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# Plant Disease Identification using Convolution Neural Network

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**ABSTRACT:** Agriculture is the primary source of income for about 58% of India’s population. It is a backbone of Indian Economy. It contributes 15% of India’s GDP. So increase in agricultural productivity will also have a great impact on Indian Economy. A crop gets infected by various diseases due to changing environmental conditions. Hence the quality and quantity of the crop is reducing. Diseases initially affect the leaves of the plant. As farmers are unaware of the various plant diseases and many times it becomes difficult for a naked eye to detect and identify the disease This paper focuses on identification of diseases in plant through images of leaves using deep learning concepts and also provides solutions to cure the identified disease. This will help to increase the productivity of crops which will indirectly increase the farmer’s income and Indian Economy. The dataset of 500 images of cotton plant for five disease is considered and Convolutional neural network (CNN) algorithm is used.

**KEYWORDS:** Identification of diseases , Deep learning , Solutions, Convolution Neural Network (CNN)

## I. INTRODUCTION

Agriculture has a vital role in developing countries .India plays a large role in global food security. It is the field which highly affects the GDP of the countries. The agricultural sector is in third place and accounts for about 16 percent of India's GDP. Farmers spend Thousands of Rupees on disease management, typically with inadequate technical support, leading to poor disease control, pollution and harmful results. The crops gets affected due to factors like change in weather and local conditions .Plants get infected by various diseases and if these diseases remain undetected it may reduce quality and quantity of crops. To avoid such issues early plant disease detection plays a vital role.

Identification of disease by naked eyes is the common manual disease detection technique usually adopted by many farmers. It requires continuous monitoring and even farmers are unaware of many diseases .Hiring an expert for this purpose is very costly for farmers. Various image processing techniques are used in agriculture for detection of diseases in plants. Currently deep learning is most popular. CNN is the deep learning model that is most commonly used for image processing. CNN classifies the images of infected and uninfected leaves based on the extracted features.

The success of proposed model will be evaluated based on accuracy and speed to identify the type of diseases in plants. The methodology consists of three stages: image collection, image preprocessing and image classification .In first stage, collection of the images of several plants and creation of the dataset is done. The dataset consists of color images of healthy as well as infected leaves. In second stage all the images are preprocessed to make standard image .This will help the classification model to deal with images having same standard format. Finally in last stage the classification of images is done using CNN model.

## II. LITERATURE REVIEW

Paper No.	Year	Plant	Diseases	Dataset	Algorithm	Evaluation Measure	Output
1	2019	Cotton	Cercospora, Bacterial blight, Ascochyta blight, Target spot	500 images for training and 100 images for testing the model	The images are resized to 512x512. Classification is done using Deep Convolution Neural Network	Accuracy	Accuracy : 96% Healthy leaf : 95% Cerespora : 100% Bacterial Blight : 90% AscochytaBlight : 95% Target Spot : 100%
2	2020	Apple,	Black rot,	Dataset consists	Image preprocessing :	Accuracy	Logistic Regression :

		potato, tomato, grape, Strawberry, corn	rust, bacterial spot, early blight, late blight, leaf scorch, target spot, mosaic virus of different crops	of 20,000 images divided into 19 classes	Gaussian Blur, Segmentation : K-means, Classification : Logistic Regression , KNN , SVM , CNN		66.4% KNN : 54.5% SVM : 53.4% CNN : 98%
3	2019	Tomato , Grapes, Corn, Apple and Sugar cane	LateBlightTomato, EarlyBlightTomato, CeresporaGrayleafSpotCorn, Black rot Grape, LateBlightGrape	Image dataset was gathered from plant village repository. It consists of 35,000 images with 32 classes of diseases.	The image are resized to 96x96 resolution . The classification is done using Convolution Neural Network	Accuracy	Average accuracy : 96.5% LateBlightTomato : 99.62% EarlyBlightTomato : 75.36% Black rot Grape : 95.09% Cerespora Gray leaf Spot Corn : 99.56%
4	2018	Cotton	Bacterial blight, Magnesium deficiency	Dataset consists of 130 images in which 50 images of Bacterial blight , 50 images of magnesium deficiency and 30 healthy leaf images	Segmentation:K-means Feature Extraction: GLCM Classification : SVM	Accuracy	Average accuracy : 98.46%
5	2018	Tomato	Leaf Miner, Phoma Rot, and Target Spot.	The dataset consist of 4,923 images of tomato plant leaves which are categorized into Healthy and diseased leaves.	Disease Recognition : Faster R-CNN and CNN	Accuracy	CNN : 91.67% F-RCNN : 80%
6	2019	Turmeric	Leaf Spot and Leaf blotch	Dataset consists of 200 images of leaf spot and leaf blotch.	Segmentation : K-means Feature Extraction : GLCM Classification : SVM	Accuracy	Average Accuracy : 90.4%
7	2017	Citrus	Alternaria, Anthracnose, bacterial spot, canker	Dataset consists of 60 images with 35 diseased leaves images and 25 healthy leaves images.	Segmentation : K-means, Feature extraction : GLCM, Classification : SVM	Accuracy	Leaf Spot : 98.38% Healthy Leaf : 96.77%
8	2018	Chili, grape, rice, soya bean, wheat, cotton, mango	Bacterial blight, Cerospora leaf spot, powdery mildew and rust leaf disease	Dataset 560 images with 115 images of bacterial blight, 120 images of Cerospora leaf spot , 200 images of powdery mildew and 125 images of rost leaf disease	Segmentation : K-means Classification :Support Vector Machine (SVM)	Accuracy	Average accuracy : 98%

### III. METHODOLOGY

To detect and classify the type of disease in leaves of plants, our proposed model consists of 3 stages as listed below (which is the 4th stage)

- Dataset Creation
- Image Pre-processing
- Classification



Fig. 1 Workflow of Proposed Methodology

#### 1. Dataset Creation

Dataset consists of 500 images of leaves which are divided into 5 classes. We have selected cotton plant for our research. It consists of diseases like bacterial blight, alternaria leaf spot, chlorosis, grey mildew and some images of healthy leaves.

#### 2. Image Pre-processing

Image preprocessing are the steps taken to format the images. It helps to decreases model training time and increase model execution speed. Fully connected layers of CNN model requires all the images in the same standard format. The system is using “Keras” library of python for image pre-processing. The image pre-processing consists of resizing , rescaling , removing noise, shearing, rotating, zooming and flipping . The images are resized to 150x150 resolution for processing. To enrich our dataset we have rescaled, flip, sheared and zoomed the image.

#### 3. Classification

For classification of diseases we have used deep convolution neural network (CNN). CNN model consists of 4 layers :

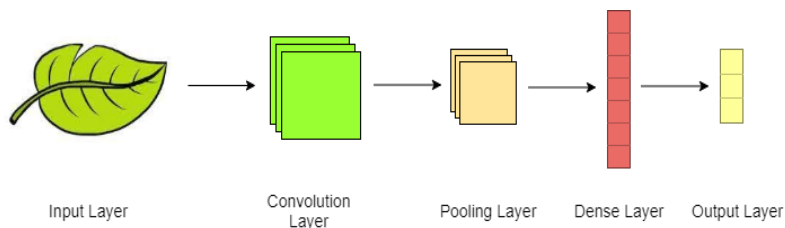


Fig. 2 Architecture of CNN Model

#### a. Convolution Layer

The convolution layer multiplies the input image matrix with the feature detector matrix to get the reduced size feature map matrix. In convolution layer we move stride by stride through input image matrix. This reduced feature map matrix helps for faster computation.

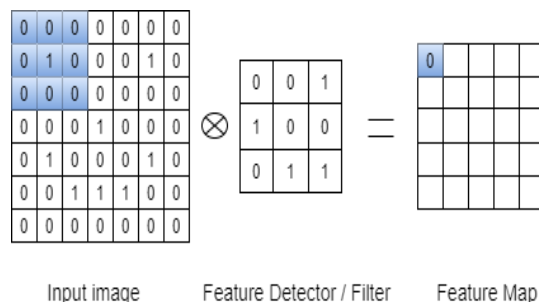


Fig. 3 Convolution Layer

Fig. 3 exhibits the operation for 7x7 input matrix which is multiplied by 3x3 feature detector matrix and the result is 5x5 feature map matrix of reduced size.

*b. Pooling Layer*

We are using Max-Pooling layer in our training model. In this layer the pool size is 2x2. We are selecting maximum value from each pool and forming pooled feature map from convoluted feature map. This layer is used to reduce the overfitting of information by reducing the 75% of data from feature map.

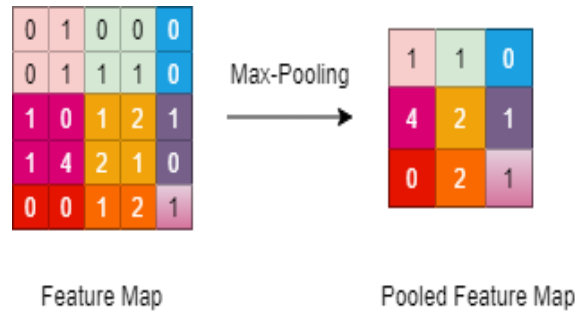


Fig. 4 Pooling Layer

*c. Flattening*

The numbers from pooled feature map are taken row by row to form huge vector because later we want to input this vector into Artificial Neural Network (ANN) for further processing.

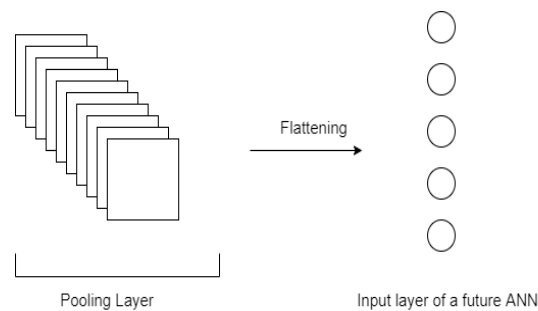


Fig. 5 Flattening Layer

*d. Fully Connected Layer*

The Fully Connected Layer consists of input layer, fully connected hidden layers and output layer. The output vector that we got after flattening is the input layer. The features are combined to form attributes which will help us to predict the class. The output layer consists of all the classes.

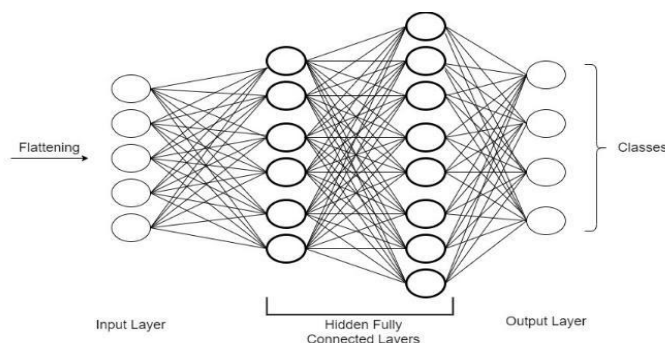


Fig. 6 Fully Connected Layer

Activation function:

Activation functions are mathematical equations to determine the output of a neural network. In a network, the function is attached to each neuron. Based on whether each neuron's input is relevant for the model's prediction it determines whether it should be activated ("fired") or not. In proposed model ReLU and Softmax activation functions are used.

*ReLU* : The rectified linear activation function or ReLU linear function that will output zero if the input value is zero or negative otherwise it will output positive value as it is.

*Softmax* : It is used in the output layer and when we need to classify into multiple categories. It normalizes the output for each class between 0 and 1 and then divides by their sum, to find the probability of input data in specific class.

#### IV. CONCLUSION

In this paper, we have provided a accurate solution for plant disease detection and classification using Convolution Neural Network model. The model presented consists of data set containing 500 images among 4 classes. This model can also made more accurate by using large amount of images in data set. We are also going to provide remedies to disease identified on input image. This model can also be available on android phones so that the farmers can use it for their benefits.

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