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# Detection of Disease Affecting on a Specific Plant Organs of Okra and Remedies for Sustainable Crop Management

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**ABSTRACT:** The issue of effective plant disease and pest prevention is compactly connected to the issues of sustainable agronomics and climate change. Okra plant diseases and pests cause intense monetary losses to the growing okra industry, but their accurate and rapid identification remains troublesome due to the lack of efficient approaches.

The okra crop, commonly called lady's finger, is a commercial crop grown by farmers. But when these crops are infected, they wreak havoc on the life of farmers as well as on the economy. Plant disease issues are due to problems arising in agricultural activities and climate change. It causes money problems and losses to profits, farmers, and to whole industry depending on okra. If disease identification is done without appropriate techniques, then the problem remains the same.

Various researches have proposed several techniques to overcome these infections. CNN, Deep learning, and many other machine-learning techniques are used for detecting and classifying plant diseases.

**KEYWORDS:** Convolutional Neural Network, Image Processing, Okra Crop, Agriculture, Plant Disease.

## I. INTRODUCTION

One of the most important and fundamental pillars of any economy, and perhaps more so in India, is the agricultural sector. One of India's largest industries, agriculture employs a sizable portion of the country's people. Farmers that are on the cutting edge of agriculture typically rely on visual inspection and identification of various crop illnesses and problems. The okra crop, commonly called lady's finger, is a commercial crop grown by farmers. Crop experts employ the same procedure with a bit more expertise. However, both farmers and experts are only capable of precisely identifying a certain number of crops. Despite the use of methods that appear to be infallible, there is a chance that the outcomes will be inaccurate; they may have revealed improper assessment or be incorrect diagnosis. This takes time and wastes material and financial resources, which reduces the effectiveness of crop production, has an impact on farmers' investments, and could be seen as a blow to the farming industry and the country's economy. It thus reduces crop growth further, creating a shortage in the market and inflation in price. The use of image processing methods in automatic detection may prove to be a useful strategy that produces quicker and better results.

Deep learning and the use of recognition models are simply two of the few contemporary methods that could deliver an ideal outcome. In this project, we'll employ deep convolutional networks, which are typically used to classify images of leaves, to try to tackle the challenge of detecting and identifying various crop/plant illnesses.

## II. OBJECTIVES

We focus on the detection of diseases affecting a specific plant organ and explore effective remedies for their management. The objective of this project is to identify and manage diseases affecting okra plants, focusing on specific organs such as leaves, flower, and fruits. We aim to accurately diagnose the diseases and suggest remedies for

sustainable crop management. Through knowledge dissemination and ongoing research, our goal is to establish long-term sustainability in okra cultivation, benefiting farmers and promoting food security.

### III. LITERATURE REVIEW

Okra yellow vein mosaic, also known as the bhindi yellow vein mosaic virus, is a viral disease that affects okra plants and is brought on by a monopartite Begomo virus. It was initially discovered in 1924 in Sri Lanka and Bombay, India. It is the main factor limiting okra output. This disease is transmitted by whitefly. We collected data for 2000 images of okra leaves (diseased & healthy) and organized them into a train, validation, and test folders. The goal is to identify the yellow vein mosaic disease in okra leaves. Datasets are first obtained by having photos of the okra crops. Various studies outline the methods for categorizing and identifying plant diseases. Different algorithms, including those that use classification and regression approaches, are applied in machine learning and neural networks. Researchers [1] and others employ SVM Naive Bayes, logistic regression, and linear discriminant analysis to produce effective results and identify issues or infections in crops with fewer pictures collected. Unlike these Densenet is also used to serve the purpose. The training and testing sets are separated into two portions, making up the dataset. The dataset's feature vector is trained using the Densenet.

The Plant Village dataset was used to obtain the images for 6 different tomato crop illnesses and healthy samples. In the segmented images of the dataset, all background pixels in the three channels (Red, Green, and Blue) are set to 0, except for the pixels related to the leaf, which are used in this study. For the selected diseases and healthy ones from the collection, a total of 13,262 segmented images were available. The  $256 \times 256$  original input image was increased to  $227 \times 227$  for the Alex Net model [3] and  $224 \times 224$  for the VGG16 net. The design has a total of eight layers, the first five of which are convolutional layers and the final three of which are completely connected. To extract the most features possible, the first two convolutional layers are linked to overlapping max-pooling layers. The fully connected layers are immediately coupled to the third, fourth, and fifth convolutional layers. The ReLu non-linear activation function is coupled to each and every output of the convolutional and fully connected layers. A softmax activation layer, which generates a distribution of 1000 class labels, is coupled to the final output layer.

The categories are Leaf Mold Images, Early Blight Images, Late Blight Images, Bacterial Spots Images, and Healthy. Further features are extracted and provided to the classifier to predict different types of disease on different types of leaves. This method when implemented on okra crops classifies the different diseases infected on okra leaves. The recovered vector is saved in training sets and datasets, and Densenet is once more used for training. Based on the parameters provided to the model [4], the generated feature vector will be used for the testing image of leaves. Then feature vectors are created, which under-trained and under-tested classifiers were supposed to save for predicting accurate results.

Images of plant disease samples are either taken under controlled conditions in a laboratory with a white background or in the field with a complex background, according to Meunkaewjinda et al. (2008) (Jadhav and Patil, 2016) [5]. For image acquisition, a variety of tools, including Android mobile phones, CCD color cameras, CCD multispectral cameras, and hyperspectral imaging systems are used [6].

There are 14 different types of crops in the public dataset called Plant Village, which can be downloaded from Kaggle. They decided to use a tomato leaf [9] for this project. This dataset on tomato crops has 10 different classes. One of them is in a healthy class, while the other nine are ill classes. Shah et al. (2016) [10] suggested creating an image database using familiar photos from the live farm, which would be directly captured in digital form with numerical values for use in digital image processing. The Redmi Note 5 camera's high pixel intensity was employed by Ramesh and Vydeki (2020) to take pictures of both healthy and sick rice leaf portions. Resized to  $256 * 256$  Pixels were all the leaf samples collected from the rural region.

### IV. METHODOLOGY

In this project we use okra (*Abelmoschus Esculentus*) as the data input. These image data become inputs in convolutional neural network algorithm. Deep learning based to detect macronutrient deficiency of plant based on image input data. Gather a diverse dataset of okra plant images, including healthy plants and plants affected by various diseases. A large number of training images help CNNs to enhance the ability of anti-interference under complex conditions and avoid the overfitting issue during the training stage. To predict the disease, trained model is compared

with the test image. We focus on the detection of diseases affecting a specific plant organ and explore effective remedies for their management to detect a plant disease at very initial stage. we evaluate various remedies for disease control.

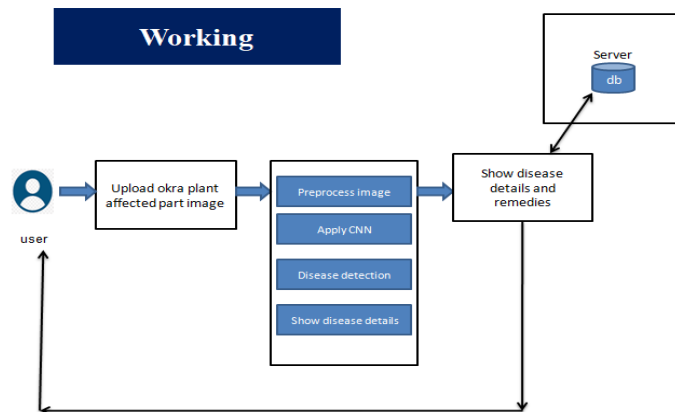


Figure 1: Working

**CNN (Convolutional Neural Network):** CNN uses filters on the pixels of any image to learn detailed patterns compared to global patterns with a traditional neural network. To create CNN, we have to define:

1. **A convolutional Layer:** Apply the number of filters to the feature map. After convolution, we need to use a relay activation function to add non-linearity to the network.
2. **Pooling Layer:** The next step after the Convention is to down sampling the maximum facility. The objective is to reduce the mobility of the feature map to prevent overfitting and improve the computation speed. Max pooling is a traditional technique, which splits feature maps into subfields and only holds maximum values.
3. **Fully connected Layers:** All neurons from the past layers are associated with the other next layers. The CNN has classified the label according to the features from convolutional layers and reduced with any pooling layer.

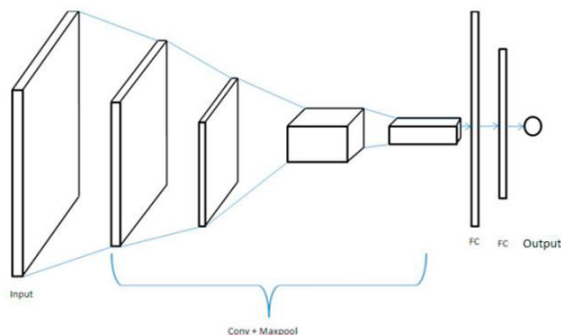


Figure 2: CNN Architecture

**CNN Architecture:**

- o **Convolutional Layer:** It applies 14 5x5 filters (extracting 5x5-pixel sub-regions),
- o **Pooling Layer:** This will perform max pooling with a 2x2 filter and stride of 2 (which specifies that pooled regions do not overlap).
- o **1,764 neurons,** with the dropout regularization rate of 0.4 (where the probability of 0.4 that any given element will be dropped in training)

- **Dense Layer (Logits Layer):** There are ten neurons, one for each digit target class (0-9).

Important modules to use in creating a CNN:

1. `Conv2d ()`. Construct a two-dimensional convolutional layer with the number of filters, filter kernel size, padding, and activation function like arguments.
2. `max_pooling2d ()`. Construct a two-dimensional pooling layer using the max-pooling algorithm.
3. `Dense ()`. Construct a dense layer with the hidden layers and units

We can define a function to build CNN.

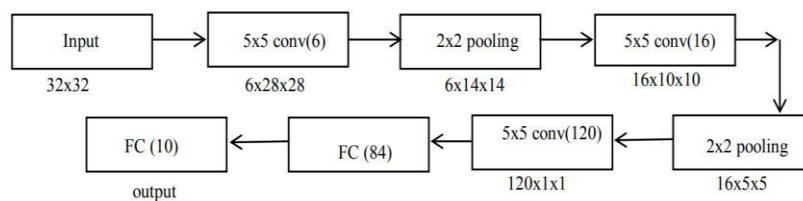


Figure 3: CNN Layers

**Input layer:** We need to define a tensor with the shape of the data. For that, we can use the module `tf.reshape`. In this module, we need to declare the tensor to reshape and to shape the tensor. The first argument is the feature of the data, that is defined in the argument of a function. A picture has a width, a height, and a channel. The MNIST dataset is a monochromatic picture with the 28x28 size. We set the batch size into -1 in the shape argument so that it takes the shape of the features ["x"]. The advantage is to tune the batch size to hyperparameters. If the batch size is 7, the tensor feeds 5,488 values (28 \* 28 \* 7).

**Convolutional Layer:** The first convolutional layer has 18 filters with the kernel size of 7x7 with equal padding. The same padding has both the output tensor and input tensor have the same width and height. TensorFlow will add zeros in the rows and columns to ensure the same size. We use the Relu activation function. The output size will be [28, 28, and 14].

**Pooling layer:** The next step after the convolutional is pooling computation. The pooling computation will reduce the extension of the data. We can use the module `max_pooling2d` with a size of 3x3 and stride of 2. We use the previous layer as input. The output size can be [batch\_size, 14, 14, and 15].

**Pooling Layer and Second Convolutional Layer:** The second CNN has exactly 32 filters, with the output size of [batch\_size, 14, 14, 32]. The size of the pooling layer has the same as ahead, and output shape is [batch\_size, 14, 14, and 18].

**Fully connected (Dense) Layer:** We have to define the fully-connected layer. The feature map has to be compressed before to be combined with the dense layer. We can use the module `reshape` with a size of 7\*7\*36. The dense layer will connect 1764 neurons. We add a Relu activation function and can add a Relu activation function. We add a dropout regularization term with a rate of 0.3, meaning 30 percent of the weights will be 0. The dropout takes place only along the training phase. The `cnn_model_fn()` has an argument `mode` to declare if the model needs to trained or to be evaluate.

**Logits Layer:** Finally, we define the last layer with the prediction of model. The output shape is equal to the batch size 12, equal to the total number of images in the layer. We can create a dictionary that contains classes and the possibility of each class. The module returns the highest value with `tf.argmax ()` if the logit layers. The softmax function returns the probability of every class. We only want to return the dictionary prediction when the mode is set to prediction. We add these codes to display the predictions.

**Image Augmentation:** Image augmentation is a powerful technique that artificially expands the available dataset by creating variations of existing images. It helps improve the performance of deep learning models, especially when the amount of labeled data is limited. Here are some key points related to image augmentation.

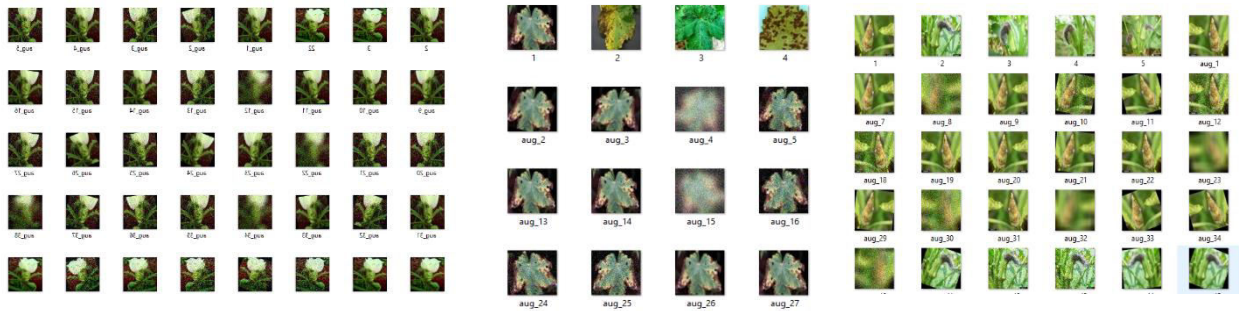


Figure 4: Okra Diseased Images

### SYSTEM ANALYSIS & DESIGN

In this system, we proposed an online web application for okra disease detection. In this application we have covered diseases for 3 parts of okra plant i.e Leaf, Fruit, Flower.

This application is a dynamic web application in which admin will be able to register new diseases and upload their images for dataset. As all disease datasets are not available we have implemented image augmentation technique for dataset generation.

Diseases Covered in this system are

- Leaf
  - Yellow Vein Mosaic
  - Leaf Spot
  - powdery mildew
  - enation leaf curl
- Fruit
  - Fruit Rot
  - shoot and fruit borer
- Flowers
  - Aphid
  - Blossom Blight

### V. EXPECTED OUTCOMES

In this study, test accuracies were measured using the proportion of the test set of the okra dataset. This study aims to evaluate the recognition efficiency of pre-trained CNN models for early recognition of diseases of the okra plant, and CNN model VGG16 were compiled with the okra dataset via transfer learning approach. Manual detection of plant disease using leaf images is a tedious job. Hence, it is required to develop computational methods which will make the process of disease detection is automatic. The table shows some diseases and their remedies of okra on leaf, fruit and flower.



Table: Okra Diseases and Remedies

Plant Organ	Disease	Symptoms	Remedies
Leaves	Powdery Mildew	White powdery patches on leaves; yellowing and curling	1. Apply sulfur-based fungicides.
		of leaves; stunted growth.	2. Maintain proper spacing between plants to improve air circulation.
			3. Remove and destroy infected plant parts to prevent spread.
Leaves	Leaf Spot	Circular brown spots on leaves; yellowing and wilting	1. Apply copper-based fungicides.
		of leaves; lesions may have a yellow halo.	2. Avoid overhead watering to reduce moisture on leaves.
			3. Practice crop rotation to reduce disease buildup in the soil.
Leaves	Yellow Vein Mosaic	Yellow veins on leaves; mosaic patterns; leaf deformation	1. Remove and destroy infected plants to prevent spread.
		and curling; stunted growth.	2. Plant disease-resistant varieties if available.
			3. Control aphid populations, which can transmit the virus.
Flowers	Blossom Blight	Brown lesions on flower petals; premature flower drop	1. Remove and destroy infected flowers.
			2. Apply fungicides during flowering to prevent infection.
			3. Improve air circulation and reduce humidity around plants.
Fruit	Fruit Rot	Dark sunken spots on fruits; softening and decay	1. Harvest fruits promptly to avoid overripening.
			2. Avoid overhead irrigation; water at the base of plants.
			3. Apply fungicides before symptoms appear during fruiting season.

VI. CONCLUSION

In this project we proposed CNN algorithm to detect Okra Diseases, as we are using CNN algorithm for classification there is no need to use separate algorithm for features extraction. Hence time required to extract features will be reduced and hence we can conclude that the proposed system is very fast and efficient. We have created dataset for three parts of okra plants; leaf, fruit and flower using image augmentation technique. We have developed a dynamic web application in which admin can increase and train dataset any time from his panel. We have implemented CNN algorithm for classification and we got 97% accuracy.

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