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Quantitative and Qualitative Analysis of Plant Leaf Disease

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Abstract:

Plant disease detection is very important because agriculture is the backbone of the country like India. Crops and plantations get destroyed mainly due to two major reasons, first reason is destruction by natural calamities and second reason is the destruction by the pathogens such as viral, bacterial and fungal. Through naked eye farmers could not detect the type of plant disease. To overcome this a technique is developed in which plant disease is detected using image processing technique. Disease detection begins with image acquisition. The input image is then converted into gray image by the library function. This is followed by filtering where median filter is used to remove the noise and smoothening of the image. The next process is feature extraction done with GLCM. K-means clustering and GLCM algorithm would generate the features from the images. This is proceeded with enhancement. Here adaptive histogram equalization is involved. Then segmentation is performed based on some common properties of the objects present in an image like color, texture and, shape etc. Finally, the disease and area of the affected region in the leaf is found.

Keywords **—Leaf disease identification, SVM, GLCM, Quality Analysis, Segmentation**

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I. INTRODUCTION

In several parts of the world, a great challenge to plant growth and crop production is plant diseases which affect the plants by interfering with several processes such as plant growth, flower & fruit development, absorbance and translocation of water and nutrients, photosynthesis, and cell division and enlargement. Plant diseases can be caused by different types of fungi, bacteria, phytoplasma, viruses and other agents. The severity of diseases caused by these pathogens varies from mild symptoms to decline of the infected plants, depending on the aggressiveness of the pathogen, host resistance, environmental conditions, duration of infection and other factors. Plant disease symptoms vary with the infecting pathogen and the infected part and can include leaf spots, leaf blights, root rots, fruit rots, fruit spots, wilt, dieback and decline.

The scientific study of plant diseases which are caused by pathogens and other environmental conditions is termed as Plant pathology. Pathogens include fungi, oomycetes, bacteria, viruses, viroids, phytoplasmas, protozoa, nematodes and parasitic plants. The various steps of Plant pathology include the study of pathogen identification, disease etiology, disease cycles, economic impact, plant disease epidemiology, plant disease resistance, how plant diseases affect humans and animals.

The important methods used in this project are K-means clustering, GLCM algorithm and segmentation using SVM.

II. PLANT LEAF DISEASES

Organisms that cause infectious disease include fungi, oomycetes, bacteria, viruses, viroids, virus-like organisms, phytoplasmas, protozoa, nematodes and parasitic plants. Symptoms differ based on the internal and external expression of the disease. General classification includes local (within a limited area of host tissue), systemic (reaction of a greater part or all of the plant), primary (pathogen activity on invaded tissues), secondary (physiological effects of disease on distant tissues and uninvaded organs), microscopic (disease in cell structure or cell arrangement) or macroscopic (abnormal effects on host cells, tissues, and organs). Few diseases with their symptoms and characteristics are explained below;

A. Alternaria Alternata

It is a fungus that causes leaf spots, rots, blights and other diseases on over 380 host species of plant. It can also cause upper respiratory tract infections and asthma in humans.

Fig. 1. Example of Alternaria Alternata

B. Anthracnose

It is a fungus that causes leaf spots, rots, blights and other diseases on over 380 host species of plant. It can also cause upper respiratory tract infections and asthma in humans.

Fig. 2. Example of Anthracnose

C. Bacterial blight

It is a disease caused by the bacterial pathogen *Xanthomonas campestris* which is characterized by small, pale green spots or streaks which soon appear water-soaked. Infections are spread by splashing of bacterial ooze by rain drops, plant to plant contact and insects. This develops on the upper leaves during cold and wet weather.

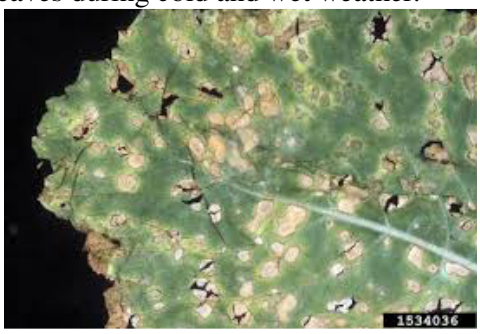

Fig. 3. Example of Bacterial blight

D. Cercospora Leaf Spot

It is a common disease in beetroot, capsicum, carrot, avocado and coffee crops. It causes small, brown flecks develop with a reddish border, round water-soaked lesions on leaves, petioles and stems. This tissue also becomes thin and brittle.

Fig. 4. Example of Cercospora Leaf Spot

III. EXISTING SYSTEM

An automatic soft computing approach BRBFNN for identification and classification of disease from plant leaves. The proposed method uses Bacterial Foraging Optimization (BFO) to assign optimal weight to Radial Basis Function Neural Network (RBFNN) and to find the optimal region for the different disease present on the plant leaves. The efficiency of the Radial Basis Function Neural Network is further enhanced by using region growing method searching for seed points and grouping them having similar attributes that help in feature extraction process.[1]

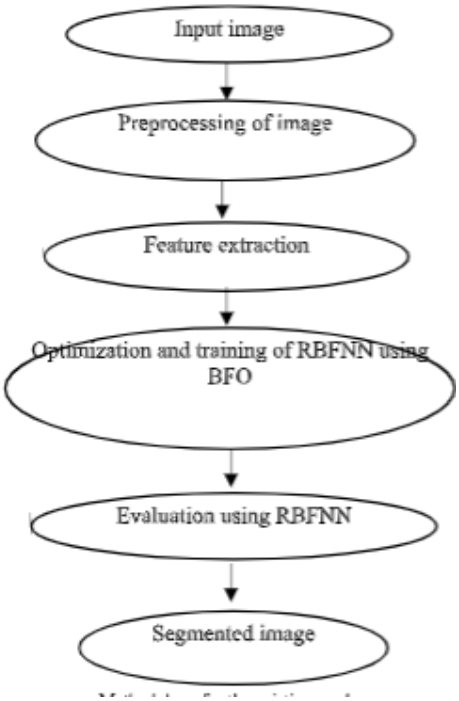

Fig. 5. Methodology for the existing work

IV. PROPOSED SYSTEM

The proposed method includes various techniques such as changing image size, filtering of noise, image conversion, enhancing image. K-means clustering method partitions the images into clusters in such a way that at least one part of cluster contains an image with major area of affected part. GLCM has been used extensively in the field of image processing. It has been for texture analysis in gray scale as well as color texture recognition. The different methods implemented in this project within MATLAB are been explained below.

A. *Median filter*

The input image is pre-processed by the median filter for better results. The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries referred as window pattern.

B. *Adaptive Histogram Equalization*

AHE improves the local contrast and enhances the definitions of edge in each region of an image. AHE features a tendency to overamplify noise in relatively homogeneous regions of an image. A variant of adaptive histogram equalization called contrast limited adaptive histogram equalization (CLAHE) prevents this by limiting the amplification. Each pixel is transformed supported on the histogram of a square surrounding the pixel. The transformation function is proportional to the cumulative distribution function (CDF) of pixel values in within the neighbourhood.

C. *K Means Clustering*:

K-Means starts by randomly defining k centroids. From there, it works in iterative (repetitive) steps to perform two tasks:

1. Assign each data point to the closest corresponding centroid, using the standard Euclidean distance. In layman's terms: the straight-line distance between the data point and the centroid.
2. For each centroid, calculate the mean of the values of all the points belonging to it. The mean value becomes the new value of the centroid.

Once step 2 is complete, all of the centroids have new values that correspond to the means of all of their corresponding points. These new points are put through steps one and two producing yet one more set of centroid values. This process is repeated over and over until there is no change with in the centroid values, meaning that they need been accurately grouped. Or, the method are often

stopped when a previously determined maximum number of steps has been met.

D. ***Gray Level Co-Occurrence Matrix (GLCM):***

Feature extraction involves simplifying the quantity of resources required to explain an outsized set of data accurately. When performing analysis of complex data one among the main problems stems from the amount of variables involved. Analysis with an outsized number of variables generally requires an outsized large amount of memory and computation power or a classification algorithm which over fits the training sample and generalizes poorly to new samples.

E. ***Image Quality Assessment:***

Measurement of image quality is vital for several image processing applications. Image quality assessment is associated with image similarity assessment during which quality is predicated on the differences (or similarity) between a degraded image and therefore the original, unmodified image. There are two ways to live image quality by subjective or objective assessment. Subjective evaluations are expensive and time-consuming. It is impossible to implement them into automated real-time systems. Objective evaluations are automatic and mathematical defined algorithms.

F. ***SVM:***

The Support Vector Machine is a theoretically superior machine learning methodology with great leads in pattern recognition. Especially for supervised classification of high dimensional datasets and has been found competitive with the simplest machine learning algorithms. The proposed classification procedure followed, leading in the final object classification. The classification results were compared to the closest Neighbor object-based classifier results, and were found satisfactory. The SVM methodology seems very promising for Object Based Image Analysis and future will specialize on integrating SVM classifiers with rule-based classifiers.

V. OUTPUT

Qualitative analysis like Clustering and quantitative analysis like feature extraction and image quality assessment is used to segment the affected portion in the scanned leaf image. To segment the portion, first need to filter out the

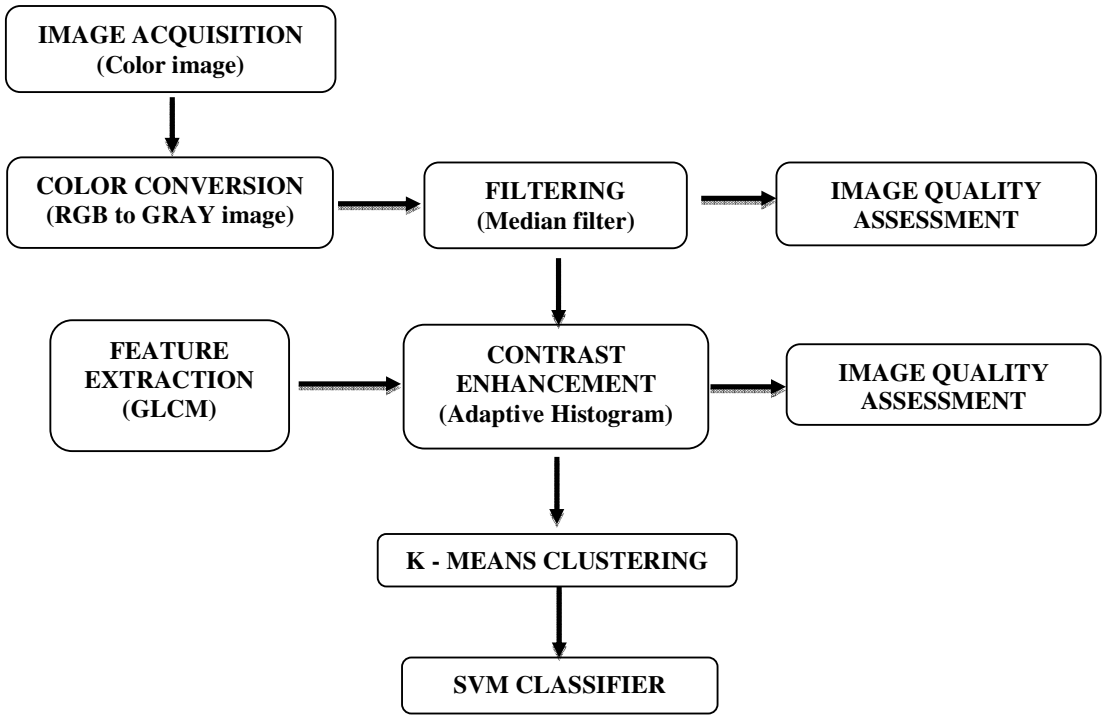

Fig 6: Block diagram for the proposed work

acquired image based upon masking methodology. The clustering function are to be applied throughout the filtered image. By the tactic of morphological bounding, box will be drawn over the affected portion. Then the region enclosed by bounding box will be segregated separately. After filtering and contrast enhancement, image quality assessment is calculated to match other techniques. Then the percentage affected is calculated. Finally, accuracy estimation is to be finished algorithm efficient level.

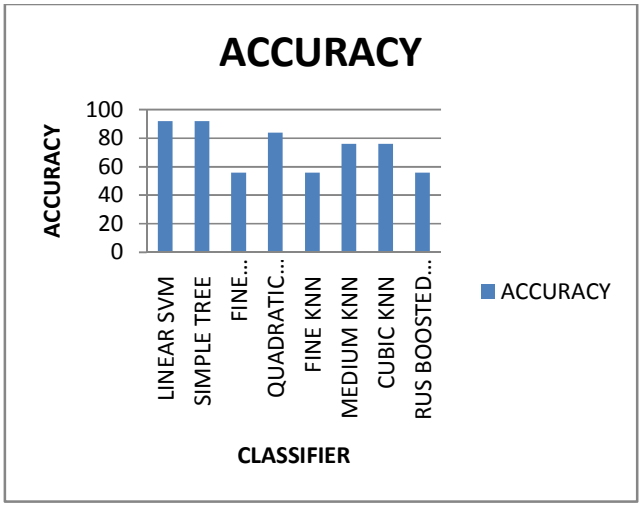

Fig. 7. Accuracy

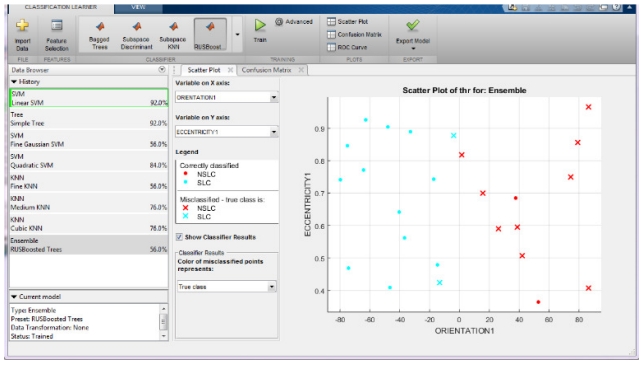

Fig. 8. Scatter plot – Linear SVM

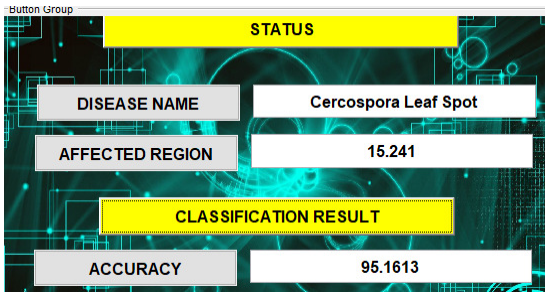

Fig. 9. Confusion matrix – Linear SVM

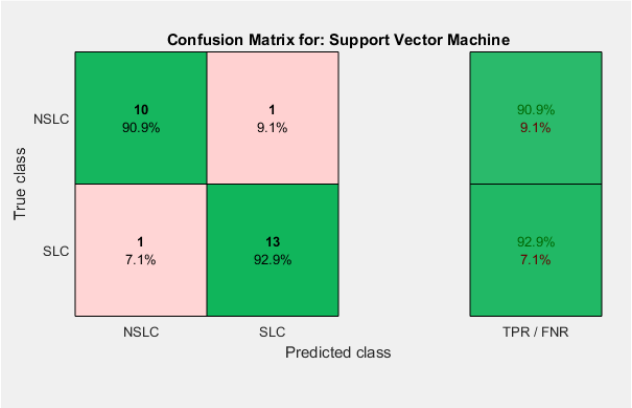

Fig. 10. Disease detection output

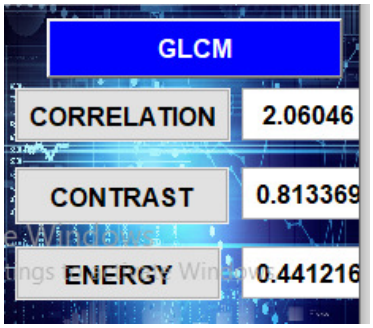

Fig. 11. GLCM output

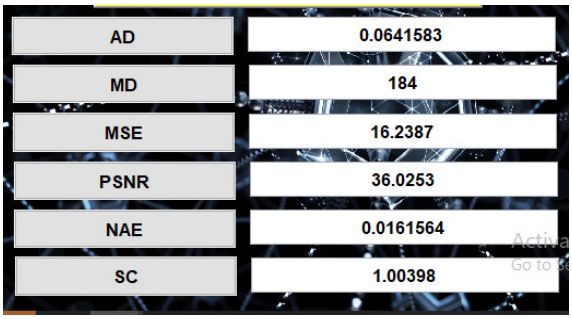

Fig. 12. Image quality assessment results

VI. CONCLUSION

In this paper, the detection and classification of plant leaf disease is made by means if KNN techniques, segmentation and detection by means of intensity computation, thresholding and features extraction. The diseases are classified with the help of SVM and were able to distinguish between four different types of grading level with an average accuracy of 94.17%. As an extension of our work, it is suggested to identify and classify various stages of plant diseases and different diseases caused by bacteria and virus.

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