



# COTTON LEAF DISEASE DETECTION USING DEEP LEARNING

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**Abstract:** Cotton is one of the economically noteworthy agricultural products in northern region of Maharashtra, but it is majorly getting affected at its leaf area because of different pests and diseases. The aim of this project is to develop end to end web application which will help to analyze the disease present on the respective cotton plant with the help of deep learning algorithms, not only this but this will help in recommendation of the products that a farmer should use in order to reduce the disease or eliminate it thoroughly. To achieve this aim, we first need to acquire different images of cotton plant. There are multiple diseases that could affect the cotton crop badly, however this project is subjected to distinguish between diseases such as Sucking and chewing pest disease, Bacterial blight disease and Curl virus disease. In order to properly train the algorithm, we will be using dataset of approximately 1752 (approximately 440 images in each class) images classified into different categories according to the diseases. This model will be developed using tools present in Anaconda such as Jupyter Notebook, Spyder etc. This project will reveal the feasibility of its usage in real-time applications and the potential need for IT-based solutions to support traditional or manual disease and pest's identification.

**Key Words:** *Deep Learning, Convolutional Neural Network (CNN).*

## 1. INTRODUCTION

The cotton plant can get affected to several disorder attacks because of temperature fluctuation, diseases, and pests. According to the recent statistics the whole world produces nearly 570kg per hector of cotton crops, out of which approximately 10% of production loss occurred due to different cotton leaf diseases. India has approximately 24% of cotton land of the whole world. The statistics says that generally, 18% of cotton crops production was lost every year due to different diseases that attacked the cotton plants which had its impacts on losing almost 900 thousand of Indian rupees.

Detection of different diseases with bare eyes increases the complexity of cotton crops productivity which then decreases the accuracy in identification of correct disease at early stage, even an expert may fail to assess and diagnose the diseases with their bare eyes and this inadequate technique leads to over wastage of cotton crops. Due to this mistaken diagnosis, most of the time, certain unnecessary pesticides which badly affect healthy cotton are applied.

This project mainly focuses on developing an identification model for cotton leaf diseases and pests using deep learning called convolutional neural networking. There are multiple diseases that could affect the cotton crop very badly, however we will be using three different diseases and those are bacterial blight, sucking and chewing pest disease and curl virus disease, these have been affecting cotton productivity and quality. Dataset of leaf images which we will using in this project are both primary as well as secondary types of datasets. Primary data is type of data collected fresh for the first time whereas secondary data collected is taken from different agriculture related sites and forums.

Among different diseases and pests occurred, about 80 to 90% were on the leaves. Cotton disease and pests are difficult to identify through bare eyes.

## 1.1 Problem Statement

Since cotton crop is the economically noteworthy crop, this crop adds lots of importance to the economy of nation because of its high market price. Preventing the yield from the attack of pests and insects should be our prime concern which will lead to high profit, healthy crop yield and less yield loss. Even after taking care of crop yield, because of weather conditions or some other reasons if it gets affected by any pests or insects then, eliminating that disease is another important aspect. So, to reduce all these efforts we are going to develop the system which will not only detect the disease present on the leaf of cotton plant but it will also recommend the products which will help the farmers to eliminate that present disease from that plant. With the help of modern technology named deep learning which is nothing but a subset of artificial intelligence, we will be creating this web application. This project will also include another feature named FarmKart, which will help the farmer to get to know about the different agricultural products available at multiple market places. List of agricultural centers exclusively working/ doing their research on cotton crop will help them to contact these centers if they want further consultation.

## 1.2 Diseases chosen for detection

Diseases that are chosen for detection in this project are listed as follows:

- 1.Sucking and chewing pest disease
- 2.Bacterial blight
- 3.Curl virus disease

### 1.Sucking and chewing pest:

As the name itself suggests its meaning, the pest will suck up the liquid from the leaves and restricts the growth of plant.



### 2.Bacterial Blight:

The disease can cause due to *Xanthomonas citri* pv. *Malvaceous*. It will create dark red spots on the leaf of plant and will cause loss.



### 3.Curl Virus:

The disease will make the leaves to curl in and changes the shape of leaves of plant. This disease cause yield loss.



## 2. LITRATURE REVIEW

According to reference no [3] the research outlines the deep learning model in order to classify different images present in dataset according to the different diseases present on the cotton leaf or plant. The research classified each of them into 3 different categories and those categories are as follows:

- 1.Bacterial Blight disease
- 2.Spider Mite disease
- 3.Sucking and chewing pest disease.

Where research address approximately 1200 images from which approximately 600 images were used to train the CNN structure.

According to reference [2], the research proposed work that exposes an advanced computing technology that has been developed to help the farmer to take superior decision about many aspects of crop development process. Suitable evaluation and diagnosis of crop disease in the field is very critical for increased production. They used pesticides recommendation which is given to farmer to ensure their crop and reduce the yield loss.

According to reference [1] in the research of identifying and diagnosing cotton disease, the pattern of diseases important part in that, various features of images are extracted viz. The color of actual leaf, there are so many diseases occurred on the cotton leaf so the leaf color is also different for different disease, also there are various other features related to shape of images, also there are different shape of holes present on the leaf of the image.

Generally, the leaf of infected image has elliptical shape of holes, taking this point into the consideration, the research tried to detect the disease present on cotton leaf or plants which can be classified into different categories as given by reference no [3] that are,

1. Bacterial blight disease
2. Spider Mite disease
3. Sucking and chewing pest disease.

According to reference [4] in the research of identifying the cotton leaf lesions using deep learning techniques, the research used two different algorithms such as GoogleNet and Resnet50, both the algorithms were good to do the work of detecting the disease present on the cotton leaf, but their accuracies were bit less than that of expected accuracy.

According to reference [5] in the research of detection of disease of cotton leaf, the research was focused on using different technique named, k-mean clustering which comes under the roof of machine learning algorithms. The accuracy of that algorithm was approximately around 80%.

### **3. METHODOLOGY**

The research methodology includes following steps, these steps are required to detect the disease present on cotton leaf.

#### **3.1. Acquisition of image:**

The first step involved in the research methodology is the image acquisition. The user has to either select the image from the existing test image folder or can click the fresh image to detect the disease.

#### **3.2. Processing an image:**

In the processing of an image, to analyze the image thoroughly, we have to apply some parameters on that image i.e., image needs to be rescaled, rotated and to be magnified.

#### **3.2. CNN:**

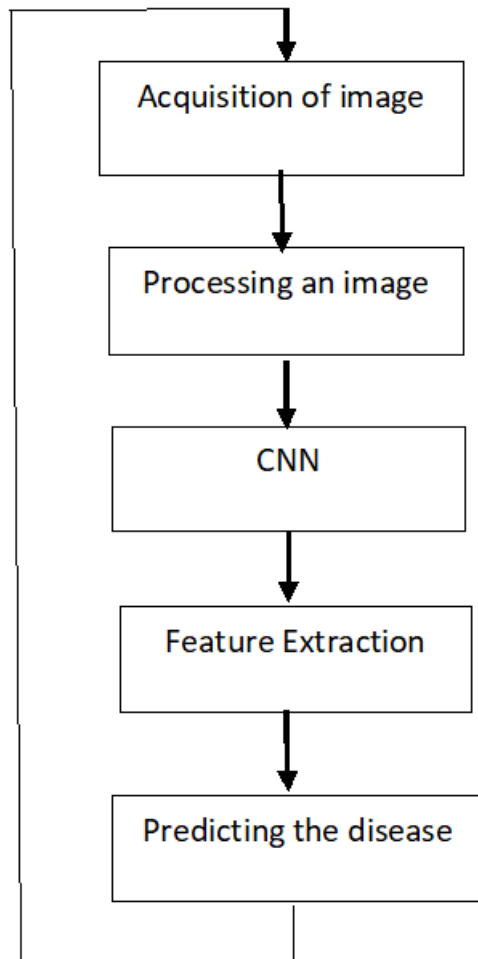
Convolutional Neural Network, with the help of this model will get trained, the CNN will have different convolutional layers, dense layer and max pooling layers. With the help of the CNN the learning data will get different ways of representations, it would start from first layer and will go deep by becoming more specific.

#### **3.3. Feature Extraction:**

In this module, the neurons in the neural network will pass the highest value of combination i.e.,  $(bias + (weight * input))$  to the next layer and that is nothing but the feature extraction is.

#### **3.4. Predicting the disease:**

According to the all above steps, at the final layer of neural network i.e., at output layer, the algorithm will provide the correct result and it will diagnose the correct disease present on leaf of cotton plant.



**Fig. Research Methodology**

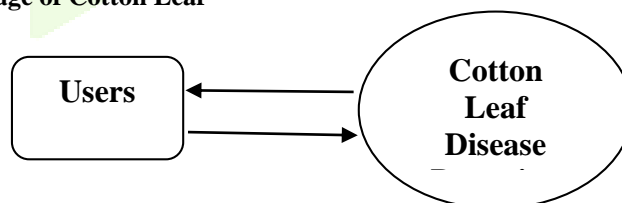
**4. DATA FLOW DIAGRAMS**

Data Flow Diagrams (DFDs) describe the processes of how the transfer of data takes place from the input till prediction of the corresponding output.

**4.1. Data Flow Diagram – Level 0:**

The DFD Level 0 depicts the users to input the image of the cotton plant leaves. The system in turn detects and recognizes the cotton leaf disease.

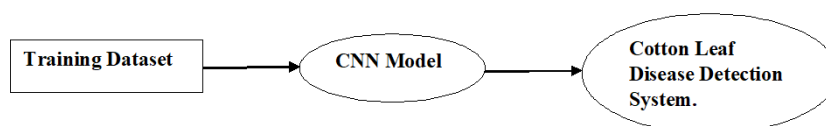
Image of Cotton Leaf



**Fig. 1 Data Flow Diagram - Level 0**

**4.2. Data Flow Diagram – Level 1:**

In the DFD Level 1, the CNN model takes the image from the training dataset and then CNN model predicts the type of disease of the leaf.



**Fig. 2 Data Flow Diagram – Level 1**

### 4.3. Data Flow Diagram – Level 2:

DFD Level 2 goes one step deeper into parts of 1-level DFD. It can be used to plan or record the specific/necessary detail about the system's functioning.

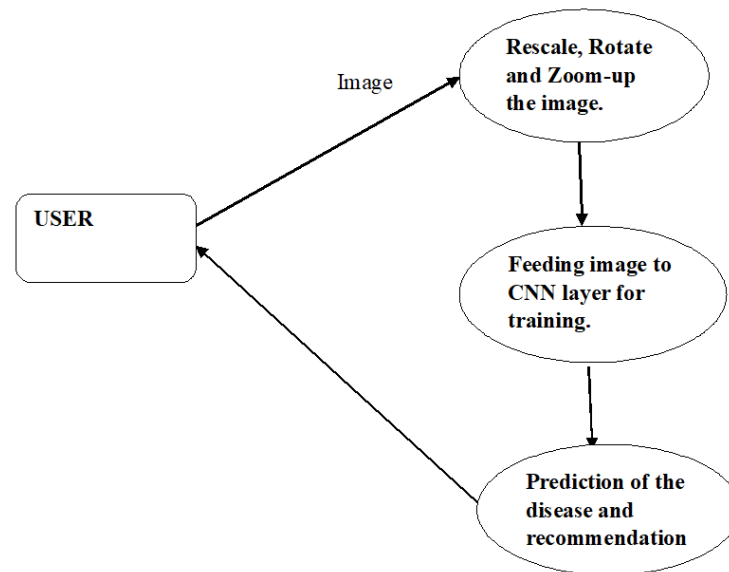


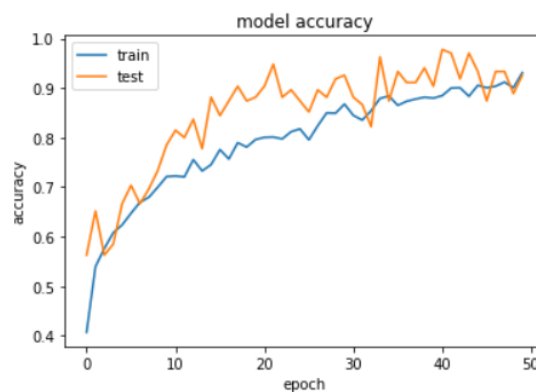
Fig 3. Data Flow Diagram – Level 2

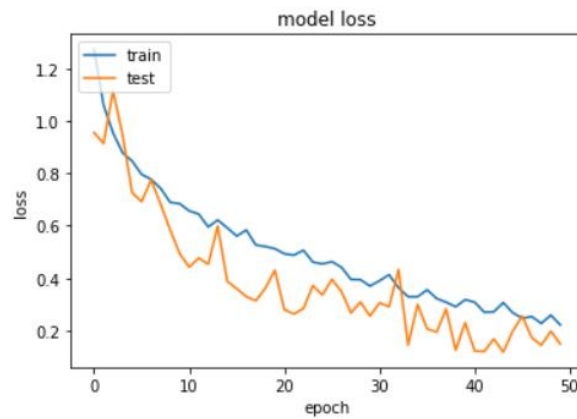
### 5. EXPECTED RESULTS

As the research is about to find out the type of disease present on leaf of particular cotton plant from chosen varieties of diseases, the system will provide output to user in such a way that user will get to know about the disease the cotton leaf has and will also get recommendations in order to eliminate or reduce the disease to some extent. The other modules of the system will provide the list of agriculture centers to the users and the Farmkart module will suggest some products (i.e., fertilizers, pesticides, books) to user that they may use for their crop.

### 6. GRAPHS FOR ACCURACY AND LOSS OF THE MODEL

Both the graphs for accuracy and loss are given below. As the number of epochs are increasing the accuracy of the model has started to increase. It is going to be approximately around 90% from the graph given below. The loss is inversely proportional to the rising number of epochs, as the count of epochs is increasing, the loss is decreasing. It is approximately around 0.2 for test and 0.3 for train.





## 7. CONCLUSIONS

The research is focused to create a system which will be able to diagnose the disease present on the leaf of the cotton plant. Since detecting the disease present on cotton crop with necked eyes might bring some errors, so doing the same with the help of machine will reduce the chances of misprediction. The main module of the system will help the user from analyzing the disease, predicting the disease, recommending the remedies for that disease. The other modules of the system will provide the list of agriculture centers which exclusively doing their research on cotton crop, it will also suggest the products to the user that they may use and can purchase it directly. The system will be designed in such a manner that it will help the user all throughout their journey of analyzing the present on the cotton crop.

The base of the system is the CNN model, which will actually help to diagnose the diseases present on the cotton crop. The accuracy of the model is going to be approximately 90% and the loss is going to be approximately 0.2. The accuracy can be enhanced by increasing the number of epochs and increasing the size of the dataset. As the accuracy of model will increase, eventually the loss will decrease.

## 8. FUTURE WORK

Since, no system or model is flawless, each system could have different flaws in it and that could be resolved in the future, with the help of advanced knowledge, technology and information. The proposed system in this research also has some flaws and that could be resolved by future researchers.

The future work includes following points:

1. The proposed system is having the accuracy of approximately 90% and loss is approximately 0.2. So, the future work includes increasing the accuracy and decreasing the loss to the possible extent.
2. The model can be trained by using different transfer learning techniques, such as Resnet50, Inception V3 etc. to have comparative studies of the models on the basis of accuracy, loss, number of trainable parameters, time required for execution and much more.
3. Instead of using Deep Learning techniques, future researchers can focus on Artificial Intelligence, Image Processing techniques to make it more precise.
4. Since, the system is going to be a web-based application, it can be made vernacular so the users knowing different languages will be able to interact with the system.

## REFERENCES

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