Size estimation and detection of disease for Betelvine leaf using image processing

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***Abstract*— Plant species identification is a vital problem for biologists, environmentalists, agricultural researchers, taxonomists and in the field of Ayurvedic. Plant identification can be done by manually by the botanical experts using books or plant identification manual, but it can be time consuming and a low efficiency process. The proposed system brings out an efficient method for plant classification using color, texture and GLCM feature extraction with Support Vector Machine (SVM) is used as a classifier. The main phases of proposed approach are pre-processing Color recognition and classification, feature extraction and leaf classification. In the preprocessing stage, the acquired leaf image is resized and converted into binary image with filling the unwanted hole in order to extract the optimal feature. In the color recognition phase system classifies the leaf on the basis of various intensities like red, green to reduce the complexities. Feature extraction phase consists of geometrical feature and texture feature extraction which covers features like aspect ratio, rectangularity, convex area ratio, eccentricity, diameter, form factor, narrow factor, perimeter ratio, solidity, circularity, irregularity, contrast, homogeneity, correlation, energy, entropy. On the other end, training is given for leaves with the similar method and result is stored in the dataset. In the final phase SVM classifier is trained to identify the exact leaf disease. It is done to acquire high efficiency with less computational complexity. Training is carried out for 30 leaf images belong to 3 different classes. The proposed approach is more suitable for disease identification that have high accuracy with less computation time.**

***Keywords*— Leaf disease, Color, texture, GLCM, Support Vector Machine (SVM)**

I. INTRODUCTION

Numerous varieties of plants exist in the world, which is essential for human beings in various fields such as Agricultural field, medical field and environment. This is a reason knowing the plant details are necessary. In earlier days identifying an unknown plant species needed the consultation of human experts, using the plant identification manual but that was a low-efficiency process and requires more time to identify the plant using leaf, fruit, flower or its visual features. Image processing and pattern recognition methods are widely used techniques in plant species recognition and disease detection and in other areas. Plant classification is a process in which each individual plant should be properly classified. In these days the internet has consisted huge database of plan from different botanical experts and professional guides hence, the people can easily get significant information of the plant by composing the queries with the keywords. However, it could be infeasible for non-professionals to find appropriate keywords for the unidentified plant species and rate of recognizing the exact plant species is low. In order to avoid these problems, the categorization of the plant can be done base on fruit, flower and leaves. The fruits and flowers are difficult for classification which is also time-consuming because it needs to extract more features than leaf, for this reason, the classification of the plant is done by using leaves. Various categories of leaves were collected as samples for testing the proposed system. This work proposes an optimal methodology in which user can identify the plant species using leaf image as an input and it will provide a classification of plants with internet link of that plant to get precise information as output. The proposed approach of plant species identification using plant leaves images to recognize the leaf class. It distinguishes the different leaves by extracting the morphological features like color, textural features and geometrical features of the leaf. Train the leaves by extracting the same features and stores this information in its dataset, which uses support vector machine (SVM) classifier to classify the various leaf images. Support vector machine (SVMs) is kind of classification model which need labeled training data. This kind of model can be used in classification and regression analysis. For the given set of training examples, it will separate input into one or the other categories. SVM classification training algorithm construct a model that builds a training set to one class or the other which make it binary classifier. For this reason, SVM classifier is used in the proposed work to achieve high accuracy and less time complexity.

II. .LITERATURE REVIEW

In [1] authors have proposed fusion classification technique is used to detect downy and powdery mildew grape leaf disease. In this system disease identification is classified into two phases i.e. Test phase and Train phase. Image pre-processing operation is performed for resizing, thresh holding and noise reduction. Leaf disease segmentation is done by using K-means clustering. Feature extraction is performed based on color and texture of the image. Finally disease classification is done by using fusion classification technique. In [2] authors proposed plant disease detection using Image processing. In this paper various types of image segmentation techniques like K-means clustering, Ostu's method, converting RGB image into HIS model etc. were explained. Also different feature extraction technique like color co-occurrence method, color extraction using H and B component are described. Finally disease classification was performed by ANN and Back propagation technique. In [3] authors have proposed automated segmentation of powdery mildew disease from cherry leaves using image processing. In this paper to enhance the extraction of the desired diseased part, various pre-processing and post-processing techniques are computed. The morphological operations are used to remove the

noise and background of the image. At last extraction of powdery mildew disease is performed by Contrast Limited Adaptive Histogram Equalization (CLAHE).In [4] authors provided a algorithm of plant disease identification for mango leaf. In this system disease identification is classified into two phases. Image pre-processing segmentation and feature extraction are separately carried out for both the phases. A minimum distance classifier and support vector machine classifier has been used for disease identification. In [5] authors have proposed a work for detection of plant leaf disease using image processing techniques. The multi SVM technique is used for disease classification with high accuracy.

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III. METHODOLOGY

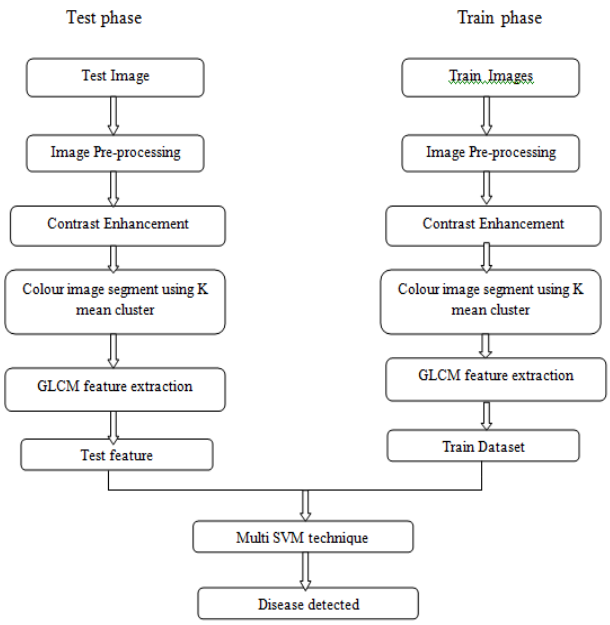

Figure1. System block diagram

i. **Image acquisition:**

When a leaf area is to be measure in field condition, it is difficult to keep cameras optical axis vertical with leaf plane. The Image of the plant leaves are captured through the camera. This image is in RGB (Red, Green and Blue) form. Color transformation structure for the RGB leaf image is created, and then a device independent color space transformation for the color transformation structure is applied.

ii. **Image Pre-processing:**

To remove noise in image or other object removal, different pre-processing techniques is considered. Image resizing, clipping i.e. cropping of the leaf image to get the interested image region. The image preprocessing is done on gathered images for improving the image quality. It removes the background noise as well as to suppress the undesired distortion. In this step, image is first resized to 300x300 size, and then thresholding is done to get all green color component. Gaussian filtering is carried out to remove noise in the image.

iii. **Contrast enhancement:**

The principle objective of image enhancement is to process a given image so that the result is more suitable than the original image for specific application. The enhancement doesn't increase the inherent information content of the data, but it increases the dynamic range of the chosen features so that they can be detected easily. Contrast is the difference in luminance or color that makes an object distinguishable. In visual perception of the real world, contrast is determined by the difference in the color and brightness of the object.

iv. **Image segmentation:**

Segmentation means partitioning of image into various parts of same features or having some similarity. Image segmentation is the process of partitioning the given image into different regions with respect to some features. Clustering is a method by which the large sets of data are grouped into clusters of smaller sets or segments of similar data. The segmentation can be done using various methods like otsu' method, k-means clustering, converting RGB image into HIS model etc. In present work, K-means clustering is used to for segmenting an image into three groups. One or more clusters include diseased part of leaf. Before clustering 'a' component is extracted from L*a*b space.

v. **K-means clustering:**

The K-means clustering is used for classification of object based on a set of features into K number of classes. The classification of object is done by minimizing the sum of the squares of the distance between the object and the corresponding cluster. The main aim of the k-means clustering is to divide n observations into k clusters, where each observation belongs to the cluster with the nearest mean serving as a prototype of the cluster.

The algorithm for K –means Clustering can be written as follows:

1. Pick center of K cluster, either randomly or based on some heuristic.
2. Assign each pixel in the image to the cluster that minimizes the distance between the pixel and the cluster center.
3. Again compute the cluster centers by averaging all of the pixels in the cluster. Repeat steps 2 and 3 until convergence is attained.

vi. **Feature extraction:**

Feature extraction plays an important role for identification of an object. In many application of image processing feature extraction is used. Color, texture, morphology, edges etc. are the features which can be used in plant disease detection. Shape, texture and color are the major types of features that are mostly used in image processing technique. For Downy Mildew color features and for Powdery Mildew texture features are need to be used. Hence in this system color and texture features both are extracted to get better accuracy. Before training the classifier, the texture and color (9+9=18) features are first need to be combined.

vii. **Multi SVM technique:**

In machine learning, support vector machines (SVMs, also support vector networks) are supervised learning models with associated learning algorithms that analyze data used for classification and regression analysis. SVM is a binary classifier to analyze the data and recognize the pattern for classification. The classification of the feature extracted from the input image was made by classifying each row of data in the dataset which is in a matrix of data form. The data in the matrix was presented in a row and column where row corresponds to the number of sample used for training while column correspond to the feature extracted from the image. Thus, the training data used should consist the similar number of columns as the input data. Each row of data in a matrix of data of the dataset is classifies using the information in a support vector machine classifier structure SVM Struct, created using the SVM train function. The SVM classify function uses results from SVM train to classify vectors *x* according to the following equation:

$$\text{Entropy} = \sum_i a_i k(s_i, x) + b$$

where s_i are the support vectors, a_i are the weights, b is the bias, and k is a kernel function. In the case of a linear kernel, k is the dot product. If $c \geq 0$, then *x* is classified as a member of the first group, otherwise it is classified as a member of the second group.

IV. RESULTS

We are using SVM classifier to detect the leaf disease. Classification involves two stages, training stage and testing stage. In training phase, classifier is trained using feature values and its respective target values. This trained classifier is then used to classify test images. . In this work total 50 images of leaf samples were used for training phase.. For testing phase 10 to 15 leaf samples were used.

The first step is image acquisition, normal leaf and infected leaf are shown in the below figure1

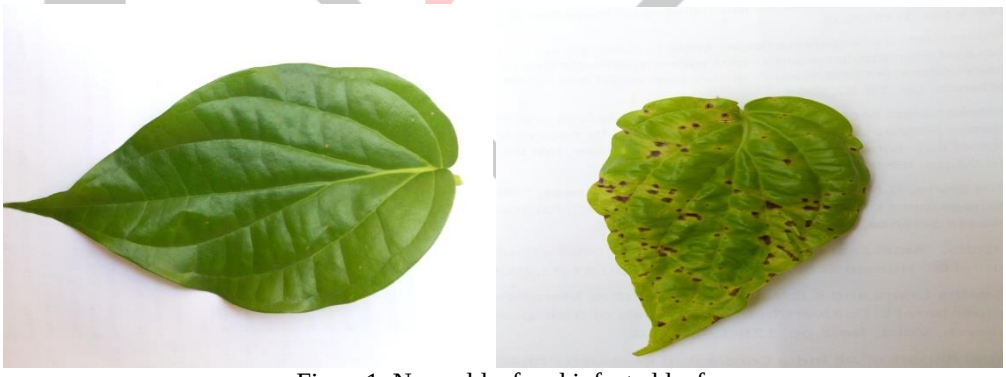

Figure1. Normal leaf and infected leaf

The resized image of 300*300 is shown in figure2

Figure2. Resized image

Then filtered image is segmented into 3 clusters using K-means clustering. Figure 3 shows 3 clusters formed using K-means clustering.

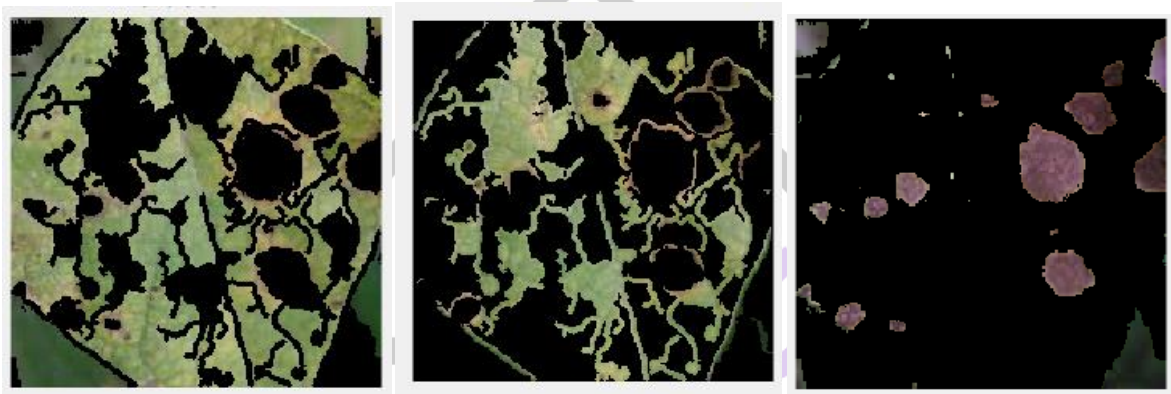

Figure3. Segmentation using K-means Clustering

Finally, Disease identification and severity is calculated using SVM classifier technique which is shown in figure4

Figure4. Disease detection

The experimental results are shown in the table1.where thee types of disease are identified with its affected area and accuracy. In this technique we can achieve the maximum accuracy of 82%.

Types of disease	Severity	Accuracy
Cercospora Leaf spot	22.41	78.46
Bacterial	23.28	81.84
Powdery Mildew	15.61	79.32

Table1. Disease classification with severity and accuracy

V. Conclusion and Future scope

The methodology proposed for detection of disease is automatic and its complexity is low, making the process suitable for real time applications. The unwanted noise, non uniform illumination and low contrast between disease and leaf are the major difficulty faced in segmentation of disease; all these are addressed in this proposed work. The morphological operators used with intensity adjustment provides a better result and also computationally cheap. Future work in this direction may be to explore other methods of Powdery Mildew extraction with more improved computational speed.

As future scope, this method can be further used for leaf disease detection with plant species identification. There is a lot of scope for future enhancement in the proposed method, by extraction of other leaf features and capture of leaf image under various backgrounds and multiple leaf recognition.

VI. ACKNOWLEDGEMENT

We express our deepest gratitude and respect to our guide Mrs.Vrunda Adkar, Asst. Professor , Department of Electronics and Communication Engineering, for his valuable guidance and encouragement while doing this project work. We extend our thanks to the Management of Shri Madhwa Vadiraja Institute of Technology and Management, Bantakal, Udupi for providing good laboratory and library facilities. We also remain grateful to the co-operation and help rendered by the teaching and non-teaching staff of the Electronics and Communication Engineering Department. Lastly, we take this opportunity to offer our regards to all of those who have supported us directly or indirectly in the successful completion of this project work.

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