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Identification of Plant Leaf Diseases using Image Processing Techniques

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***Abstract*— Image processing is a diverging area where researches and advancements are taking a geometrical progress in the agricultural field. Various researches are going on vigorously in plant disease detection. Identification of plant diseases can not only maximize the yield production but also can be supportive for varied types of agricultural practices. This paper proposes a disease detection and classification technique with the help of machine learning mechanisms and image processing tools. Initially, identifying and capturing the infected region is done and latter image preprocessing is performed. Further, the segments are obtained and the area of interest is recognized and the feature extraction is done on the same. Finally the obtained results are sent through SVM Classifiers to get the results. The Support Vector Machines outperforms the task of classification of diseases, results show that the methodology put forward in this paper provides considerably better results than the previously used disease detection techniques.**

***Index Terms*—Image processing, Feature extraction, SVM (Support Vector Machines) Classifiers.**

I. Introduction

Agriculture, which has revolutionized entire civilization starting from pre-historical ages in a global aspect. Agriculture is being practiced from ages and there are many advancements and changes taking place. Agriculture is a primary factor of food providence, and it is a growing entity day by day. Agriculture is considered as one of the top core occupation and on the other hand it helps in improving the economy of the country. Farmer"s economic growth relies on the quality of the products that they grow, which is directly dependent on the plant"s growth and the yield they get. Plants are exposed to outer environment and are highly prone to diseases that affects the growth of the plant which in turn effects the ecology of the farmer. Plants are the major victims of the plant diseases.

Plants are attacked by numerous kinds of diseases which target different parts of the plant body such as leaf, stem, seed, fruit, and so on. Diseases are specific to specific parts of the plant body. Leaves can be addressed as the core part of the plant, it is only with the help of leaves the course of photosynthesis can be performed. If the plant leaf is prone to disease it directly effects the plant life cycle. In order to handle these diseases bravely it is essential to put forward a system which identifies and classifies the diseases automatically. To solve this problem machine learning seems to be a better option. Various machine learning techniques are recently proposed for identification and classification of plant diseases from plant images. These automated techniques have made way to solve the problems, but the greatest challenge being faced is the accuracy and the robustness of the results obtained. In this paper we make use of image processing techniques as well as machine learning techniques for the identification of the plant diseases.

II. Related Work

Revathi et al [10], proposed an approach for identifying visual diseases of the cotton crop. The digital copies of the plant is taken and pre-processed. Then the feature extraction methods like edge detection, color space and textural features are performed. The extracted features are then passed through classifiers, here 3 different classifiers are used: Support Vector Machines (SVM), Back Propagation (BP), Fuzzy and GA Feature selection.

Al Bashish et al [5], have proposed a work for detection of visual plant stem and leaf diseases. The developed framework is based on image-processing and consists of the following steps; firstly, K-Means technique is used to segment the images, secondly the obtained segments are passed through a trained neural network. Final results indicate that the proposed approach precisely and automatically detects the leaf diseases. The classifier developed which is based on statistical classification had performed well and can successfully classify and detect the diseases.

Camargo et al [2], had showcased an algorithm that perpetuates the visional symptoms of plant diseases, through color image analysis. The developed algorithm starts by converting the Gray scale image of the infected plant or leaf, into color transformations like I3a, I3b and H. Next the transposed image is segmented by figuring out the intensity distribution in a histogram. This technique is particularly used to target on the one with a large distribution of intensities in the image data set. Once the segmentation process is complete, the obtained region is afterwards refined to remove the pixel regions which are not a part of the target region. This procedure was accomplished by the neighborhood analysis of each pixel and the gradient change between them. The results obtained were satisfying all the conditions and was successful in identifying the diseased regions in the plant.

Camargo et al [1] have put forward an algorithm for identification of diseased region of plants using image processing. Initially the image is captured and the color transformation is performed. By using Gaussian filter the enhancement of transformed images are done. Segmentation is then performed to obtain the area of interest. The segments are separated by locating the optimum threshold. Then by using SVM classifier the segmented regions are classified and labeled as diseased or healthy.

III. METHODOLOGY

The step by step procedure used in disease detection:

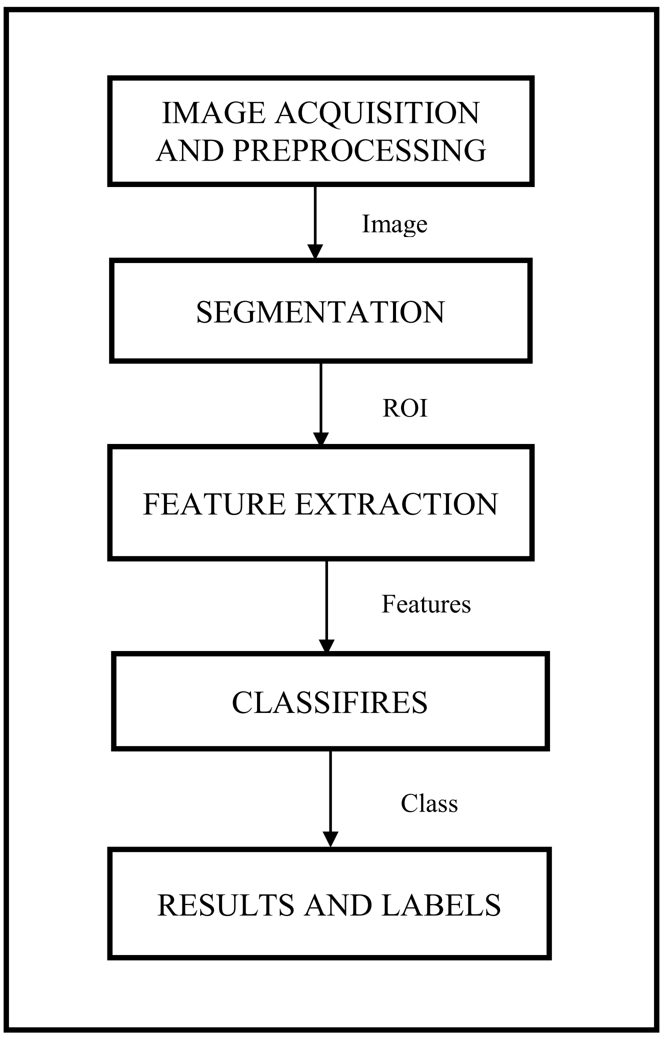

Figure 1: Steps to be followed for Disease Detection

The detection of unhealthy region of plant leaf consists of various steps which are depicted roughly in Figure 1, which indicates a proposed multi layered approach. Various stages of this approach are described below:

Image Acquisition and Image Pre-Processing:
Initially the concentration is on 5 types of plant leaf diseases which are common for a large number of plant species. For which a training set of 227 images and a testing set of 121 images is constructed. The training and testing set consists of a combination of the 5 diseases and a pest. The Images captured might be of various forms and of various dimensions, hence the images are preprocessed and brought to same dimension, removes noise, background and reduces unwanted distortions. The output image obtained is given as input to the next module.

Segmentation:
Segmentation is done to get the areas of interest i.e. the infected region. It is done using K-Means Clustering algorithm, Otsu‟s detection, converting RGB to HSI. Segmentation is done using Boundary and spot detection algorithms, which helps to find the infected area. For boundary detection the 8 connectivity pixels are considered and respective algorithms are applied. A set of features are considered to form clusters using K-Means clustering algorithm. Otsu‟s Method is used to set the threshold. Thresholding helps in creating binary images from grey-scale, i.e. by setting some threshold value and the pixels below that threshold are set to 0 and above the threshold are set to 1. The images are in RGB format; which can be divided into 3 spaces and make them as 3 clusters using the above mentioned methods. Next the cluster with ROI (Region Of Interest) is chosen. The ROI is explicitly entered by the user. This chosen cluster is the input to the next step.

Feature Extraction
After segmentation the Region of Interest selected which is having better image data using, various features are extracted using feature extraction techniques. This precisely describes the diseased region based on color, shape and textural features. Various feature extraction methods such as color co-occurrence, skewness, contrast, correlation etc. are used to extract the desired set of features.

Classification:
This is the final stage; here „Support Vector Machines (SVM)‟ is used for classification. This gives us better and more accurate results. The classifier is tested using combination of various features.

IV. EXPERIMENTAL RESULTS

Various intermediate results and the final results obtained during the experiment are discussed in this section.

Table 1: Infected Plant Leaf Images, Images obtained after Pre-Processing, Cluster's obtained after Segmentation and Cluster Number where the ROI is found

Name of	**Original**	**Pre-**	**Clusters**	**Cluster**

the Disease	Infected Image	Processed Image	Obtained	No. with ROI
Alternaria Alternata				1
Anthracnose				2
Bacterial Blight				1
Cercospora Leaf Spot				3
Mosaic				2

The infected leafs are initially identified and captured. Since the captured images are of different size, shapes and also vary in many aspects, all are mapped to a normalized size. The samples images of each disease are shown above in the column 2 of *Table 1*. Then the normalized images obtained after applying the pre-processing techniques like enhancing the contrast and resizing the images etcetera is done and sample pre-processed images are depicted in column 3 of *Table 1*. Next the clusters are obtained from CIELAB i.e. the L, a and b components are made into clusters, then the user is asked to input the Region Of Interest. The column 4 in *Table 1* depicts the clusters obtained and the column 5 in *Table 1* shows the cluster number containing the ROI.

Here 250 images are taken to train the network, from which 25 are of Alternaria Alternata category, 50 samples are of kind Anthracnose, 52 samples belong to Bacterial Blight, 73 are of type Cercospora Leaf Spot and 52 samples are of Mosaic category are considered for training and testing.

Table 2: Recognition rate

Name of the Disease	Samples considered	Recognized Samples	Misclassified Samples	Rate of Recognition (%)
Alternaria Alternata	23	21	2	91.3
Anthracnose	50	45	5	90
Bacterial Blight	52	48	4	92.31
Cercospora Leaf Spot	73	68	5	93.15
Mosaic	52	49	3	94.23

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The above table gives us the recognition rate of the diseases considered for the experiment. By considering the above table we can calculate the overall recognition rate, which was found out to be 92.4%.

V. CONCLUSION

The paper mainly focuses on the plant disease detection and through the application of various methodology. Usage of various feature extraction techniques and a stable, sufficient data set have facilitated in obtaining satisfactory experimental results. The usage of classifier „Support Vector Machines (SVM)" have enhanced the performance of the system which provides better results.

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