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AN EFFICIENT IDENTIFICATION AND DETECTION OF PLANT LEAF DISEASES USING REGION-BASED THRESHOLDING ALGORITHM

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Abstract— Now a days Agricultural activities are reducing due to more diseases effected to crops and plant leaves. This may affect the national economy as well as the life of population among the countries leading to food shortage. In order to maintain the economy of country and balanced life of population agriculture plays an important role. To improve the agriculture we need detect the diseases as early as possible and have to know about the solution for them which will increase the yield and quantity of the crops. This will increases the economy of nation and removes the food shortage. In this, detection and identification plant leaf diseases in early stage more accurately and efficiently in two phases like training/learning phase and testing phase using region based thresholding segmentation process (hybrid method) and SVM as a classifier to detect healthy and unhealthy plant leaves.
Keywords—masking, feature extraction, segmentation, pre-processing, GLCM, green pixels.

I. LITERATURE SURVEY

Multi K. Singh, Subrat Chetla and Malti Kri Singh proposed the detection and classification plant leaf diseases by using K-means clustering segmentation techniques and BPNN as a classifier [11]. In this they have used Beans and tea leaves and mainly they have classified the fungal diseases. In this they have used morphological operations to pre-processed digital image.

According to [12] the plant leaf diseases are detected and classified by using image segmentation and soft computing techniques. In this, genetic algorithm is used for detection and classification; involves the k-means clustering technique and minimum distance criterion is used for segmentation and SVM as classifier. They have used the banana, beans, jackfruit, lemon, mango, potato, tomato and sapota leaves for detection and classification. The

combination of k-means clustering (genetic algorithm) and SVM has the accuracy of 95.71%.

According to [13] classification of plant leaf disease is done by a nine layer deep conventional neural network. In this, PCA(Principal component analysis), image flipping, gamma correction, noise injection,, rotation and scaling is used as data augmentations for segmentation and classification of diseases. Totally they used around 61,486 data set which includes the plant leafs like apple, grape, tomato, cherry, potato, soybean, peach, blueberry. This has an accuracy upto 96.46%.

According to [14] detection and classification of leaf disease has done by optimized fuzzy interface system (OFIS) algorithm. In this paddy leaf diseases are classified by OFIS optimized by VSSFA (variable step size firefly algorithm). OFIS is used for segmentation and classification of plant leaf diseases. This system has an accuracy of 95%.

According to [15] tomato leaf disease is detected and classified using CNN and LVQ (Learning vector quantization) algorithm accurately. In this, totally 500 images is used for testing (100 images) and training (400 images); these images are cropped to size 512X512 size. And they have classified the fallowing disease like bacterial spot, late blight, septeria leaf spot, and yellow leaf curl [16].

According to [17] plant leaf disease are detected and classified using k-means clustering and ANN. In this, k-means clustering is used for image segmentation and ANN are used for classification. Mainly in this the feature extraction done by SGDM matrix and co-Occurance matrix. This system classified early scorch, cotton mold, ashen mold, tiny whiteness disease efficiently.

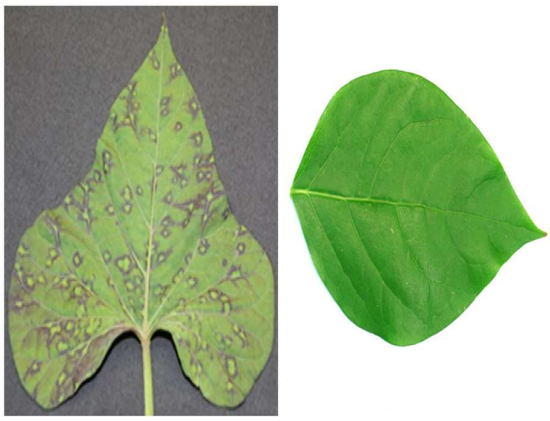
II. INTRODUCTION

India is the top country has the more agricultural activities in the world. More than 80% of the population in the nation is depend on the agriculture. If production of crops quality and quantity reduced then it directly effect on the people leads to shortage food and economic growth of the nation. To overcome these problems we need to detect the plant diseases (viral, bacterial, fungal, etc.) in earlier stage of the crops. This increases the production quantity and quality of crops.

In this detection and identification of plant leaves is done in the beginning stage. It detect and identify the diseases like viral diseases, bacterial diseases, fungous diseases, etc. in two phases. Firstly the system undergoes the training/learning phase and the system detect the image as healthy or unhealthy images using classifier. Both phases includes the common process are as follows:

i) Loading image
ii) Image pre-processing
iii) Image acquisition
iv) Image segmentation
v) Masking the pixels
vi) Extracting the features (entropy, energy, homogeneity, etc.)

vii) Classification and detect the healthy or unhealthy images shown in figure 1.



a) b)

Figure 1. a) Healthy leaf b) unhealthy leaf

Some of the plant diseases can also detect by seeing bare eyes on field from the farmer using his knowledge. But this is not good for all time so they need one tool to detect the plant diseases in early stage. In this, we consider the fallowing plant leaf diseases[1]:

Table 1. Types of plant diseases

Bacterial diseases	Viral disease	Fungal diseases
Bacterial tilt, blight	Mosic, verticilliaum	Fungal leaf spot
Crown gall	Leaf crumple	Anthcrnose
Lint deraclatias	Leaf roll, leaf curl	Rust, wilts
Bacterial brown spot	Distortion	Crankers, rots
Soft spot	Dwarfing	Mildew
	Mottling	Molds

In this we collected the fallowing plant leafs

Table 2. Different types of plant leafs

Plant name	Numbers of samples
Tomato	35
Strawberry	10
Sapota	05
Mango	16
Lemon	11
Beans	13
Banana	12
Apple	12
Healthy plant leaf images	34

III. PROPOSED WORK

Figure 2. Shows that the proposed methodology which has two phases.

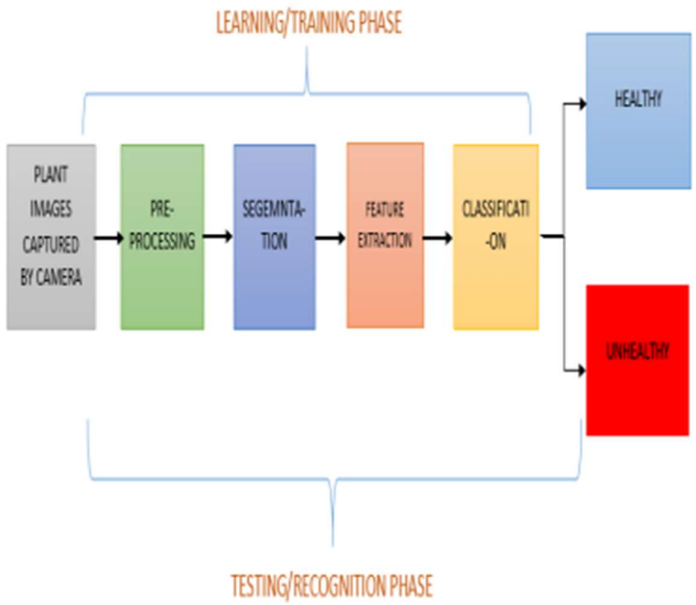


Figure 2. Proposed methodology

i) Training/learning phase: in this phase the SVM classifier is trained for different types of the plant leaf diseases. Firstly already tested standard images are used for training. In this image is first pre-processed by basic image processing techniques then pre-processed image is segmented using region-based thresholding segmentation technique. After segmentation the segmented images is masked and the features are extracted by using YCbCr[10] and GLCM. Finally the image is classified as healthy or unhealthy images using SVM classifier including knowledge base.

ii) Testing/recognition phase: In this phase image is classified and tested for healthy and unhealthy plant leaf images using knowledge based of camera captured images fallowing same steps in the learning/training phase.

Both phases of system consist the following steps:

i) Loading image (captured by camera)
ii) Image pre-processing and acquisition
iii) Image segmentation using hybrid method using region-based thresholding method
iv) Masking the green pixels
v) Extracting the features (entropy, energy, homogeneity, etc.) using GLCM
vi) Classification and detect the healthy or unhealthy images as shown in figure 1. Using SVM as classifier.

a) Image pre-processing and acquisition: In this, if image is color image then image is converted into grayscale image using rgb2gray command in matlab and if image size is larger then it conerted to 256x256 image matrix. Lastly the image intesity adjusted using histogram equalisation or other basic imge processing techniques.

b) Image segmentation: image segmentation is defined as dividing image into smaller parts depending on the grouping of similer components such as pixels in images , frames in video. In this we used region-based thresholding segmentation technique.

Region-based thresholding is the combination of region based segmentation and thresholding segmentation technique. The image segmentation is done from the fallowing steps

shown in figure 3.

1. Take the image
2. Consider the region of interest(ROI)[6] and check the similarity conditions will satisfy the pixels ; if yes, then consider the entire rgion as an area of interest else divide the area of interest.
3. Repeat the step two untill to get exact region
4. Select the initial threshold value (T) then divide the image pixels into two groups as group 1 consists the pixels which have the intesity less than T and group 2 consist the pixels have intesity greater than T.
5. Find the mean value of the both groups and find the new threshold value using

$T = ½ (\mu 1 + \mu 2)$

6. Repeat the steps 4 and 5 untill differences in T is smaller than intial value T(T0).

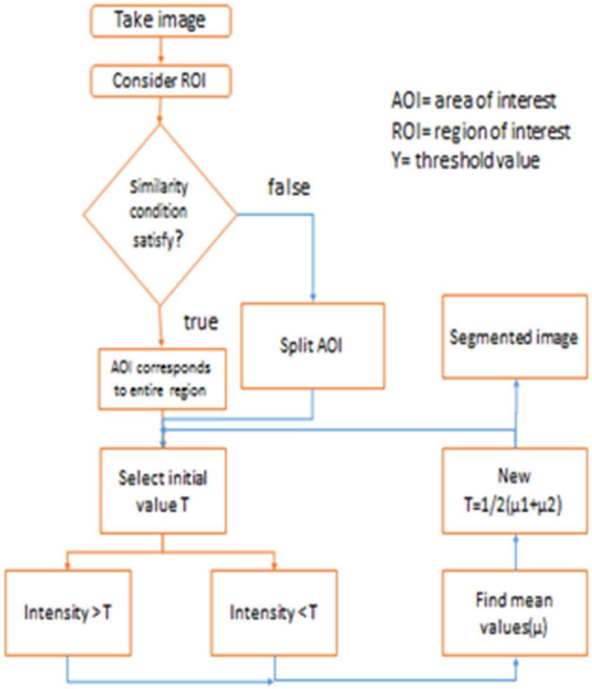


Figure 3. Segmentation process.

c) Masking the green pixels: masking is done only for green pixels because these green pixels region is healthy region. It hasa done by selecting threshold value to compare the all pixels. If threshold value is less than the pixel intensity value then that pixels are set to 0 (black color) (healthy leaf) shown in figure 5. and pixel intesity value is greater than the threshold vlaue the thant picels are set to 1 (white color)(diseased leaf) shown in figure 6. This masking will increases the efficiancy to detect defected or unhealthy regions by masking[8] or removing healthy region from the leaf.

Figure 4. shows the example for color transformation, masking and segmented image.

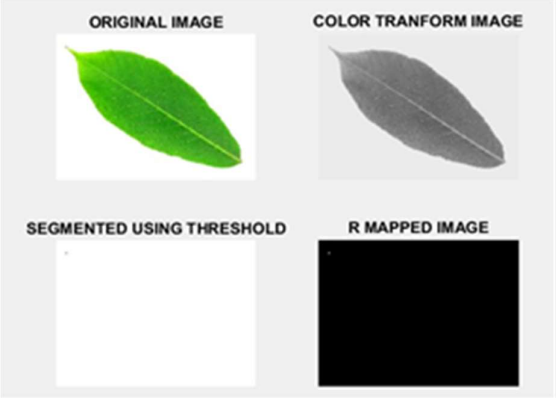


Figure 4.example for masking and segmentation

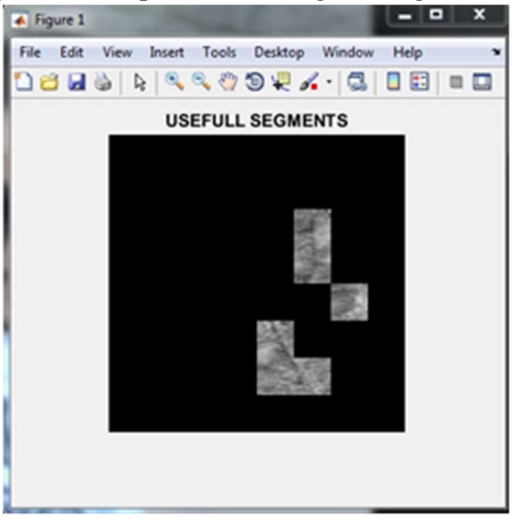


Figure 5. Masking of unhealthy leaf region

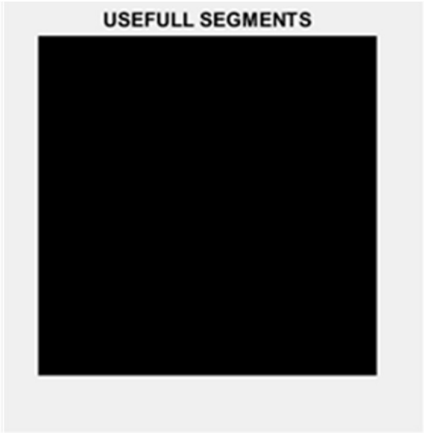


Figure 6. Masking of healthy leaf regions

d) Feature extraction : It is done by the GLCM[2] matrix for segmented image measured in 00 , 450, 900 and 1350angles. Extracting the features play an important role to identifying the objects in region of interest. In this we are calculated the energy, entropy, homogenity variance, contrast, correlation.[3][4].

e) Classification : classififcation is done by the SVM(support vector machine)[5] classifier. It classify the images into healthy or unhealthy plant leafs depending on the calculated features.

IV. RESULTS AND DISCUSSIONS

For detection and identification of plant leaf disease we consider the diseases which are shown in table 1. And collected totally 148 images; in this 34 are healthy and 114 are unhealthy plant leafs. Figure 7, figure 8 and figure 9 show the segmented and color transformed image, detecting and identification of healthy or unhealthy images and identification of images using SVM classifier respectively.

We used the combination of healthy and unhealthy plant leaves to check the efficiency and accuracy of the methodology which is shown in the below table 3. Figure 10 shows that the incorrectly detected images.

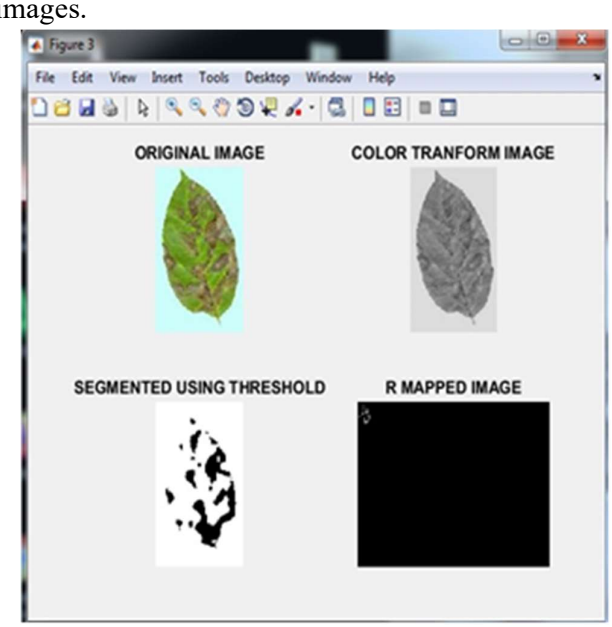


Figure 7. Segmented, color transformed (pre-processed) and masked images

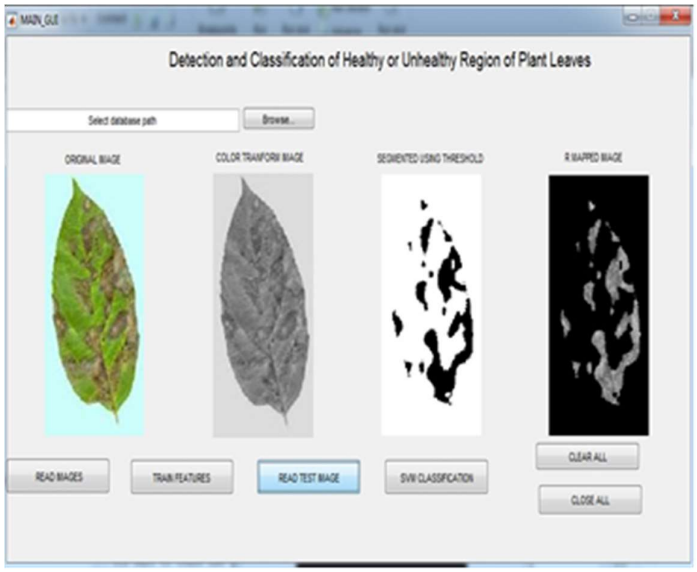


Figure 8. GUI interface for detection and identification

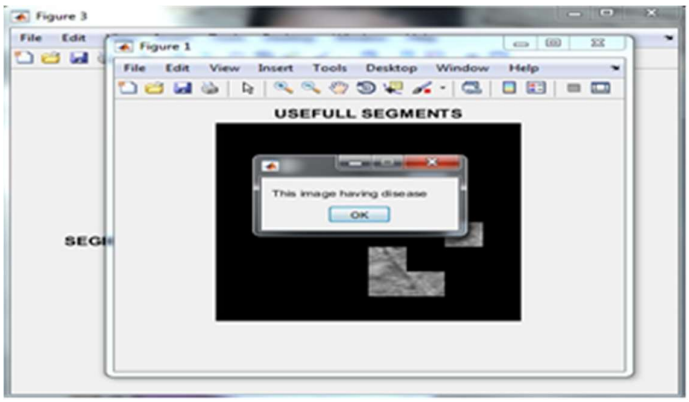


Figure 9. Detecting the healthy or unhealthy images window.

Table 3. Testing the samples.

Name	Samples	Unhealthy samples	Healthy samples	Correctly detected samples	Incorrectly detected samples	Accuracy (%)
Tomato	69	35	34	66	3	95.65
Strawberry	40	10	30	40	0	100
Sapota	35	5	30	31	4	97.14
Mango	41	16	25	38	3	92.68
Lemon	45	14	34	41	4	91.11
Beans	43	13	30	39	4	90.69
Apple	46	12	34	43	3	93.47
Banana	32	12	20	28	4	87.5

Average = 93.53%

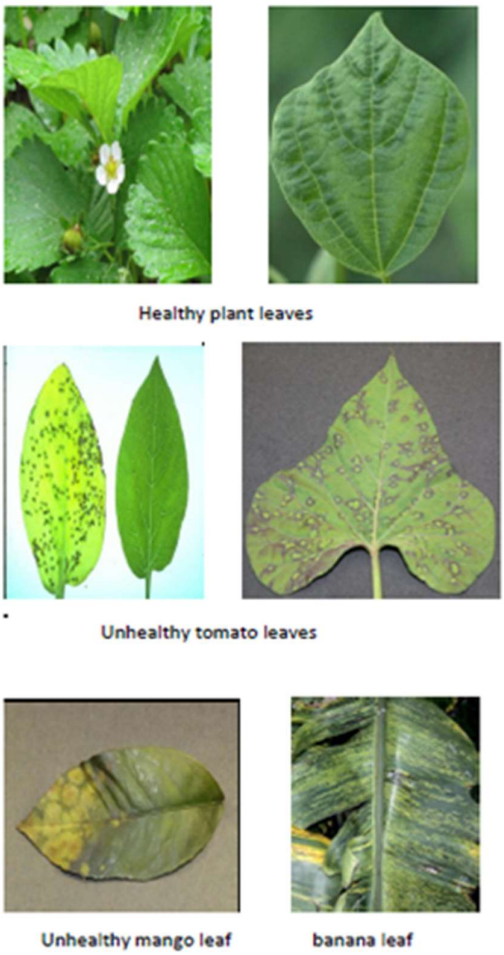


Figure 10. Incorrectly detected samples

These incorrectly samples are not detect correctly due to the masking and one of the disadvantage of the SVM classifier. This will overcome by using deep learning and machine learning [7].

V. CONCLUSION

This system efficiently detect and identify the plant leaf diseases using region-based thresholding segmentation and SVM classifier. And masking of green pixels increases the efficiency and accuracy of the system. This system detect and identify the plant leaf images with 93.53% of accuracy. This proposed algorithm is tested for prescribed plant leafs which are listed in the above table 2. And diseases listed in table 1.

VI. FUTURE SCOPE

This algorithm can be implemented using different types of segmentations like hybrid methods and ANN as classifier which is combination of PNN and SVM which will classify the images more accurately. And finally creating an android application to detect the images in the land which will help to farmers in early stage.

A. Abbreviations and Acronyms

ROI: - Region Of Interest

AOI: - Area Of Interest
GLCM: - Gray Level Co-Occurance Matrix
SVM: - Support Vector Method
ANN: - Artificial Neural Network
PNN: - Probabilistic Neural Network
YCbCr: - Y-component, Chrominance-blue,
Chrominance-red
GUI :- Graphical User Interface.

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