Banana Leaf Disease Identification Technique

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Abstract—There is no machine learning techniques have been used in an attempt to detect diseases in the banana plant such as banana bacterial wilt (BBW) and banana black sigatoka (BBS) that have caused a huge loss to many banana growers. The study investigated various computer vision techniques which led to the development of an approach that consists of four main phases. In phase one, images of Banana leaves were acquired using a standard digital camera. Phase two is the preprocessing phase where resizing and morphological operations occur. Next phase is the segmentation phase which translates RGB(Red Green Blue) image to YCbCr (Luminance Chrominance) color space which is then converted to a gray scale image and finally to a binarized image using Adaptive Contrast Map method. Next is the feature extraction phase where extraction of leaf features like color, texture and, shape occurs. Then comes the prominent phase were classification done Using Support Vector Machine classifier as classifier. Lastly, the performance of the classifier is evaluated to determine whether a leaf is diseased or not.

Keywords—Banana, Leaf Spot, Sigatoka, SVM, Image Processing, Disease Detection Etc.

I. INTRODUCTION

Banana research in India is directed towards increasing the production and productivity. However, banana cultivation continues to face several pests and diseases which affect the production and productivity. Many diseases occurring on banana leaf such as, Panama wilt, Sigatoka leaf spot, Bunchy top, Anthracnose, Mosaic, and Bacterial wilt etc. fungal diseases occurring on banana, Sigatoka leaf spot incited by MycosphaerellamusicolaR. Leachex J.L.Mulder also called as yellow Sigatoka is considered as a serious threat to world banana production. When leaf spots become severe, it reduces the yield drastically. Integrated pest and disease management technology have been developed for the effective, eco-friendly management of major pests and diseases, which affect productivity. Improved nutrition can boost defense mechanisms which in turn results in disease reduction through direct inhibition of fungal activity.

The banana plant is prone to diseases like BlackSigatoka, Panama wilt and Mosaic etc. In BlackSigatoka, small lesions are present parallel to the veins of the leaves. Some spots developed to form dark in color Fig 1. Yellow spots are present on the leaf surface.

Fig.1: Black Sigatoka disease on leaf

In Panama wilt, the main symptoms of this disease are yellowing ad withering of leaf. This leads to entire foliage within 2 or 3 days. In Fig 2.Shows the image of the leaf with Panama wilts disease.

Fig.2: Panama wilts disease on leaf

In Mosaic disease light green path is present parallel to the veins of the leaf. This leads to loss of green color of the leaf and mosaic path may appear parallel to the vein. In Fig 3 It shows the leaf with the mosaic disease.

Fig 3.Mosaic disease on leaf

II. RELATED WORKS

Jagadeesh Pujari , Rajesh.Yakkundimath and Abdulmunaf. Syedhusain. Byadgi [1] p r o p o s e d a grab

cut segmentation [9] approach to segment the sample image. It segments the regions between foreground and background. Features are extracted using discrete wavelet transform (DWT). Daubechies db4 wavelets are applied to the image samples for decomposition. From each color component Coefficients of approximation (CA1) and sub-image details are obtained. Principal Component Analysis (PCA) used for feature reduction. Squared Mahalanobis Minimum Distance and Probabilistic Neural Network Classifier are used as classifiers with an accuracy of 83.17% and 86.48%.

Godliver Owomugisha, John A. Quinn, Ernest Mwebaze, James Lwasa[2] Extracted the color histogram by transforming the RGB to HSV and RGB to L*a*b*.Shape was also considered as feature, which is determined by three process such as thresholding, extraction of connected components and determining the morphological features for each connected components. Peak components [12] are used for calculation of max tree [13]. The seven classifiers are used for disease classification such as, Nearest Neighbors, Decision tree, Random forest Extremely Randomized Trees, Naive Bayes and support vector classifier [7][10]. Area under the curve (AUC) analysis is used for classifiers performance evaluation.

Tejal Deshpande, Sharmila Sengupta, K.S.Raghuvanshi[3] recommended the image processing approach to identify the Bacterial Blight disease on pomegranate leaf . K-means clustering method has been used for segmentation of diseased region. Disease grading has been performed using Fuzzy logic.

Neetu Chahal , Anuradha[4] Described a methodology to detect the plant leaf diseases. It uses K-means clustering algorithm to classify objects based on a set of features into K number of sub classes. Otsu's method used for thresholding the image.color feature extracted from Color Co-occurrence Method (CCM). The texture feature taken as angular moment (E), product moment (cov), entropies, entropy feature (e), information measures of correlation (inf2), Contrast (id) and Correlation. Neural Networks (NNs) are used for classification with a precision between 83% and 94%.

H. Muhammad Asraf, M. T. Nooritawati, M.S.B. Shah Rizam[5] presented a Comparative Study in Oil Palm Leaves Nutrient Disease'. Nutrients disease is due to the imbalance between nutrients like nitrogen, potassium and magnesium. Pattern recognition approaches are used to detect the nutrient diseases. The features used are color, histogram-based texture features and gray level co-occurrence matrix (GLCM)[6]. SVM classifier with soft margin is capable of best performance with an accuracy of 95%.

III.   PROPOSED SYSTEM

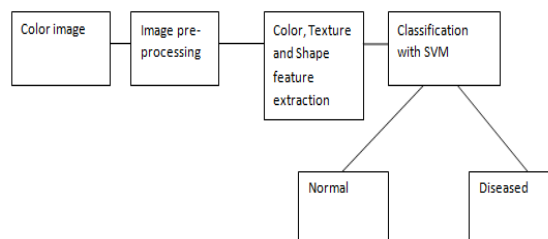The figure 4 shows the block diagram of the proposed system.

Fig.4: Block Diagram of proposed system

Here the work is applied on the banana leaf for Black Sigatoka disease detection. The first step is to take the input image in RGB format. Then convert it into YCbCr color space. From that grayscale image, Y component extracted. The next step is to apply adaptive contrast map to enhance the leaf diseased portions. This image is then converted into the binary image using a threshold. The threshold value is set to 0.1. The morphological operations like dilation, filing holes are applied. The small components in the leaf are removed. The resultant image obtained shows white pixels in the diseased area and black pixels in the normal portions. The color, texture and shape features are extracted for classification. skewness, kurtosis and mean are taken as the color features. To do this, we transform RGB to YCbCr.

Mean is used to represent average value of Red, green and blue color channel

$$\mu = \frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N} Pij \tag{1}$$

Skewness is used to check the symmetry of data distribution. If a distribution is symmetric, it looks the same to the left and right of the center point. Kurtosis is used to check whether the data are peaked or flat relative to a normal distribution [8].

Skewness can be described as follows,

$$S = \frac{\sum_{i=1}^{M}\sum_{j=1}^{N}(Pij - \mu)^3}{MN\sigma^3} \tag{2}$$

Kurtosis can be described as follows,

$$k = \frac{\sum_{i=1}^{M}\sum_{j=1}^{N}(Pij - \mu)^4}{MN\sigma^4}$$

(3)

Shape features used are solidity, extent, minor axis length and eccentricity. The Gray-Level Co-occurrence Matrix (GLCM) is used to extract the texture features. The texture features extracted are contrast, correlation, energy, and homogeneity. Eccentricity is the measure of whether the disease shape is a circle or line segment. It is the ratio of the distance between major axis length and the foci of the ellipse-shaped disease region. An ellipse with eccentricity 0 is representing a circle and, an ellipse whose eccentricity is 1 is representing a line segment. Minor axis length represents the length of the diseased region. Extent is the measure of the area of the diseased region that is divided by the area of the bounding box. Solidity is used to calculate the area of the diseased region divided by the pixels in the convex hull. These 17 features are classified using Support Vector Machine (SVM) classifier.

i) SUPPORT VECTOR MACHINE

SVM was chosen as the binary classifier because it can classify accurately even when limit samples were available. The hyperplane samples the data samples also it can be calculated using function f(x) =sign (w.x) + b, where w is a weight vector and b is a threshold cut-off. To maximize the function, we need to minimize w and b.

$$Xi.w + b \geq +1 \, for \, yi = +1$$
$$Xi.w + b \leq -1 \, for \, yi = -1$$
$$Yi\,(xi.w + b) - 1 \geq 0$$

(4)

Slack variable is used to prevent over fitting, it can be written as,

$$Xi.w + b \geq +1 - \xi \, for \, yi = +1$$
$$Xi.w + b \leq -1 + \xi \, for \, yi = -1$$
$$Yi\,(xi.w + b) - 1 + \xi \geq 0$$

(5)

In svm classifier, non-linear data is classified using a hyperplane figure 5 shows the image of nonlinear data classification
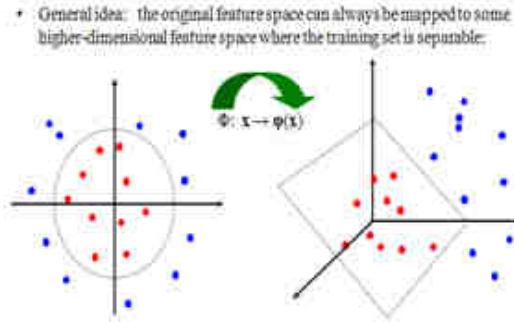

Fig.5: Nonlinear data separation

Different types of svm classifiers used for classification are shown in Table I,

Table.I: Different kernel in SVM

linear	$K(x_i, x_j) = x_i^T x_j$
quadratic	$K(x_i, x_j) = ((x_i, x_i^1) + 1))^2$
polynomial	$K(x_i, x_j) = ((x_i, x_i^1) + 1))^3$
Radial basis function	$K(x_i, x_j) = \exp\left(-\frac{\|xi - xj^T\|^2}{2\sigma^2}\right)$

Output from the classification determines whether the leaf is diseased or not. Fig.6 shows the block diagram of steps in disease detection.
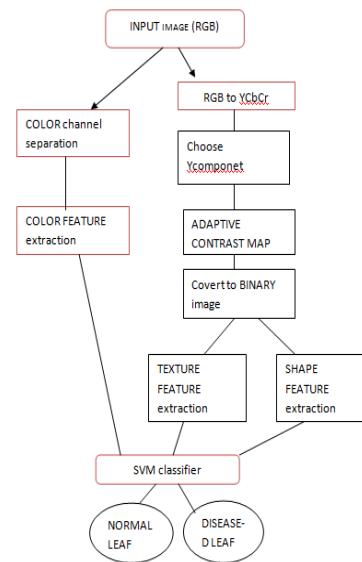

Fig.6: block diagram of steps in disease detection.

IV. IMPLEMENTATION

The proposed work is implemented using MATLAB R2013a. The normal and diseased samples of banana leaves are collected from Chirayikeezhu agricultural farm. The two dataset are created for training and testing phase. The dataset first contains 11 diseased leaf images and dataset two contains 3 normal leaf images. Six diseased

images and 2 normal leaf images are used for training. Five diseased images and one normal leaf are used for testing the classifier. Fig 7 shows the sample diseased leaf images used for testing.
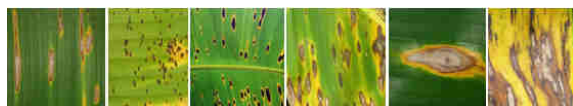

Fig.7: Sample diseased leaf images

Fig 8 shows the sample normal leaf images used for testing.

Fig.8: Normal leaf images

The input image is the RGB color image of banana leaf figure 9 shows the sample input image. The RGB image is first converted into YCbCr color space and the gray scale image is obtained by using 'Y' component. The next step is to apply adaptive contrast map to enhance the leaf diseased portions figure 10 shows the image of enhancement of leaf diseased portion. This image is then converted into the binary image using a threshold figure 11 shows the binarized result. The threshold value is set to 0.18. The morphological operations like dilation, filing holes are applied. The small components in the leaf are removed. The resultant image obtained shows white pixels in the diseased area and black pixels in the normal portions in figure 12.
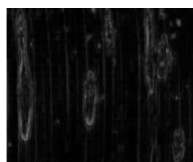

Fig.9: Input image

Fig.10: Adaptive contrast map
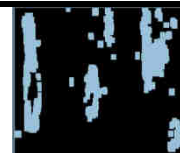

Fig.11: Binarized result

Fig.12:Binary Image after Morphology

V.   RESULTS AND DISCUSSION

This work is implemented using MATLAB R2013a.The two dataset are created for training and testing phase. The dataset first contains 11 diseased leaf This thesis work is implemented using MATLAB R2013a.The two dataset are created for training and testing phase. The dataset first contains 11 diseased leaf images and dataset two contains 3 normal leaf images. Six diseased images and 2 normal leaf images are used for training of the classifier. Five diseased images and one normal leaf are used for testing the classifier.

Features are extracted as shown as below,

Table.II: Features of Diseased Leaf

```
********* Shape Features **********
Solidity = 1.000000
Extent =1.000000
Minor axis length=10.392305
Eccentricity=0.435890
********* Texture Features ***********
contrast = 0.000000
correlation =NaN
Energy=1.000000
Homogeneity=1.000000
********* Color Features **********
Mean = 87.240656,110.800794,43.973495
skewness =1.727413,1.103354,2.322765
kurtosis=5.484925,5.026168,12.465870
```

Table.III: Features of Normal Leaf

```
********* Shape Features **********
Solidity = 0.904167
Extent =0.438827
Minor axis length=11.098462
Eccentricity=0.976920
********* Texture Features **********
contrast = 0.000000
correlation =NaN
Energy=1.000000
Homogeneity=1.000000
********* Color Features **********
Mean = 127.773181,181.679431,23.814214
skewness =-0.181327,-0.321896,1.481901
kurtosis=2.837969,2.558014,6.146515
```

Normal and diseased leaf has the different texture, color and shape features. The Diseased leaf contains different Red, Blue and Green distribution values. The Mean is high for normal leaf compared to diseased leaf. Solidity and Extent are unique for diseased leaf but it is less for the normal leaf.

The two dataset are created for training and testing phase. The dataset first contains 11 diseased leaf images and dataset two contains 3 normal leaf images. Six diseased

images and 2 normal leaf images are used for training of the classifier. Five diseased images and one normal leaf are used for testing the classifier. Table IV shows the number of dataset.

Table.IV: Dataset

Process	Number of diseased leaf	Number of Normal leaf
Training	50	40
Testing	60	30

VI. CONCLUSION & FUTURE WORK

This work presents an efficient method for image pattern classification in Banana leaf disease identification. Firstly, normal and diseased leaf images are collected and pre-processed. Then, features of shape, color and texture are extracted from these images.

17 features are used for the classification. Images are captured in RGB format. RGB cannot represent color in terms of human perception. It transforms image color from RGB to YCbCr. After that, these images are classified using support vector machine. These algorithms described in chapters are explained as testing proves that SVM classifier gives the good result.

This work just determines whether the plant leaf is diseased or not and does not grade the disease. To ensure greater efficiency and effectiveness we need a grading system which enables us to prioritize the disease according to their intensity. The grading system can be Determined by calculating percent infection and then ranked accordingly through fuzzy logic technique.

The existing technology takes still image as the input while the future work is to video input.

The existing system takes into 17 features from the input image then the proposed system reduces the unimportant features and finds out important features. The enhanced system uses machine learning approaches to ensure that only relevant features are extracted.

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