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Detection of Unhealthy Region of plant leaves using Neural Network

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Abstract: A leaf is an organ of vascular plant and is the principal lateral appendage of the stem. Each leaf has a set of features that differentiate it from the other leaves, such as margin and shape. This work proposes a comparison of supervised plant leaves classification using different approaches, based on different representations of these leaves, and the chosen algorithm. Beginning with the representation of leaves, we presented leaves by a fine-scale margin feature histogram, by a Centroid Contour Distance Curve shape signature, or by an interior texture feature histogram in 64 element vector for each one, after we tried different combination among these features to optimize results. We classified the obtained vectors. Then we evaluate the classification using cross validation. The obtained results are very interesting and show the importance of each feature. The classification of plant leaf images with biometric features. Traditionally, the trained taxonomic perform this process by following various tasks. The taxonomic usually classify the plants based on flowering and associative phenomenon. It was found that this process was time consuming and difficult. The biometric features of plants leaf like venation make this classification easy. Leaf biometric feature are analyzed using computer based method like morphological feature analysis and artificial neural network and Naive bayes based classifier. KNN classification model take input as the leaf venation morphological feature and classify them into four different species. The result of this classification based on leaf venation is achieved 96.53% accuracy in the training of the model for classification of leaves provide the 91% accuracy in testing to classify the leaf images.

Keyword: Artificial neural network, K-NN Classification, Leaf venation pattern, Morphological Features

I. INTRODUCTION

Plant diseases have turned into a dilemma as it can cause significant reduction in both quality and quantity of agricultural products. In India 70% of the population depend on agriculture. Farmers have wide range of diversity to select suitable Fruit and Vegetable crops. However, the cultivation of these crops for optimum yield and quality produce is highly technical. It can be improved by the aid of technological support. The management of perennial fruit crops requires close monitoring especially for the management of diseases that can affect production significantly and subsequently the postharvest life. In [2] the authors have worked on the development of methods for the automatic classification of leaf diseases based on high resolution multispectral and stereo images. Leaves of sugar beet are used for evaluating their approach. Sugar beet leaves might be infected by several diseases, such as rusts (Uromyces betae), powdery mildew (Erysiphe betae).

Disease is caused by pathogen which is any agent causing disease. In most of the cases pests or diseases are seen on the leaves or stems of the plant. Therefore identification of plants, leaves, stems and finding out the pest or diseases, percentage of the pest or disease incidence , symptoms of the pest or disease attack, plays a key role in successful cultivation of crops. It is found that diseases cause heavy crop losses amounting to several billion dollars annually.

Fig1: Potato leaf affected by the late blight

Fig2: Leaf symptoms of canker on top and bottom of leaf

Disease management is a challenging task. Mostly diseases are seen on the leaves or stems of the plant. Precise quantification of these visually observed diseases, pests, traits has not studied yet because of the complexity of visual patterns. Hence there has been increasing demand for more specific and sophisticated image pattern understanding. In biological science, sometimes thousands of images are generated in a single experiment. These images can be required for further studies like classifying lesion, scoring quantitative traits, calculating area eaten by insects, etc. Almost all of these tasks are processed manually or with distinct software packages. It is not only tremendous amount of work but also suffers from two major issues: excessive processing time and subjectiveness rising from different individuals .Hence to conduct high throughput experiments, plant biologist need efficient computer software to automatically extract and analyze significant content. Here image processing plays important role.

II. BIOLOGY POINT OF VIEW

In leaves recognition research, a lot has been done about general features extraction or recognition between different classes of objects. In case of specific domain recognition, taking into account the unique characteristics that belong to this category, improves the performance of the system. Despite the high technical aspect of this project, dealing with leaves gives a biological connotation. A very basic knowledge on leaves has to be learned and knowing the perspective of how biologists themselves recognizing a leaf is and add on. Biologists also emphasize the importance of leaves; indeed their size, their shape, their disposition can vary very much and be a good mean for differentiating similar blooms. The disposition of the leaves on the stem can be alternate, opposed or whorled as illustrated in Figure 1.3. The enervations of the leaf can be of different types; there are leaves with dichotomist, parallel, palmate, pinnate nerves. These features are well explained below:

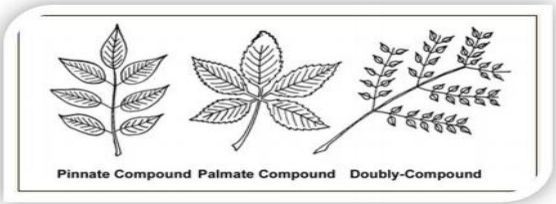

Figure 1.3: Compound leaves.

III. LITERATURE SURVEY

Ana Carolina Quintao Siravenha (2015), Plant identification and classification play an important role in ecology, but the manual process is cumbersome even for experimented taxonomists. In this work, a methodology for plant identification and classification based on leaf shapes, that explores the discriminative power of the contour-Centroid distance in the Fourier frequency domain in which some invariance (e.g. rotation and scale) are guaranteed. In addition, it is also investigated the influence of feature selection techniques regarding classification accuracy. Our results show that by combining a set of features vectors - in the principal components space - and a feed forward neural network, an accuracy of 97.45% was achieved[7]. **Francis Rey F. Padao (2015),** here research aims to study plant classification using naive Bayes (NB) method. Leaf shape and texture serves as input features to the model classifier. The test result shows that the classification accuracy of the model is high that the true positive rating is excellent and the weighted average of the false positive rating is 0.09%, which is considered very minimal and acceptable [14]. **Ghulam Mustafa Choudhary(2015)**, There author aimed to design & implement an image processing software based solution for automatic detection and classification of plant leaf disease. Naked eyes gives result less and are time consuming, so a new strategy is acquainted for detecting plants leaf diseases. It is very sensitive and accurate method in the detection of plant diseases, which will diminish the losses and enhances the economical profit. In this author, describe two distinct classes of plant diseases viz. scorch and spot are implemented for the detection of plant diseases. The main characteristics of disease detection are speed and accuracy. Hence, there is working on development of automatic, efficient, fast and accurate which is use for detection disease on unhealthy leaf [15]. **Sachin D. Khirade et al. (2015),** the key is to prevent the losses in the yield and quantity of the agricultural product of the plant diseases Identification. Visually observable patterns seen on the plant is the studies of the plant diseases. Monitoring health and detection of disease on plant is very critical for sustainable agriculture. It is very difficult to monitor the plant diseases manually. It requires tremendous amount of work, expertise in the plant diseases, and also require the excessive processing time. Hence, image processing is used for the detection of plant diseases. Here various methods are discussed which are used for the detection of plant diseases using their leaves images with some segmentation and feature extraction algorithm that are used in the plant disease

detection [29]. **Arti N. Rathod (2014),** here author represents that in agriculture research of automatic leaf disease detection is essential & benefits in monitoring large fields of crops, and thus automatically detect symptoms of disease as soon as they appear on plant leaves. The term disease is usually used only for destruction of live plants. Here, various methods studies are for increasing throughput and reduction subjectiveness arising from human experts in detecting the leaf disease. The main characteristics of disease detection are working on the development of automatic, efficient, fast and accurate detecting of unhealthy leaf [9]. **Khushal Khairnar (2014)**, here author aimed to decrease the diseases which restrict the growth of plant and quality and quantity of plant also reduces. Image processing is best way for detecting and diagnosis the diseases. In which initially the infected region is found then different features are extracted such as color, texture and shape. Finally classification technique is used for detecting the diseases. Here explained the survey of all detection procedures used for object detection [21]. **Prof. Meeta Kumar et al. (2013)**, In this paper we present survey on various classification techniques which can be used for plant leaf classification. A classification problem deals with associating a given input pattern with one of the distinct classes. Plant leaf classification is a technique where leaf is classified based on its different morphological features. There are various successful classification techniques like k-Nearest Neighbor Classifier, Probabilistic Neural Network, Genetic Algorithm, Support Vector Machine, and Principal Component Analysis. Deciding on the method for classification is often a difficult task because the quality of the results can be different for different input data. Plant leaf classifications has wide applications in various fields such as botany, Ayurveda, Agriculture etc. The goal of this survey is to provide an overview of different classification techniques for plant leaf classification [24]. **Smita Naikwadi et.al. (2013)** We propose and experimentally evaluate a software solution for automatic detection and classification of plant leaf diseases. Studies of plant trait/disease refer to the studies of visually observable patterns of a particular plant. Nowadays crops face many traits/diseases. Damage of the insect is one of the major trait/disease. Insecticides are not always proved efficient because insecticides may be toxic to some kind of birds. It also damages natural animal food chains. The following two steps are added successively after th segmentation phase. In the first step we identify the mostly green colored pixels. Next, these pixels are masked based on specific threshold values that are computed using Otsu's method, then those mostly green pixels are masked. The other additional step is that the pixels with zeros red, green and blue values and the pixels on the boundaries of the infected cluster (object) were completely removed. The experimental results demonstrate that the proposed technique is a robust technique for the detection of plant leaves diseases. The developed algorithm's efficiency can successfully detect and classify the examined diseases with a precision between 83% and 94%, and can achieve 20% speedup over the approach proposed in [30]. **Abdul Kadir et.al. (2012)** This paper reports the results of experiments in improving performance of leaf identification system using Principal Component Analysis (PCA). The system involved combination of features derived from shape, vein, color, and texture of leaf. PCA was incorporated to the identification system to convert the features into orthogonal features and then the results were inputted to the classifier that used Probabilistic Neural Network (PNN). This approach has been tested on two datasets, Foliage and Flavia, that contain various color leaves (foliage plants) and green leaves respectively. The results showed that PCA can increase the accuracy of the leaf identification system on both datasets[1]. **Gurpreet kaur et.al. (2012),** Plants play an important role in human life and provide required information for the development of human society. The urgent situation is that due to environmental degradation and lack of awareness, many rare plant species are at the risk of extinction so it is necessary to keep record for plant protection. We believe that the first step is to build up a database for protecting plants. So the need arises to teach a computer how to classify plants. Despite the great advances made in Botany, there are many plants which are still unknown. This research focuses on using digital image processing for the purpose of automate classification and recognition of plants based on the images of the leaves. In this paper we review leaf architecture and various techniques for automated plant classification and recognition. [16]. **Samuel E. Buttrey et.al. (2002)** we construct a hybrid (composite) classifier by combining two classifiers in common use— classification trees and k-nearest-neighbor (k-NN). In our scheme we divide the feature space up by a classification tree, and then classify test set items using the k-NN rule just among those training items in the same leaf as the test item. This reduces somewhat the computational load associated with k-NN, and it produces a classification rule that performs better than either trees or the usual k-NN in a number of well-known data sets [28].

IV. METHDOLOGY

1. RGB image acquisition
2. Create the color transformation structure
3. Convert the color values in RGB to the space specified in the color transformation structure
4. Apply K-means clustering

5. Masking green-pixels
6. Remove the masked cells inside the boundaries of the infected clusters
7. Convert the infected (cluster / clusters) from RGB to HSI Translation
8. SGDM Matrix Generation for H and S
9. Calling the GLCM function to calculate the features
10. Texture Statistics Computation
11. Configuring Neural Networks for Recognition
12. Grading and percentage uses Naïve Bayes system.

V. RESULTS

The Chapter result and discussion incluse the different snapshort of the work . These snapshorts are given below :

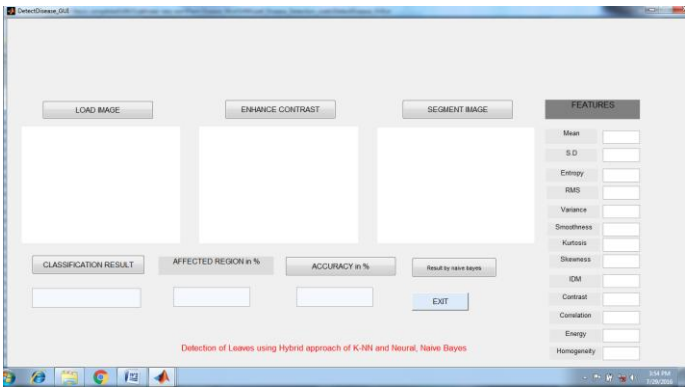

Figure 1.4: Input User interface

Figure 1.4, shows the output window as GUI part in which we select first leaf image by selecting Laod Image button and then another buttons are there for performing functions to detect leafs disease.

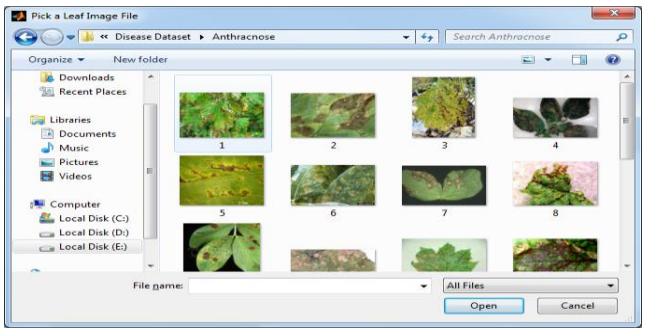

Figure 1.5: Leaf Browsing Window for selecting Leaf

Figure 1.5, shows the window for browsing leaf image, after selecting button Load image.

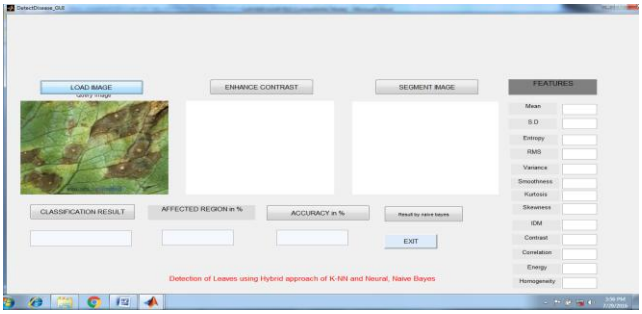

Figure 1.6: Original image on User Interface

Above, figure 1.6, shows the original image of leaf which we have selected for detecting disease.

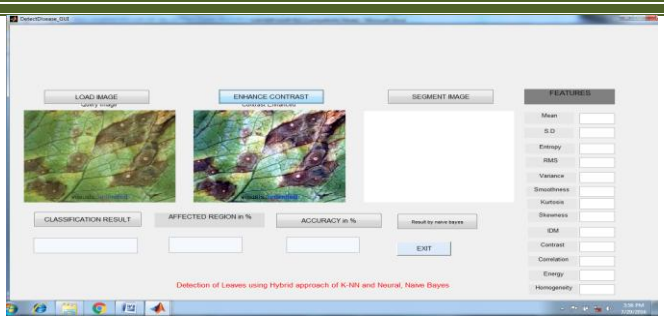

Figure 1.7: Enhanced Image of Original on User Interface

Figure 1.7, shows the Enhanced image of original image after clicking on button Enhanced Contrast of original image. Enhancing of an image is done for feature extraction.

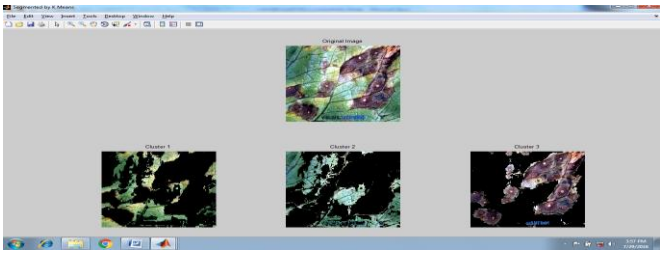

Figure 1.8: K-mean Segmentation of Original image on User Interface

Above, figure 1.8, shows the output image as K-mean segmentation done with cluster classification up to 3 is shown by selecting button segmentation. Here, actually images through K-mean i.e K-NN is used for clustering the images into different cluster level and shows the images.

After that a small dialog box appears in which it will ask the number for classification with neural network and Naïve Bayes to get the accuracy and result for disease classification or the area of leaf which is affected by name of the diease is identified.

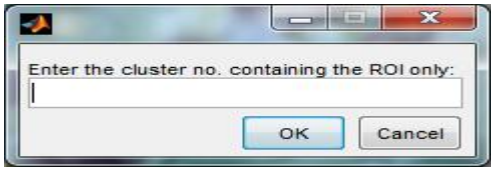

Figure 1.9: Clusterting number entered for identifying disease type and accuracy

Figure 1.9, shows the dialog box for entering clustering number after segmentation for getting out accuracy and identified the disease type which had affected on leaf.

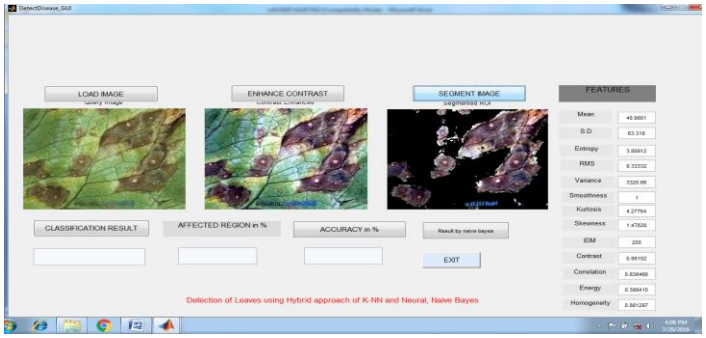

Figure 1.10: Result of clustering with segmented Image

Above Figure 1.10, the segmented through K-NN clustering as entered iin the dialog box shown in figure 1.9. after segmention and feature clasification result in name of disease type and affected region is calculated. Figure 1.11, shows the name of disease in dialog box below.

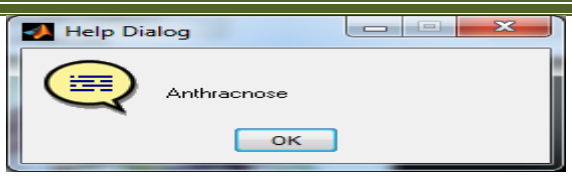

Figure 1.11: Dialog box showing name of disease type

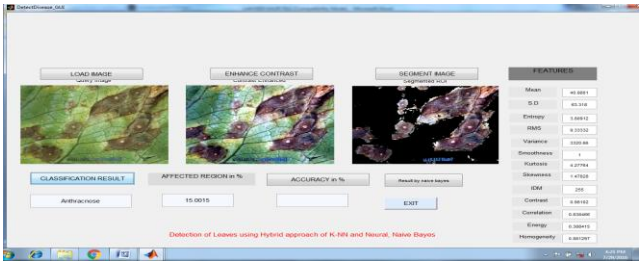

Figure 1.12: Result of Classification of disease type and affected region

Figure 1.12 above shows the result of affected region of leaf part in percentage (%). And the name of disease type from which the selected leaf is affected.

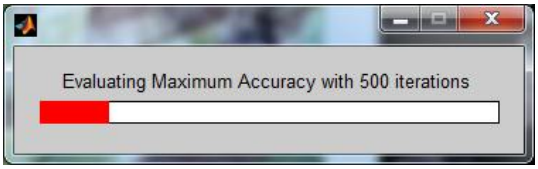

Figure1.13: Calculating accuracy through Neural Network.

Figure 1.13, above shows the accuraaacy rate of plant detection using neural network classifier with the iteration of 500. Accuracy result will be display on when button named Accuracy in % is clicked. Result will be shown in percentage(%) in figure 1.14 below.

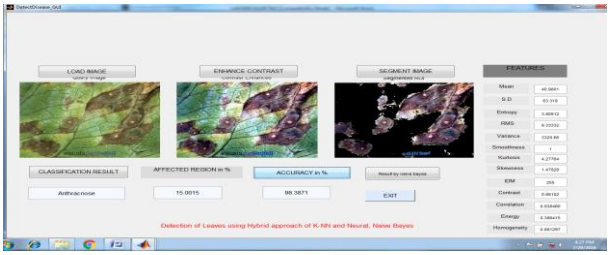

Figure 5.14: Neural network Accuracy Result

Figure 1.14, below shows the graphical representation means through graph expaling about the Naive bayes with fuzzy system as showing accuracy of leaf diseases in percentage and grading point. Naive bayes is also a classifier which is used for testing the training datasets like neural network . there is difference only in their approaching ways and how does the data is selectted and defined.

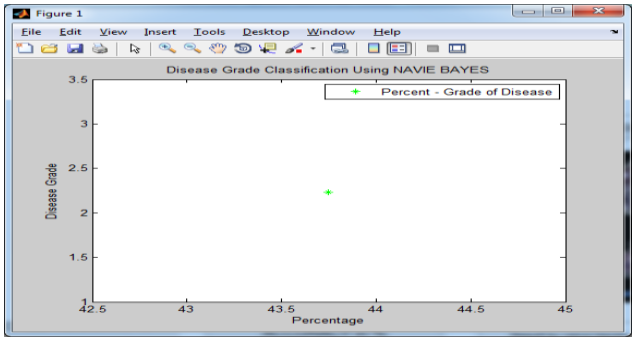

Figure 1.15: Naive Bayes Result of Accuracy

Figure 1.15, shows the grading and percentage of Accuracy that had infected the leaf and disease has been affected on leaf. X-axis shows the percentage from 1 to 100 and at Y-axis shows the Grade of Disease 0 to 5.

VI. DISCUSSION

The above GUI part can be solved for any type of leaf which is infected by any type of disease. Leaves are detected from virus which infected the leaf of plants. İn this, we use to firstly take an image from images database of leaf, then feature extraction is done by enhancng the image of selceted leaf and binary calculation is calculated. Segmentation is done on the binary means the enhanced image using different types of clustering range 1 to 3. Then at last we use to find out classification of leaf disease types and its affected region of selected leaf. At last we can save this image and gets percentage as accuarcy of affectec part through Neurl Network and Naive Bayes classifiers.

Table 5.1: Result of Accuracy through our Proposed Methods as Comparison

Image or Disease Type	Name of Segmentation on 2 type Clustering	Neural Network Accuracy of affected part	Naive Bayes Accuracy of affected part
	Alternaria Alternata	15.0112	10.9
	Anthracnose	15.7195	41
	Bacterial Blight	15.0061	49.4
	Cercospora Leaf Spot	15.4235	37.4
	Healthy Leaf	95.1613	47.4

VII. CONCLUSION

Plants play an important role in our lives, without plants there will not be the existence of the ecology of the earth. The large amount of leaf types now makes the human being in a front of some problems in the specification of the use of plants, the first need to know the use of a plant is the identification of the plant leaf. This work proposed a comparison of supervised classification of plant leaves, where we used to represent species in seven different representations, using three features extracted from binary masks of these leaves: a finescale margin feature histogram, by a Centroid Contour Distance Curve shape signature, and by an interior texture feature histogram. Results were very interesting in a way that gives as clear ideas: In term of representation: we can differentiate leaves by its margin better than shape or texture, but, experiments shown in this study prove our idea: the more we combine these features, the more precise the difference between samples is and that is what gives better results in classification. In term of classification: distance based algorithms give the best result for plant leaves classification. So, we can conclude that these algorithms are the most suitable for that task. On the other hand, the approach based on decision tree gives the worst results because of the

overfitting problem. In general, a learning algorithm is said to overfit relative to a simpler one if it is more accurate in fitting known data but less accurate in predicting new data. Use of the three features proved that there is some information more important than other. We discovered that margin representation can affect results more than the shape of the leaf. However, the combination of the three features gives the best result. In our algorithm, an enhancement on different methods such as K^{th}-Nearest Neighbor with Neural Network and Naive Bayes are compared and hybrid in classification of image analysis to improve grading and accuracy of result. So, the post-processing of leafs are the detection of visual defects in order to classify the infected part depending on their appearance. Also we can detect the disease type from our model.

VIII. FUTURE SCOPE

We can further study, in the research that can be extended on the different types of leaves and plants variety. Even this work can be done on fruits and vegetables quality detecting. To solve this problem, we plan, as future work, use of feature extraction algorithms, like PSO, to clean dataset and keep the important information in order to optimize the obtained results and avoid overfitting problem posed by decision tree algorithm. We plan also to use bio-inspired algorithms. They are part of a new research domain that is becoming more important due to its results in different areas.

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