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Classification of Cotton Leaf Spot Disease Using Support Vector Machine

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Abstract
In order to obtain more value added products, a product quality control is essentially required Many studies show that quality of agriculture products may be reduced from many causes. One of the most important factors of such quality plant diseases. Consequently, minimizing plant diseases allows substantially improving quality of the product Suitable diagnosis of crop disease in the field is very critical for the increased production. Foliar is the major important fungal disease of cotton and occurs in all growing Indian cotton regions. In this paper I express Technological Strategies uses mobile captured symptoms of Cotton Leaf Spot images and categorize the diseases using support vector machine. The classifier is being trained to achieve intelligent farming, including early detection of disease in the groves, selective fungicide application, etc. This proposed work is based on Segmentation techniques in which, the captured images are processed for enrichment first. Then texture and color Feature extraction techniques are used to extract features such as boundary, shape, color and texture for the disease spots to recognize diseases.

***Key Words*:** Feature extraction, segmentation, Support vector Machine (SVM)

I. INTRODUCTION

India is known as agricultural country where large percentage of the population depends on agriculture. The farming of different crops for optimum yield and quality product is highly important. It can be improved with the help of technological support. India is the important cotton growing country. Many states in India grows cotton. Cotton is also known as" The White Gold" or the "emperor Fibers" enjoys a most excellent status among all cash crops in the country. It provides livelihood to about sixty million people and is an important agricultural commodity providing remunerative income to millions of farmers both in developed and developing countries. The world textile industries require cotton. India thus enjoys the distinction of being the earliest country in the world to domesticate cotton and utilize its fibre to manufacture fabric. The main cause for the disease is the leaf of the cotton plant. About 80 % of disease on the cotton plant is on its leaves. Therefore our study of interest is the leaf of the cotton tree rather than whole cotton plant the cotton leaf is mainly suffered from diseases like fungus, Foliar leaf spot of cotton,. The machine vision system now a day is normally consists of computer, digital camera and application software.

Image recognition has attracted many researchers in the area of pattern recognition, similar flow of ideas are applied to the field of pattern recognition of plant leaves, that is used in diagnosing the cotton leaf diseases. We know that observation of the human eye is not so strong that he can the infected part of image because that minute variation pattern of color can be a different disease present on the leaf of cotton. Our software can provide the exactly differentiate the difference of color present on these leaves and depending upon that difference the further compare with database stored image features related to the color

1.1 The Image analysis in agriculture

The Image analysis techniques are extensively applied to agricultural science, and it has great use especially in the plant protection field. Image analysis can be applied for the following purposes:

1. To detect diseased leaf, stem, fruit
2. To quantify affected area by disease.
3. To find the boundaries of the affected area.
4. To determine the color of the affected area
5. To determine size & shape of fruits.
6. To identify the Object correctly. [2]

1.2 Types of cotton leaf spot diseases

The various diseases recognize on the cotton leaf spots are classified as

- Grey mildew
- Bacterial blight
- Leaf curl
- Fusarium wilt
- Verticillium wilt

- Alternaria Leaf Spot-alternaria Macro Spora

1.3 Symptoms of Cotton Diseases

1.3.1 Foliar leaf spot on cotton

As shown in above figures the, the disease is known as foliar disease arises due to potassium deficiency [2], [3], [4].

Fig -1: Foliar leaf spot on cotton

Fig -2: Foliar leaf spot on cotton

The early stage of this disease is as shown in fig 1, now if the more spots of this disease results into the final stage of this plant where the plant leaf is get fall so it is called as Foliar disease of the cotton plant as shown in fig 2. The leaf is having multiple no of spots which clearly denotes more potassium deficiency in the plant. [3]

1.3.2 Bacterial Blight

Xanthomonas campestis PV. Malvacearum Bacterial blight starts out as Dark green, water soaked angular leaf spot of 1 to 5 mm across the leaves and bracts, especially on the under surface of leaves with a red to brown border

Fig -3: Bacterial Blight

The angular appearance is due to restriction of the lesion by fine veins of the cotton leaf. Spots on infected leaves may spread along the major leaf veins as disease progresses, leaf petioles as shown in Fig. The angular leaf spot, results in premature defoliation and stems may become infected resulting in premature defoliation. [2][3]

1.3.3 Alternaria Leaf Spot-alternaria Macro Spora

Fig -4: Alternaria Leaf Spot-alternaria Macro Spora

This causes small, gray, pale to brown, round or irregular spots measuring 0.5 - 3 mm in diameter and cracked centers appears on the affected leaves of the plant. Affected leaves become dry and fall off [2][3]

1.3.4 Grey mildew

This disease primarily appears on older leaves as the plants reach middle age, in the form of irregularly angular, pale spots, usually 3-4 mm in diameter and The lesions are light to yellowish green on the upper surface. As the spots grow older, the leaf tissues turn yellowish brown while a whitish frosty growth appears chiefly on the under surface but occasionally also on the upper surface. [1][2][3]

1.3.5 Cerco Spora-leaf Spot Cerco Spora

Fig -5: Cerco Spora-leaf Spot

The disease affects older leaves of mature plants. The spots are round or irregular in shape yellowish brown, with purple, dark brown or blackish borders and white centers affected leaves become pale in color and finally fall off [3]

II. LITERATURE SURVEY

The fuzzy feature selection approach fuzzy curves (FC) and surfaces (FS) - is proposed to select features of cotton disease leaves image. In order to get best information for diagnosing and identifying, a subset of independent significant features is identified exploiting the fuzzy feature selection approach. [6] Detection and classification of rice diseases, including RBLB, RSB and RB. Rice disease spots were segmented efficiently according to color and outline of disease spots. Four shape features (rectangularity, compactness, elongation and roundness) and 60 texture features (contrast,

uniformity, entropy, inverse difference and linearity correlation) of disease spot were extracted [9]

The objective of this paper is to concentrate on the plant leaf disease detection based on the texture of the leaf. Leaf presents several advantages over flowers and fruits at all seasons worldwide [2] Homogenize techniques like sobel and canny filter has been used to identify the edges by P.Revathi *et al.* [3]. These extracted edge features have been used in classification to identify the disease spots. The proposed homogeneous pixel counting technique for cotton diseases detection (HPCCDD) algorithm has been used for categorizing the diseases. They claim the accuracy of 98.1% over existing algorithm. [2] Dheeb Al Bashish, et al. [4] developed neural network classifier based on statistical classification and could successfully detect and classify the diseases with a precision of around 93%. Menukaewjinda *et al.* [14] tried another ANN, i.e. back propagation neural network (BPNN) for efficient grape leaf color extraction with complex background. They also explore modified self organizing feature map (MSOFM) and genetic algorithm (GA) and found that these techniques provide automatic adjustment in parameters for grape leaf disease color extraction. Support vector machine (SVM) has been also found to be very promising to achieve efficient classification of leaf diseases. The major techniques for detection of plant diseases are: BPNN, SVM, K-means clustering, and SGDM. These techniques are used to analyses the healthy and diseased plants leaves. Some of the challenges in these techniques viz. effect of background data in the resulting image, optimization of the technique for a specific plant leaf diseases, and automation of the technique for continuous automated monitoring of plant leaf diseases under real world field conditions. The review suggests that this disease detection technique shows a good potential with an ability to detect plant leaf diseases and some limitations. [10] WEB-based Intelligent Diagnosis System for Cotton Diseases Control has been developed in BP neural network as a decision-making system to establish an intelligent diagnosis model[16]. In [12] paper, Zhang Jian applied support vector machine method to the identification of cucumber diseases. They carried out two sets of tests using different kernel functions. The results showed that, the SVM method based on the RBF kernel function when they took each spot as a sample made the best performance for classification of diseases of cucumber Presented work carried out CMYK based image cleaning technique to remove shadows, hands and other impurities from images. The images are subsequently classified using two indigenous techniques RPM and Dis Bin and compared with the classical PCA based technique. [15]

III. METHODOLOGY

The methodology for diagnosing cotton leaf spot diseases involves several tasks, such as Image acquisition, image enhancement, segmentation, shape feature extraction and color based segmentation, and cotton leaf diseases classification based on lesion percentage, lesion type, boundary color, spot color, and cotton leaf color.The first phase is the image acquisition phase. In this step, the images of the various leaves that are to be classifies are taken using a digital camera. In the second phase image preprocessing is completed. In the third phase, segmentation is performed to discover the actual segments of the leaf in the image. Later on, feature extraction for the infected part of the leaf is completed based on specific properties among pixels in the image or their texture. After this step, certain statistical analysis tasks are completed to choose the best features that represent the given image, thus minimizing feature redundancy. Finally, classification is completed using support vector machine.

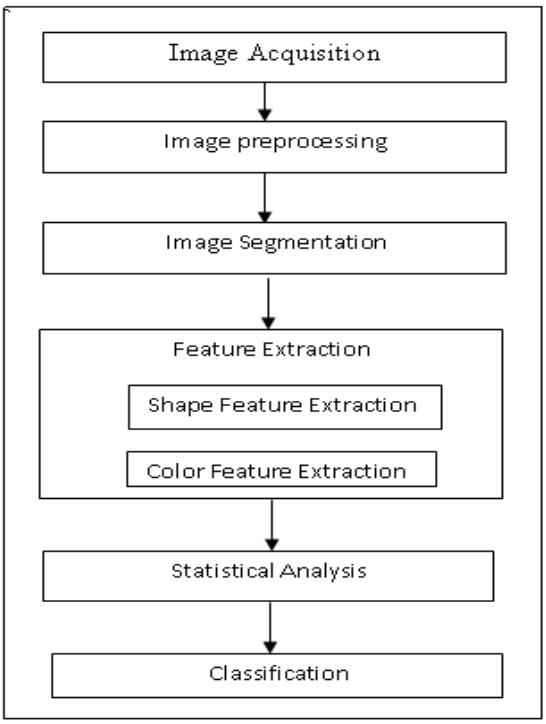

Fig -6: Stages for classification of cotton leaf spot diseases

3.1 Image Acquisition

The RGB color images of cotton leaf are captured using a digital camera. Images are stored in BMP format.

33.2. Image Pre-Processing and Segmentation

The pre-processing task involves some procedures to prepare the images enhancement.

Cotton leaf image is in RGB color format. The RGB image is converted to a grayscale image, next, the image segmentation based on gray-level threshold segmentation is adapted and the binary image is gained. This research applied global threshold, variable threshold and Otsu method for an automatic threshold. Camera flash can act as noise and affects the image quality. Hence, median filter and morphological operators are applied to remove unnecessary spots

3.3 Feature Extraction

When crops suffer from many diseases, batches (spots) often happen on leaves. Leaf spots are considered the important units indicating the existence disease and regarded as indicator of crops disease. In order to classify disease leaf samples category, a set of spot features for Classification and detection of the different disease leaves are investigated. Spot features are extracted from image using the appropriate image processing method. These features are very important for the color and morphology of the leaf spots and they provide critical information about its visual representation. The features correspond to color characteristics are the mean and variance of the gray level of the red, green and blue channel of the spots; and other features correspond to morphological and geometrical characteristics of the spots. By using segmentation technique it is easy for us to extract the features of disease leaf of the image.

The image analysis here focuses on the shape feature extraction and color based segmentation.

3.3.1 Shape Feature Extraction

General descriptors such as number of the object, area of the shape object, width and length of the object, and area of image, are important characteristics to describe its shape. Those characteristics are used to extract feature the lesion, spot and percentage of the lesion. Blob Analysis is used in this research to calculate statistics for labeled regions in a noise free binary image, such as the number of the object, area, and perimeter.

3.3.2 Color Feature Extraction

Color is an important sign in recognizing different classes. The pixel in a color image is commonly represented in the RGB space, in which the color at each pixel is represented as a triplet *(R, G, B)*, where *R*, *G* and *B* are respectively the red, green, and blue value from a color image capturing device. Other color spaces like the HSI and CIE color model are also used in many other segmentation methods where their benefits and limitations are analyzed and reported [13]. Generally, the color difference is evaluated using the distance between two color points in a color space. The most common distance is Euclidean distance. Our planned technique is based on the CIELab color space, which is a uniform chromaticity color space to get boundary color, spot color and broken leaf color. It is known that Euclidean distance of two colors is proportional to the difference that human visual system perceived in the CIELab color space [14]. Generally the image is composed of RGB color components. Thus, we must convert RGB color components to CIELab color component.

3.4 Statistical Analysis

Statistical analysis tasks are completed to choose the best features that represent the given image, thus minimizing feature redundancy. [4]

3.5 Classification

The Concept of SVM (Support Vector Machine) was introduced by Vapnik and co-workers. It gains popularity because it offers the attractive features and powerful machinery to tackle the problem of classification i.e., we need to know which belongs to which group and promising empirical performance. The SVM is based on statistical learning theory. SVM's better generalization performance is based on the principle of Structural Risk Minimization (SRM) .The concept of SRM is to maximize the margin of class separation. The SVM was defined for two-class problem and it looked for optimal hyper-plane, which maximized the distance, the margin, between the nearest examples of both classes, named SVM.

At present SVM is popular classification tool used for pattern recognition and other classification purposes. Support vector machines (SVM) are a group of supervised learning methods that can be applied to classification or regression. The standard SVM classifier takes the set of input data and predicts to classify them in one of the only two distinct classes. SVM classifier is trained by a given set of training data and a model is prepared to classify test data based upon this model. For multiclass classification problem, we decompose multiclass problem into multiple binary class problems, and we design suitable combined multiple binary SVM classifiers [17].

Most traditional classification models are based on the empirical risk minimization principle. SVM implements the structural risk minimization principle which seeks to minimize the training error and a confidence interval term. A number of applications showed that SVM hold the better classification ability in dealing with small sample, nonlinearity and high dimensionality pattern recognition. Support Vector Machines are based on the concept of decision planes that define decision

boundaries. A decision plane is one that separates between a set of objects having different class memberships. The classifier that separates a set of objects into their respective classes with a line. Most classification tasks, however, are not that simple, and often more complex structures are needed in order to make an optimal separation, i.e., correctly classify new objects (test cases) on the basis of the examples that are available (train cases).

All the information from above processes is given to multiclass SVM .The Multiclass SVM is used for cotton leaf spot disease classification. The cotton leaf color is segmented corresponding to number of weight vectors. Information from segmented images both diseased and non-diseased pixels are used for training in support vector machine for cotton leaf disease segmentation.

IV. PERFORMANCE ANALYSIS

Researchers have investigated for different feature extraction technique and different classifier. Some analyses from different research paper are listed below.

Table -1: Performance analysis

Ref no	Purpose/Feature Extraction	Classifier	Accuracy(%)
1	Canny edge detection, color feature extraction	HPCCDD	98.1
16	WEB-based Intelligent Diagnosis System for Cotton Diseases Control	BPNN	90
5	fuzzy feature selection approach-for fuzzy curves (Fe) and surfaces (FS)	BPNN	90
15	CMYK based image cleaning technique-to remove shadows, impurities	RPM ,Dis Bin, PCA	83
17	Wavelet transform	SVM	97
18	RGB color feature extraction model	NN	75.9
3	Image enhancement-anisotropic- diffusion technique Color image segmentation - unsupervised SOFM network	ANN	85-91
9	Texture feature extraction-GLCM	SVM	97.2

V. CONCLUSIONS

This work consists of identifying the affected part of the disease. Cotton leaf spot disease spots were segmented efficiently according to color and outline of disease spots. Initially Image segmentation is done, and finally image analysis and important features are extracted and classification of diseases is performed using SVM classifier.

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