# A 3-Stage Method for Disease Detection of Cotton Plant Leaf using Deep Learning CNN Algorithm

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**1 author:**

Sriramakavacham Ramacharan
G. Narayanamma Institute of Technology and Science

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# A 3-Stage Method for Disease Detection of Cotton Plant Leaf using Deep Learning CNN Algorithm

Dr. S. Ramacharan
*Associate Professor, IT Department, GNITS, Hyderabad*

***Abstract: Agriculture is one of the significant occupation in various countries including India. As major part of the Indian financial system is reliant on agriculture production, the intense consideration to the concern of food production is essential. The nomenclature and recognition of crop infection got much significance in technical as well as economic in the Agricultural Industry. While keeping track of diseases in plants with the support of experts can be very expensive in agriculture region. There is a necessity for a method or system which can automatically identify the diseases as it can bring revolution in monitoring enormous fields of crop and then plant leaflet can be taken ca The detection of cotton leaf disease is a very important factor to prevent serious outbreak.re imme4diately after recognition of disease. The aim of this paper is to provide guidelines for the development of application which recognizes cotton plant leaf diseases. For availing this user need to upload the image of the cotton leaf and then with the help of image processing one can get a digitized colour image of a diseased leaf which can be further processed by applying CNN algorithm to predict the actual root cause for the cotton leaf disease.***
***Keywords: Cotton leaf disease detection, Convolution neural network(CNN), epoch, feature extraction, Image Acquisition***

## I. INTRODUCTION

Six Decades back our father of nation Mahatma Gandhi told Agriculture is the backbone of the Indian Economy. India ranks second in the agricultural output worldwide. Here in India, farmers cultivate an unrestricted variety of crops. It contributes 18% of the overall GDP and accounts for employment of approximately 41.49% of the Indian population. Fast growth in agriculture is vital not only for self-reliance but also to earn valuable foreign exchange.

Numerous factors such as climatic conditions, soil conditions, innumerable disease, etc. distress the production of the crops.Henceforth the detection of plant diseases is an significant facet in cumulative the yield of a crop. The existing method for plants disease detection is simply naked eye observation which requires more manual labour, scientifically equipped laboratories, expensive devices, etc. And improper disease detection may have led to incorrect pesticide usage that can lead to development of long term resistance of the pathogens, reducing the ability of the crop to fight back. The plant disease detection can be done by observing different parts of the affected plant. The technique adopted to detect plant diseases is image processing using Convolution neural network(CNN).

### *A. Objectives*

Crops can be protected from the attack of pests by using pesticides and remedies. The main objective is to identify the plant diseases using image processing. We can lessen the dimensions of the images by appropriate size reduction techniques and observe that the quality is not conceded to a great extent. We can expand the work of the earlier mentioned authors such that the remedy to the disease is also shown by the system. After detection of the disease the system suggest the name of appropriate pesticide to be used. It also identifies the pathogens responsible for the disease. Apart from these parallel objectives, this work can be time saving. The model budget is quite expensive for small scale farming but in turn would be value for money in large scale farming. It completes each of the process sequentially and hence achieving each of the output.

Thus the main objectives are:

1) To design system to detect crop disease and pest accurately.
2) Create database of insecticides for particular pest and disease.
3) To deliver remedy for the disease that is identified.

### *B. Scope*

The aim of this work is to develop a system which identifies crop diseases. In this the user need to load an image on the system, Image processing starts with the digitized colour image of the diseased leaf. Eventually, based on CNN plant disease can be predicted.

### *C. Problem definition*
Recognition of cotton leaf disease is a very imperative factor to prevent severe outbreak. Most cotton diseases are caused by fungi, bacteria, and insects. A new method is proposed for careful detection of diseases and timely handling to prevent the crops from heavy losses.

## II. LITERATURE SURVEY
This work is formulated on Convolutional Neural Network to identify cotton plant leaf diseases. It provides more capable means to identify infection created by Bacteria and environmental consequences. Disease detection at a primary stage on crop is a challenging task for farmers where bodily presence is a must. Disease recognition on the crop are very important. There are numerous image processing algorithms available for disease identification based on image classification like KNN, SVM, Random Forest, Artificial Neural Network and CNN. Earlier image classification algorithms like face recognition essential to pay attention at where the face is situated in an image this key difficult is overcome by CNN and the features of an image are intensely processed at each layer. Each disease on crop has diverse structures which are removed at each layer of the convolution network.
Some of the references that have been considered while developing this work are mentioned T.Shamyuktha Banu, & Dr.V.R.S.Manititled, “Cotton Crop Monitoring System Using Cnn”,Xi'an Jianzhu Keji Daxue Xuebao/Journal of Xi'an University of Architecture & Technology. A deep learning approach by means of diverse convolution neural network model is engaged to categorize cotton leaf disease, cotton stages as well as weed in cotton with high accuracy. In this work VGG16 CNN, RESNET50 model is trained on 3000 samples.
In this work, a multi-layered VGG16 CNN model is used. It has 16-19 hidden layers. It is an uncomplicated network possessing only3×3 convolutional layers stacked on top of each other in expanding depth. Reducing volume size is handled by max pooling. Two fully-connected layers, individually with 4,096 nodes are then tracked by a softback classifier. Alternative model RESNET-50 is used to categorize the cotton crop images. Ignore connection named as remaining block are adopted in the model. It is used to evade vanishing gradient difficulties and dead neurons. Remaining block is used to surge the number of hidden layers from earlier models without worrying about vanishing gradient problems. RESNET-50 has 23 million parameters to learn.
Basic operation of CNN layers is Convolution which consists of the following three basic operations in which,
*1)* Input image is detected first
*2)* Then the second process is feature detection; here the input image is converted into a feature matrix. Here, feature detection is also called as filtering. The filter is generally 3 x 3 as well as 7 x 7.
*3)* Third process is the activation function, which is used to reduce the size of an image and image detection is to be unique to identify the specific object or to perceive the position of disease in the cotton image. ReLU layer is the third layer to maximize non-linearity in CNN. Pooling layer becomes fourth layet that enables the CNN to identify numerous image features regardless of lighting difference as well as angle of a diseased image. It supports to minimize the over fitting problem in CNN. Flattened layer is set as fifth layer and used to alter Pooling feature draw into single column. Fully connected layer become sixth layer. Softmax function is adopted to attain the output class.

Data set was prepared as real time images are taken from kudipatti cotton farms, Madurai district. Consolidated database consists of images related leaf diseases like cercospora leaf spot, fusarium wilt, verticillium wilt, as well as cotton boll rot, bacteria blight. Cotton phases like flower stage, cotton boll, evolved cotton images as well as barnyard grass, lambs’ quarters weed images are taken using realme 2 pro phone camera.

### *A. Implementation Phases of Google colab (Google colaboratory) is Described Below*
*1)* Data set collection
*2)* Uploading the dataset into drive
*3)* Accessing colab
*4)* Mounting drive in Google colab
*5)* Coding implementation, testing and training.

### *B. Data set Collection*
Real time images are accumulated by means of web camera and kept in database. Stored database images are transformed into test images as well as train images.

### *C. Uploading the Dataset into Drive*

In the Google drive, the upload folder option is used to upload the test and train dataset which are named as test cotton and train cotton.

### *D. Accessing Colab*

First, sign in the Google accounts. And proceed to the Google colab welcome page.
Click on the newpython three notebook preference to begin the session fresh.
Choose runtime menu choice or notebook choice to select GPU.
Configure notebook instance, to download the necessary packages.

### *E. Mount Drive in Google Colab*

Click on mount drive choice, an authorization code is produced and it is entered in Google drive, which produces the image folder path

### *F. Code Implementation, Test and Train*

Python coding implementation established on diverse CNN model such as VGG16 and RESNET50. Need to train the above CNN model as well as test the images to get enhanced accuracy and get the predicted disease.
The trained VGG16 as well as RESNET50 model is tested with diverse cotton disease; cotton stage and cotton weed image dataset. Constraints like accuracy value, loss value, ETA (Estimated time of arrival value) are quantified. Diseases such as cercospora leaf spot, fusarium wilt, verticillium wilt, and cotton boll rot, bacteria blight are predicted. Cotton stages such as flower stage, cotton boll, matured cotton and barnyard grass, lambs' quarters weed are also perceived. One Epoch is interpreted as the total of all images processed one time forward and backward separately in the convolution neural network. Epoch are used once to update the weights.

$$\text{One epoch} = \frac{\text{No of Iterations} * \text{Batch size}}{\text{Total no of images in training}}$$

The conclusions attained are Pre trained VGG16 and RESNET50 model is adopted to identify the cotton leaf disease, cotton stage as well as weed in cotton with enhanced accuracy. RESNET50 has better performance compared to VGG 16. In future the similar network can be trained with additional diseases in cotton, dataset count will be improved and the model will be implemented in FPGA in real time and its performance will be studied for continuous monitoring and detection in cotton farms.

### *G. Existing Approaches/ System*

There are existing approaches like "Detection & classification of Diseases of Banana Plant Using SVM" built and attained an accuracy of 90.9% using SVM classifier and Other approach "Detecting Jute Plant Disease adpting Image Processing as well as Machine Learning measured 86% accuracy for test images and also many other approaches with different algorithms and accuracies.

### *H. Drawbacks in Existing System*

There are many existing systems implemented to predict plant leaf disease detection for different plants and using different algorithms. The existing systems have the lower accuracy and performances which are almost less than 95%. Our Model "Cotton Plant Disease Detection "is implemented using Deep Learning CNN algorithm where our model attained the accuracy of 97%.

### *I. Motivation for Proposed System*

The objective is to develop a system which identifies crop diseases. In this the user need to load an image, Image processing begins with the digitized colour image of the diseased leaf. Eventually, by using CNN plant disease can be predicted. A. Purpose of Proposed System:

*1)* Developing a user-friendly web-based system for farmers
*2)* Identifying Cotton leaf diseases accurately based on input images
*3)* Anticipate corrective and preventive measures for the identified diseases

Cotton leaf diseases focused

*a)* Alternaria Macrospora
*b)* Bacterial Blight

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## III.OVERALL DESCRIPTION

The methodologies of machine vision are widely concerned to agricultural science, and it has prominent perspective particularly in the plant protection field, which eventually leads to crops management. The proposed system for plant leaf disease detection is based on the infected images of various plants. Images of the contaminated or infected plants are reproduced by digital camera and processed applying image growing, image segmentation techniques to identify infected parts of the plants.

1) *Image Acquisition:* In this phase, raw image is taken as input from the user and converted into equivalent grey scale image. Similarly, the image is rescaled into size of 128*128.
2) *Convolutional Layers:* After the alteration of captured image, the processed image further passes through three different hidden layer in which feature extraction, pooling and flattening layer are also performed.
3) *Disease Prediction:* After applying CNN, using Softmax layer the leaf image is predicted with disease which is gaining highest probability of occurrence.

### *A. Product Functions*

The projected system categorizes the leaf image by means of image classification algorithm CNN. It can automatically identifythe diseases based on extracted features at individual convolution layer. Below figure shows the structural design of the planned system. The system utilized image processing method for disease recognition. The user required to upload the cotton plant leaf image. The system intially pre-process the uploaded image later apply CNN technique. By means of CNN method test the image with trained dataset and extract the features.

### *B. Design Specification*

The following static structure diagram describes the structure of the system. This comprises of the classes included in this work along with the functions present in each class and their attributes.

Plant Leaf Disease Detection majorly consists of these four classes, namely Normalization, CNN model, Training Model, Lead Disease, Leaf Classification

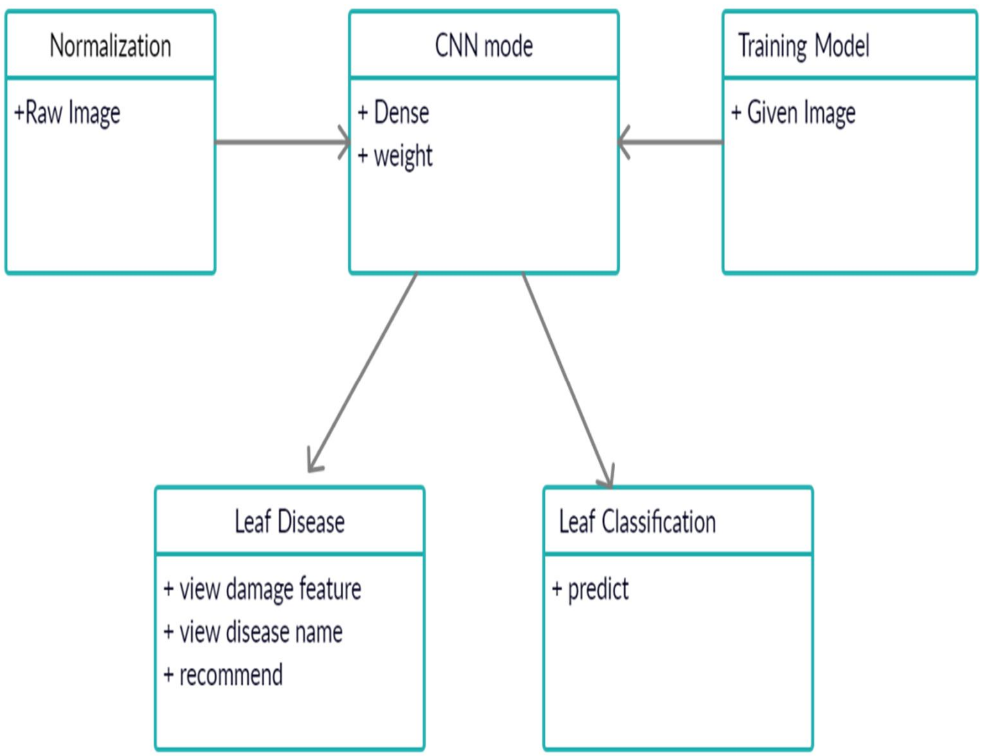


Fig: 1 Plant Leaf disease detection classes

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## IV. METHODOLOGY (WITH FLOWCHART)

The input test image is acquired and pre-processed in the next stage and then it is converted into array form for comparison. The selected database is properly segregated and pre-processed and then renamed into proper folders. The model is appropriately trained by CNN and then organization takes place. The correlation of the test image and the trained model take place superseded by the display of the outcomes. If there is animperfection or disease in the plant the software displays the disease along with the remedy.

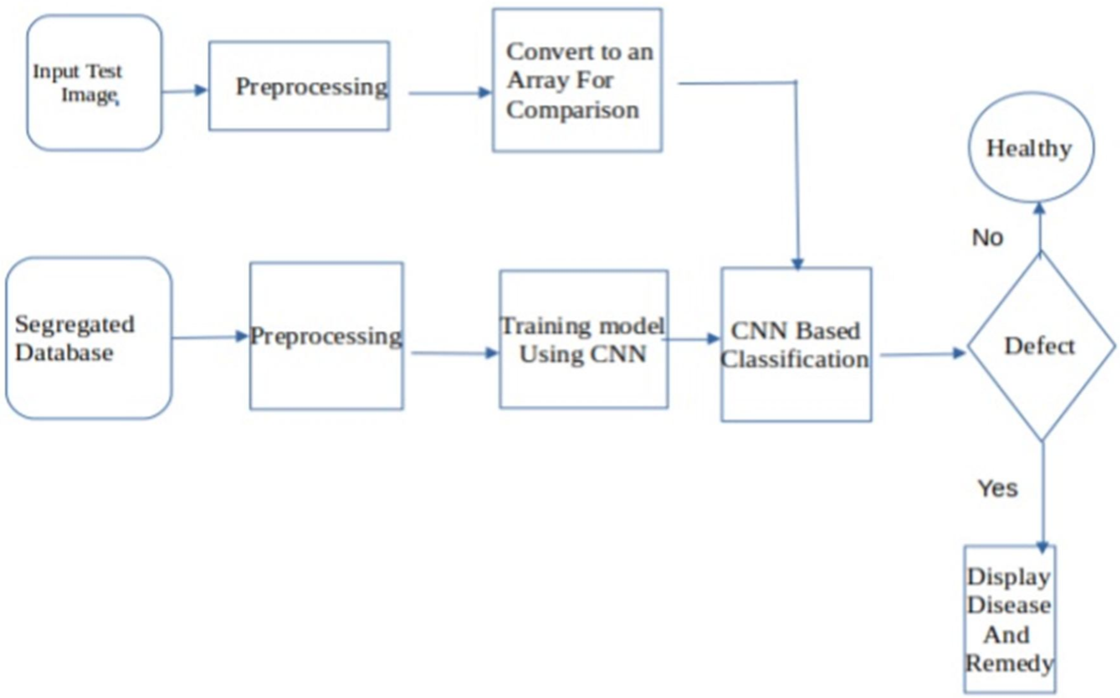



Fig 2: Flow chart for Cotton disease

## V. SYSTEM ARCHITECTURE

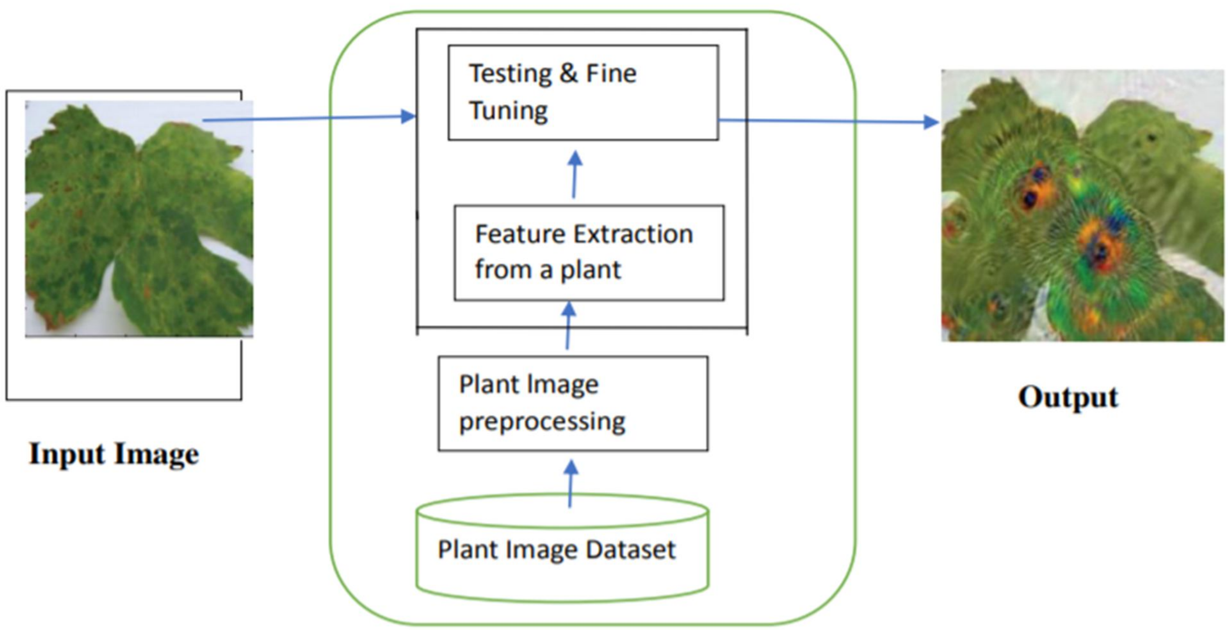



Fig: 3 System Architecture

*A. Pre-processing and Training the model (CNN):*

The database is Pre-processed such as Image reshaping, re-sizing and conversion to an array form. Analogous processing is done on the test image. A database includesnearly 32000 distinctive plant species is collected, out of which any copy can be used as a test image for the software. The trained database is used for trainthe model (CNN)to identify the test image as well as the disease it has. CNN has distinctive layers that are Dense, Dropout, Activation, Flatten, Convolution2D, MaxPooling2D. Once the model is trained effectively, the software can recognize the disease if the plant species isavailable in the database. After effective training as well as pre-processing, based on comparison of test image and trained model predicts the disease.

*1) Sample-1*

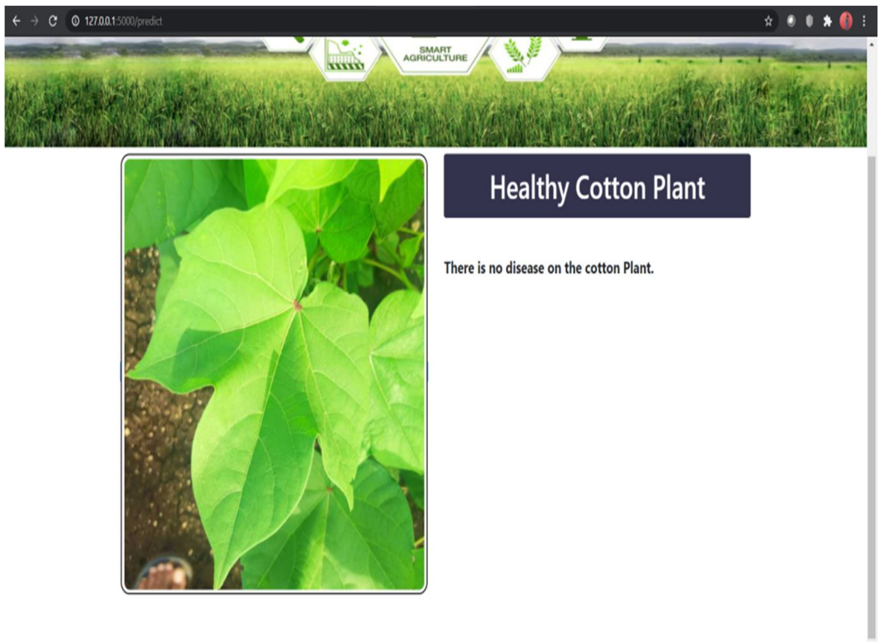



Fig 4: Plate 1

*2) Sample-2*

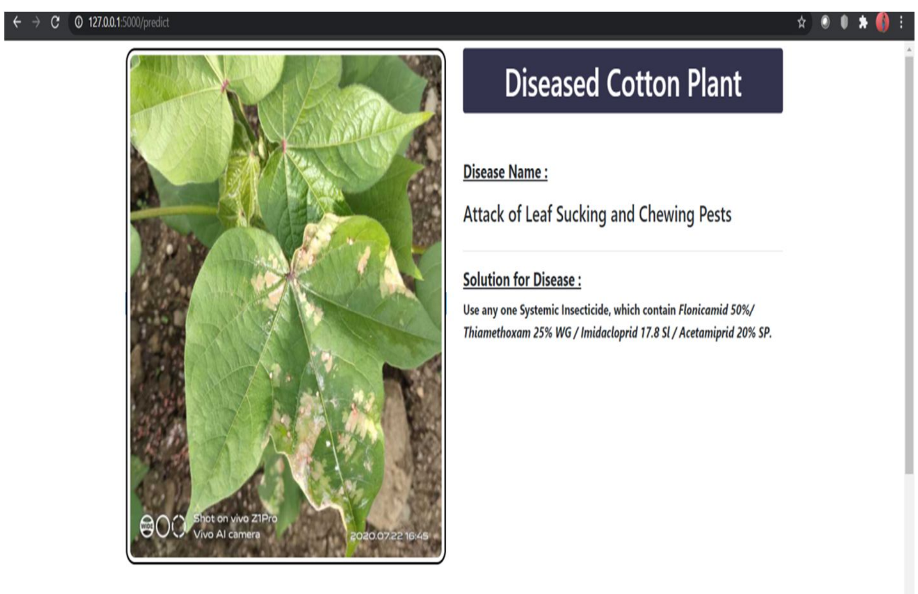



Fig 5: plate 2

3) *Sample-3*

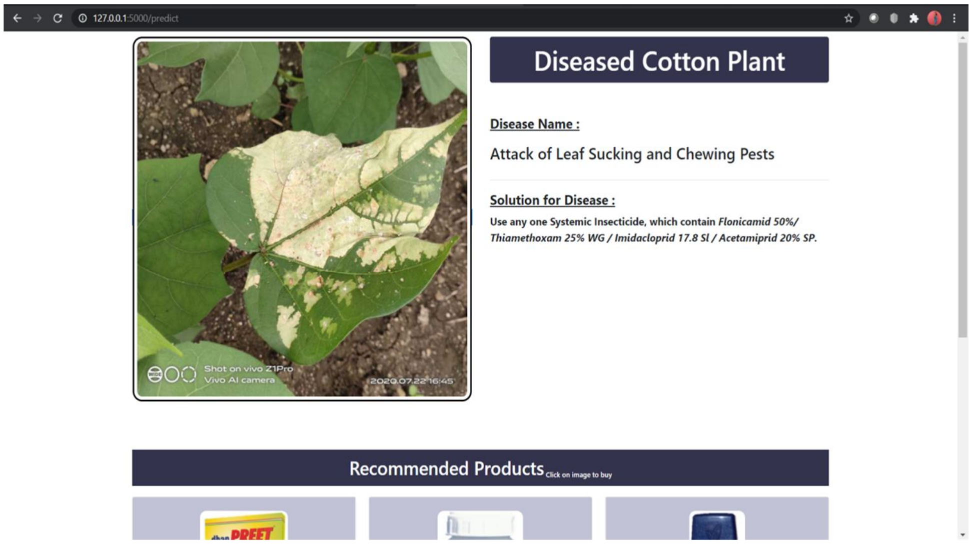



Fig 6: plate 3

4) *Sample-4*

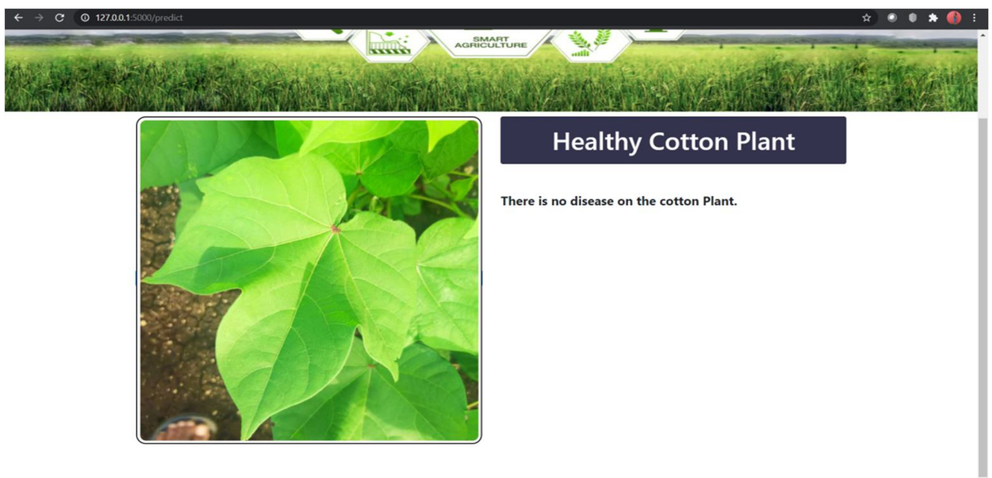



Fig 7: plate 4

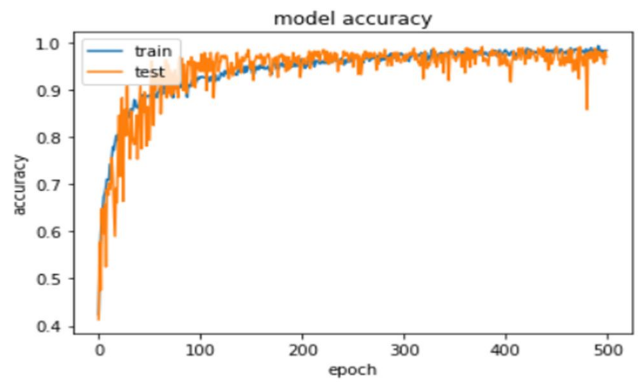
5) *Sample-5*

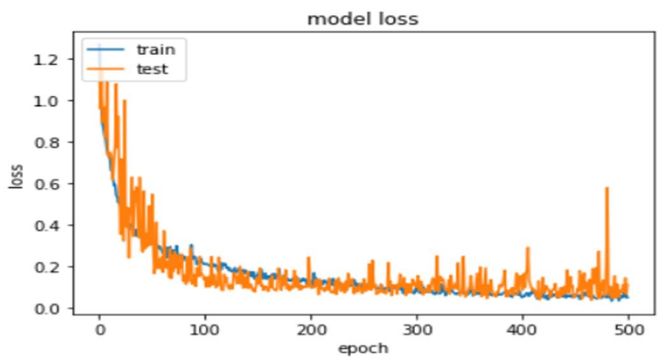

Fig 8: plate 5

## VI. RESULTS AND CONCLUSION

### *A. Result analysis / Performance analysis*

Model Accuracy has been increased by increasing number of epochs. In this work 500 epochs adopted based on which could achieve 96.6% accuracy




### *B. Conclusion & Future Scope*

An application of detecting the plant diseases and providing the necessary suggestions for the disease has been implemented. Hence the proposed objective was implemented on the cotton plant. The diseases specific to cotton plant were considered for testing of the algorithm. The experimental results specify the projected approach can distinguish the diseases with a nominal computational effort. With this technique, the plant diseases can be recognized at the initial stage and by using the pest control tools problems can be solved while minimizing risks to people as well as to the environment.

In order to enhance disease identification rate at several stages, the training samples can be improved with the optimum features given as input condition for disease recognition and fertilization management of the crops.

As a part of Future Enhancement the complete process described in this work can be automated so that the result can be delivered in a very short time. Further enhancements can include upgrading user interface and the accuracy to detect specific diseases along with product recommendations.

## REFERENCES

[1] Challa Karthik and Nagul Ulaganathan(2020) “Application for Plant’s Leaf Disease Detection using Deep Learning Techniques ,” International Research Journal of Engineering and Technology (IRJET),Volume: 07 Issue: 08.

[2] N. R. Bhimte and V. R. Thool, "Diseases Detection of Cotton Leaf Spot Using Image Processing and SVM Classifier," 2018 Second International Conference on Intelligent Computing and Control Systems (ICICCS), Madurai, India, 2018, pp. 340-344, doi: 10.1109/ICCONS.2018.8662906.

[3] https://towardsdatascience.com/crop-plant-disease-identification-using-mobile-app-aef821d1a9bc

[4] Rothe, Prashant & Kshirsagar, R.. (2015). Cotton leaf disease identification using pattern recognition techniques. 1-6. 10.1109/PERVASIVE.2015.7086983.

[5] Banu, T & Mani, V.R.s. (2020). COTTON CROP MONITORING SYSTEM USING CNN. Xi'an Jianzhu Keji Daxue Xuebao/Journal of Xi'an University of Architecture & Technology. 12. 2. 10.37896/JXAT12.03/529.