Detection of Diseases on Cotton Leaves and Its Possible Diagnosis

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Abstract

In a research of identifying and diagnosing cotton disease, the pattern of disease is important part in that, various features of the images are extracted viz. the colour of actual infected image, there are so many diseases occurred on the cotton leaf so the leaf colour for different diseases is also different, also there are various other features related to shape of image, also there are different shape of holes are present on the leaf of the image, generally the leaf of infected image have elliptical shape of holes, so calculating the major and minor axis is the major task. The features could be extracted using self organizing feature map together with a back-propagation neural network is used to recognize colour of image. This information is used to segment cotton leaf pixels within the image, now image which is under consideration is well analyzed and depending upon this software perform further analysis based on the nature of this image.

Keywords: Image Processing Application in Agriculture Science, Coding, Analysis and Recognition, Biomedical Image Processing.

1. INTRODUCTION

The world textile industries are being ruled by “King Cotton”. The antiquity of cotton has been traced to the fourth millennium BC. For over three thousand years (1500 BC to 1700 AD), India was recognized as cradle of cotton industry[1]. India thus enjoys the distinction of being the earliest country in the world to domesticate cotton and utilize its fiber to manufacture fabric. India is India accounts for approximately 25 per cent of world’s cotton area and 16 per cent of total cotton production. Maharashtra is the important cotton growing state in India with 31.33 lack hector area and production of 62.00 lack bales (2008-09). The 2nd largest producer of cotton in the world. About 3 million farmers are engaged in cotton cultivation in the state mostly in backward region of Marathwada and Vidarbha[1].

In Vidarbha region, cotton is the most important cash crop grown on an area of 13.00 lacks hectors with production of 27 lack bales of cotton (2008-09). Disease on the cotton is the main problem that decreases the productivity of the cotton.

The main source for the disease is the leaf of the cotton plant. About 80 to 90 % of disease on the cotton plant is on its leaves. So for that 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, Alternaria leaf spot of cotton. The machine vision system now a day is normally consists of computer, digital camera and application software. Various kinds of algorithms are integrated in the application software. Image analysis is one important method that helps segment image into objects and background. One of the key steps in image analysis is feature

detection [8]. Study of diseases on the cotton leaf can robustly studied by the image processing toolbox and also the diagnosis by using MATLAB helps us to suggest necessary remedy for that disease arises on the leaf of cotton plant.

We know that perception of the human eye is not so much stronger that he can differ minute variation in the infected part of image because that minute variation pattern of colour can be a different disease present on the leaf of cotton.

Our software can provide the exactly differentiate the variation of colour present on these leaves and depending upon that variation the further compare with database stored image features related to the colour.

2. REVIEW OF PRIOR FEATURE TECHNIQUE

Various papers are suggesting to diagnosis the cotton leaves using various approach suggesting the various implementation ways as illustrated and discussed below. In the research of identifying and diagnosing cotton disease using computer vision intellectively in the agriculture, feature selection is a key question in pattern recognition and affects the design and performance of the classifier. In previous paper [9], 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. Firstly, utilize FC to automatically and quickly isolate a small set of significant features from the set of original features according to their significance and eliminate spurious features; then, use FS to get rid of the features dependent on the significant features. This approach reduces the dimensionality of the feature space so that lead to a simplified classification scheme appropriate for practical classification applications. The results show that the effectiveness of features selected by the FC and FS method is much better than that selected by human randomly or other methods. Also another approach is used to diagnosis the grape leaf disease identification or diagnosis, i.e. paper explaining the grape leaf disease detection from colour imaginary using hybrid intelligent system, in that automatic plant disease diagnosis using multiple artificial intelligent techniques. The system can diagnose plant leaf disease without maintaining any expertise once the system is trained. Mainly, the cotton leaves disease is focused in this work. The proposed system consists of three main parts (a) cotton leaf colour segmentation (b) cotton leaves disease segmentation and (c) analysis and classification of diseases.

Segmentation algorithms fall into two general classes, based on whether they searching for discontinuities or similarities. Algorithms focusing on locating discontinuities in the data are primarily edge-based, while algorithms concerned with locating adjacent pixels based on similarities are primarily region-based.

Threshold techniques, a major category of algorithms, can fall into either class. In addition to these two major classes, there are also a number of general subcategories. For instance, algorithms either process colour or gray-scale data, operate on either an individual pixel basis (global) or a neighbourhood of pixels (local), and may use different window sizes or different colour representations [10]. For example survey of segmentation algorithms [11]. Cheng discussed the major segmentation approaches for segmenting monochrome images: histogram threshold, characteristic feature clustering, edge detection, region-based methods, fuzzy techniques, neural networks training method.

The cotton leaf disease segmentation is performed using modified self organizing feature map with genetic algorithms for optimization and support vector machines for classification. Finally, the resulting segmented image is filtered by Gabor wavelet which allows the system to analyze leaf disease colour features more efficient. The support vector machines are then again applied to classify types of grape leaf diseases. Similar idea can be extracted from to grape leaf disease diagnosis system [7] and applicable to cotton leaves diagnosis system.

3. DISEASES ON LEAVES OF COTTON

The diseases on the cotton leaves are classified as

a) Bacterial disease: e.g. Bacterial Blight, Crown Gall, Lint Degradation.
b) Fungal diseases: e.g. Anthracnose, Leaf Spot.
c) Viral disease: e.g. Leaf Curl, Leaf Crumple, Leaf Roll.
d) Diseases Due To insects: e.g. White flies, Leaf insects.

Out of the above types of disease these are dramatically affect the leaf of cotton plant and its leaves. We go through the selective type of diseases on the cotton leaves. And further we discuss the ANN image segmentation method to detect the diseases on cotton plant by scanning of cotton leaves through our portable dedicated scanner.

Various diseases are found on the cotton plant out of this we discuss the disease some of the major diseases which are often found on the leaves of cotton, that are viz.

3.1 Foliar leaf spot on cotton

FIGURE 1

FIGURE 2

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

3.2 Curl Gemini virus

FIGURE 3

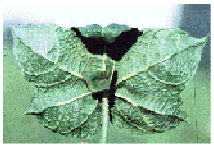


FIGURE 4

FIGURE 5

Cotton leaf curl Gemini virus (CLCuV) causes a major disease of cotton in Asia and Africa [2],[3],[4]. Leaves of infected cotton curl upward Fig 3. and bear leaf-like enations on the underside along with vein thickening Fig 4. Plants infected early in the season are stunted and yield is reduced drastically. Severe epidemics of CLCuV have occurred in Pakistan in the past few years, with yield losses as high as 100% in fields where infection occurred early in the growing season. Another cotton Gemini virus, cotton leaf crumple virus (CLCrV), occurs in Arizona, California, and Mexico. CLCrV symptoms are distinguishable from CLCuV symptoms in that infected leaves curl downward accompanied by interveinal hypertrophy and foliar mosaic Fig 5, both CLCrV and CLCuV infect dicotelydonous plants and are whitefly-transmitted (Brown et al., 1983; Mansor et al., 1993). Previous studies (Brown and Nelson, 1984; 1987; Hameed et al., 1994; Mansor et al., 1993) suggested that they belong to the subgroup III Gemini viruses. However, little information is available on the relationship of these two viruses with each other and with other subgroup III Gemini viruses.

3.3 Bacterial Blight

FIGURE 6

Xanthomonas campestis pv. Malvacearum Bacterial blight starts out as angular leaf spot with a red to brown border [2],[3],[4]. 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 6. The angular leaf spot, results in premature defoliation and stems may become infected resulting in premature defoliation.

3.4 Cerco Spora-leaf Spot Cerco Spora

FIGURE 7

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 colour and finally fall off [2],[3],[4] as shown in Fig 7.

3.5 Alternaria Leaf Spot-alternaria Macro Spora

FIGURE 8

As shown in Fig 8, small, 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 [3],[4],[5],[6]. The disease may cause cankers on the stem. The infection spreads to the bolls and finally falls off.

4. FEATURES OF LEAF IMAGE

When crops suffer from many diseases, batches (spots) often happen on leaves [7]. 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, as in Fig 9 ,10,11 are investigated[9].

FIGURE 9 FIGURE 10 FIGURE 11

Spot features are extracted from image sing the appropriate image processing method. These features are very important for the colour and morphology of the leaf spots and they provide critical information about its visual representation. The features correspond to colour 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.

There is main feature related to colour of leaf image i.e. infected part of the particular disease leaf image is having the variations in its RGB values, means that variations is certain, i.e. that variation of RGB values i.e. combined RGB value is not repeated with another diseased leaf image RGB values.

The extraction of the features and image disease classification during this steps is as shown in the following fig. 12. There are various features of the leaf of image, thresholding, sobel features, canny features etc.

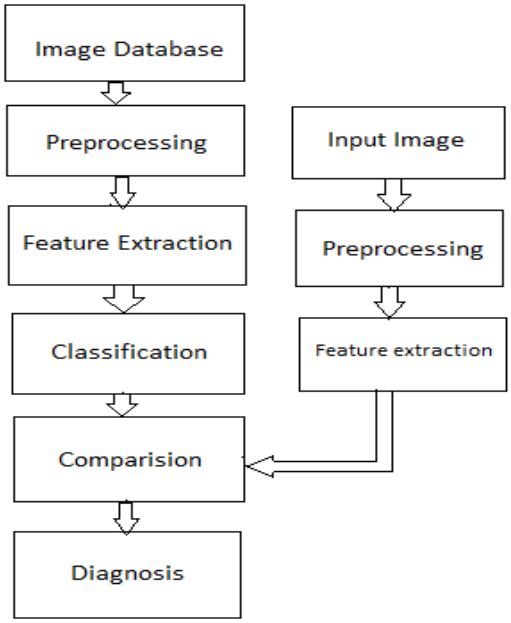


FIGURE 12: Overview of Diagnosis system using feature extraction

Here in the feature extraction, we have to classify our features in accordance with the various diseases presents on the leaf. As the diseases changes features are also changes and lastly actual image compare and final result should be available.

5. COLOR IMAGE SEGMENTATION

It is one of the colour image feature extraction technique, this technique is called as colour image segmentation [8],[9]. Using this technique it is easy for us to extract the various features of diseased leaf of cotton image. as shown in fig 13 below.

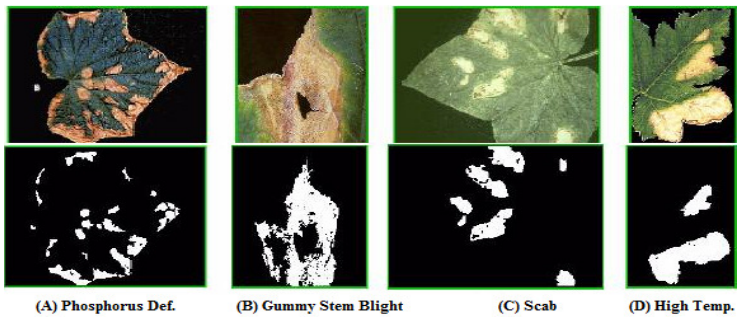


FIGURE 13

Now by formulating overall cotton leaf diagnosis system as shown in Fig 14

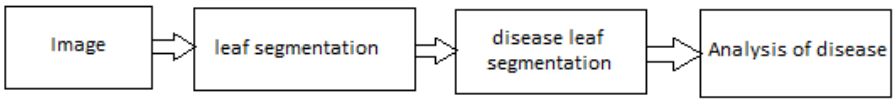


FIGURE 14: Cotton leaf diagnosis system

In this part the input image is enhanced by using anisotropic-diffusion technique to preserve the information of extracted pixels before extracting cotton leaf colour from background and B components from HIS and LAB colour space, respectively, are use to reduce effect of illumination. The resulting colour pixels are clustered by the unsupervised SOFM network to obtained group of colour in the image. The back propagation neural network is then applied to extract cotton leaf colour from diseased part of image. The implementation can be shown in fig 15.

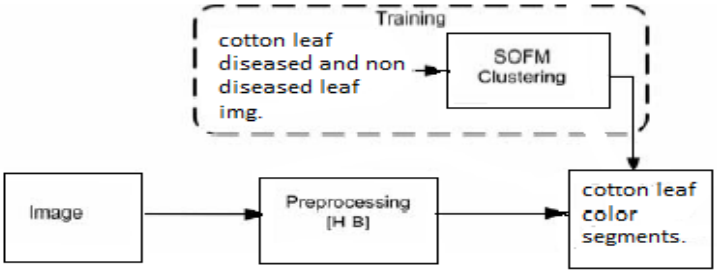


FIGURE 15: Cotton leaf colour extraction system diagram

5.1 Cotton Leaf Disease Colour Extraction

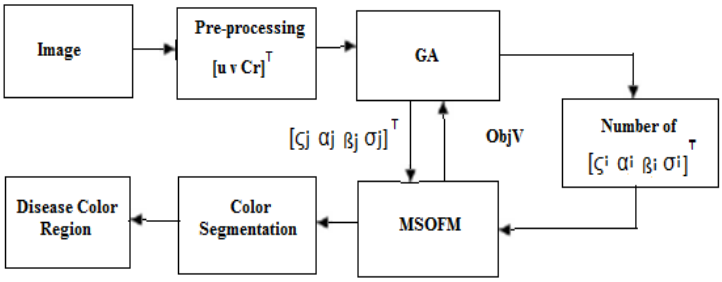


FIGURE 16: Cotton leaf disease colour extraction

The image background is additionally processed to remove the edge pixels in order to preserve the actual affected pixels as many as possible. In additions A,U, and Cr components from LAB, UVL and YCbCr colour space, respectively are applied for affected leaf colour extraction with the

purpose of less illumination effects. The remaining colour pixels are then extracted for cotton leaf disease colour by using modified self organization feature map, the clustering process does not require any training nor predefined no of colour groups[7]. This network is also adjustable allowing similarity of each colour group to be fine tuned. The cotton leaf disease colour extraction system is shown in the fig. 16.

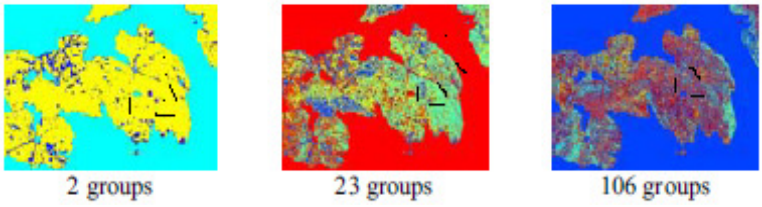


FIGURE 17: Example of different no of colour group from MSOFM

The cotton leaves disease colour are segmented corresponding to number of group of colour, the information from both disease and non-disease pixels are used for training with support vector machines(SVSM) for cotton leaf disease segmentation as shown in fig.17 using this SVSM technique perform better segmentation for cotton leaves[8]. We consider SVMs are trained using only 20 cotton leaves disease samples and 25 non disease samples. The resulting segmented pixels are then processed for classification of cotton leaves disease.

Now before the classification process, some irrelevant pixels is eliminated by method of convolution and thresholding applied. Here H and S components (from HIS colour space) and Cr component (from YCbCr colour space) are used to extract salient colour features of diseased cotton leaf. Now by using the Gabor filter we can separate different disease[12] appearance features. Now all information from this technique is used to examining affected pixels within the image.

In order to obtain optimum no of colour group Genetic Algorithm (GA) is applied developed to search for optimal parameters above fig. 18 shows the required result.

5.2 Equations

$$d_{wx} = \frac{1}{N_w}\sum_{g=1}^{N_w}\frac{1}{N_g}\sum_{i=1}^{N_g}\sqrt{(x_{g1}-w_{g1})^2+(x_{g2}-w_{g2})^2} \quad (1)$$

$$d_{ww} = \frac{1}{N_d}\sum_{j=1}^{N_d}\sum_{i=j+1}^{N_w}\sqrt{\sum_{k=1}^{n}(w_{ik}-w_{jk})^2} \quad (2)$$

$$ObjV = d_{wx} + \frac{N_w}{d_{ww}} \quad (3)$$

Where,
X=colour component of input pixel
W=weight vector
N_w=Number of weight vector
N_g=Number of colour pixels within the weight vector
N_d=Number of measures between weight vectors
n=Number of input x
d_{wy}=distance between input and weight vector
d_{ww}=Distance between weight vector
ObjV=Objective value.

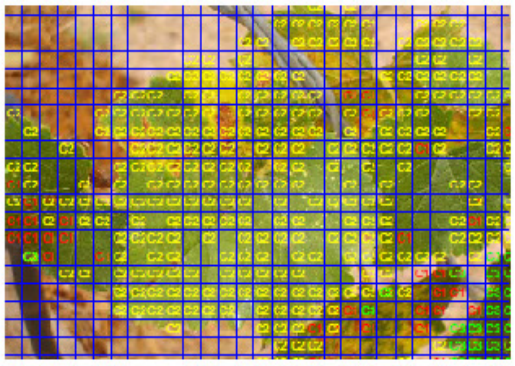
With the help of above equations[7] the model of cotton leaf disease detection can be formulated that equations suggests the model of the SVM(support Vector Machine) which is used for clustering of cotton leaves pixels using GA(Genetic Algorithm).

5.3 Detection of disease

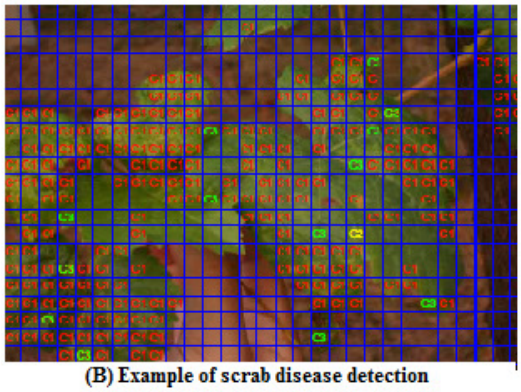
Various disease like Scab, Rust etc mainly, and their detection in accordance of map and feature extraction techniques [7]. We have following results as shown in table 1

Diagnosis	Disease Type: Number of sub images		
	Scab	Rust	No disease
Scab	16,690	2,245	619
Rust	2,059	17,130	900
False Detection	755	599	0
Correction	84.5	83.5	92.5
Average	86.83		
Detection	90.5		

TABLE 1: Results



(A) Example of rust disease detection



(B) Example of scrab disease detection

FIGURE 18: Example of cotton leaf diagnosis result.

Results obtained (as shown in TABLE 1) can be provided by means of method of feature extraction as shown in fig.16 [7]. Where show two disease detection (A) Rust disease detection and at another hand (B) Scarab disease detection [7] mainly as shown in fig. 18.

6. CONCLUSION

Using the colour image segmentation method to exact intensity pattern to various diseases accordingly it is then possible to analyze the n no of cotton diseases and it works very efficiently. Here there is more scope to reduce the various errors which will be occurred during the simulation, that can be minimize as the more no of input is provided accordingly. That is because of training feature of ANN approach which will not available with fuzzy method. ANN method is providing 85 to 91% of exact disease detection depending upon the quality of image provided by the portable scanner and the training. More train network leads to a very efficient diagnosis of the diseases on the cotton leaf.

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