Plant Disease Detection Using Image Processing Technique

Maneesh Kumar Meena
Department of Electrical Engineering
Institute of Technology,Kanpur
Email : manee@iitk.ac.in

Arvind Kumar Meena
Department of Electrical Engineering
Institute of Technology,Kanpur
Email : arvindkm@iitk.ac.in

Abstract **- The purpose of this project is to detect and classify the disease in plant by observation using image processing technique . For good and healthy productivity disease detection and solution of disease in plant is very important task. In agriculter or domestic plant detection of disease require time and expertise and also is expensive . Using Image Processing Techniques we can detect and classify a disease quickly and less expensive .Hence Image processing is important for disease detection . In this project we use simple processes like Image acquistion, Image preprocessing,Image segmentation and Feature extraction from segmented image ,Static analysis of Image and based on result we classify the disease in plant . Detection of disease mainly depend on Image segmentation process,In our project we use K-mean clustering process for image segmentaton then using multi-svm we classify the disease. In our project based on result accuracy is quite good for disease detection.**

1 . INTRODUCTION

Now a day due to various reason productivity of agriculteral crop in villages has droped and continuously droping. In agriculteral crop or domestic plant production depend on development of the plant .With good seeds and fertilizer monotering of the health of plant is also important for good production . So study of plant diseases is very important . Detection and classification of disease in plant require a lot of time and also costly . So for an alternative solution we can use Image Processing technique to detect and classify diseases that are pre – recognised with a very good level of accuracy. Disease detection using Image processing is very efficient and quick and costly efficient .

Our project uses Image processing technique to detect a set of predefined Diseases in plant . In our project we apply some simple Image processing technique in a sequence to detect and classify the disease. Using Image processing processes we firsr find out the region of interest that contain the symptom of a disease and we static analysis the features obtain from reigon of interest and using multi-svm we classify the disease . In our project for Disease detection we uses the fact that different disease have diffetent symptom in plant leaves . They are different in color , saturation ,energy from each other . Using this we find out that different disease have different features in leaves. So statical analysis of feature give different result for different disease .Our project have limitation in detection of disease as if disease with some similar symptom or some new disease accuracy of our detection process goes down .

For our project we have used plant images with different diseases . Images with different diseases and simple background obtain from camera .Here are some Sample Images -

Fig 1.1 (Source : Internet)

Fig 1.2 (Source –internet)

Fig 1.3 (Source : Internet)

Fig 1.4 (source – Internet)

Disease detection and classification goes through several steps before final results.

2 . PREVIOUS WORK

In the field of disease detection using image processing various research and different work is done by peoples .

[1] Wenjiang Huang developed new technique for spectral indices for identify the winter wheat disease .He study three disease in wheat – Powdery , Yello dust , Aphid . In his work he usease Relief - F algorithm for calculating least relevant wavelength.

[2] Prof. Sanjay et al presented an automatic dieases detection technique . Prof . Sanjay used the morphological feature with their productive structure to identify fungi and becteria in leaves. He compute the statics from SGDM matrices to identify plat leaf dieases.

[3] Anand. H. Kulkarni and Ashwin Patil R. K described a methodology to accurately detecting plant diseases .They used image processing techniques along with artificial neural network (ANN) to identify the dieases

[4] R. Deshmukh compare the Otsu threshold and the k-means clustering algorithm used for infected leaf analysis . They have concluded that the extracted values of the features are less for k-means clustering. The clarity of k-means clustering is more accurate than other method.

3. METHODOLOGY

We have used many steps to detect and classify a disease in plant. First we convert our raw RGB image enhanced contrast image using histogram process . For segmentation purpose we convert image to HSI image and LAB color space image for better cluster formation. In LAB color space we use A and B color space because it have better color information and then we conduct all operations on it . Here is block diagram of our approach.

Our Approach:

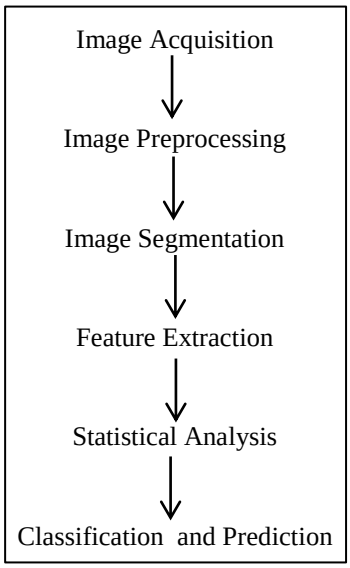


Fig . Block Diagram of Current Approach

3.1 Image Acquisition

In this process we obtain raw (rgb) image of plant leaves that are affected from some disease. Image of leave is obtain from camera and it have simple background . After acquistion of image we crop the leaf part that has deases symptom . For the better result we consiter single image for processing rather than a bunch of images together . After this image is send to pre processing process.

3.2 Image Preprossing

After acquistion of image , in image preprocessing stage we remove noise and smooth the image for further process. In this process we clip the region of interest of leaf and then we enhance the image quality. For enhance the image quality we first convert the image from RGB to gray level and then apply histogram equilization to enhance image contrast . anter enhancing the image quality we smooth the image for better edge using various smooth finction . After enhancing the image quality image is further processed for segmentation process.

3.3 Image Segmentation

In our project disease detection is mainly based of proper image segmentaaion. In this process we segment the image in various part – background part , Green pixel of non effected area of image and part that contain the disease affected area. Based of the segmentation of disease part we obtaion feature and classify the disease . In our project we used k- mean clustring algorithm along with otsu's threshold method for segmentation.

1) K – mean clustring :

In our project we used K-mean clustring algorithm for segmentation purpuse. In this process we segment the image into k clusters that contain various imformation about image . Classification of image is done by using set of features in k clusters . In this process formation of cluster is done by minimizing elucidean distance between cluster and pixel of image.

The algorithm for K-mean clustering :

Input image $\boldsymbol{I_{mxn}}$
Output Image ***K segmented images***
Choose ***K cluster center*** *in image randomly*
For *all pixel in* $\boldsymbol{I_{mxn}}$
Calculate ***Elucidean*** *distance between pixel and all k cluster center*
Assign each pixel to cluster that has ***minimum*** *distance*
After assigning each pixel ***recalculate*** *cluster center using*
K_j = *(sum of all pisel in Kj cluster) / number of Pixel in* K_j *cluster*
After calculating all k cluster location recalculate distance again
Repeat until there is ***no change in K-cluster center position***
end

In our project we uses 3 cluster that contain information about background , green pixel and disease part . For k mean clustring process we firsr convert RGB image to HSI and LAB color component because they have better color information for diseases . In HSI image we use H and B part of color for K mean clustering process. In LAB color space we uses A and B color space for better k mean cluster results .

2) Otsu's Threshold Method for Segmentation

Otsu's Threshold method depend on fact that various disease leaves different type of color symptoms on plant leaves . We first extracted rgb component of image and after that based on otsu method we calculate threshold value and then convert image from rgb to binary image.

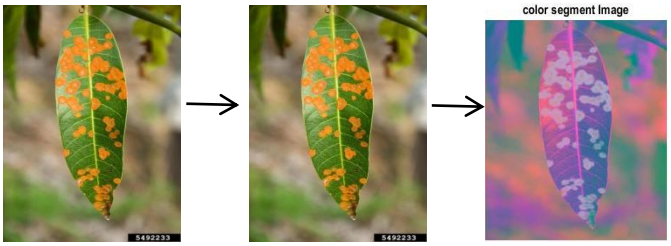
Algorithm of otsu's method :

Input Image grey $\boldsymbol{I_{mxn}}$
Output image Binary threshold image $\boldsymbol{I\_Otsu_{mxn}}$

- *first choose a threshold value and divide the image into two part*
- *for each part calculate mean of all pixes in each part*
- *find the distance between mean and square it*
- *Multiply numbet of pixel in two parts*

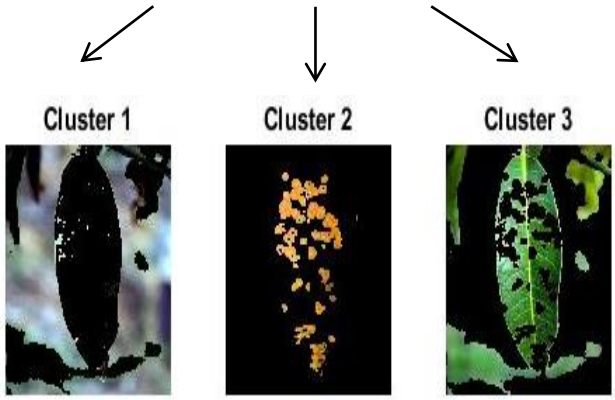
Using otsu's method for threshold minimize the within class variance . If we substruct weighed image variance of two part from image variance we get within calss variance . within class variance is minimum at otsu threshold value .

Example :



Original Image Enhanced image LAB color space

From Lab color space image we create three cluster containing various information about various part.



K – mean clustering result

Fig 2.3. Segmentation process

After segmentation process image is further reffered to feature extraction process .

2.4 Feature Extraction

In this process we extract useful feature from the segmented image . Feature extraction is very important to classify image .Different disease in leaves hane different symptoms so feature also differ from disease to disease . From segmented image we extract feature like edge , color ,texture feature like energy ,contrast ,local homogenity and correlation and morphological feature . For feature extraction we use method like color co-occurence method and Grey level co-occurence matrices (GLCM). Some feature are listed below for detect of image :

Contrast :

Contrast is measure of the intensity contrast between a pixel and its neighbor over image. For calculating contrast we use

$$\text{Contrast} = \sum_{i,j=0}^{N-1} (i,j)^2 \, \text{I(i, j)}$$

Energy :

Since every disease has different type of color symptom and different effect on different area so energy for every disease is different .Energy is calculated by square sum of element of image . for a constant image energy is 1 .

$$\text{Energy} = \sum_{i,j=0}^{N-1} I(i,j)^2$$

Homogeneity :

Homogeneity is measure of Closeness of the distributed element in an affected images . Different disease cause different effect on image . Some disease have continuously symptoms like fig 1.1 while some disease have symptom of discrete effect like fig 1.3 .

$$\text{Homogeneity} = \sum_{i,j=0}^{N-1} \text{I(i, j)}/(1 - (i-j)^2)$$

Correlation :

Correlation measures how one pixel of image is correlated to another pixel of image .

$$Correlation = \sum_{i=1}^{N-1}\sum_{j=1}^{N-1} \frac{\{i\ x\ j\} \times I(i,j) - (\mu - \gamma)}{\sigma x \times \sigma y}$$

Color co-occurance Method :

To get a unique feature from segmented image we use both texture and color of the segmented image . for this we first convert RGB image into HSI color model using standard method .

H = { θ if B < G
360 – θ if B > G
};

S = 1 – (3/ (R + G + B)) [min R G B];

I = (R + G + B) / 3;

From extracted features we compute Grey level co –occurance marix and further process for statical analysis. From segmented image we extracted more than 10 features to classify the disease in image . All the features are used to form training set . Element of the Grey level co-occurance matrix are frequency at which two element occur at distance d with two different intensity .

$$I_{\Delta x,\Delta y}(i,j) = \sum_{i=1}^{N-1}\sum_{j=1}^{N-1} \{\, 1\, , if\ \text{I}(x,y) = i\ and\ I(x+\Delta x, y+\Delta y) = j$$

2.5 Static Analysis

After doing segmentation and feature extraction process we analysis the feature data statically . We first create the traning set of images with different disease and extract all their feature and make an matrix . Based on the created matrix and extracted feature we analysis the data of test image to find the disease class. Class that shows better similiraty for static analysis we conside that disease to be found in the leave . After static analysis we further process the image to classify the image .

2.6 Classification and Prediction

This is the last process of our project to detect the disease . For the classification and prediction ,a fter statistical analysis of data we classified the plant dieases based on certain feature. For classification we can use different network like K-nearest neighbour , Radial basis function Convolution neural network , Support vector machine , Back propagation network Probabalistic neural network on matlab plate form. After the classification of disease we predict the plant diease . In our project we uses multi – support vector machine process for classification and detection of disease.

For a training data vector $\boldsymbol{x}$ and test data vector $\boldsymbol{y}$ SVM optimizes

$$min\ \frac{1}{2} W^T W + C \sum_{i=1}^{N} \varepsilon_i$$

$$subjected\ to\ y_i\ (W^T \varphi(x_i) + b \geq 1\text{-}\ \varepsilon_i$$

4. RESULTS AND ACCURACY

In our project we generally detect four disease with above 10 feature extracted . Here are some result for feature extraction for some disease along with accuracy. Accuracy is calculated for a test case for running different iterations.

Test	mean	Area effected	correl ation	Energy	Disease	Accuracy
1	30.16	15.22 %	0.84	0.5	Anthraconos e	98.38
2	35.7	18.32 %	0.83	0.48	Leaf spot	96.72
3	22.3	15.01 %	0.58	0.58	Bacterial blight	96.77
4	17.13	53.56 %	0.71	0.71	Alternaa	98.38

As we can see in above table for different disease there are different features .

5. CONCLUSION

In our project we detect diseae for a few type but it can be expanded into man type diseases. We use multi-SVM for classification but several other like Ann network , machine learning technique also be used for classification. Diseases that have some what similat symprom are difficult to distinguish as they have same features . If affected area of disease is too much for two s=different disease still there is less accuracy in detection. In our project we can't detect a deases that is not predefined . But overall image processing technique for detection has above 90% accuracy and time and cost efficient .

6. REFERENCE

[1] Wenjiang Huang, Qingsong Guan, Juhua Luo, Jingcheng Zhang,Jinling Zhao, Dong Liang, Linsheng Huang, and Dongyan Zhang, "New Optimized Spectral Indices for Identifying and Monitoring Winter Wheat Diseases", IEEE journal of selected topics in applied earth observation and remote sensing,Vol. 7, No. 6, June 2014

[2] Prof. Sanjay B. Dhaygude and Mr. Nitin P. Kumbhar, "Agricultural plant Leaf Disease Detection Using Image Processing" *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Volume 2, Issue , 201*3.

[3] Anand H. Kulkarni and Ashwin Patil R. K, "Applying image processing technique to detect plant diseases", *International Journal of Modern Engineering Research (IJMER), Volume 2, Issue.5, pp-3661-3664 ISSN: 2249-6645, 2012*

[4] Savita N. Ghaiwat, ParulArora, "Detection and Classification of Plant Leaf Diseases Using Image processing Techniques: A Review*", International Journal of Recent Advances in Engineering and Technology, ISSN: 2347-2812, Volume 2, Issue 3, 2014.*

[5] Zulkifli Bin Husin, Abdul Hallis Bin Abdul Aziz, Ali Yeon Bin Md Shakaff Rohani Binti S Mohamed Farook, "*Feasibility Study on Plant Chili Disease Detection Using Image Processing Techniques", 2012 Third International Conference on Intelligent Systems Modelling and Simulation.*

[6] A. Meunkaewjinda, P. Kumsawat, K. Attakitmongcol and A. Srikaew, *"Grape leaf disease detection from color imagery using hybrid intelligent system", Proceedings of ECTI-CON 2008.*

[7] Muhammad Hameed Siddiqi1, Suziah Sulaiman, Ibrahima Faye and Irshad Ahmad, *"A Real Time Specific & Weed Discrimination System Using Multi-Level Wavelet Decomposition", International Journal of Agriculture Biology, ISSN Print: 1560–8530; ISSN Online1814-9596 ,09–118/YHP/2009/11–5–559–565*

[8] *For training set we took Images from internet from random search with disease name . Training data matrix is borrow from internet source . Information about different disease is also borrow from internet* **.**