observing present conditions of fruit.Some diseases also infect other parts of tree i.e. shoot and branches. Common diseases of mango :- pectobacterium, agrobacterium,

rhinocladium, anthracnose, powdery mildew, red rust. Pectobacterium and agrobacterium are bacterial disease of mango. Rhinocladium is a fungal mango disease. Anthracnose is caused by humidity and change in climatic conditions i.e. temperature between 24-30 degree and extra rainy conditions. Powdery mildew is caused by rain or mist accompanied by cooler night during flowering. Red rust is caused by alga. As Mango is irregular in shape so, visual inspection of mango is not enough to judge its conditions.

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 rayscale images are obtained by histogram equalization method. In image segmentation, Co-occurrence matrix method algorithm is used for texture analysis and Kmeans 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 CoOccurrence 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, cooccurrence 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 pretrained 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. System Design

For detecting disease the image should go through the following steps:

1) Pre-processing

2) Segmentation

3) Feature extraction

4) Classification.

Image Pre-processing:

The aim of this step is to eliminate noise and to enhance the image quality. Super resolution technique can be used for converting low resolution image into high resolution image. Morphological operations can be used to remove noise.Pre-processing required for shadow removal, image correction. Shadow removal is very important because shadow may disturb segmentation and feature extraction.

Image Segmentation:

Partitioning of image into foreground and background or finding the region of interest by using certain algorithms or making clusters of regions by comparing the similarities between adjacent pixels.
Thresholding:
This technique is used when the contrast of background and foreground is easily distinguishable. In global threshold a benchmark is chosen below that all the pixels are marked ‘0’ and considered as background and above that all the pixels are marked as ‘1’ and considered as the part of foreground. ‘Otsu threshold’ is a thresholding technique in which threshold value selected will depend upon the infraclass variance pixels.
Region Growing:

In region growing technique a seed is chosen based on the properties of the neighborhood pixels expansion of the region of interest starts. In this

technique seed selection is a key operation. Expansion of R.O.I is based upon similarities between the adjacent pixels.

k-mean Clustering:

In this technique k is the no. of clusters. It operates on Actual Observations. K-mean treats each observation as an object. In this k-mean clustering, partition is found in which different objects in the cluster are nearer to each other and objects in other clusters are far away to each other. Iterative algorithm is used in order to decrease the sum of distances from each object to its clustered centroid.

Fuzzy C-mean Clustering:

in c-mean clustering, iterative algorithm is used. Initially, calculation is done for fuzzy cluster centers and also fuzzy partition matrix is created. In the next step of iteration, the objective function is reduced in order to find the better position for the cluster. This iteration process is stop automatically when the maximum number of iterations is reached.

Feature extraction

It extracts relevant information from the input image in order to minimize the extent of sources required to define a dataset.

Color :

A color feature is one of the visual features as it is very stable.RGB and HIS colour system is mainly used. Infected part of a fruit can be easily identified by colour feature. Color image processing is categorized into three principle areas :Colour transformation, Spatial processing of individual colour planes, Colour vector processing.

Texture:

Image texture provides information about spatial arrangements of colour of an image. When fruit suffer from any disease its texture feature change. So, we can analyze disease type by using texture feature.

Shape:

Morphology is tool used for extracting image components. By using morphological operations, infected part shape can beextracted from healthy fruit and leaf. Erosion operation can be used for obtaining boundaries of the image. Four major characteristics:

1) Geometric characteristics – it includes perimeter, area, axis, orientation angle and so on.

2) Area description features – depending on the target area its feature is described using a set of characteristics.

3) Moment invariants: In these, geometric characteristics such as Hu invariant moments, orthogonal moments, etc. are described by using its feature.

4) Fourier shape descriptor.

Classification

Support Vector Machine (SVM) making an N-dimensional hyper plane which is optimally partitions the data into different parts. Support vector models are related closely to neural networks. SVM evaluates more relevant information in a convenient way.

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.

In Fruit Detection System we had analyzed that the proposed technique based on fuzzification in which fuzzy curves and fuzzy surfaces rapidly find the feature for pattern recognition system. Fuzzy surfaces remove those features that are based on other significant features. It had proved for providing good results in feature extraction. K-mean clustering algorithm had proved to be the one of the best techniques for segmentation. SVM had proved to be best for classification as it maps input data with high dimensional feature space through linear or non-linear mapping techniques. When the quality of image is low or the resolution of image is low Intent Search Technique had proved to be best for improving the quality of image.

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