HEALTHY LEAVES SEGMENTATION AND SHAPE IDENTIFICATION

K. Dhanalakshmi[1*], Dr. S. Lakshmi Prabha[2]

[1]Research Scholar,
[1]Periyar University,
[1]Salem-11, Tamil Nadu, India.

[2]Assistant Professor,
[2]Government Arts College for Women,
[2]Salem-8, Tamil Nadu, India.

Abstract

Plant leaf identification is the one of the growing research area in image processing. Most of the image based leaf disease identification methods are extract only affected parts from the leaf image by using color feature. Some leafs naturally have brown or yellow spot, in this case it will lead wrong results. In order to overcome this problem we need to identify the healthy leafs patterns before identify the disease. In this work, we applied k-mean and active contour algorithm to identify the leaf color and shape of the image then we identify the actual texture of the segmented healthy leaf image.

Keywords: *Healthy Leaf Identification, Color Features, Shape Features and Texture Features.*

1. Introduction

It is very important to now the normal growth of a plant leaf before identifying the disease. If you do not know what is the normal healthy plant then you cannot recognize when something is wrong. If we can recognize leaves, it is possible to determine the leaves healthy status. Insects, pests and crop disease may change the color of the leaf to yellow, brown, black and bites or holes in the leaves. Once the appearance of the healthy plant is determined, several comparisons can be made between the healthy plant leaves and problematic plant leaves. Compare features such as overall shape, size, texture and coloration. In this paper we used color, shape or edge and texture features to achieve the accurate healthy leaf identification.

2. Literature Survey

2.1. Color Based Segmentation

The color histogram represents the distribution of colors in an image [1]. A histogram of a color image is produced first by the discretization of the color in the image into number of bins and counting the number of image pixels in each bin. After computing histogram value in order to obtain illumination changes, the RGB color image is normalized. But the color histogram techniques provides classification inaccuracy because some color information is shared by the entire all the objects of an image [2].

Guilliaume cerutti et al [3,2] have used L*a*b color space which is perceptually different from regular RGB color manifestation and intersects well the chrominance information from the luminance. The color distribution of L*a*b forms a straight continuous cylinder. But other color spaces such as HSL, RGB produce curved cylinders [2]. This algorithm initially selects the smaller region in L*a*b color space after it considers the same axis for the whole leaf [2]. This color segmentation considers leaf pixel which is not close to the initial region of leaf image and it discriminates the leaf of interest from other leaves of similar color in the background [2].

Manisha Bhange et al [4] used k-means approach to cluster large number of image database for pomegranate images. But in our approach we are using plain backgrounds, so it is quite simple to segment foreground from the background. For this problem we used k-means clustering to segment leaf image into two clusters. One is foreground consists of green leaf and another one is background which may be a plain black or white color surface.

2.2. Shape Features

I.Kiruba Raji et al[2] applied active contour model of Chan-Vese algorithm for real time images .This gives better results compared to basic edge detection methods. The level set approach was introduced. Initially the level set approach was applied to whole regions rather than edges. So contours are represented implicitly. Here we apply Chan- Vese active contour for whole region of images rather than edges. But in techniques took 1000 iterations to gives better result. But in our approach we are applying only already segmented part so it takes only 300 iterations to give better result.

Chunming Li et al[5] proposed, "Distance Regularized Level Set Evolution method" to identify the contour of the image. The main advantage of the DRLSE over Conventional level set Formulations including the following [5]:

1) It Completely eliminates the need for reinitialization[5]
2) It allows the use of large time steps to significantly speed up curve evolution, While ensuring numerical accuracy [5]
3) Computationally more efficient than conventional level set formulations [5].

Rami Cohen et al's [6], Chan-Vese active contour is a powerful and flexible method which is able to segment many types of images. This model is based on an energy minimization problem, which can be reformulated using the level set formulation to solve this problem. Most of the level set formulation methods are based on first order and second order partial differential equations of the curvature models [2,6,7].

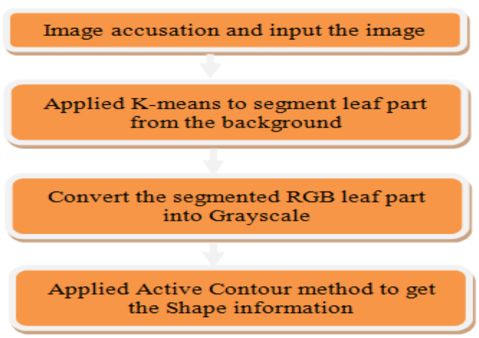
Trishen munisami et al[8], used distance map approach to measure the shape. In this they used two methods one is vertical and horizontal map another one is centroid radial map.

But in our approach we are calculating centroid and finding distance between each boundary pixel in the image which is shown in figure 5.a and b respectively.

2.3. Texture Feature

Dheeb AI Basish et al[9] used Color co- occurrence Matrixes to identify both color information and texture information as well. In that paper they calculate some of the texture features such as homogeneity, intensity level, variance of intensity, correlation, contrast and entropy to identify the texture of different types of plant diseases.
S. Arivazhagan et al[10] also used Color Co- occurrence Matrixes to identify both color information and texture information .In that paper they calculated contrast, Energy, Local Homogeneity , cluster shade, Cluster prominence features to identify leaf disease. But in our work we already segmented leaf color so we used gray level co-occurrence matrices to get the texture features and we calculated only few texture features such as contrast, correlation, energy, entropy, homogeneity, cluster prominence and cluster shades.

3. Methodology



3.1. K-Means based Segmentation

K-means partitions the points in the n-by-p data matrices X into k-clusters [4]. Partitions minimizes the sum and over all clusters, of the within cluster sum of point to cluster centroid distances. Rows of X correspond to points p, columns of X correspond to variables q.
In this k-mean approach we use Euclidean Distance to calculate the distance,
If p=(p1-p2) and q=(q1-q2) then the distance is given by the Formula,

$$d(\mathbf{p},\mathbf{q}) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2} \quad \text{——} \quad (1)$$

But in this aproach we need to initialize the k value.

3.2. Active Contour Using Chan-Vese

The Chan-Vese based Active Contour method is region-based active contour method, Segment image into foreground and background using active contour [2,6].

It segments the 2-D grayscale image A into foreground (object) and background regions using active contour based segmentation. The output image BW is a binary image where the foreground is white (logical true) and the background is black (logical false)[2,6].

MASK is a binary image, same size as that specifies the initial position of the active contour. The boundaries of the object region(s) (white) in MASK define the initial contour position used for contour evolution to segment the image [2,6]. Typically faster and more accurate results are obtained when the initial contour position is close to the desired object boundaries.

3.3. Texture Features

Texture features are extracted from Gray- Level Co-occurrence Matrix[10], so firstly we need construct the GLCM. Texture features like Contrast, Energy, Local Homogeneity, Cluster Shade, Cluster Prominence, Correlation and Entropy are computed by the following formulas,

Contrast [10],

$$\sum_{i,j=0}^{N-1} (i,j)^2 C(i,j) \quad \text{.............} \quad (2)$$

Energy [10],

$$\sum_{i,j=0}^{N-1} C(i,j)^2 \quad \text{——} \quad (3)$$

Local Homogeneity [10],

$$\sum_{i,j=0}^{N-1} C(i,j)/(1+(i-j)^2) \quad \text{——} \quad (4)$$

Cluster Shade[10],

$$\sum_{i,j=0}^{N-1} (i-M_x+j-M_y)^3 C(i,j) \quad \text{.............} \quad (5)$$

Cluster Prominence[10],

$$\sum_{i,j=0}^{N-1} (i-M_x+j-M_y)^4 C(i,j) \quad \text{.............} \quad (6)$$

Correlation [9],

$$\frac{\sum_{i=0}^{Ng-1} \sum_{j=0}^{Ng-1} ijP(i,j) - I_2{}^2}{I_2} \quad \text{.............} \quad (7)$$

Entropy [9],

$$\sum_{i=0}^{N_g-1} \sum_{j=0}^{N_g-1} P(i,j)\, lnP(i,j) \quad \text{.............} \quad (8)$$

4. Experiments and Analysis

To evaluate the proposed approach, Firstly, we did image accusation with the help of camera and we use the taken image as input for the system. Before taking the picture we need plug the required image and keep it in a plain black or white background surface. In this we use papaya leaf as an input image shown in figure 2. The input image resized into 300X300. Then we applied k-means based segmentation approach to segment unwanted background and leaf respectively, the segmentation result shown in figure 3. After leaf segmentation, we need only leaf part to get color information ,which shown in figure 4.a then we convert the segmented leaf part into grayscale image, shown in figure 4.b then constructed gray level co-occurrence metrics to extract the some of the main texture feature such as contrast, correlation, energy, entropy and homogeneity. Then we applied edge detection shown in figure 5.a and the active contour methods to get the shape information of the leaf, After that we calculated the centroid pixel of the leaf which marked as red circle in figure 5.b and calculate the distance between each edge pixels with centroid pixel to get the shape values. After this all feature extraction process, we constructed feature vector for the input image and compute similarity between the feature vectors with the existing leaves feature database. Finally, with this approach we identify the leaf type and name.

Figure 2: The Orignal Input leaf Image.

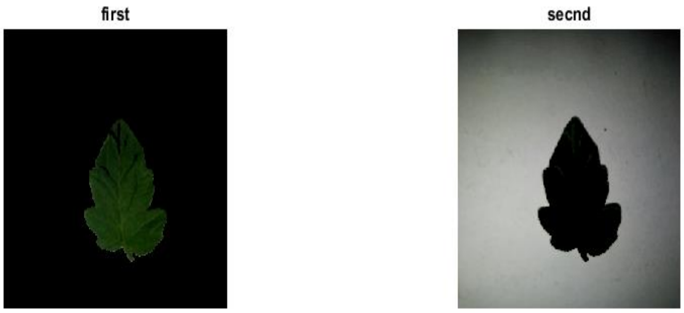
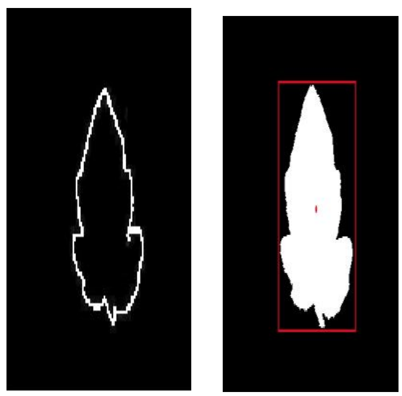


Figure 3: Segmentation result of k-means, Initialized K=2.

a) b)

Figure 4: a) segmented color information b) Gray Scale image of segmented leaf part to extract texture information



a) b)

Figure 5: a) Edge detection result b) Active contour method result to identify leaf shape and centriod.

5. Conclusion and Future Work

Content based healthy leaves identification plays an important role in leaf disease management. Most of the existing leaf disease identification methods focusing on only affected parts they didn't focus on the calculation of how much a leaf affected by disease or pests. In order to overcome this drawback we propose healthy leaf shape identification approach. In this approach we can compare the affected leaves shape with the healthy leaves shape so that we can accurately determine a leaf is affected or not. It gives better result for plain background images. In this paper we focused on only healthy leaves shape identification method and in our future work we will extend our work to identify disease affected leaves with complex background as well.

References

[1]. H.Kebapchi,B.Yanikoglu, "Plant Image Retrieval using color, Shape, Texture Features", The computer Journal- IEEE Explorer, pp: 1475-1490,2011

[2]. I.Kiruba Raji, " An analysis of Segmentation Techniques to identify Herbal Leaves from Complex Background, International Conference on Computer, Communication and Convergence - Elsevier, pp: 589-599,2015.

[3]. Guilliaume cerutti, Laure Togune, "Understanding leaves in natural images-A model based approach for tree spices identification", Computer vision and Image Understanding, pp:1482-1501,2013

[4]. Manisha Bhange, "Smart Farming: Pomegranate Disease Detection Using Image Processing", Second International Symposium on Computer Vision and the Internet, Elsevier, pp: 280 – 288, 2015.

[5]. Chunming Li, "Distance Regularized Level Set Evolution and its Applications to Image Segmentation ", IEEE Trans. Image Processing, Vol.19 (12), 2010.

[6]. Rami Cohen, "Chan-Vese Algorithm", Introduction to medical imaging, 2010.

[7]. Mahimood R.Glozarian, "Segmentation of cereal Plant Images using level set methods-A comparative study," International Journal of Information and Electronics Engineering , pp:72-78, 2011

[8]. Trishen Munisami, "Plant Leaf reorganization using shape feature and color histogram with k-nearest neighbor Classifiers", Second International Symposium on Computer Vision and the Internet, Elsevier, pp: 740-747.

[9]. Dheeb Al Bashish, "A Framework for Detection and Classification of Plant Leaf and Stem Diseases" International Conference on Signal and Image Processing, pp: 113-118, 2010.

[10]. S. Arivazhagan, "Detection of unhealthy region of plant leaves and classification of plant leaf diseases using texture features", Agri Eng Int: CIGR Journal, pp.211-217, 2013.