International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 02 Issue: 04 | July-2015 www.irjet.net p-ISSN: 2395-0072

Detection of Diseases on Cotton Leaves Using K-Mean Clustering Method

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Abstract - ***This paper presents an approach for careful detection of diseases, diagnosis and timely handling to prevent the crops from heavy losses. The diseases on the cotton are critical issue which makes the sharp decrease in the production of cotton. So for the study of interest is the leaf rather than whole cotton plant because about 85-95 % of diseases occurred on the cotton leaves like Alternaria, Cercospora and Red Leaf Spot. In this proposal initially preprocessing the input image using histogram equalization is applied to increase the contrast in low contrast image, K-means clustering algorithm is used for segmentation which classifies objects based on a set of features into K number of classes and finally classification is performed using Neural-network. Thus image processing technique is used for detecting diseases on cotton leaves early and accurately. It is used to analyze the cotton diseases which will be useful to farmers.***

Key Words: *Classification, Diagnosis, Diseases, Histogram equalization, K-mean Clustering Algorithm, Neural-network.*

1. INTRODUCTION

This project work is exposes to automatic detection of disease on cotton leaves. Cotton is one of the major domains in agriculture which decides economy of the nation. However there are certain issues with field crop like to identify deficiency of nutrition in plants, to identify various diseases, various pests which affect crops. Each issue has an importance. Among one is detection of pests so that proper action should be taken to control it leading to minimize loss.

When any of such a condition occurs then farmers aware about the pest, then they can take correct action and control the situation but if farmers does not have correct knowledge, then misidentification of any pests can be possible and incorrect controls measure like non-affecting pesticides can be used leading to wasting of work and money and most importance it may lead to serious problem to crops. Otherwise they may approach to any agricultural experts who give them suggestion regarding detection of diseases and increase the crop productivity. But, commonly they may face following situations like: Sometimes they have to go long distances for approaching the expert and expert may not be available at that time [1].

Sometimes, the expert whom a farmer contacts, may not be in a position to advise the farmer with the available information and knowledge [1].

1.1 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.

1.1.1 Alternaria Leaf Spot Disease on Cotton

Fig -1: Alternaria Leaf Spot

It arises due to potassium deficiency. Leaf shows brown necrotic spots. Lesions and concentric rings are seen on the leaves. Neorotic tissues turn a sooty black color due to prolific sporulation by the fungus.
Treatment of Pseudomonas fluorescens Pf-1 10g/kg seed and foliar spray @ 0.2% on 30, 60 and 90 DAG

1.1.2 Cercospra Leaf Spot Disease on Cotton

Fig -2: Cercospra Leaf Spot

Red dot marks on the leaves which expand in diameter to about 2 cm. Irregular brown lesions, often surrounded by chlorotic tissues. The angular leaf spot appearance is due to restriction of the lesion by fine veins of the cotton leaf. Treatment of Pseudomonas fluorescens Pf-1 10g/kg seed and foliar spray @ 0.2% on 30,60 and 90 DAG.

1.1.3 Red Leaf Spot Disease on Cotton

Fig -3: Red Leaf Spot

Nutritional deficiency symptoms – Nitrogen content below 2% in leaf. Water logged soil conditions. Decrease in minimum temperature below 15^0C lead to the formation of anthocynin pigment in the leaf.

1.1.4 Cotton Disease Recognition System

Cotton is one of the major domains in agriculture which decides economy. Diseases on the cotton plant are decreases productivity of the cotton production. Thus image processing technique is used for detecting diseases on cotton leaves early and accurately.

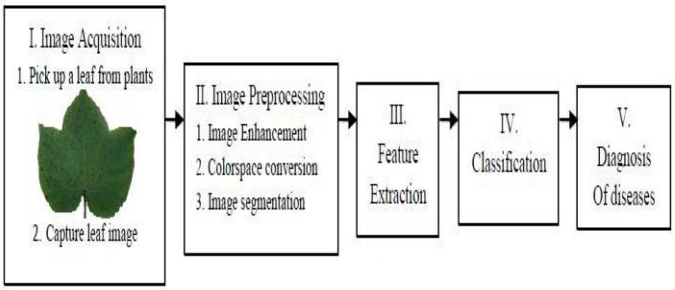

Fig -4: Cotton Disease Recognition System Block Diagram.

Image Acquisition: For capturing the rich details of cotton leaf patterns, an acquisition system should have a minimum resolution of 512 X 512 pixels in frame.
Image Preprocessing: In this proposal initially preprocessing the input image using histogram equalization is applied to increase the contrast in low contrast image.
Feature Extraction: In this, Color feature variance is used for matching the train image features to database images.
Leaf Segmentation: For detection of internal and external boundaries of the cotton leaf, use K-mean clustering algorithm technique.
Leaf Recognition: Before actual recognition process of cotton leaf image, the disease spot is located using color feature technique. Finally recognition is performed using neural-network to recognize the diseases.

2. PROPOSED METHODS

The proposed method is flexible for all image sizes. It is common practice to have the preprocessing of Cotton leaf images before it has been extracted and classified. The processing scheme consists of image acquisition through digital camera or web, image pre-processing includes image enhancement and image segmentation where the affected and useful area are segmented, feature extraction and classification. Finally the presence of diseases on the plant leaf will be identified. For feature extraction, we are using K-mean clustering algorithm method for classification and Neural-network as recognizer.

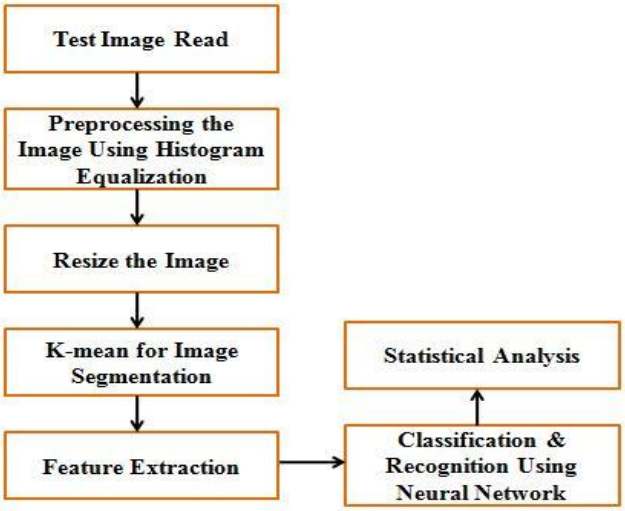

Fig -5: Flow Chart for Cotton Leaf Disease Detection Using Image Processing Technique

3. DATABASE

Table -1 shows details of database taken from Dr. Punjabrao Krishi Vidyapith, Akola.

Table -1: Database Description

Data Set	Dr. Punjabrao Krishi Vidyapith, Akola
Total number of classes	5
Number of image per class	350, 450, 380, 250, 400
Number of intra-class comparisons	2000

4. PREPROCESSING STAGES

It is common practice to have the preprocessing of Cotton leaf images before it has been extracted and classified.

There are five main steps used for the detection of plant leaf diseases as shown in fig. The processing scheme consists of image acquisition through digital camera or web, image pre-processing includes image enhancement and image segmentation where the affected and useful area are segmented, feature extraction and classification. Finally the presence of diseases on the plant leaf will be identified.

In the initial step, RGB images of leaf samples were picked up. The step-by-step procedure as shown below:

1) RGB image acquisition;

2) Preprocessing of image using Histogram equalization;

3) Resize the image;

4) K-mean Algorithm for image segmentation;

5) Computing features extraction;

6) Classification & Recognition using neural networks.

7) Statistical analysis.

4.1 Preprocessing of Cotton Leaf Image

The input image has to be preprocessed because images are corrupted by a type of multiplicative noise like light intensity and shadow on a cotton leaf images that may contain useful information about the leaf spot that can be used in the diagnosis. The preprocessing is done with the contrast enhancement using Histogram equalization.

4.1.1 Contrast Enhancement

It improves the perceptibility of objects in the prospect by enhancing the intensity difference between objects and their background. It is typically performed contrast stretch followed by tonal enhancement, although this procedure could both be performed in single step. A contrast stretch improves the intensity differences consistently across the dynamic range of the image, whereas tonal enhancements improve the intensity differences in the highlight (bright), midtone (grays), or shadow (dark) regions at the expense of *the* brightness differences in the further regions.

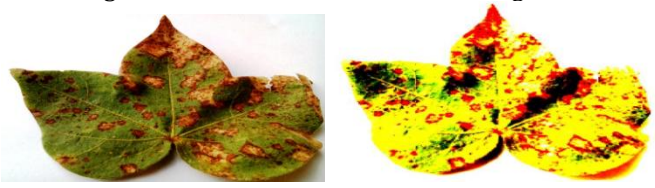

Fig -6: (a) Capture image. (b) Image after reflection removed

4.1.2 Image Segmentation

The leaf spot in the capture image generally contains reflection from source, which forms some intense spot in the cotton leaf, but pixel value within the cotton leaf is over a particular threshold (20) then it is replaced by pixel value of some neighborhood pixel. This operation fills all intense leaf spot present in cotton leaf area as shown in Fig -7.

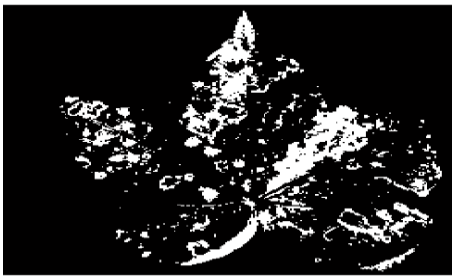

Fig -7: Segmented Result

4.1.3 Classification

Instance-based classifiers such as the k-mean classifier operate on the premises that arrangement of unknown instances can be done by concerning the unknown to the known considering to some distance/match function. The instinct is that 2 instances distant separately in the instance space defined by the appropriate distance function are less probable than 2 closely located instances to belong to the similar class.

The objective of the k-mean clustering algorithm is to use a database in which the data points are separated into several separate classes to predict the classification of a new sample point.

The non-parametric k-mean classifier is tested in this study. It classifies a test sample to a class according to the majority of the training neighbors in the feature space by using the minimum Euclidean distance criterion. The algorithm for the nearest neighbor rule is summarized as follows; given an unknown feature vector x and a distance measure, then:

Out of the N training vectors, identify the k nearest neighbors, regardless of class label.

Out of these k samples, identify the number os vectors, ki, that belong to class wi, i=1, 2, ..., M.

Assign x to the class wi with the maximum number ki of samples.

4.1.4 Image Enhancement

The image enhancement of normalized image has been carried out due to reasons of low contrast, background illumination and Non uniform brightness. This type of problem can be overcome by removal of background

illumination in order to get a good distributed texture image.

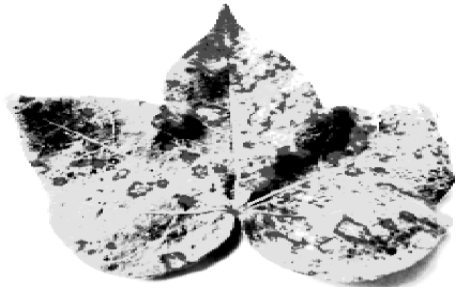

Fig -8: Enhanced Version

5. SIMULATION RESULTS

5.1 Preprocessing Result of Cotton Leaves Disease

Fig -9: Test RGB Image

The processing scheme consists of test RGB image acquisition from database or web. Image pre-processing includes image enhancement and image segmentation where the affected and useful area are segmented each filter having size of 512 X 512 pixels.

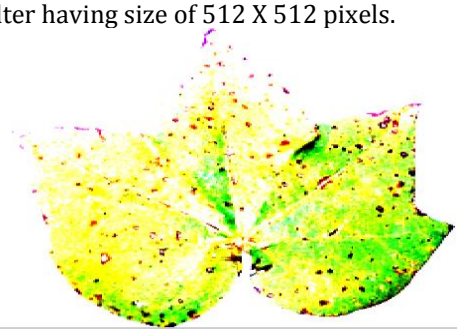

Fig-10: Enhance Test image using Histogram Equalization.

Here the size of feature vector is the size of image 512 X 512 pixels. Fig -10 shows that Enhance Test image using histogram equalization.

Preprocessing the test image using histogram equalization is applied to increase the contrast in low contrast image where, leaf spot is highlight in Fig -10.

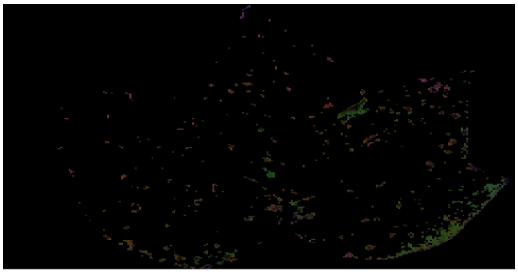

Fig -11: Segmentation Result.

Fig -11 shows a segmentation Result for classification, K-means clustering algorithm is used for segmentation which classifies objects based on a set of features into K number of classes.

Fig -12: Segmentation Result.

An above segmented result with 0 and 1 has shown as black and white. Based on those segmented pattern we have obtained an image shown in Fig -12.

5.1.2 Recognition Result Of Cotton Leaves Disease

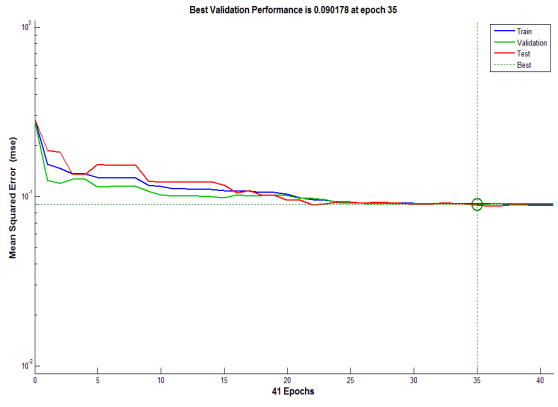

Fig -13: Plot of Validation Performance is 0.090178 at Epoch 35

The plot shows that the five curves each representing TPR and FRR intersects at certain point which is nothing but Mean Square Error rate point and shows that for epoch of 35 we get minimum error rate of 0.090178 which is practical result got for our proposed system.

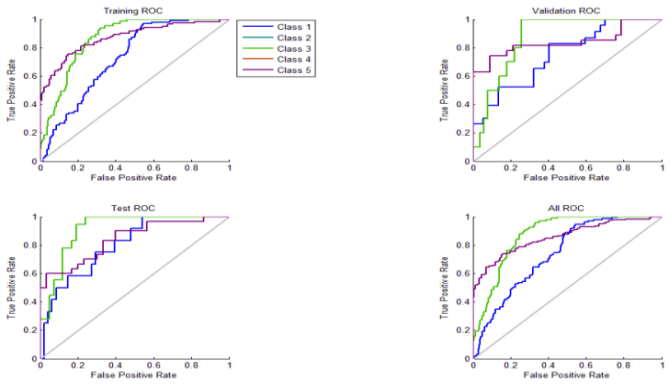

Fig -14: Plot of TP Vs FP Rate for Training, Validation & Test ROC

Fig -14 shows that Plot of TP Vs FP Rate for Training, Validation & Test ROC.
In Fig -14 where class 1 indicate that Alternaria disease, class 2 indicates that normal leaf, class 3 indicates that Cercospra disease, class 4 indicates that Grey Mildew disease and class 5 indicates that Red Leaf Spot disease.

5.1.3 Cotton Diseases Detection Recognition Parameters

Recognition Accuracy Comparisons, Execution Time Comparisons, False Accept and False Reject Rates for Dr. PDKV, Akola datasets are compared below in respective table.

5.1.4 Recognition Accuracy

Table -2 shows that recognition accuracy for detecting diseases on cotton leaves. It shows that K-Mean Clustering algorithm has highest accuracy of 80.56%.

Table -2: Recognition Accuracy Comparisons

Sr. No.	Feature Extraction Methods / No. of Dataset	K-Mean Clustering Algorithm Accuracy
1.	10	60.25 %
2.	20	65.12 %
3.	40	66.35 %
4.	80	70.20%
5.	160	74.65%
6.	250	82.85 %
7.	500	89.56 %

5.1.5 Execution Time

Table -3 shows that execution time in second for detecting diseases on cotton leaves. Out of which K-Mean Clustering algorithm takes less execution time.

Table -3: Execution Time Comparisons

Sr. No.	Feature Extraction Methods / No. of Dataset	K-Mean Clustering Algorithm (Sec)
1.	10	179.89
2.	20	292.36
3.	40	305.69
4.	80	332.23
5.	160	385.65
6.	250	421.23
7.	500	436.95

6. CONCLUSIONS

In this paper, Study of diseases on the cotton leaf can robustly studied by using 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 color can be a different disease present on the leaf of cotton. MATLAB software can provide the exactly differentiate the variation of color present on these leaves and depending upon that variation the further compare with database stored image features related to the color.

This paper provides a method to detect cotton leaves diseases using image processing technique. Firstly, K-means clustering algorithm is used for segmentation which classifies objects based on set of features into K no. of classes where feature extraction is color feature variance used for matching the train image features from database images and finally recognition is performed using Neural-network. The recognition accuracy for K-Mean Clustering method using Euclidean distance is 89.56% and the execution time for K-Mean Clustering method using Euclidean distance is 436.95 second and also thresholding is done by a dynamically range [0,1] depending on color intensity from leaves image.

So we conclude that disease detection using K-Mean Clustering method using Euclidean distance is the best methods to disease detection on cotton leaves. It achieves best validation performance is 0.090178 at epoch 35. Best result is obtained in the plot of True Positive Rate Vs False Positive Rate for Training ROC, Validation ROC, Test ROC and All ROC which describe with the help of five different disease classes. It is analyzed that after K-mean thresholding is applied for increasing the correct classification result which show graphical result with removing complete green color from test image and only quantified area is obtained. Finally, neural network is used for recognizer where, initialization the images from the database that are highly correlated to the test image, which is given by user. It is used to analyze the cotton diseases which will be useful to farmers.

ACKNOWLEDGEMENT

I welcome this opportunity to express my heartfelt gratitude and regards to Dr. S. R. Ganorkar, Department of E&TC, Sinhgad College of Engineering, Vadagaon (Bk), Savitribai Phule Pune University, Pune, Maharashtra, India, for his unconditional guidance.

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BIOGRAPHIES

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