COMPUTER AIDED DISEASES IDENTIFICATION FOR BETEL LEAF

P.Tamilsankar[1], Dr.T. Gunasekar[2]

[1] PG scholar, EEE Department, Kongu Engineering College, Tamilnadu, India
[2] Assistant Professor, EEE Department, Kongu Enginnering College, Tamilnadu, India

---***---

Abstract- ***The leaves of betel vine are normally called as pan in India. In India, betel leaf consumers are nearly about 20-30 million on regular basis. Its cultivation is highly labour intensive and offers more employment throughout India. During the cultivation, betel vine are mainly affected by three types of diseases such as leaf rot, leaf spot and powdery mildew diseases. The key feature of this project is to identify the diseases in earlier stage using image processing, pattern recognition and classifier techniques. Using high resolution digital camera, different stage of healthy and diseased digital images can be collected. Collected digital image of betel vine leaves can be analysed using image processing toolbox in version 8.1 released in 2013 which gives a standard pattern of digital image. System is used to store the both healthy betel leaves and diseased betel leaves at different stages. Using CIE lab color space, color feature is extracted from both healthy and diseased betel leaves. By using classifier, it identifies whether the betel leaf is affected or not and also to identify the type of diseases.***

Keywords- *Betel leaf, CIELAB, Pattern recognition, classifier, Watershed Segmentation.*

1. INTRODUCTION

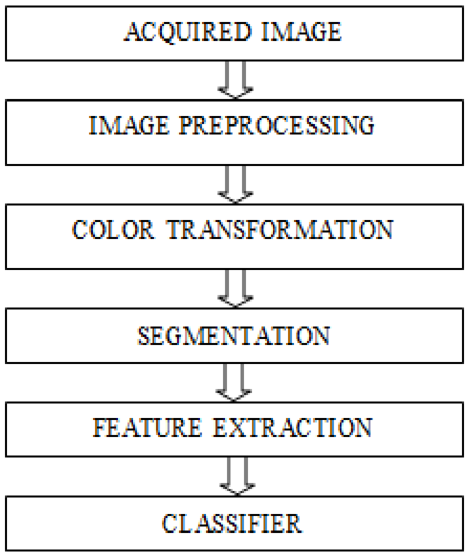
Betel leaf is used as medicine and antiseptic. These leaves are affected by foot rot, leaf rot and powdery mildew diseases [1][2]. The acquired images are processed to detect these diseases by using color transformation, segmentation, feature extraction and classifier.

The image preprocessing is done using median filter for removing noise in betel vine leaf [5]. Color transformation is done by CIELAB space model. It is used to transform RGB color component to CIELAB color component. In CIELAB color model, 'L' represent color brightness [6]. The watershed segmentation is used to segment the betel leaf (fore ground) from its background image. The watershed, segments the image by gradient factor. The gradient factor is obtained by 'L' value from CIELAB color model.
The high intensity gradient divides the neighboured local minima and segments the foreground image [9][10]. The HOG feature is extracted for affected betel leaf image. The HOG feature include extraction of gradient value for each blocks, histogram generation and normalization [11]. The Minimum Distance Classifier is used to classify the affected or not and to identify the types of diseases in betel leaf [12].

2. METHODOLOGY

The acquired image is preprocessed and segmentation is carried out to segment the fore ground betel leaf. The HOG feature is extracted and applied to classifier.

The methodology follows here to differentiate the three types of disease in betel leaf. The methodology explained in flow graph which describes the proposed work.



3. ACQUIRED IMAGE

The image is acquired from the agriculture farm. The acquired image is taken in the resolution 5312*2988. The Healthy and diseased betel leaves images are collected for processing. Totally 100 images are collected which includes both healthy and diseases affected betel leaves shown in Fig 1.


a. Healthy leaves


b. Foot Rot


c. Leaf Rot


d. Powdery Mildew

Fig-1 Samples of betel leaves

4. IMAGE PREPROCESSING

The enhancement includes filtering which removes the noise and process the image efficiently. The filter used is median filter [5].

4.1 Median filter

The median is operated by sorting all the pixel values from the window into numerical order, and then replacing by middle pixel value. The median filter gives the PSNR value as 13.74. The median filter removes the noise efficiently. It is used to reduce noise and improve the quality of the image. The filtering is done by median filter because it is useful in edge detecting.

5. COLOR TRANSFORMATION

The CIELAB is color space specified by the International Commission on Illumination [6]. It is device independent and describes the color which is visible to human. The most segmentation was done in color space model. Each color assigns the values where luminance L* varies from 0 to 100 (0 for black and 100 for white) and a*, b* represent two color gamut that vary from -120 to +120. The layer a* ranges from green to red and the layer b* ranges from blue to yellow.

The component a* and b* is based on the opponent color, which indicates that a color cannot be red and green or blue and yellow at the same time. The Fig 2 shows the transformation from RGB space to CIELAB space.

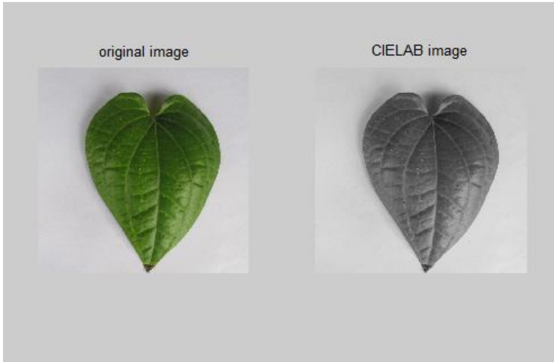


Fig-2 CIELAB color model of betel leaf

6. SEGMENTATION

Watershed means line that divides areas drained by different river systems. The watershed separates the image region by determined boundaries. Color transformed image is given as input to the segmentation. Edge detection is done by using sobel operator [10]. The gradient magnitude of edge detected image is calculated. Then the regional maxima of opening-closing by morphological reconstruction are determined. The flow of watershed segmentation is shown in Fig 3

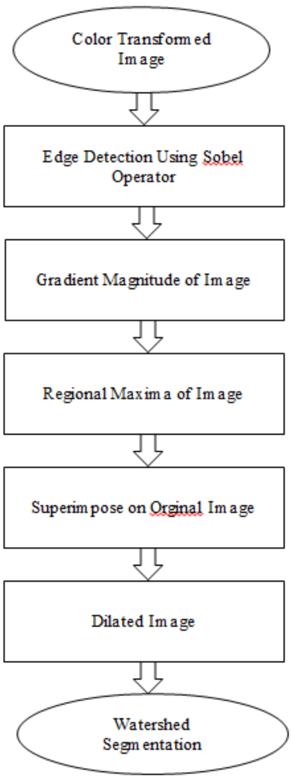


Fig-3 Flow of Segmentation

The reconstructed image is superimposed on input image. The dilated image is obtained by cropping maximal marker level region. Finally watershed transformation is done to obtain the segmented betel leaf image.

The watershed transform of gradient magnitude is shown in Fig 4. The watershed algorithm is shown in Fig 5.

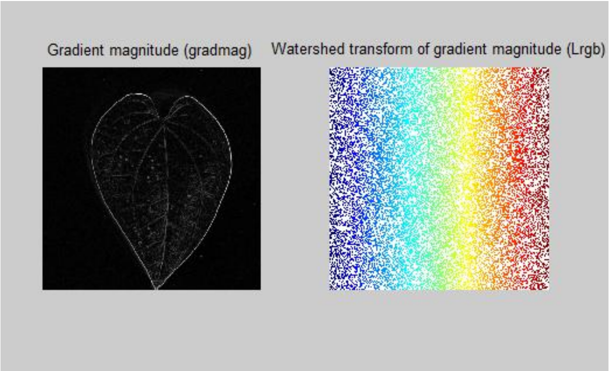


Fig-4 Watershed Transform of Gradient Magnitude

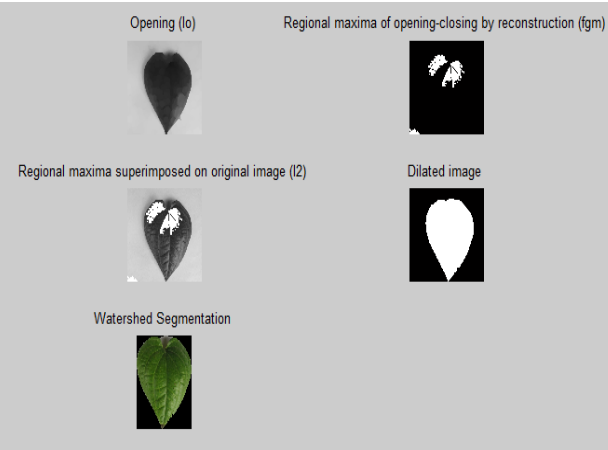


Fig-5 Watershed Algorithm

7. FEATURE EXTRACTION

Histogram of Oriented Gradient (HOG) feature is extracted for this algorithm [11]. HOG features are obtained by orientation histograms of edge intensity in local region. These features will be used then for classification and object recognition. The betel vine leaf is segmented into small connected cells for gradient calculation. Each cell calculates a histogram of gradient directions for the pixels within the cell. For improved accuracy, block is obtained by calculating a measure of the intensity over a larger region of the image for contrast normalization of local histogram and then using this value to normalize all cells within the block. Using calculated gradient value feature of betel vine leaf can be obtained.

The extraction of HOG feature for betel vine leaves are obtained by following steps

7.1 Gradient Computation

In HOG feature extraction of betel vine leaf, first order differential coefficients, $G_x(i,j)$ and $G_y(i,j)$ are computed by the following equations.

$$\begin{cases} G_x(i,j) = f(i+1,j) - f(i-1,j) \\ G_y(i,j) = f(i,j+1) - f(i,j-1) \end{cases} \quad (1)$$

Where f(i,j) means luminance at (i, j).

Then magnitude m and direction θ of the computed gradients are computed by the following expressions, respectively.

$$m(i,j) = \sqrt{G_x(i,j)^2 + G_y(i,j)^2} \quad (2)$$

$$\theta(i,j) = \arctan\left(\frac{G_x(i,j)}{G_y(i,j)}\right) \quad (3)$$

7.2 Histogram Generation

After obtaining the values of m and θ histograms are generated as follows:

a) Determine the class which θ(i, j) belongs to
b) Increase the value of the class determined by step 1
c) Repeat above operations for all gradients belong to the cell.

In order to reduce the effect of aliasing, the values of two neighbouring classes are increased. The increment make n indicates a class number which θ(i, j) belongs to, and n+1 would be the class which is the nearest one to class n. The increased values mn and mn+1 are computed as follows:

$$\begin{cases} n = \left\lfloor \frac{b\theta(i,j)}{\pi} \right\rfloor \\ m_n = (1-\alpha)m(i,j) \\ m_{n+1} = \alpha m(i,j) \end{cases} \quad (4)$$

Where b indicates the total number of classes, α is a parameter for proportional distribution of magnitude m(i,j) which is defined as the distance from θ (i, j) to class n and n+1,

$$\alpha = \frac{b}{\pi}\left(\theta(i,j) \bmod \frac{\pi}{b}\right) \quad (5)$$

7.3 Histogram Normalization

By combining all generated histogram the large histogram is obtained. In order to reduce the influence of variations in illumination and contrast, L1-norm is adopted in this project. The large histogram is normalized by

$$v = \frac{V_k}{\|V_k\| + \varepsilon} \qquad (6)$$

Where V_k is the vector for combined histogram, ε is a small constant, and v is the normalized vector, which is a final HOG feature of betel leaf.

The gradient value of three types of diseased betel leaf is obtained by above feature extraction steps. The extracted gradient values of diseased betel leaf shown in TABLE 1. Totally 80 blocks are obtained and each block represent 3*3 mask size. According to different features value the histogram class can be differentiated. The extracted gradient value of diseased betel leaf is given as input to the classifier.

TABLE-1 Gradient Values of Diseased Betel Leaf

BLOCKS	FOOT ROT	LEAF ROT	POWDERY MILDEW
1	0.4887	0.6792	0.5326
2	0.7110	0.1523	0.3349
3	0.0260	0.0572	0.0752
4	0.4002	0.5605	0.4098
5	0.1978	0.6896	0.4848
6	0.1245	0.4745	0.1125
7	0.8988	0.7538	0.9173
8	0.0323	0.1945	0.0961
9	0.0035	0.3272	0.0103
10	0.3666	0.3603	0.7573
11	0.1764	0.2540	0.0519
12	0.9584	0.4586	0.1254
13	0.5687	0.2456	0.0265
14	0.2965	0.8974	0.2365
15	0.9685	0.7564	0.1296
16	0.1348	0.9678	0.1275

8. CLASSIFIER

Minimum Distance Classifier used to differentiate the betel diseases such as leaf rot, foot rot and powdery mildew. The obtained classes from feature extraction are stored in the classifier. Diseased and non-diseased betel leaf is trained. In the testing, the gradient values of untrained betel leaf are given as input to the classifier. If the given values are near to the foot rot class, then the classifier identified that untrained betel leaf belongs to foot rot diseases as shown in Fig 6.

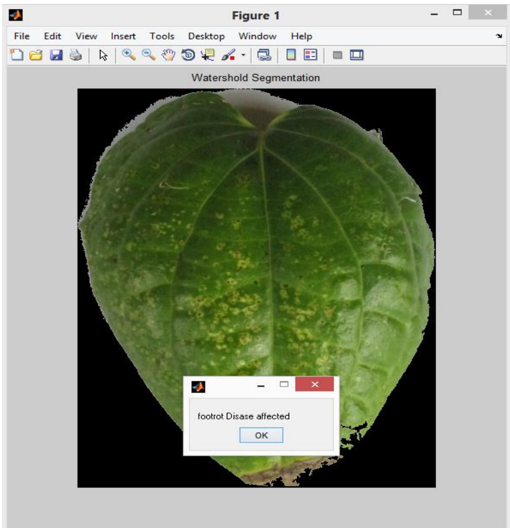


Fig-6 Classifier Output of Foot Rot Diseases

If the given values are near to the leaf rot class, then the classifier identified that untrained betel leaf belongs to leaf rot diseases as shown in Fig 7.

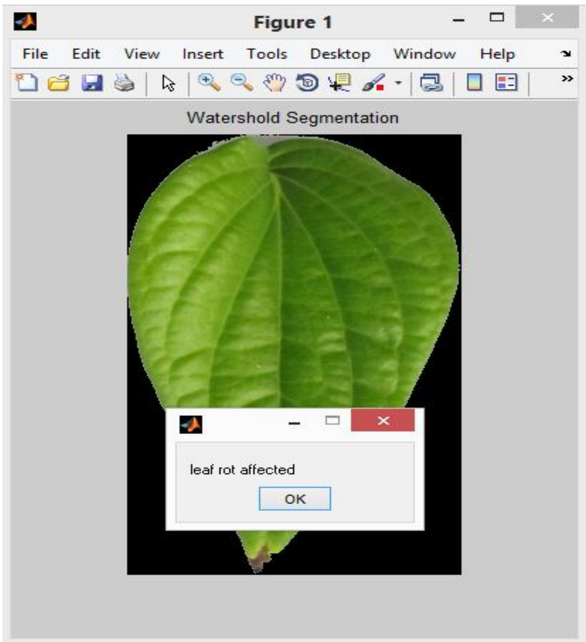


Fig-7 Classifier Output of Leaf Rot Diseases

If the given values are near to the powdery mildew class, then the classifier identified that untrained betel leaf belongs to powdery mildew diseases as shown in Fig 8.

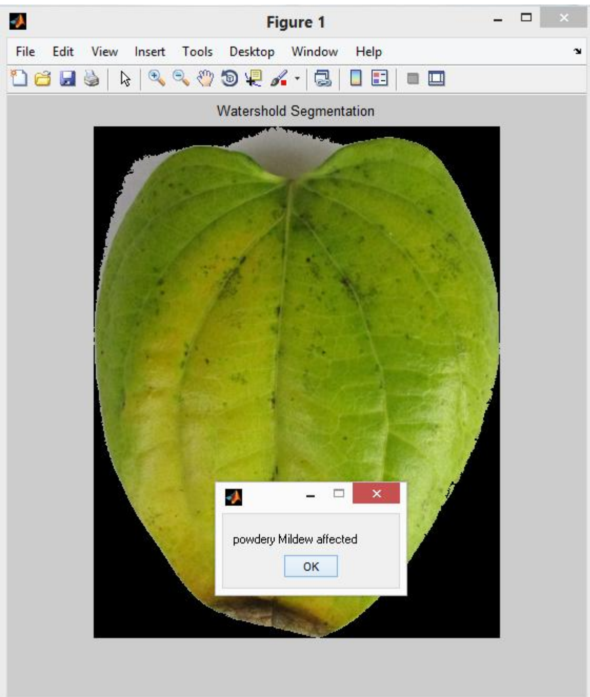


Fig-8 Classifier Output of Powdery Mildew Diseases

9. CONCLUTION

The proposed method is to detect the leaf rot, foot rot and powdery mildew diseases affected in the betel vine plantation. It is clearly mentioned with proof. Image processing is a safe tool for detecting diseases affected or not in a efficient and accurate manner with in a short periode of time. In Watershed segmentation foreground image is sharply segmented and removed from the background images. By using HOG techniques the gradient feature value of betel leaf images are obtained. Mimimum distance classifier, classfies betel vine diseases by using feature values of the images in an accurate manner. In this paper, the watershed segmentation and miminum distance classifier are the recent techniques used. Still more research are going in this field for increasing the performance and efficiency of the system. In future, the detection can be made automatically that can even reduce the physical work of human and it is more advantage for the farmer.

REFERENCES

[1] Anupama K, Nutankumar S. Jane1, "Review of Study of Different Diseases on Betel vine Plant and Control Measure", IJAIEM, Volume 3, Issue 3, 2014.

[2] Arivazhagan S, Newlin Shebiah R, "Detection of unhealthy region of plant leaves and classification of plant leaf diseases using texture features", Agric Eng Int: CIGR Journal, Volume 15, No.1 211, 2013.

[3] Dhaygude B, Prof. Sanjay, "Agricultural plant Leaf Disease Detection Using Image Processing", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Volume 2, Issue 1, 2013.

[4] Sabine D. Bauer, Filip Korc, Wolfgang Forstner, "The Potential of Automatic Methods of Classification to Identify Leaf Diseases from Multispectral Images", Springer Science Business Media, LLC, 2011.

[5] Geng Ying, Li Miao and Hu Zelin, "A Study on the Method of Image Pre-Processing for Recognition of Crop Diseases", ICACC, IEEE, pp. 202-206

[6] Antonio Cezar de Castro Lima, Camila Baccili, "Segmentation of somatic cells in goat milk using color Space CIELAB", Journal of Agricultural Science and Technology, 2014.

[7] Nawar Fdhal, Matthew Kyan, "Color Space Transformation from RGB to CIELAB Using Neural Networks", Springer Verlag Berlin Heidelberg, 2009.

[8] Anand K. Chaudhari, Dr.A.N.Cheeran, "Color Transform Based Approach for Disease Spot Detection on Plant Leaf", IJCST, 3(6), pp. 65-70, 2012.

[9] Manisha Bhagwat, Krishna R K, "Image Segmentation by Improved Watershed Transformation in Programming Environment MATLAB", International Journal of Computer Science & Communication Volume 1, No. 2, pp. 171-174, 2010.

[10] Liu C Q, Salman C, (2003), "Image Segmentation and Edge Detection Based on Watershed Techniques", International Journal of Computers and Applications, Volume 25, no. 4, pp. 258-263.

[11] Dalal N, Triggs B, (2005), "Histograms of oriented gradients for human detection", IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'05), pp. 886-893.

[12] Aziz Ahmed, Muhammad Muaz, "Comparing Pixel-based Classifiers for Detecting Tobacco Crops in North-West Pakistan", ICRDF, pp. 211-216, 2015.