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Leaf Disease Detection using Image Processing

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Abstract

The revelation of plant disease is a prominent research theme in the field of computer science. With the aid of Intelligent systems, the diseases can be detected effectively .The plant leaves are mainly affected by varied micro organisms. This paper centers on the discovery of disease in plants using the input picture. The disease identification concerns the steps like transfiguration of the picture format from RGB to Grayscale. Adaptive Histogram Equalization (AHE) is accustomed to improvise the contrast in the picture. The 13 prominent attributes are extracted by handling a feature extraction method called GLCM or Gray Level Co-occurrence Matrix .The standard benchmark images are trained using SVM classifier and the outcomes are displayed in the output screen.

Keywords: AHE, Feature extraction, GLCM, SVM classifier.

1. Introduction

The revelation of disease is decisive in enriching the grade of the agricultural output and intercepting the overall depletion of the plants. The research on plant ailment is the mechanism of learning the detectable patterns visible on the plant. The plants being exposed to the outside environment get diseases from exposure. [1]Plants are attacked by several diseases which usually target the specific plant parts like stem, fruit, leaf, seed etc. [2]Leaf symptoms are an important origin of knowledge to detect the diseases in multiple types of plants and therefore it has to be contemplated in identifying the disease. This paper reports about the revelation of leaf disease using Image processing strategies, as it is a trendy process being used in agriculture. Pooja V et.al [3], focused on five sorts of disease with training set of 227 images and testing of 121 images. They have inured K-means clustering algorithm for segmentation and used varied feature extraction strategies like skewness, contrast, etc.to pull out desired features. SVM classifiers were implemented for classification. Their model procured a recognition rate of 92.4%. In the proposed work, initially we take the picture of the leaf to identify which section is corrupted. Then image preprocessing is done where the picture is changed from RGB to Grayscale and Adaptive Histogram Equalization (AHE) is applied to enhance the contrast of the picture. There are many features in the image like texture, edges, morphology, color .Monica Jhuria et al [4] accounts color, texture and morphology. They have proved that morphological results are good than other results. S.W.Zhang et.al [5], have employed K – nearest neighbor classifiers to recognize the plant disease. The 13 prominent features are accounted in this paper. The outcomes of the features are matched and the results are classified using SVM classifiers and the resultants are presented to the user. Pranjali.B.Padol et.al [6], have used Linear SVM classifier and K-means clustering to identify diseases in grape leaf. Their model procured an accuracy of 88.89%.

This paper is structured as follows. The transfiguration from RGB to Grayscale is discussed in Section 2. Section 3 reports the AHE. Section 4 demonstrates the feature extraction. The use of SVM for classification is flaunted in section 5. Section 6 shows the block diagram and Section 7 demonstrates the methodology. The exploratory results are exposed in section 8.

2. Grayscale Conversion

A RGB photograph is basically a M*N*3 array of color pixel, in which each color pixel is a triplet which corresponds to red, blue and green shade issue of RGB image at a specific spatial location[7].Similarly, A Grayscale picture may be regarded as a single layered image. In MATLAB, a grayscale image is largely M*N array whose values have been scaled to represent intensities [8].In MATLAB, there is a function referred to as rgb2gray () is to be had to convert RGB picture to grayscale picture. I = rgb2gray (RGB) converts the true coloration image RGB to the grayscale image.

3. Adaptive Histogram Equalization

AHE is used for improvising the contrast and edges in the input picture. CLAHE is a modified part of AHE. In this approach enhancement characteristic is implemented on over all community pixels and transformation function is derived. This is differing from AHE because of its comparison limiting. In paper [9] Zhiyuan Xu et.al, applied CLAHE approach for the process of enhancement. The method used maximum value to clip the histogram and redistribute in grey stage image. Their algorithm implemented one at a time for heritage and foreground and restricts the noise, enhance the evaluation. Distribution parameter are used for shape of histogram equalization graph, in paper [10] 'Rayleigh' distribution parameter are used for bell formed histogram. CLAHE can be applied over both type of photos, gray scale and colored.

4. Feature Extraction

The majority of the diseases that corrupt the plant can be scrutinized by discoloration of leaves, or the presence of residue on the leaves thereby converting the natural texture of the leaves

4.1 Texture Feature Extraction

The texture can also be said as the regularity of patterns in the picture. The standard practice employed for is the concept of GLCM [11].It is a strategy of deriving second order statistical features. In a picture with pixels of different intensities, GLCM is a categorization of the frequency of combinations of gray levels that co-occurs in a section of the picture. The GLCM is a square matrix where the rows and columns are impartial to the quantity of gray levels in that image. The distances (i.e.), the similarities among the various histograms are used to evaluate the matrix by employing averages of four angles, 0, 45, 90, 135 degrees between the selected histogram and its encircling ones[12]. Consider a pixel with a value x and one of its surrounding ones with value y. Then mathematically, a GLCM is constructed for the image I of size N×N using the formula

$$G=\sum_{i=1}^{N}\sum_{j=1}^{N}\begin{Bmatrix} 1 if\ I(i,j)=x\ and\ I\left(i+d_i, j+d_j\right)=y \\ 0 \qquad\qquad otherwise \end{Bmatrix} \qquad (1)$$

After devising the GLCM, the following features are accounted.

Table 1: Formulae for Texture Feature Extraction

Contrast	$\sum_i \sum_j (i-j)^2 G(i,j)$
Correlation	$\frac{\sum_i \sum_j (ij) G_{ij-\mu_i \mu_j}}{\sigma_i \sigma_j}$
Energy	$\sum_i \sum_j G\,(i-j)^2$
Homogeneity	$\sum_i \sum_j \frac{1}{1+(i+j)^2} G_{ij}.$
Mean	$\frac{1}{N}\sum_i \sum_j G_{ij}.$
Standard Deviation	$\sqrt{\left(\frac{\sum(x_i-\mu)^2}{N}\right)}.$
Entropy	$-\sum_{i=1}^{N}\sum_{j=1}^{N} G_{ij} \log[G_{ij}]$
Variance	$\frac{1}{N}\sum_{i=1}^{N}\sum_{j=1}^{N}\frac{(i-\mu)^2 G_{ij}}{\sum_{ij} G_{ij}}.$
Skewness	$\frac{\frac{1}{N}\sum_{i=1}^{N}(x_i-x')^3}{\left(\frac{1}{N}\sum_{i=1}^{N}(x_i-x')^2\right)^{\frac{3}{2}}}$
IDM	$\frac{\sum_{i=0}^{N}\sum_{j=0}^{N} G_{ij}}{1+(i-j)^2}.$

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5. Support Vector Machines

Support vector machines are employed for classification of the disease. The SVM classifiers are trained using the images and disease types in the dataset. The features, dataset, and the type of the disease is given as input to the SVM classifier to train and test the data. [13]The kernel trick is employed to map the classes from input space to a kernel space. [14]The varied types of kernel functions are polynomial kernel function, Radial Basis Function (RBF), sigmoid kernel function. The RBF kernel function is propounded in this paper. If xi and xj are two samples then the Formula for $k(x_i - x_j) = e^{-\gamma(x_i - x_j)^2}$ (2)

Where $\gamma = \frac{1}{2\sigma^2}.\sigma$ (3) is a free parameter.

5. Block Diagram

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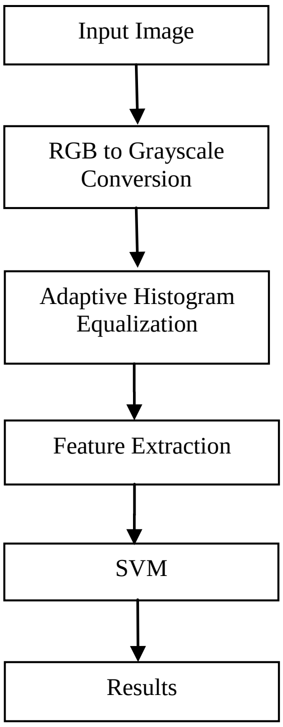

6. Methodology

Input: Standard benchmark images in RGB scale.

Output: Name of the disease

Step 1: The RGB color components of the image are transformed into Grayscale components

Step 2: Adaptive Histogram Equalization is applied to enhance the picture contrast.

Step 3: Application GLCM for texture extraction

Step 4: Classification of disease using SVM classifiers

Step 5: Display the results

7. Experimental Results

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The image of the proposed project as mentioned in the previous chapters is implemented and tested on more than 500 images taken from standard benchmark images with intensity values in the range 0-255. The following sample images are taken as the dataset of the project reported, and are used for the testing of the various operations that are done

Fig. 1 : Disease label : Anthracnose

Fig. 2 : Disease Label: Bacterial Blight

Fig. 3: Disease Label: Citrus Canker

Fig. 4: Disease Label: Gray Mould

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The image of the leaf that is to be given as the input is put into the folder and then the GLCM values of the image has to be loaded into the database. Let us assume an input leaf as shown below.

Fig.5 Input Leaf Image

According to the flow of the project, the above input image is converted into its grayscale image. The result obtained upon converting is the figure shown below.

Fig.6: Grayscale Image

This grayscale image is then subjected to Adaptive histogram equalization to enhance the contrast of the image. The result of the adaptive histogram equalization is as follows.

Fig.7: Result of AHE

The value of the 8×8 GLCM matrix that is constructed for the above image of the adaptive histogram equalization is shown in the table.

Table2: GLCM values

640	613	103	28	10	1	0	0
578	17347	2444	141	53	20	15	1
148	2409	15950	2751	274	100	48	7
23	125	2881	13478	2933	331	141	33
1	28	217	3240	10735	2121	216	56
0	3	43	271	2388	6602	1112	123
0	0	6	53	239	1254	3056	537
0	0	0	1	23	113	563	1293

The values for the 13 statistical parameters calculated using the GLCM matrix is given below.

Table3: GLCM parameters values

1	Contrast	0.4343
2	Correlation	0.9162
3	Energy	0.1010
4	Entropy	7.5866
5	Homogeneity	0.8471
6	IDM	255
7	Kurtosis	2.2498
8	Mean	77.0277
9	RMS	14.8734
10	Skewness	0.6318
11	Smoothness	1.0000
12	Standard Deviation	62.3032
13	Variance	2.3924e+03

And finally, the output is given as the disease infecting the leaf.

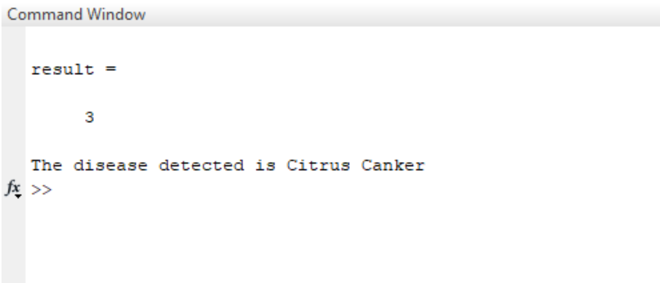

Fig.8: Output window snip

9. Conclusion

The color constituents of the image are deformed into grayscale. Adaptive Color Histogram is applied so as to reduce the overall contrast of the image. Textural feature extraction is done using GLCM. The dataset is trained using SVM classifiers, and thus the system identifies the disease that the leaf is affected. This project focuses on simple revelation of diseases in leaves at a relatively lower cost and time than conventional methods. In the future work, Convolutional Neural Networks can be used for the image classification. Also, Image Compression can be applied so that the processing time is lower than conventional methods.

References

[1] UdayPratap Singh , Siddharth Singh Chouhan ,Sukirty Jain and Sanjeev Jain ,"Multilayer Convolution Neural Network for the Classification of Mango Leaves infected by Anthracnose Disease",volume 7,pp. 43721-43728,2019

[2] Muhammad Attique Khan, M IkramUllahLali, Muhammad Sharif,KashifJaved, Khursheed Aurangzeb,Syed IrtazaHaider,AbdulazizsaudAltamrah and TalhaAkram, “An Optimized Method for Segmentation and Classification of Apple Diseases”,Special Section On New Technologies For Smart Farming 4.0:Research Challenges And Opportunities, 2019

[3] Pooja V, Rahul Das,Kanchana, “Identification of Plant Leaf Diseases using Image Processing Techniques”, IEEE International Conference on Technological Innovations in ICT for Agricultural and rural Development,pp. 130-132,2017

[4] Monicajhuria, Ashwani Kumar, and RushikeshBorse, “Image Processing for Smart Farming: Detection of Disease And Fruit Grading”, IEEE Second International Conference on Image Information Processing , 2013

[5] S.W.Zhang,Y.J.Shang and L. Wang,“Plant disease recognition based on plant leaf image”, The Journal of Animal & Plant Sciences, 25 (3 Suppl. 1) 2 Special Issue Page: 42-45,2015

[6] Pranjali B. Padol Prof. Anjali A. Yadav “SVM Classifier Based Grape Leaf Disease Detection”, 2016 Conference on Advances in Signal Processing (CASP).pp. 175-179,2016

[7] Kaleigh Smith, Pierre-Edouard Landes, Jöelle Thollot, Karol Myszkowski, Apparent Greyscale ,"A Simple and Fast Conversion to Perceptually Accurate Images and Video", 27(2), 2008.
[8] Mark Grundland, Neil A. Dodgson, Decolorize,"Fast, Contrast Enhancing, Color to Grayscale Conversion",40(11), 2007, pp.2891-2896.
[9] Gyu-Hee Park; Hwa-Hyun Cho; Myung-Ryul Choi, "A contrast enhancement method using dynamic range separate histogram equalization," Consumer Electronics, IEEE Transactions on , vol.54, no.4, pp.1981,1987, November 2008.
[10] Zhiyuan Xu; Xiaoming Liu; Xiaonan Chen, "Fog Removal from Video Sequences Using Contrast Limited Adaptive Histogram Equalization," Computational Intelligence and Software Engineering, 2009. CiSE 2009. International Conference on , vol., no., pp.1,4, 11-13 Dec. 2009
[11] Miss. Dhanashree S. Kalel , Miss. Pooja M. Pisal , Mr. Ramdas P. Bagawade, "Color, Shape and Texture feature extraction for Content Based Image Retrieval System: A Study" in International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 4, April 2016.
[12] P. Mohanaiah, P. Sathyanarayana , L. Guru Kumar, "Image Texture Feature Extraction Using GLCM Approach",International Journal of Scientific and Research Publications, Volume 3, Issue 5, May 2013K.R. Rao and P. Yip, "Discrete Cosine Transform – Algorithms, Advantages and Applications", Academic Press, San Diego, CA, 1990.
[13] Rajkumar.N, Jaganathan.P,"A new RBF kernel based learning method applied To multiclass dermatology diseases classification", Proceedings of IEEE Conference on Information and Communication Technologies,pp.551-556,2013
[14] Khaoula Tbarki, Salma Ben Said, Riadh Ksantini, Zied Lachiri, "Kernel based SVM Classification for Landmine Detection and Discrimination", International image processing applications and systems conference,pp. 1-6 ,2016

Biography

Mr. N. Karthikeyan received B.Tech., degree in Information and Technology in 2010 from Anna University, Chennai. He received M.E.in Computer Science and Engineering in 2015, University College of Engineering, BIT campus, Chennai. He is doing Ph.D.in Information and communication in Anna University, Chennai. He is doing his research work in various fields of Deep Learning and Image Processing like Image Compression, Image Security-Encryption and Decryption, Features Extraction, Image Retrieval and Image Enhancement. He has publications in various International conferences and publications in reputed Journals. He has contributed to the society as a Technical member and Guest Lecturer on Image Processing, Problem Solving Using C, C++, Python, in various Colleges in India. His area of research includes digital image processing and video processing.

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