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Automatic Detection and Classification of Brinjal Leaf DiseaSES

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Abstract*: The diseases in the Brinjal can be identified through the symptoms occur in Brinjal leaf. The indication in touch difference bin of various plant diseases. The designation of disease detection need the specialist's opinion. The inappropriate identification can result in tremendous quantity of economic loss for farmers. Rather than manual identification, computers are accustomed to give automatic detection and classifying differing kinds of diseases. In this paper, lesion areas affected by diseases are segmented using different techniques, namely DeltaE, Otsu, FCM, k-means algorithm are employed. The proposed method is the image blend by discrete wavelet transforms to increase the excellence of image and reduce uncertainty and redundancy for identification and assessment of agricultural yield which can be done by DeltaE. Further color, texture and structural based features are mixed collectively for getting better performance when compared with single feature extraction.

***Keywords* :Wavelet Transform, DeltaE, FCM, Segmentation**

I. INTRODUCTION

Research says that excellence of cultivated crops is decreased by plant diseases. The study of vegetal syndrome caused by infectious organism is known as plant pathology. The variations of diseases are found in the brinjal leaves based on the symptoms occur in the leaves. The brinjal leaves can be classified as normal leaf, Infectious leaf, Alternaria leaf spot (*Alternoria Melongenea*), and Tobacco mosaic virus (TMV).The disease in the leaf can be detected using k- means clustering and artificial neural network(ANN) and is used for the effective recognition of leaf disease [1]. Using GLCM method the texture features are extracted, and it is given to the ANN [2]. Local Gray Gabor Pattern (LGGP) is obtained by combining LBP and Gabor[3],efficiency obtained by this method is more than 80% . SVM and ANN classifiers are used and SVM has proven to be applicable for the recognition and categorization of plant related problem which reduce agricultural harvests [4].To characterize the leaves Fuzzy logic is used and 99% of accuracy is proved [5]. SVM and neural network classifiers give better accuracy in the detection of plant disease [6]. Segmentation is done by HSV and Multilayer Perception (MLP). Radial Basis Function (RBF) classifiers are used and the comparison between PLP and RBF is done to get better accuracy [7]. Fuzzy logic and Probabilistic Neural Network (PNN) is developed to extract and categorize the problem using PNN and the precision obtained is 91.46% [8]. For training and testing BPNN multilayer, k-Nearest Neighbor (k-NN) classifiers are used [9].Otsu Thresholding based segmentation is done to form the binary mask in the affected region. The efficiency in this method is about 94% [10]. To segment the images into clusters, k-means algorithm is developed. Hill Climbing algorithm provides the parameters for deciding on the number of clusters[11].

An efficient system is developed to increase the quality of image and diminish uncertainty and redundancy.

II. PROPOSED TECHNIQUE

For the proposed method, images were collected using camera and data bases. The database has 500 leaf images. 400 leaves were affected by infection and 100 leaves were normal. Figure.1. shows the complete flow representation of the proposed system.

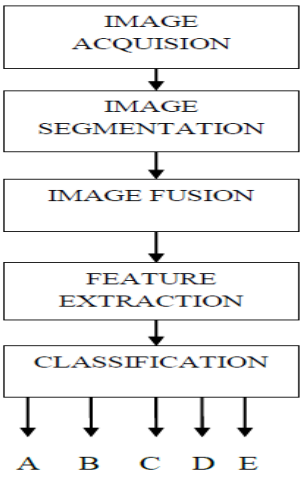

Figure.1 Flow representation of proposed method: A - Normal image, B - Pseudomonas solanacearum C - Cercospora solani D - Alternoria Melongenea E - Tobacco mosaic virus.

2.1. IMAGE ACQUISITION

The brinjal leaf images are taken directly from the agricultural field by high quality camera. As the images are physically captured from quite a few open farms, most of the captured images have many leaf image in the agricultural field. So the leaves are crops from the collected images. The standard JPEG format is used to store these images. Figure 2 represents the original image.

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Figure2. Original Image

2.2. IMAGE PRE-PROCESSING

The standard JPEG stored image is resized.with the dimension ofe of 256 * 256 pixels. For making a more effective image in reducingdistortions and enhancing its features Image pre-processing techniques are applied. Itcomprises image enhancementand color space transformation.

2.3. DELTA E

Delta E (DE) is an algorithm [12]based on color used for the segmentation of images by calculating the distance between color. Symptoms of an image are accumulated as a model and the superior image is segmented by using tolerance adjacent to the model and energy difference. The color difference E between a⁄ b⁄ two colors with respect to its L⁄, a⁄, b⁄ component values is calculated by Equation. (1)

$$\Delta E = \sqrt{(L'_1 - L'_r) + (a'_1 - a'_r) + (b'_1 - b'_r)} \quad (1)$$

Where

$$\Delta L' = L'_1 - L'_r \quad (2)$$

$$\Delta a' = a_1' - a'_r \quad (3)$$

$$\Delta b' = b_1' - b'_r \quad (4)$$

Here L'_1, $\Delta a'$ and $\Delta b'$ represents the 3 channels of input the image L'_r, a'_r and b'_r are denotes as LAB color space. $\Delta L'$ is the lightness variation. $\Delta a'$ is the variation among red and green and the $\Delta b'$ is the variation among yellow and blue. The T represents the threshold value that is calculatedby ΔE. The binary image I_b is determined by using the threshold on Input I_{in} as given below.

$$I_b = \begin{cases} 1, & if\ I_{in} \le T \\ 0, & otherwise \end{cases} \quad (5)$$

2.4. IMAGE FUSION USING WAVELET TRANSFORM

The tool to identify local features in an image processing and to decompose two dimensional (2D) image into multiresolution levels for analysis. This technique has been very much useful in applications in different fields like texture verification, data compression, feature recognition.

The schematic diagram for wavelet based image fusion techniques is represented in figure 3

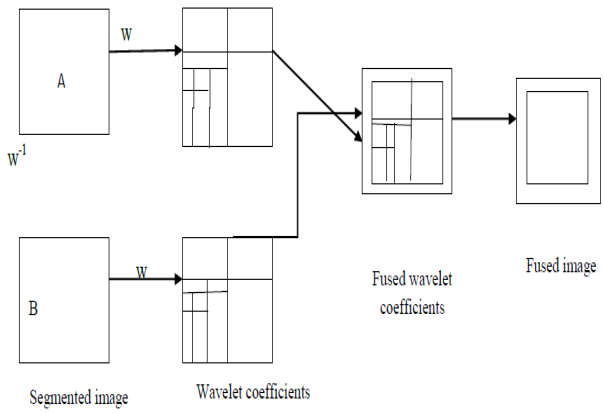

Figure 3: Image Fusion using discrete wavelet transform

2.5. FEATURE EXTRACTION

Set of features taken from the segmented image is known as feature vector, which organizes a depiction of an image in a single array.

2.5.1. Color Feature

In agricultural field color is the greatest tool for image recovering system in visual basis.

To standardize the RGB triplet into ranges 0 to 1.

$$R = \frac{T_{max} - r}{T_{max} - T_{min}} \quad (6)$$

$$G = \frac{T_{max} - g}{T_{max} - T_{min}} \quad (7)$$

$$B = \frac{T_{max} - b}{T_{max} - T_{min}} \quad (8)$$

Where T_{max} is extreme value.

T_{min} is smallest value. Secondly, color variation is used to retrieve the image in an effective and efficient manner.

2.5.2 Textures Feature

Texture represents the formation of an image. The texture of a plant leaf is used in the retrieval process.

1.5.2.1 Gray Level Co-occurrence Matrix (GLCM).

GLCM is a standard tool used for retrieving textural feature.

• Contrast:

Quality of the image contrast or the quantity of differences available in an infected image which is a Sum of Square Variance.

$$\text{Contrast} = -\sum_{x=1}^{k}\sum_{y=1}^{k} AS_{xy}(x-y)^2 \quad (9)$$

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• Correlation:

$$\text{Correlation} = \sum_{x=1}^{k}\sum_{y=1}^{k}(x-m)(y-m)AS_{xy} \quad (10)$$

• Energy:

$$\text{Energy} = \sum_{x=1}^{k}\sum_{y=1}^{k}(AS_{xy})^2 \quad (11)$$

• Entropy:

Entropy is the quantity of data about the infected image used for image compression, which measures the data an image.

$$\text{Entropy} = \sum_{x=1}^{\kappa}\sum_{y=1}^{\kappa} AS_{xy}\log(AS_{xy}) \quad (12)$$

• RMS :

The RMS value of the x[th] column of an x*y input matrix m is given by

$$\text{RMS} = \sum_{x=1}^{k}\sum_{y=1}^{k}\frac{|AS_{xy}|}{k} \quad (13)$$

• Variance:

Variance of an infected image is calculated by taking a square of a set size around a center pixel and is given by

$$\text{Variance} = -\sum_{x=1}^{\kappa}\sum_{y=1}^{\kappa} AS_{xy}(x-y) \quad (14)$$

2.5.2.2 Structural features

Region properties are used to measure the properties for each connected component in the binary image and the array can be represented by any number of dimensions of the infected part of the leaf. They are an area of the object, centroid, perimeter and diameter.

2.5.2.2.1. Area

Area of the region can be calculated by using Region of Interest because every pixel in the object contributes towards the measurement.

$$\text{Area} = A(S) = \iint J(x,y)\,dx\,dy \quad (15)$$

Where

$$J(x,y) = \begin{cases} 1, & if\ the\ pixel\ is\ within\ a\ shape\ (x,y)\epsilon S \\ 0, & otherwise \end{cases} \quad (16)$$

2.5.2.2.2. Perimeter

Perimeter

$$P_r(S) = \int \sqrt{a^2(t) + b^2(t)} \quad (17)$$

a(t) and b(t) represents the coordinates in S

2.5.2.2.3. Centroid

The centroid of a non self-intersecting closed region is represented by *n* vertices $(a_0, b_0), (a_1, b_1), \ldots, (a_{n-1}, b_{n-1})$ is the point (C_x, C_y), where (C_x, C_y) is given in equation (18) and (19).

$$c_x = \frac{1}{6A}\sum_{x-0}^{n-1}(a_x + a_{x+1})(a_i b_{x+1} - a_{x+1}b_y) \quad (18)$$

$$c_y = \frac{1}{6A}\sum_{x-0}^{n-1}(b_x + b_{x+1})(a_x b_{x+1} - a_{x+1}b_y) \quad (19)$$

A = Area given in equation (20)

$$A = \frac{1}{2}\sum_{x=0}^{n-1}(a_x b_{x+1} - a_{x+1}b_y) \quad (20)$$

2.5.2.2.4. Diameter

For calculating the valueπ, the circumference is divided by the diameter. This relationship is expressed in the following equation as (21)

$$\frac{C}{D} = \pi \quad (21)$$

WhereC is the circumference and D is the diameter.

III. RESULTS AND DISCUSSION

The image of the affected brinjal leaves includes Pseudomonas solanacearum, Cercospora solani, Alternoria Melongenea, and Tobacco mosaic virus (TMV). Initially the images were preprocessed by using a Gaussian filter for removing the noise The original image is given in Figure 4(A), and then the images are converted to gray scale as shown in Figure. 4(B).

(A) (B)

Figure. 4.(A). Original image and (B).Gray scale image

The segmented area in the infected area of the leaves can be done by using different techniques such as otsu, FCM, K means and Delta E is given in the figure 5 as shown below.

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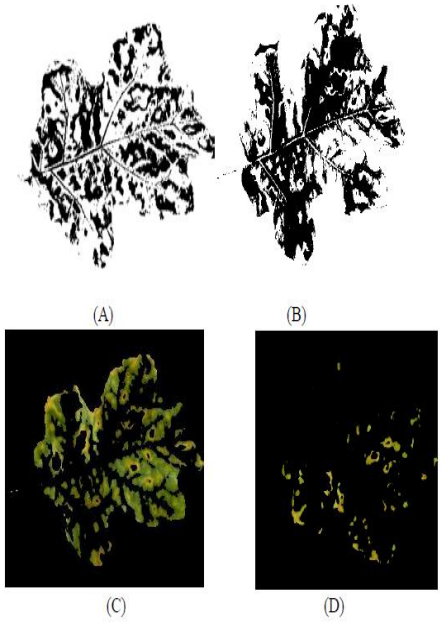

Fig. 5.(A). Otsu segmentation,(B) FCMsegmentation,(C) K-means segmentation. (D) Delta E

Table 1 shows the structural feature of various segmentation technique.

Table 5. Structural feature

METHODS	AREA	PERIMETER	CENTROID	DIAMETER
OTSU	6749	317.05	81.69	94.1
FCM	871	126.50	26.733	36.78
KMEANS	5343	355.04	78.85	91.19
DELTA E	5460	349.61	72.85	86.18

IV. CONCLUSION

In this paper, the recognition and categorization of diseases in the brinjal leaves were identified. The color, texture and intensity features were evaluated for Five diseased leaves. 3 color feature, 10 texture and 4 structural features of each image occur with a color machine vision system were extracted. It was found that either color ,texture or intensity features alone was not sufficient to increase the performance of system beyond 65%.When these features are mixed together, there was a good enhancement in the retrieval of diseased leaf images. FFNN & CFFNN classification were used in the propsed system. It was found that FFNN classification performed better by using combined feature as compared to CFFNN. The overall classification results shows 86.7541% accuracy & 82.79% AUC. Thus the proposed technique helps the farmers to do agricultural and detecting the diseases. Moreover, this will make decision to enhance the yield by taking necessary precaution, prevention and thereby taking a correct measure to improve the growth of the brinjal leaves. By providing mobile applications,the proposed technique is supportive for formers.

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