

Comparative Study of Cotton Leaf Disease Classification

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Abstract

50% of the Indian population depends on the cotton crops for their business. The recognition of cotton disease is very important because it decreases the quality and productivity of the cotton. It starts with detecting the diseases by collecting the images of the diseased leaf. In this paper the major cotton leaf disease are alternaria, bacterial blight, cercospra, and Myrothecium leaf spot. Few of the common basic steps to detect the cotton disease have been used in this paper such as image acquisition, pre-processing, feature extraction and classification. The methods used for the segmentation are k-means clustering and Otsu's threshold. The ANN and SVM are the two methods which we have used most for classifying the type of the cotton disease. The ANN and SVM provide the accuracy of 80-90%.

Keywords: cotton disease, ANN, SVM, feature extraction, classification

1. Introduction

Agriculture is the main occupation in India. Agriculture is the backbone of our country. Two-third of Indian population is dependent on agriculture directly or indirectly. It is not important not only from economic point of view, but also in social, political, and cultural life. India's agriculture is composed of many crops. Indian farmers mainly depend on wheat and rice crop as their main source. When coming to non-food items most of the farmers depend on cotton. In this paper we are specifying more about growth of the cotton and the diseases that affecting the production of cotton.

Cotton plant is grown in different part of the country. Northern part of the country it is grown in Punjab, Haryana and Rajasthan. It is mainly grown in Gujarat, Maharashtra and Madhya Pradesh as the central part of the country. In southern part of the country it is grown in Andhra Pradesh, Tamil Nadu and Karnataka. Cotton plays a crucial role in the field of clothing, medicine, educational, biodiesels and etc. Cotton plants are the great demand in business. Various diseases have been found on the cotton plants that are infecting the plants badly. This causes business a great loss. Due to the diseases the production of cotton has decreased to a great extent so proper management of the plants is needed to be taken care.

Different types of diseases that are damaging the plants are Alternaria, Bacterial, Cercospra, Myrothecium and etc.

1.1 Alternaria Leaf Spot:

This disease is caused due to the potassium deficiency in the leaf. It appears in the form of circular spot and has a color that vary from circular brown. Leaf shows brown necrotic spots. This disease mainly appears on the lower leaf of the plant when compared to the upper leaf of the plant. Cotyledon and cotton bolls are the part of the cotton plant where the disease symptoms are seen. It appears in small, circular brown or grey brown color spots that varies in size from 1-10mm. Disease can be seen in all stages of the plants. It is seen that this disease becomes severe when the plants are of 45-60 days old.

1.2 Bacterial Blight

Figure 1 shows this disease can be seen on various parts of the plant. It can affect the cotton plant for the duration of the special stages of the plant growth. Bacterial blight infects stems, leaves, bracts and bolls of the cotton plant. Appears at the leaves within the form of water-soaked region and later it will become black and gets dried up. Later this region enlarges into angular reddish spot of approximately 1mm in diameter. Hence it is also called as angular leaf spot. Symptoms are more seen on lower leaves than the upper leaves.



Figure 1.1: Bacterial Blight

1.3 Cercospora Leaf Spot

Figure 1.2 shows the Cercospora leaf disease which are mainly found on the older leaves of the plant. Reddish lesions appears on the leaves at a very early stage of infection. Time to time these lesions increases in size infecting the plant more. Lesions changes from white to light brown or grey in color. They can change their shape and size according to time and infection. This disease makes small dark and light brown or red margins spots on the leaves. It makes the leaves pale in color which causes them to fall off.



Figure 1.2: Cercospora leaf spot

1.4 Myrothecium leaf spot:

Figure 1.3 shows the Myrothecium leaf disease and occurrence was seen in India, China, Brazil, Pakistan, Ecuador. This caused yield reduction of about 60%. This disease appears as reddish spot of about 0.5mm to 1cm on the margins of the leaves. Symptoms of Myrothecium disease are lesions with necrotic rings. The affected part of the leaf falls off which makes shot holes in the leaves. The symptoms can be seen on the petioles, bracts, leaves and the bolls of the cotton plant.



Figure 1.3: Myrothecium leaf spot

These diseases are affecting the entire plant eventually increasing the losses. So, these diseases need to be identified and managed. The techniques used for the detection of the diseases on the cotton plants are k-means algorithm, Otsu's threshold, GLCM. The classifiers used by the disease detection system are ANN, KNN, SVM and CNN. This results in the accuracy of about 80-90%.

2. Literature Survey

There are various feature extraction and classification techniques used to classify or recognize the various cotton leaf diseases.

Shantanu Kumbhar et al [1], Cotton plant disease detection has become a great concern for the farmers and industries. Detection of diseases in the early stages will lead to prevention of the plant from getting affected. Diseases that are mostly found on the cotton plants are alternaria macrospora, bacterial blight. The algorithms used by the system to detect the diseases are k-means and GLCM. Image acquisition is the first step that is done by the system where the image of the leaf is captured to identify the plant color. Extracted features such as color and texture are used to detect the diseases in each convolutional layer. On that basis the prediction of diseases are made by the system. CNN classifier is used in the system that provides the accuracy of 80%

S. Batmavady et al[2] Agriculture is the main occupation for half of the Indian population. Cotton disease is a threat to the growth and production of cotton. To find out the type of cotton disease input of cotton leaf image will be taken. The captured image will be divided into parts to remove the unwanted noises. Fuzzy c-means algorithm is used for the segmentation. From the segmentation the different features will be extracted. The identified features will be taken as an input to the SVM and RBF classifier. Using the different classifier, the type of the cotton disease will be identified.

Mr. Ketan D. Bhode et al [3] Cotton plays an important role in both economy and industrial activities of India. Cotton is used for different purposes. But nowadays the production of cotton is very less because of severe diseases that affecting the cotton leaves. In this

paper we can see four diseases that affects the growth of the cotton, they are grey mildew, curl leaf disease, bacterial blight and Alternaria leaf disease. To distinguish these diseases, a automatic detection system is used which helps in identifying the disease type. This system is a web portal which is easily available to the farmers and is easy to access. First the user should login to this portal using username and password. Once, the user has logged into this web portal they have to select the images of the diseased part cotton leaf. After the selection of images, accumulation method is used for the calculation of the severity of causing the disorder. This method displays the result as 1 for yes and 0 for NO. The total score is calculated at knowledge base server (KBS) that's used for the detection of disease and its level consistent with that pesticide will be advised.

T. Gayathri Devi et al [4] Agriculture is the chief determination of most of the countries. One third of India's population depends in agriculture. But due to various kinds of disease on plant there is not much growth in the production of the plant. There are several techniques which will be used to find out the kind of disorder that is caused on the plant. The techniques involved in the following steps are image acquisition, image pre-processing, image segmentation, feature extraction, classifier, results and discussion etc. For feature extraction step they are using GLCM method and to recognize the diseases the SVM classifier is used.

Patil Tushar et al[5] Indian money owed for approximately 25% of world's cotton place and 16% of total cotton production. Some of the diseases on the cotton plant have large effect. To reduce the loss of cotton crop because of those illnesses, its far crucial to locate the inside diseases at very early stage. In this paper we can see three types of diseases red spot, white spot, and crumple leaf. To detect these diseases in the early stage there are some steps that are going to be used for cotton leaf disease detection system. Image acquisition then image pre-processing, image segmentation, feature extraction and classification. Segmentation process is carried out using various methods like otsu's method, k-means clustering and using ANN classification is done.

Sujatha R et al [6] Identification of the plant sickness may be very difficult in agriculture field. Identifying the type of disease is major task. Therefore, the identification needs to be correct in order to reduce the huge loss of crop production. Finding out the leaf disorder can be done using various data mining techniques. First pick out the part of the plant that is affected by the disease and take the picture of the leaf. Upload the image into the system and divide it into segments. K-means algorithm is being used for the clustering or dividing. After segmentation features will be extracted and type of the disease will be classified using SVM.

Mr. Chandrakant et al [7] Detection of diseases on the plants needs to be identified to prevent the plants getting infected. The most affected part of the plant is leaf. The diseases that are found to be affecting the plants are Bacterial Blight, Myrothecium, and Alternaria.

Identification of cotton plant diseases is done by image processing and segmentation process. Snake segmentation algorithm is used to identify the leaf spot. Features that will be extracted by the system are color of the leaf. Neural network classifier is used that results in the accuracy of 85.52%.

A. Sivasangari et al [8] proposed that examined that cotton disorder may be studied by using the image processing and also using android applications. In this paper, the proposed system is an android application through which the users can find the diseases on the basis of the images taken by the mobile phones. There are three techniques for pre-processing; they are resize of image, Color transformation, Binary image. After pre-processing scaling process is done. Scaling is the technique of changing the dimensions of an image. Then the image will be partitioned into small segments and feature will be extracted and the type of disease will be classified. For classifying the type of the disease they used SVM - GA,SVM,BPN etc.

Supriya S. Patki et al[9] Crop diseases are increasing day by day that needs to be detected in the early stage of the process. Red spot, White spot, Crumple Healthy leaf are the diseases that are affecting the cotton plant. The system works in the following five steps that are image acquisition, image pre-processing, image segmentation, feature extraction, classification. The infected part of the leaf is captured. Image is pre-processed and segmentation is done using the Otsu's threshold technique. Next the features will be extracted from the segmented image of the plant. Usually extracted features are color and texture of the leaf by GLCM technique. For classification process Support Vector Machine (SVM) is used once the features are extracted. The system gives the accuracy of 87.5% for detection of diseases.

Vijay S. Bhong et al [10] Cotton is one of the most crucial fibers and coin crop of India. But today we can see there is less growth in the production of the cotton due to the different types of diseases that occur on cotton leaves. There are 3 types of diseases they are Alternaria, Cercospra and red spot. To rectify the type of disease there are certain steps to be followed. The steps are Image Acquisition, Image pre-processing, Image segmentation, Feature Extraction, leaf segmentation and leaf recognition. The leaf segmentation uses k-means algorithm and color feature to identify the disease.

Bhumika Prajapati et al [11] Cotton is the Cash crop of India. It is recognized as king of fibers. About 80 to 90% of diseases that occur on the cotton leaves are alternaria leaf spot, cercospra leaf spot, bacterial blight and red spot. To distinguish the type of the disease certain steps to be followed. First the picture of the leaf should be captured. The captured image consists of unwanted noises; to remove the noises pre-processing is done on the captured image. Histogram equalization is used for image pre-processing. Then the image will be divided into various segments to search for the boundaries between the regions and to remove unwanted regions. For segmentation process the techniques that have been used

are k-means clustering and otsu's thresholding. After segmentation the features will be extracted and the classification will be done using ANN, NN and K-NN classifier.

Sachin D.Khirade et al[12] proposed that because of some diseases on the plants leads to reduction in both quality and quantity of the product. The image processing techniques can be used inside the plant for disease detection. The image processing technique involves some of the steps. First step begins with capturing the images through the camera, after this the unwanted noise will be removed from the image using different pre-processing techniques. Then the image will be divided using segmentation techniques. Feature extraction will be done and type will be classified using several classifiers.

Premalatha V et al[13] presented that the percentage of the diseases on the crops is increasing rapidly. Before it makes a huge problem for the farmers, diseases have to be detected and proper solution is to be provided. In this paper, they have proposed some of the algorithms such as Noise Removal using Median filters and Segmentation using Spatial FCM. They took cucumber powdery mildew, speckle and downy mildews as the sample to detect the diseases. Leaves with the spots were pre-processed and the features like color, shape, textures, edge and skeleton were extracted. Features are extracted using CBIR and Sobel edge detection method. After the features are extracted image is classified using fuzzy entropy. It was observed that the proposed algorithms perform better in the detection of diseases.

Naik Durgesh Manikrao et al[14] proposed that farming is the important sector in India for human being. Near about 55-60% people are depending directly and indirectly on it. Cotton is the main cash crop in India which gives more income to the farmer. The yield of the crop gets reduced because of the diseases that the leaves suffer from like insecticide, fungus, foliar leaf on leaf of cotton, Alternaria leaf spot of cotton. Before it affects the productivity of the cotton the diseases should be detected in the early stage only. To detect the diseases in the starting stage, image of the leaf should be captured from mobile phone or digital camera. In the next step, the input picture is pre-processed to improve the facts. After that, the image will be segmented and feature will be extracted. The SVM classifier is used for identifying the disease type.

ReenaTijare et al[15] The cotton crop is one the most important crop of India. Many people rely upon cotton crop. So identification of cotton leaf diseases becomes a duty. In this paper they mention 2 cotton leaf diseases one is foliar and another one is Alternaria. In this paper the author introduced an automatic system for detection and identification of leaf disease. Identification of leaf disease took several steps like acquiring images and later using some filters preprocess it which will be helpful to extract the required object from the image. Later the extracted object will be used for extracting the features which in turn lead to the classification of leaf diseases. There are many methods for the segmentation for example otsu's,

method, k means clustering etc. Features extracted are color, texture, morphology and edges. Using ANN classifier feature extraction can be done.

Pawan P. Warne1 et al[16] Cotton is one of the essential domains in agriculture that are used to decide the country's economic system. But nowadays there is major issue in the growth of the cotton. Due to the diseases on the cotton there is a decrease in the production on the cotton. There are 3 major diseases, alternaria, cercospra and red leaf spot. To identify the type of the diseases image processing techniques are used which involves some steps. The steps that are going to be followed are image acquisition, pre-processing, segmentation, feature extraction, classification and diagnosis of the disease. Segmentation technique used is k-means clustering and based on the color feature disease will be identified.

Malvika Ranjan et al[17] Agriculture is the crucial part of farmers. Cotton plants are planted in various part of the country. Diseases on the plants should be detected as soon as possible before it affects the whole plan which will indirectly affect the farmers. This paper is all about detecting the diseases on cotton plant using the some of the algorithms. The system first captures the image of the plant and further follows the steps like Color extraction, Creating Database, Input Image, Image Pre-processing, Feature Extraction, Classification. Result of segmentation and ANN provides the color feature. The classifier used is ANN that provides a better accuracy of about 80%. The proposed system can be used by the farmers to detect the diseases and prevent form the losses.

Nitin S. Tijare et al[18] Cotton industries are facing problems due to the decrease in the cotton plants. Cotton plants are getting affected by the chemicals that are used on the plants. Many diseases are to be found on the plants infecting the whole plant. To increase the production of the cotton plants proper management of the crops is required. The proposed system will help the farmers in the increment of cotton plants by detecting the diseases as earliest as possible. Diseases are detected on the basis of leaf miner, powdery, Downey. Author followed the same steps which are normally used to detect and identify the cotton leaf diseases. K-mean algorithm and Otsu's techniques are used for the classification of the diseases. The proposed system uses ANN and SVM as classifier.

Prof. Sonal P. Patil et al[19] India is known as agricultural country wherein large percentage of the population relies upon agriculture domain. In India cotton is grown in many states. About 80% of disease on the cotton is on the cotton plant is on its leaves. In this paper they are mainly concentrating leaf of the cotton plant tree rather than whole cotton plant. The cotton leaf is mainly suffered from disease like fungus, foliar leaf spot of cotton. There are different stages for classification of cotton leaf spot diseases like acquiring the images, later using filters to preprocess the image in order to get the better segmentation results, following which extracting the required object from the image leading to extracting features of the image and finally classification. For

segmentation process Otsu method is chosen and for classification SVM method is carried out.

Sushma S.patil, et al[20] India is vastly diverse in agriculture and half of the country depends on the agriculture for their leaving. Cotton plants are used by the farmers as the business strategies so they should be protected properly. Plants get affected easily so this system is developed to detect such diseases that might affect the whole plant. This system basically detects the cotton leaf spot to detect the diseases such as grew mildew, alternaria, bacterial blight, rust, leaf curl virus disease that might affect the plant. First the image will be captured and it will be processed. The edge detection technique will be applied on the pre-processed image and

next segmentation will be done using the k-means algorithm. Features like color, shape and texture of the leaf will be extracted. Classifier used in this system is SVM to detect the diseases to help the farmers. It will reduce the loss of farmers and will provide them better solution for their problems.

3. Results and Discussion

In the literature, there are various feature extraction and classification techniques. We nearly consider 20 papers for comparative study. Table 1 gives the comparative study of the papers.

Table 1: Comparative Study of Cotton Leaf Diseases

Name	Number of Classes /Diseases	Image Processing Steps	Disease Segmentation Technique	Extracted Features	Classifier: Accuracy
Vijay S. Bhong, Prof. B.V. Pawar	3 diseases 1) Alternaria 2) Cercospra 3) Red Spot	Acquiring the images, Preprocessing the image Extracting the region of interest, Extracting the features	k-means algorithm	Color	Not specified
S. Batmavady, S. Samundeeswar	Not specified	Input image, Image pre-processing, Image enhancement, Morphological process	Fuzzy c-means Algorithm	Color, Shape, texture	SVM:90%
Reena Tijare, Pawan Khade, Rashmi Jain	2 diseases 1)Alternaria 2)Foliar	Acquiring the images, Preprocessing the image Extracting the region of interest, Extracting the features	Otsu method, K-means clustering	Color, Texture, Morphology.	ANN
Pawan p. Warne, Dr. S. R Ganorkar	3 diseases 1)Alternaria 2)CercospOra 3)Red Leaf	Acquiring the images, Preprocessing the image Extracting the region of interest, Extracting the features	K-mean clustering	color	Not specified
Bhumika Prajapati, Vipul k. Dabhi, Harshad Kumar B, Prajapati	3 diseases 1)Alternaria 2)Bacterial 3)Cercospora	Acquiring the images, Preprocessing the image Extracting the region of interest, Extracting the features Classification	k-mean clustering, otsu Thresholding	Color, Shape, texture	SVM K-NN NN
Sujatha R	Not specified	Acquiring the images, Preprocessing the image Extracting the region of interest, Extracting the features	k-means algorithm	shape	SVM
Malvika Ranjan, Manasi Rajiv, Weginwar, Neha Joshi3, Prof. A.B. Ingole	Leaf spot	Color extraction Creating Database, Input Image, Image Pre-processing, Feature Extraction, Classification	Not specified	Color	ANN:80%

Sushma S. Patil, Mr. Suhas K. C	5 disease 1)Grew mildew 2)Alternaria leaf spot 3)Bacterial blight 4)Rust, 5)Leaf Curl virus disease	Image pre-processing, Leaf Edge Detection, Segmentation	k-means algorithm	Color, Shape, Texture	SVM
Mr. Chandrakant Deelip Kokane	3 disease 1)Bacterial Blight 2)Myrothecium 3)Alternaria	Image pre-processing, Segmentation	k-means clustering	Color	ANN:85%
Supriya S. Patil, Dr. G. S. Sable	3 disease 1)Red spot 2)White spot 3)Crumple Healthy leaf	Acquiring the images, Preprocessing the image Extracting the region of interest, Extracting the features	Otsu's thresholding, GLCM	Color, Texture	SVM:87.5%
Shantanu Kumbhar, Amita Nilawar, Shruti Patil, Bodireddy Mahalakshmi, Manasi Nipane	2 disease 1)Alternaria Macrospora 2)Bacterial Blight	Image Acquisition, Convolutional Layers Disease Prediction	k-means algorithm	Color	CNN:80%
Nitin S. Tijare, Prof. Sagar S. Badnerkar ²	3 disease 1)Leaf miner 2)Powdery 3)Downey	enhancement, segmentation, feature extraction, classification	K-mean algorithm, Otsu segmentation	Color	ANN SVM
Mr.ketan D. Bhode, Mr.Himanshu V. taiwade, Mr. Virendra. P.Yadav, Mr. Nikesh V.Aote	4 diseases 1)Grey Mildew 2)Curl Leaf Disease 3)Bacterial Leaf Blight 4)Alternaria Leaf Blight	Leaf disease images, Filtered images of observed disease infected leaf, detect the disease, disease information and suggesting pesticide.	Not specified	Not specified	Not specified
T.Gayatri Devi, P. Neelamegam, A . Srinivasan	Not Specified	Acquiring the images, Preprocessing the image Extracting the region of interest, Extracting the features	K-means segmentation	GLCM is used for feature extraction	SVM
Sachin D.Khirade, A . B . Patil	Not specified	Acquiring the images, Preprocessing the image Extracting the region of interest, Extracting the features, Detection and classification of plant disease.	k-means clustering, Boundary and spot detection algorithm, Otsu threshold algorithm	Color, texture, morphology, edges	ANN
Premalatha.V, Valarmathy.S, Sumithra.M.G.	2 category: 1)Living agents 2)Non-living agents	Image Acquisition, Image Pre-processing, Image Segmentation, Feature Extraction, Classification	Sobel edge detection, CBIR	Color, Texture, Shape, Edge, Skeleton	FCM PNN
A Sivasangari, K. priya, K. Indira.	4 diseases 1)bacterial blight 2)fusarium wilt 3)leaf blight	Image pre-processing, Scaling process, HSV model, Image segmentation,	Not specified	Shape, morphology,	SVM-0.91% BPN-0.93%

	4)root rot 5)nutrient deficiency 6)Verticillium wilt	Edge detection,			
Patil Tushar, palambe Shubham, Tawale Gauri, Patil Rajashree, Sanchika Bajpai.	3 disease 1)Red spot Disease 2)white spot Disease 3)Crumple Leaf disease	Acquiring the images, Preprocessing the image Extracting the region of interest, Extracting the features Classification	Otsu method, k-mean clustering.	Color, Texture, Morphology,	ANN
Prof. Sonal P.patil. Ms Rupali S.Zambre	5 diseases 1)Grey mildew 2)Bacterial blight 3)Leaf curl 4)Fusarium wilt 5)Verticillium wilt	Image acquisition, Image pre-processing and segmentation, Feature extraction, Classification	Global threshold, Variable threshold, Otsu threshold	Shape, color	SVM-97%
Naik Durgesh Manikrao, Dr.A.J.Vyavahare	7 disease 1)Alternaria Leaf spot 2)curl Gemini virus 3)Bacterial Blight 4)Cercospora leaf spot 5)Grey Mildew on cotton 6) Verticillium wilt 7) Leaf red spot	Image acquisition, Image pre-processing, Image segmentation, Feature extraction, Classification	Not specified	Color, Shape, texture	SVM ANN

4. Conclusion

This paper addresses mainly about the survey of the detection of cotton leaf diseases using specific strategies. Identification of the cotton leaf disease is mainly the purpose of the proposed system which recognizes the leaf diseases with computational effort. This paper gives the review of technique for disease detection on crop leaves. The diseased cotton leaves are segmented using k-means clustering and otsu's threshold techniques after pre-processing. ANN and SVM are used for the classification of cotton leaf disease. By using these technique, we can achieve good productivity by identifying the disease earlier.

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