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An Unique Technique for Grape Leaf Disease Detection

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ABSTRACT

In this paper the grape fungal diseases are detected and classified according to their features with the help of Digital Image Processing algorithms. An embedded system is used for implementing the image processing application. A plug & play Instrument Raspberry Pi 2 is utilized in multiple applications directly. India being an agro-based economy, farmers experience lots of problems in detecting and preventing diseases in fauna. Due to global warming there is change in environment which affects plants specially diseases which grow on plant. Image processing algorithms such as edge detection, RGB to grayscale conversion,Otsu‟s algorithm and watershed segmentation are implemented. This device will store input & output files on inbuilt memory cards hence external application can access it using memory address or simple file path. This tool can be used to detect various diseases in grapevine leafs & will show the result as a disease present on leaf along with its name and will suggest the related remedies.

Keywords: Embedded System,;Plug And Play; Raspberry Pi; RGB to Grayscale Conversion; Grape Leaf Disease

I. INTRODUCTION

Our economy depends on agribusiness; there are heaps of things to be taken look after great Agro generation. In India a large portion of the agriculturists are poor; they can't stand to spend on different elements like climate information, diseases acknowledgment and numerous more online applications. The stripped eye perception of specialists is the primary methodology utilized as a part of the strategy for finding and perceiving the plant infections. Be that as it may, this needs nonstop checking of specialists. At the point when there is a major ranch, this methodology may be profoundly costly and also tedious.

Further, in some creating nations, ranchers may need to go miles to contact the specialists, this makes counseling to the specialists is excessively costly and tedious and also agriculturists are unconscious of non-local infections. Plant leaf ailments broadly influence the generation of the nation here this overview contribute a brief clarification on various acknowledgment methods. Programmed discovery of plant ailments is an essential examination field as it might demonstrate resources in checking enormous field of yields, and along these lines consequently recognize infections from indication that create on plant clears out. Hence plant ailment naturally recognized with the assistance of picture preparing system which give more real and robot direction for overseeing malady. Nearly, visual distinguishing proof is less exact and tedious. Sickness ID is a repetitive assignment and generally infections are seen on the leaves or stems of the plant. There are different strategies of infection identification and demonstrate expensive. Our framework is helpful and gives minimal effort answer for the plant leaf infection discovery and characterization particularly for grape leaf diseases.

The primary goal is to build up an embedded system fit for pre-processing pictures, caught by the camera for recognition of grape leaf ailment continuously. The power of recognized ailment and its solution for beat that distinguished malady is said. . In this paper the test is performed on three sicknesses in particular Powdery mildew, Downy mildew and Black rot. Camargo and Smith (2009) proposed a method to identify regions of leaves containing lesions caused by diseases. The tests were performed using leaves from a variety of plants, like bananas, maize, alfalfa, cotton and soybean. Their algorithm is based on two main operations. First, a color transformation to the HSV and I1I2I3 spaces is performed, from which only H and two modified versions of I3 are used in the subsequent steps. After that, a thresholding based on the histogram of intensities technique[1]. Z. B. Husin et al developed quick and correct method in which the chili leaf diseases are detected using color clustering method[2].Dheeb Al Bashish et al [3] in their paper proposed an approach which consists of four main phases for five types of leaf disease. The RGB leaf image undergoes color transformation structure and then device independent color space transformation is applied, then image is segmented using K-Means clustering technique, Thirdly calculation the texture feature of segmented area of leaf.

(a) (b) (c)

Figure 1. a) Powdery b)Downy mildew c) Black rot mildew

At last classification is done through pre prepared neural network. K-Means clustering technique provides compelling results in Segmentation of RGB image. By K-Means segmentation various estimations of cluster have been tried. Best result was observed when the number of clusters is four. Kim et.al, use color texture features analysis to classify the grape fruit peel diseases. The texture features are calculated from the SGDM and squared distance technique is used for the classification. Grape fruit peel might be infected by several diseases like copper burn, greasy spot, melanose, wind scar, cankar[4]. Pre-processing used histogram equalization; features are extracted from wavelet decomposition and at last categorized by Euclidean distance method [5]. Automatic categorization of leaf diseases is done based on high resolution stereo and multispectral images [6]. color and textures features are extracted and categorization is done using neural networks [7-8] Wayne Wilcox presented grape disease control thesis and different fungicides for respected diseases [9]. A. Meunkawjin et al detected grape color by a self-organizing feature map (SOFM) with back-propagation neural network. Segmentation & optimization is done by modified SOFM with genetic algorithm. With the help of SVM & Gabor wavelet grape color feature classify & analyze [10].

II. METHODS AND MATERIAL

Subsequent to checking on different written works, obviously the undertaking of plant ailment distinguishing proof and grouping is of more prominent significance in the field of horticulture.

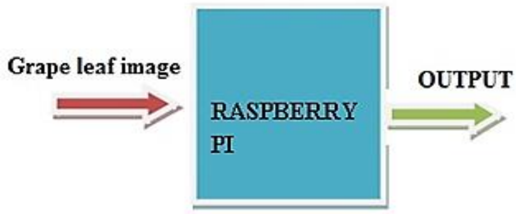


Figure 2. Block Diagram

Hence, creating electronic methods for plant sickness characterization has increased much enthusiasm for the field of exploration now days. To analyze the sickness, a picture preparing framework has been created to computerize the acknowledgment and order of different issue.

The system has image processing algorithm which processed on Raspberry pi 2 model.

A. Image Acquisition

The fundamental strategy began with capturing picture of a grape leaf utilizing the camera. The image acquisition can be done by USB webcam which we attached to Raspberry pi or another way the send image through email via internet. After the image acquisition, the HSI color transformation scheme is used.

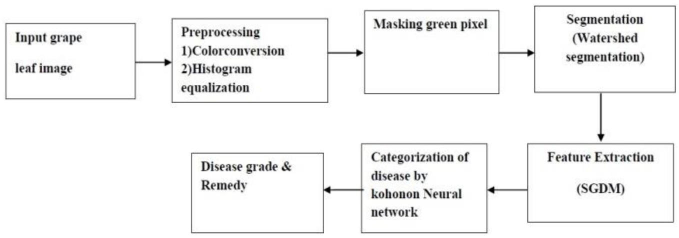


Figure 3. Basic System of Disease Detection

B. Color Transformation Structure

Hue Saturation Intensity (HSI) shading space representation of the RGB pictures of leaves are done at first. The longing of the shading space is to advance the detail of hues in some standard, for the most part in acknowledged way. This HSI (tint, immersion, force) shading model is an extremely celebrated shading model since it depends on human acknowledgment.

Electromagnetic emanation in the scope of wavelengths of around 400 to 700 nanometers is termed obvious light on the grounds that the human visual framework is receptive to this extent. Tint is for the most part identified with the wavelength of a light Hue is a shading ethicalness that alludes to the main shading as perceived by an onlooker.

Immersion call attention to the comparing immaculateness or the quantity of white light added to tone and sufficiency of the light alludes to power. Transformation of shading spaces starting with one space then onto the next should be possible effortlessly. After the change procedure, further investigation is completed with the assistance of H segment. S and I are dropped since it doesn't give additional data. [8].

Histogram equalization is one of the image enrichment techniques. This method allocates the intensities of the images. Through this allocation, increases contrast of the areas from local contrast to higher contrast. Histogram equalization is used to improve the interpretability, perceivability and quality of the image. Histogram equalization generates an output image with a uniform histogram.

C. Masking of green pixels

In this stage, the mostly green colored pixels are identified. After that, based on specific and changing threshold value means Otsu's method is used that is computed for these pixels, these mostly green pixels are masked as follows: if the pixel intensities of green component are less than the pre-computed threshold value, zero value is assigned to the red, blue and green components. This is done in the sense that these pixels have no valuable weight to the disease identification and classification steps, and areas in the leave which is in good shape represented by those pixels. Moreover, the image processing time should become significantly cut down. In next step, zero values of red, green and blue pixels were finally eliminated. More authentic disease identification and classification results with satisfied performance and the total estimation time should become very much less with the use of this phase.

D. Segmentation

From the previous steps, the infected portion of the leaf is extracted. The affected part is then segmented into proportionate size of many patches. The size of the patch is chosen in such a way that the important data is not lost. In this phase we took patch size of 32 X 32. The next stage is to extract the useful segments. Some of the segments incorporate rich amount of information. So the patches which have more than half percent of the information are taken into account for the further analysis. We used watershed segmentation method.

The watershed algorithm steps are given below

- Read in the color image & convert it to grayscale.
- Use gradient magnitude as the segmentation function.
- Mark the Foreground Objects.
- Compute background Marker.
- Compute the Watershed Transform of the segmentation function.
- Visualize the result.

Figure 4. Segmented image

E. Feature Extraction

The succeeding step is to extract texture features of the extracted diseased segments. This is done by using Gray Level Co-occurrence Matrix (GLCM) calculating. Spatial gray-level dependence matrices (SGDM‟s) are used to develop the color co-occurrence texture analysis method. Co-occurrence matrices measure the probability that pixels at one particular gray-level will appear at a specific distance and orientation from any pixel given that pixel has a second means other distant gray-level. The SGDM‟s are represented by the function P (i, j, d, θ) where the gray-level of location (x, y) in the image represented by i and j represents the gray-level of the pixel from location (x, y) at an orientation angle of θ, & at a distance d, where i is the row indicator and j is the column indicator in the SGDM matrix P (i, j, d, θ). The adjacent neighbor mask, where the reference pixel (x, y) is shown as an asterisk. The one pixel distance from the reference pixel „*‟are maintain by all eight neighbors and they are numbered as one to eight in clockwise direction as shown in the figure. The neighbors at positions 1 and 5 are both examined to be at an direction angle equal to 0◦, at the same time locations eight and four are considered to be at an angle of 45◦.[11]

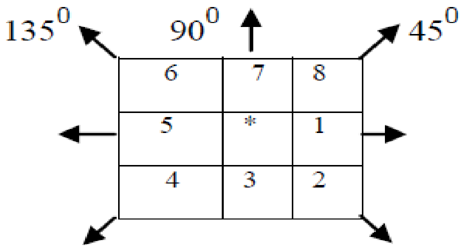


Figure 5. A sample line graph using colours which contrast well both on screen and on a black-and-white hardcopy

After the transformation processes, we calculated the feature set for H and S, we dropped (I) since it does not give extra information. However, we use GLCM function in Matlab to create gray-level co-occurrence matrix; the number of gray levels is set to 8, and the symmetric value is set to "true", and finally, offset is given a" 0" value.

The CCM matrices are then normalized using Equation 1. p(i,j) $\frac{p(i,j,1,0)}{\sum_{i=0}^{Ng-1}\sum_{j=0}^{Ng-1} p(i,j,d,0)}$ (1)

P(i,j) is the image attribute matrix,p(i,j,1,0) represents the intensity co-occurrence matrix (CCM)& Ng total number of intensity levels.Different texture features are extracted using GLCM methodology.

These features are given below.

$$\text{Energy} = \sum_{i=0}^{Ng-1}\sum_{j=0}^{Ng-1}[p(i,j)]2 \quad (2)$$

Where i, j are the spatial coordinates of the function p (i, j), Ng is gray tone.

$$\text{Entropy} = \sum_{i=0}^{Ng-1}\sum_{j=0}^{Ng-1} p(i,j)\log p(i,j) \quad (3)$$

$$\text{Correlation} = \frac{\sum_{i=0}^{Ng-1}\sum_{j=0}^{Ng-1}(i,j)p(i,j)-\mu_x\mu_y}{\sigma_x\sigma_y} \quad (4)$$

F. Detection

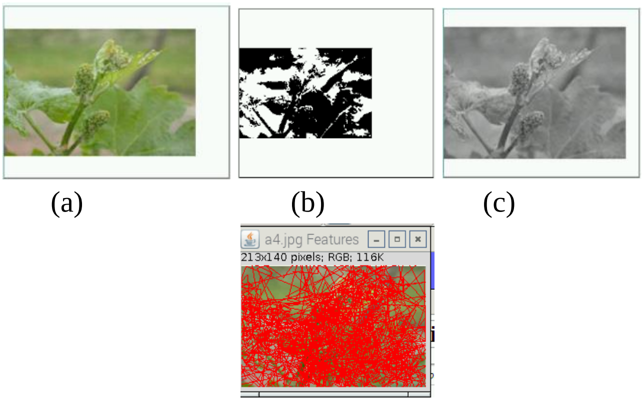
Artificial Neural Network has been a motivating methodology for training and classification purposes. In this paper,neural networks are used in the automatic detection of leaves diseases. Neural network is chosen as a classification tool due to its well-known technique as a successful classifier for many real applications. The training and validation processes are among the important steps in developing an accurate process model using NNs. The dataset for training and validation processes consists of two parts; the training feature set which are used to train the NN model; while a testing features sets are used to verify the accuracy of the trained NN model.Kohonon neural network is used to train the images. The number of neurons in the input layer corresponds to the number of input features and the number of neurons in the output layer corresponds to the number of classes. The number of nodes in the hidden layer is calculated using the Equation 5.

$$n = \frac{(I+o)}{2} + y^{0.5} \quad (5)$$

Where n= number of nodes in hidden layer,
I= number of inputs feature,
O= number of outputs, and
y= number of inputs pattern in the training set.
Once the weight of learning database has been calculated then ANN is able to test for any query image which is not already in learning database.

III. RESULTS AND DISCUSSION

We applied normal as well as Powdery mildew, Downy mildew, Black rot infected leaves of grape as input images to this device for testing. We used OpenCV libraries for this.The remedy of the detected disease is also show to user. The simulated images of the diseased leaves of grape given below



(a) (b) (c)

(d)

Figure 6. (a) Powdery mildew (b) segmented image (c) grayscale image affected leave (d) Feature extracted image

Disease Type	Training	Testing	Not detected	Percentage % Accuracy
Powdery Mildew	50	42	3	92.85
Downy Mildew	50	42	4	90.47
Black Rot	50	42	2	95.23
Normal	50	42	2	95.23
Overall percentage	93.44			

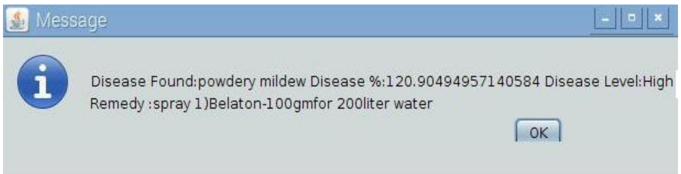
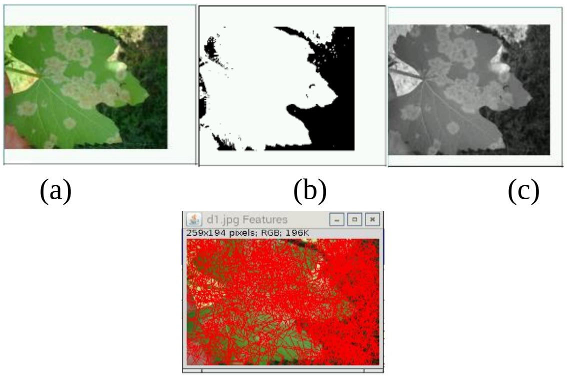


Figure 7. Result of Powdery mildew disease detected



(a) (b) (c)

(d)

Figure 8. (a) Downy mildew (b) segmented image (c) Grayscale image affected leave (d)Feature extracted image

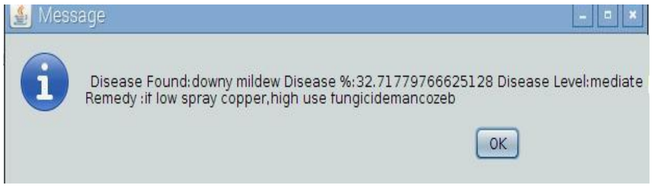
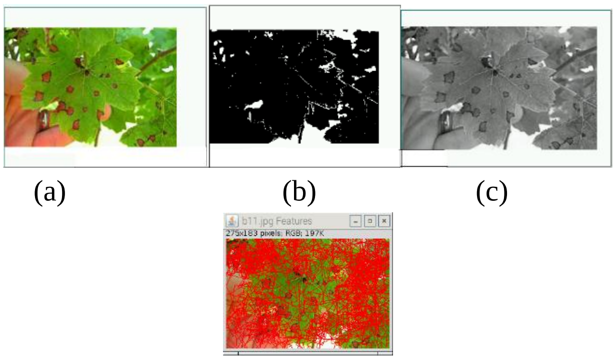


Figure 9. Result of Downy mildew disease detected



(a) (b) (c)

(d)

Figure 10. (a) Black Rot (b) segmented image (c) grayscale image affected image (d) feature extracted image.

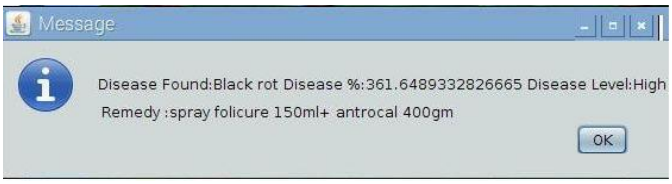


Figure 11. Result of Black Rot disease detected tables in the conclusion—these should be referenced in the body of the paper.

IV. CONCLUSION

The images of grape leaf are processed & if it is infected by any disease then the system detects the disease. Kohonen classifier is used for classifying disease on grape leaves according to their features. Overall accuracy of 93.44% has been found out with this methodology.

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