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*Research Article*

# Classification, Detection and Diagnosis of Banana Leaf Diseases using Deep Learning Technique

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***Abstract***

*Agriculture plays a significant role in the growth and development of our nation's economy. Indian economy is highly dominated by agricultural sector. But, the emergence of several agrarian diseases affects the productivity in the agricultural sector. It is necessary to cope up with this problem and to make aware farmers to counter the spread of diseases in crops. Hence, crop disease identification and diagnosis plays a significant role. Use of the deep neural network to automatically identify and provide diagnosis to crop diseases is aspired in the agriculture field. In this paper, a deep neural network model is proposed which performs disease detection of plants and cure through images of healthy leafs and disease infected plants, using deep learning technologies. We proposed a deep learning advances that improves the process of classifying diseases on banana leaves and provide diagnosis for identified disease. To classify image data sets we make use of convolutional neural network. Initial results shows us the strength of our proposed model even under challenging conditions such as complex background, different resolution, size, pose.*

***Keywords:*** *Banana leaf, disease identification, Convolutional neural network, etc.*

## Introduction

Crop disease is the prime reason for food shortage and food insecurity in our country. In fact, globally up to 16% of crop yield losses annually when plant pathogens taken into account. For Indian people Agriculture is an important source of income. Farmers grow various types of crops but diseases affect the growth of crops. Different crops suffer from different diseases. There are various parts to examine the diseases of crops. The entire crop is considered for the examination of diseases. The diseases on crop reduce quantity and quality of crops and their further growth. The easiest method of detection of crop diseases is taking the advice of agricultural expert having knowledge reinforced by practical experience on symptoms and causes of diseases. Manual detection of crop diseases takes more time and is a laborious work. The solutions to fight different diseases demand the massive use of crop protection products, which are dangerous for the environment and hence the automation of the plant diseases detection and identification essential to secure plants. A successful protection strategy should start with an early detection of the disease in order to choose the appropriate treatment at the right time to prevent it from spreading which helps farmer to increase productivity. Hence, it is a need for an automatic method to identify the crop diseases. So with the help of computer advances we can develop the automatic methods for the identification and classification of crop diseases. There can be various deep learning and image processing techniques like convolutional neural network, that can be used for the crop disease identification and detection, which results in the way to prevent the agricultural loss. Thus identification of crop diseases automatically using artificial and convolutional neural network methods which provide more accurate results and advice for management of diseases. This paper gives the introduction to deep learning and image processing technique used for disease detection of plants and diagnosis.

## Literature Survey

Wenjiang Huang et al. [1] In this paper for indirect monitoring of diseases on plants has been done through vegetation indices from hyper spectral data. But the different diseases on crop cannot distinguish using this. The author creates the new indices to detect the wheat disease for the study. According to this study, three different pests have been selected. These pests are as follows: yellow rust, aphids and powdery mildew. For detection of max and less relevant wavelength for different diseases RELIEF-F algorithms have been used. In this paper, The classification of new indices for healthy and infected leaves has been done with accuracy of 86.5%, 85.2% respectively.

Zulkii Bin Husin et al. [2] In this paper author take the leaf image of chilly plant and processed to find the health status of the chilly plant. This technique ensures that the chemicals should apply to the diseased chilly plant only. For extraction of features and for recognition of image MATLAB has been used. Pre-processing has been done using the edge detection, Fourier filtering, and morphological operations. Image classification has been performed using computer vision technique. In this paper, digital camera builds the GUI for the image capturing.

Monica Jhuria et al. [3] In this paper, To find the diseases artificial neural network has been used. Two separate Databases were created one for training and second for the query images implementation. Back propagation was used for adjustment of weights for training databases. They consider three feature vectors, which are color, textures and morphology. In this paper , author have found that the morphological feature gives better result than the other two features.

Karthik .G et al. [4] In this paper , Among various plants, Banana is considered to be one of the most valuable plants. Musa Paradisiacal is the scientific name of banana and the life of these plant is up to10 to12 months. Detection of diseases was, monitored of banana leaf. The authors have observed that the banana leaf can easily be affected by a Banana Streak disease and for prevention of this disease Embedded Linux development board was used by authors. The Banana Streak disease can reduced the growth of the plant. The ETL(Economic Threshold Level) algorithm is used for processing of captured image. This algorithm has been used to set the threshold value for a healthy image of banana leaf . Identification of the disease was performed in such a manner that If threshold value has been cross by the pixel value of the selected image then banana streak disease have been confirmed and accordingly respective recovery method is to be applied.

Sharada Prasanna Mohanty et al. [5] In their paper developed a model for the identification of the diseases in leaf using the image processing and backpropagation neural network and for the implementation of this work MATLAB has been used. The manual inspection subjectiveness has been eliminate using digital image processing and accurately identified the diseases in rice plant which are Bacterial leaf blight, brown spot and rice blast. MATLAB functions have been used for the image processing and it consist of technique such as image segmentation and enhancement, feature extraction.

V. Singh et al. [6] In this paper, the combine technique of image segmentation and soft computing was proposed for automatic detection and plant leaf diseases classification using a genetic algorithm. Initially the *K*-mean clustering with the minimum distance criteria have been used for classification purpose.It can be done with an accuracy of 86.54%. The proposed algorithm was used to improve the accuracy to 93.63%, by the using SVM algorithm the accuracy improved to 95.71%

Melike Sardogan et al. [7] In this paper, Automatic methods for classification of the bacterial spot, late blight, sartorial leaf spot and yellow curved leaf diseases on tomatoes. For an better crop yield it is important to have the early detection of diseases in agriculture. In this paper, Convolution Neural Network (CNN) model and Learning Vector Quantization (LVQ) algorithm based technique was used for tomato leaf disease detection and classification. The dataset have tomato leaves images with four symptoms of diseases and it contains 500 images. In this model, the selected filters are applied on Red Green Blue channels of images. For training the network the convolution part of feature vector has been fed with LVQ. The experimental results validate that the method effectively recognizes four different types of leaf diseases.

**Proposed Solution**

In this paper we introduce a deep learning model to classify and identify diseases on banana leaves and give proper diagnosis to disease. The architecture of the proposed model is given in Fig. 1.

A. Architecture:

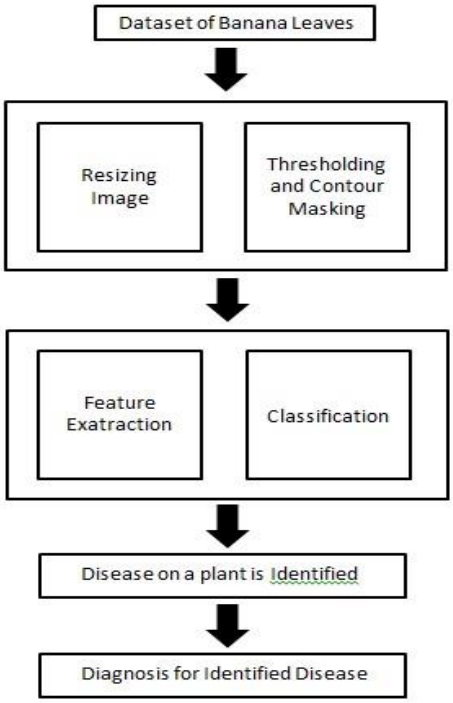


Fig. 1 Architecture of proposed System

The figure shows that the model comprised of two Main components: image preprocessing and CNN

based classification. In the following, we gives details about each components.

1. Image Processing

Each image has three channels which are RGB red (R), green (G), and blue (B). In experimentation we will test the applicability of our method to the RGB images. Then we perform a preprocessing step and in this step each image in dataset is resized then thresholding and contour masking is performed.

2. Deep learning based Model

A neural network contains multiple neurons arranged in layers. These neurons are connected to each other. The neurons learn automatically how to convert inputs into corresponding output. The convolutional neural networks are nothing but the group of multilayered neural networks. CNNs require low preprocessing for execution are known for their robustness toward low variation in data. CNN is having three main parts which are convolution, pooling and fully connected layers. The work of convolution and pooling layers is to extract features from the input images while the fully connected layer use for a classification. The important work of convolution layer is to a extract features from each input image automatically. The feature which are extracted in convolutional layer their dimensionality is reduced by the pooling layer. Then, in the fully connected layer the input images is classify into predefined classes and it makes use of activation function to learned the high-level features for classification. The proposed Model is made of two main parts: which are the automotive feature extraction model and classification model.

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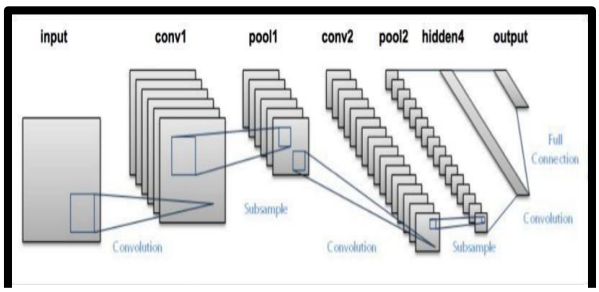


Fig. 2 Convolutional neural network. Retrieved from https://missinglink.ai/guides/convolutional-neural-networks/convolutional-neural-network-architecture-forging-pathways-future/

1. Feature extraction model

In feature extraction, the network learns to detect different high level features from the input images. It has a sequence of convolution and pooling layers.

**Convolution Layer**: Convolutional layer is used to perform a convolution operation on the input image which is to be used for passing the result to the next layer. The convolution emulates the response of an individual neuron to visual stimuli. Each convolutional neural processes data only for its respective field. The working of convolutional layer is given below:

- Line up the feature and image.
- Multiply each image pixel by corresponding feature pixel
- Add the values and find the sum Divide the sum by the total number of pixels in the feature.

**Pooling Layer**

The pooling layer combines the outputs of neuron clusters into a single neuron in the next layer. In this layer the image stack is shrink into a smaller size. Pooling is applied after activation layer. In proposed model average pooling is used and in this the average value from each of a cluster of neurons at the prior layer.

**Fully Connected Layer**

In fully connected layer we combined the features together to create a model. Finally an sigmoid activation function is used to classify the outputs into target classes.

B. Algorithm:

Step1: Acquisition of image.
Step2: Image preprocessing is performed. Step3: Extract the features from the input image Step4: Features learned by the classifier. Step5: Detect the affected leaf Step6: identify the disease.
Step7: Provide diagnosis for identified disease Step8: Analysis of Accuracy, Precision, and recall.

C. Dataset explanation

To validate the performance of the proposed approach, a dataset for banana leafs are obtained from the Plant Village project[7] and we conducted a set of experiments using this dataset. The dataset contains thousands of images of banana plant which are classified as healthy and diseased images. The images in our dataset are belonging to three different categories which are healthy (360 images), black sigatoka (220 images) and black speckle (43 images). Fig. 1 illustrates some samples of the dataset which contains in general 623 images.

**Results & Discussion**

In the implementation done so far, we acquired image of banana leaf from dataset as an input image and in preprocessing phase the image resizing is performed then thresholding and contour masking is applied. Fig 3 shows the input image and fig.4 and fig.5 are the

output images of preprocessing. Then CNN is used for feature extraction from image. So the features from input image is extracted and it is classified according to these extracted features. The input and output of current implementation is shown in following figures.

Fig.3 Input image

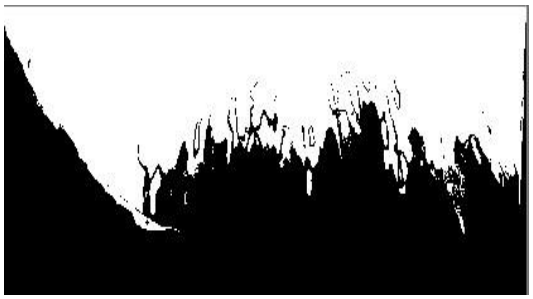

Fig.4 Thresholding results

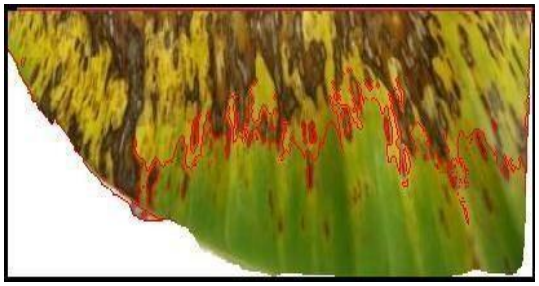

Fig.5 Contour masking

For the validation of our model we divide the dataset into train and test data. So 60% of the whole dataset is used for training the model and the 40% is used for testing the model. The performance measures like Accuracy, precision, Recall is taken into consideration for the assessment of performance of our model and Table 1 depicts the results.

Table 1 Statistical Measures

| Train | Test | Accuracy | Precision | Recall |
|---|---|---|---|---|
| 60% | 40% | 90.3 | 94.8 | 94.8 |

## Conclusion

In this paper, the proposed model can help farmers to identify the disease in the banana plant and help farmers as a decision support tool. The aim of proposed network model for banana disease detection and diagnosis. The system is able to classify the banana leaf as healthy or infected leaf. The future work involve the identification of disease and it will provide better diagnosis to identification results. Such deep learning methods helps agricultural experts in detection of disease in plants and then suggest medicines to farm.

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