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PLANT DISEASE CLASSIFICATION WITH KNN-SVM CLASSIFICATION

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Abstract— *The plants can suffer from various diseases such as little leaf in pine tree. The tree affected by disease is generally under development and dies earlier within 6 years. The effected of little leaf have been seen in Albama, Georgia and some other parts of Southern United State. Therefore the earlier recognition of disease in plants can be fruitful. This can be accomplished with continues monitoring of plant by experts and it requires high cost in case with large farms. This study developed a KNN-SVM based plant disease recognition system by using the process of feature extraction with the help of Color ,Shape and Gabor filter feature extraction model , clustering by applying KNN and SVM based classification. It is evaluated that the MSE and accuracy level of proposed work is better than the traditional classification tree method.*

Keywords—*Plant Disease Recognition, Feature Extraction, K-Nearest Neighbor, Support Vector Machine.*

I. INTRODUCTION

Pathogens are the agents that are responsible for causing diseases in plants. These pathogens or pests can be present on leaves or stems of the plant. Symptoms of such disease indicate the existence of some kind of disorder or disease that affects the plant [1]. Therefore identification of such symptoms and pests on leaves or stems is a concern in achieving successful cultivation of healthy crops. The percentage of pests present and the level of disease penetration in a plant are calculated and tracked. Such plant disease causes a loss of several billion dollars annually in crop cultivation [2]. Some of the plant diseases that are caused huge economic losses are mentioned below:

a. **Late blight of potato:** In 1845-1847, this plant disease caused death of nearly 1.5 million people who suffered starvation and 1.5 million were forced to emigrate from Ireland to other parts of the World [3]. Figure 1(a) below shows a potato leaf affected by late blight.
b. **Canker:** Canker is a serious plant disease that is very commonly in citrus plants that are found in Florida, Georgia, Alabama, Louisiana, South Carolina, Texas, Brazil and Mississippi. Since 1915, many disease eradication programs have been initiated in various parts of World in order to achieve disease free plants. Studies show that from 1999 to 2008 eradication of nearly 2,327,772 plants was carried out in different citrus nurseries [4]. Elimination of diseased plants and infected trees cost more than US$ 16 million over past decade but plants in certain parts of United States are still suffering from this disease. Plants are commonly infected by the pests present on their leaves or stems which can be checked if few traits like pests, symptoms are quantified and observed precisely. The visual identification of pests that are present on leaves or stems is a complex task due to presence of several visual patterns. This problem can be solved by using few particular image pattern understanding techniques [5]. During a single experiment with a plant number of images can be generated which are necessarily required to classify lesions, scoring quantitative traits, calculating area infected by insects, etc. These plant images are monitored manually or specific software is used to serve the purpose. The task becomes relatively more complex as each individual leads to new distinct subjects which cause excessive processing time [6]. To simply the task plant biologists use high performance software which is capable of extracting and analyzing the significant information only from the content that is collected during experiments by using image processing techniques. Figure below 1(b) shows the top and bottom view of leaves that are infected by canker.

(a) (b)

Figure 1 (a) Potato leaf affected by late blight (b) Leaf symptoms of canker on top and bottom leaves

II. PROBLEM FORMULATION

In the previous techniques, image has captured through the digital camera on which different operations like image segmentation, Color, Shape and Texture Features has extracted and then classification has performed using classification tree. The main problem with previous techniques was that it has used color, shape and texture features to extract the features from the image. And sometimes the acquisition image or captured image may be vague which leads to the variations in the extracted features. Secondly, for the testing purpose, classification tree has used where all the values are defined based on the threshold at every level. Thus, to maintain, define or analyze the whole tree to make an efficient decision is a complex task. Correspondingly, there is a need to be proposed a technique which can efficiently extract the features appropriately and can perform classification automatically.

III. PROPOSED WORK

As in the existing technique, feature extraction through texture is complex when the image is vague. Thus, in the proposed work, feature extraction method has updated by replacing the color, shape and texture features through color, shape and Gabor based feature extraction. Proposed technique can extract the features in an efficient manner using Gabor feature extraction technique as compared to the texture features in the traditional method. Secondly defined problem in the traditional techniques was the use of the classification tree. So in the proposed technique, it has replaced with the KNN based clustering technique and SVM as a classifier to classify and recognition. KNN will help in collaboration and reduce the data count which will be easy for the classifier i.e. SVM to classify the plant.
The methodology of the proposed model is as follows:

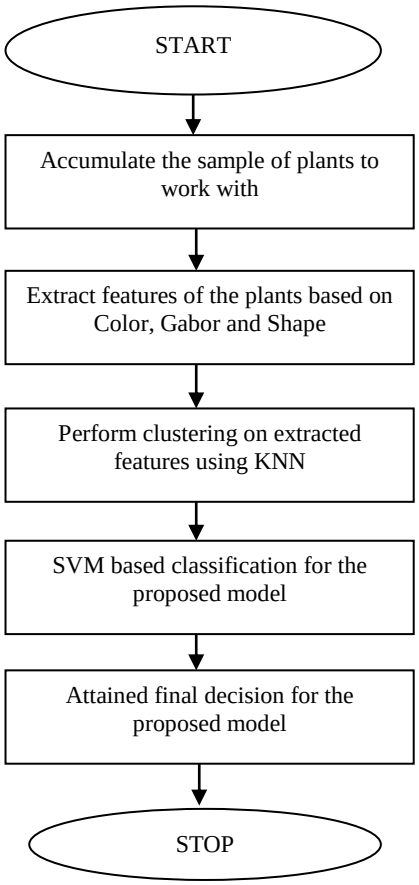

Figure 2 Block Diagram of proposed work

1. The first step is to collect the dataset on which work is to be done for the matching purpose.
2. Second step is to extract the features for the selected sample on basis of below written feature models
    a. Color
    b. Shape
    c. Gabor filter feature extraction
3. Next step is to clustered the extracted feature of the proposed model this will be done by using the KNN clustering technique

4. After all the clustering and the feature extraction classification is to be some which is the major section of the proposed model for the in the proposed model an SVM based classifier will be used to get the final decisions for the proposed work.

IV. RESULTS

The experimental analysis has performed using the proposed work and the acquired results are shown in this section. The performance of the proposed model has been evaluated using MSE i.e. Mean Square Error. The degradation level of the proposed technique can be evaluated using this parameter. The value of MSE signifies the level of acceptance of minimum error in the system.

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - K(i,j)]^2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

The acquired results are shown as:

The figure 3 depicts the Gabor sampling of proposed technique. Initially, sample 1 plant image suffering from a disease. Then, the layers of the sample image are separated into three parts such as Red, Blue and Green. The position where the respective color is more that portion will be whiter or the intensity of white color will be more at that part as shown in the below figure. In addition to separation of layers, Gabor features are also extracted. Likewise, sample 2 and sample 3 are also used for extraction of features in figure 4 and 5 respectively.

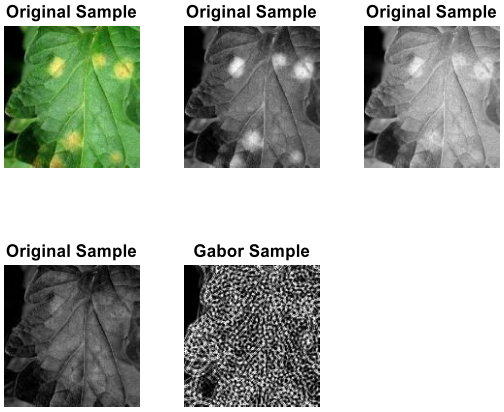

Figure 3 Gabor features of sample 1 using proposed technique

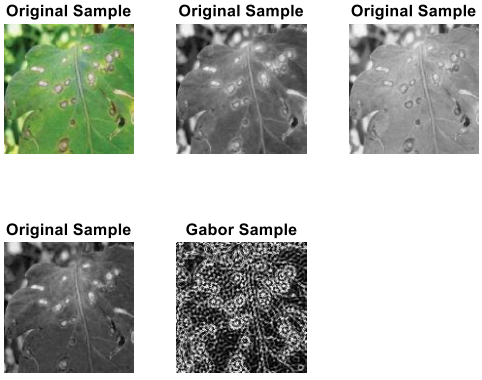

Figure 4 Gabor features of sample 2 using proposed technique

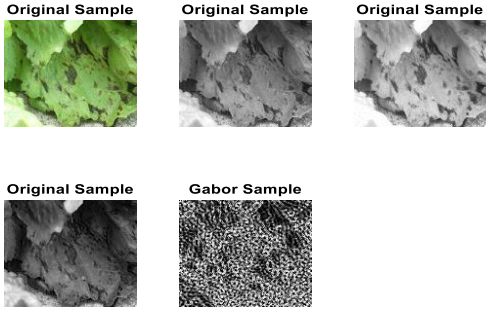

Figure 5 Gabor features of sample 3 using proposed technique

The figure 6 elaborates MSE performance parameter of traditional technique. This value should be least to confirm the level of error in the system. The amount of error in the traditional technique is shown in the below figure. The value

reaches at 0.3077 which concludes that traditional system contains error and cannot detect the plant suffering from disease. The calibration of data is done with the help of classifier.

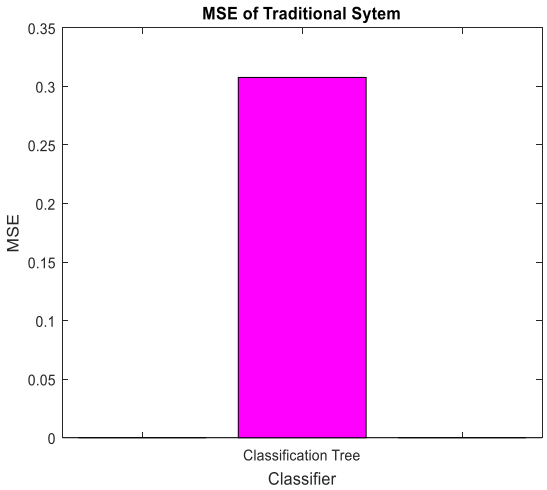

Figure 6 MSE performance parameter of traditional model

The figure 7 shows the accuracy percentage of the traditional system. The accuracy percentage of the system concludes the efficiency which means that how much efficient a system is in identifying the plant suffering from a disease. The figure below concludes actual percentage which is 92.3077%.

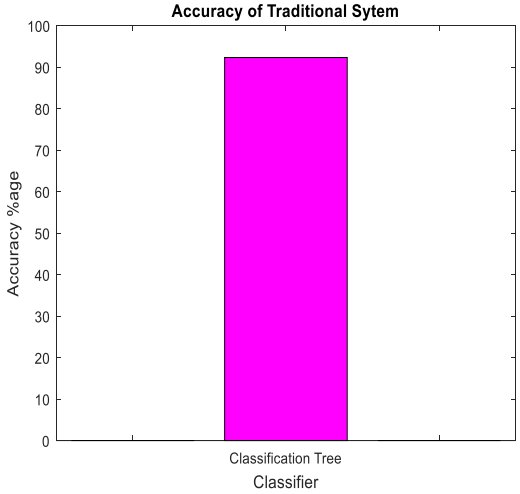

Figure 7 Accuracy acquired from traditional model

The figure 8 and 9 shows MSE and accuracy percentage of the proposed technique. The MSE of the proposed technique is 0.0192 which is quite lesser than the error in the traditional technique. The proposed technique utilizes the KNN-SVM classifier for the classification purpose and the results acquired from the proposed techniques has been concluded its efficiency.

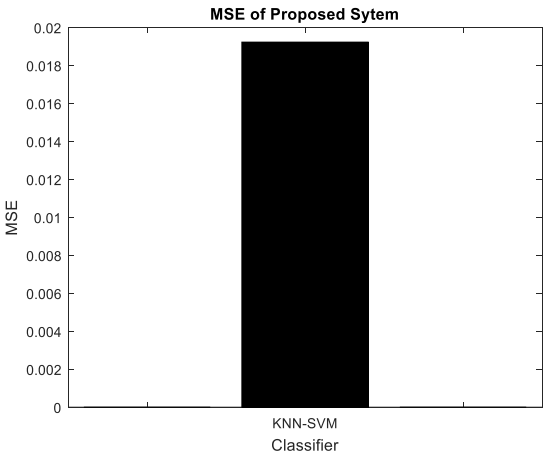

Figure 8 MSE performance parameter of proposed technique

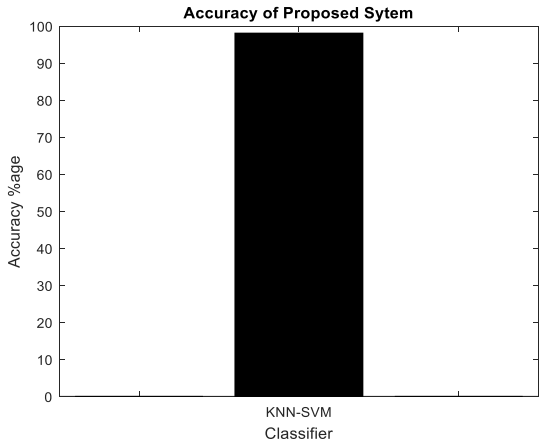

Figure 9 Accuracy of proposed system

The figure 9 shows the accuracy percentage acquired from the proposed technique. The proposed technique accuracy is 98.0769% which concludes its effectiveness in detecting disease of a plant.

In order to confirm the effectiveness of the proposed technique, it is required to compare the proposed work with the existing work in terms of different performance parameters such as accuracy and Mean Square error. The figure 10 below represents the comparison between traditional and proposed technique in terms of MSE. The proposed technique make use of KNN-SVM classifier whereas the traditional technique Classification tree. From the results attained, it has been concluded that proposed technique outperformed the traditional technique as MSE in the proposed work is less in comparison with the traditional work. The MSE of traditional and proposed technique is 0.3077 and 0.0192 respectively. Consequently, the error rate in proposed technique is not as much of traditional technique.

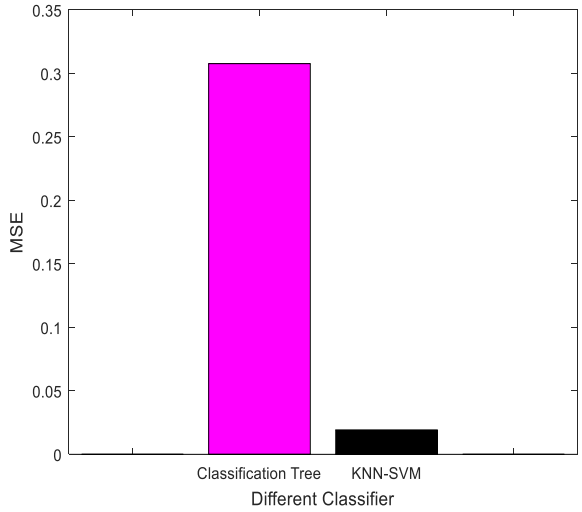

Figure 10 Comparison of traditional and proposed technique with respect to MSE

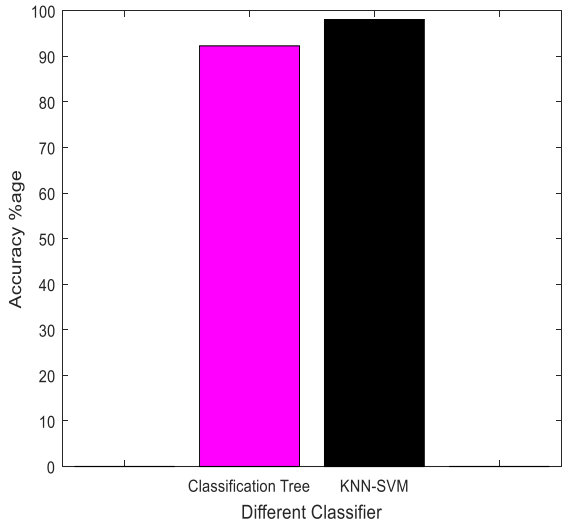

Figure 11 Comparison of traditional and proposed technique with respect to Accuracy

As the comparison has performed using traditional and proposed technique in terms of MSE, so the accuracy percentage is also attained in the figure 11. The attained accuracy of the system concludes how efficient a system is. In the traditional technique, Classification tree has used whereas KNN-SVM classifier has been employed in the proposed technique. The application of both techniques is implicated in this work and accuracy is obtained. The accuracy percentage of the proposed and traditional technique is 98.0769% and 92.3077% respectively. Consequently, proposed technique surpasses the existing classification technique and concludes proficient results which mean that proposed technique is more accurate in detecting the plant suffering from disease.

V. CONCLUSION

The detection as well as classification of plant disease in an accurate manner is quite important for successful cultivation of crops and the method followed for the same is image processing. The images of infected plants have been taken for the evolution of whether the plant is suffering from a disease or not. Considering this fact, this work has proposed a system developed using MATLAB software. Initially all the infected leaf images samples is forwarded to attain Gabor samples and from there, the classification is performed using KNN-SVM classifier. The proposed technique acquires high accuracy rate and less computational cost in comparison with traditional Classification tree technique. In order to conclude the efficiency of the proposed technique, a comparison has performed with the traditional technique in terms of MSE and Accuracy percentage. The results attained confirm that proposed technique surpasses the traditional technique as 6% improvement in accuracy percentage and less error in the proposed work. The MSE of traditional and proposed technique is 0.3077 and 0.0192 respectively which means that error rate has reduced and Accuracy is 98.0769% and 92.3077% respectively which shows improvement in the efficiency. Accordingly, the proposed technique performs competently in terms of detecting a disease in plants images.

In future more enhancements can be done by replacing the KNN clustering mechanism with advanced clustering mechanism such as Fuzzy C-Mean Clustering. More amendments can also be done by using the optimization technique to optimize the SVM classification mechanism.

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