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# Detection of Plant Disease using Web Application

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**Abstract**: Plant disease is an ongoing challenge for small holder farmers, which threatens income and food security. The recent revolution in smartphone penetration and computer vision models has created an opportunity for image classification in agriculture. Plant disease detection can be done by looking for a spot on the diseased plant's leaves. The goal of this paper is to create a Disease Detection Model that is supported by leaf image classification. To detect plant diseases, we are utilizing image processing with a Convolution neural network (CNN). It is a form of artificial neural network that is specifically intended to process pixel input and is used in image recognition.

**Keywords***:* Deep Learning, Classification, Image Processing, Convolutional Neural Network, Plant Disease Detection, Segmentation.

## I. INTRODUCTION

Plants are important for both humans and animals as they rely on them for food, oxygen, and other necessities. When a plant gets infected with a disease, all living organisms in the environment are affected in some way. This plant disease can affect anywhere on the plant, including the stem, leaf, and branch. Early detection of plant disease aids in the prevention of large-scale crop losses. It is the basis for effective prevention and control of plant diseases, and they play a vital role in the management and decision making of agricultural production. The traditional method of human analysis of classifying crop diseases by visual inspection is no longer feasible.

Hence, there is development of computer vision models that offers a quick, standardised and accurate solution to this issue. Deep learning techniques have proven to be a strong tool for plant disease detection as it has the capacity to handle an immense amount of datasets which improves the chances for better detection. In this study, one of the algorithms of deep learning, Convolutional Neural Network (CNN) has been utilized to identify infected and healthy leaves, as well as to detect illness in afflicted plants.

## II. LITERATURE REVIEW

Sharada Prasanna Mohanty et al. in the paper **"Using Deep Learning for Image-Based Plant Disease Detection" [1]** proposed an approach of smartphone-assisted disease diagnosis in crops. The CNN model is trained to identify 14 crop species and 26 diseases.

In the paper **"A Literature Survey: Plant Leaf Diseases Detection Using Image Processing Techniques" [2]** the authors K. Narsimha Reddy et al., a computerized image processing and pattern recognition technique is used to detect the disease affected leaf with the help of colour information of leaves. This study also suggests the appropriate classification tools for different input data.

Prof. A. R. Bhagat Patil et al. in the paper **"A Literature Review on Detection of Plant Diseases" [3]** has proposed an approach of building an efficient neural network by developing a precise image classifier aiming at disease diagnosis of plants using verified and processed datasets.

In the paper **"Survey on Plants Disease Detection Using Machine Learning" [4]** the authors Preetha S et al., Implementation of machine learning method in the field of agriculture for detecting disease can help us save valuable time and money. It is effortless to use and very reliable.

## III. METHODOLOGY

### Dataset

We analyze 13,876 images of plant leaves, which have a spread of 13 class labels assigned to them. Each class label is a crop-disease pair, and we make an attempt to predict the crop-disease pair given just the image of the plant leaf. One example each from every crop-disease pair from the PlantVillage dataset. In all the approaches described in this paper, we resize the images to 256 × 256 pixels, and we perform both the model optimization and predictions on these downscaled images.

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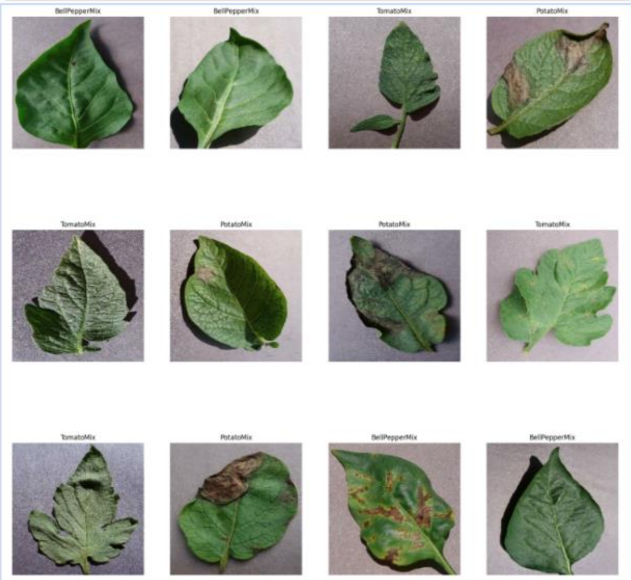
Across all our experiments, we use three different versions of the whole PlantVillage dataset. We start with the PlantVillage dataset as it is, in color; then we experiment with a gray-scaled version of the PlantVillage dataset, and finally we run all the experiments on a version of the PlantVillage dataset where the leaves were segmented, hence removing all the extra background information which might have the potential to introduce some inherent bias in the dataset due to the regularized process of data collection in case of PlantVillage dataset. Segmentation was automated by the means of a script tuned to perform well on our particular dataset.

To get a sense of how our approaches will perform on new unseen data, and also to keep a track of if any of our approaches are over fitting, we run all our experiments across a whole range of train-test set splits, namely 80–20 (80% of the whole dataset used for training, and 20% for testing).




**Deep learning**

The concept of Deep Learning (DL) originated from a paper published in Science by Hinton et al. in 2006. The basic idea of deep learning is: using neural network for data analysis and feature learning, data features are extracted by multiple hidden layers, each hidden layer can be regarded as a perceptron, the perceptron is used to extract low-level features, and then combine low-level features to obtain abstract high-level features, which can significantly alleviate the problem of local minimum. Deep learning overcomes the disadvantage that traditional algorithms rely on artificially designed features and has attracted more and more researchers' attention.

The model is composed of multiple layers, which has good autonomous learning ability and feature expression ability, and can automatically extract image features for image classification and recognition. Therefore, deep learning can play a great role in the field of plant diseases and pests image recognition.

In the area of image recognition, the use of these deep neural network models to realize automate feature extraction from high-dimensional feature space offers significant advantages over traditional manual design feature extraction methods. In addition, as the number of training samples grows and the computational power increases, the characterization power of deep neural networks is being further improved.

**Convolutional Neural Network**

Convolutional Neural Networks, abbreviated as CNN, has a complex network structure and can perform convolution operations. The convolutional neural network model is composed of input layer, convolution layer, pooling layer, full connection layer and output layer. In one model, the convolution layer and the pooling layer alternate several times, and when the neurons of the convolution layer are connected to the neurons of the pooling layer, no full connection is required. CNN is a popular model in the field of deep learning. The reason lies in the huge model capacity and complex information brought about by the basic structural characteristics of CNN, which enables CNN to play an advantage in image recognition. At the same time, the successes of CNN in computer vision tasks have boosted the growing popularity of deep learning.

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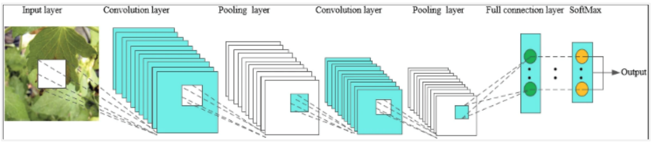



In the convolution layer, a convolution core is defined first. The convolution core can be considered as a local receptive field, and the local receptive field is the greatest advantage of the convolution neural network. When processing data information, the convolution core slides on the feature map to extract part of the feature information. After the feature extraction of the convolution layer, the neurons are input into the pooling layer to extract the feature again. At present, the commonly used methods of pooling include calculating the mean, maximum and random values of all values in the local receptive field. After the data entering several convolution layers and pooling layers, they enter the full-connection layer, and the neurons in the full-connection layer are fully connected with the neurons in the upper layer. Finally, the data in the full-connection layer can be classified by the softmax method, and then the values are transmitted to the output layer for output results.

### Segmentation Network

Segmentation network converts the plant diseases task to semantic and even instance segmentation of lesions and normal areas. It not only finely divides the lesion area, but also obtains the location, category and corresponding geometric properties (including length, width, area, outline, center, etc.). It can be roughly divided into: Fully Convolutional Networks (FCN) and Mask R-CNN.

### FCN

Full convolution neural network (FCN) is the basis of image semantics segmentation. At present, almost all semantics segmentation models are based on FCN. FCN first extracts and codes the features of the input image using convolution, then gradually restores the feature image to the size of the input image by deconvolution or up sampling.

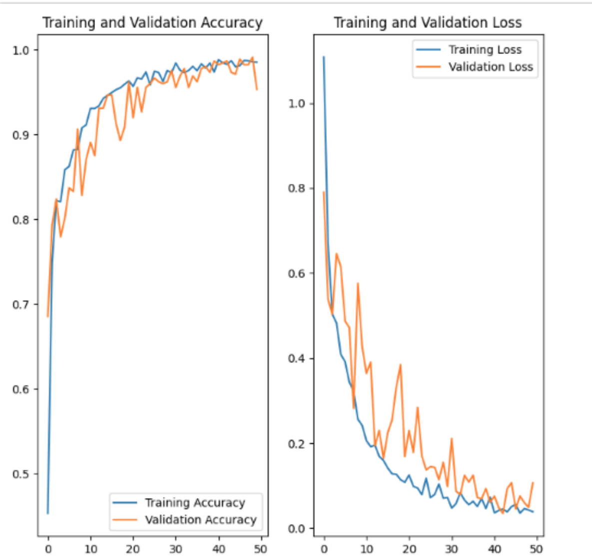
### Mask R-CNN

Mask R-CNN is one of the most commonly used image instance segmentation methods at present. It can be considered as a multitask learning method based on detection and segmentation network. When multiple lesions of the same type have adhesion or overlap, instance segmentation can separate individual lesions and further count the number of lesions.

### Evaluation Indices

Evaluation indices can vary depending on the focus of the study. Common evaluation indices include $Precision$, $Recall$, mean Average Precision (MAP) and the harmonic Mean F1 score based on $Precision$ and $Recall$.

$Precision$ and $Recall$ are defined as:
$Precision = TP / TP + FP$*100%,
$Recall = TP / TP + FN$*100%.



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## IV. PROPOSED SYSTEM

The process of plant disease detection system basically involves four phases .The first phase involves acquisition of images either through digital camera and mobile phone or from web. The second phase segments the image into various numbers of clusters for which different techniques can be applied. Next phase contains feature extraction methods and the last phase is about the classification of diseases.

**Image Acquisition:**

In this phase, images of plant leaves are taken from web. The images can also be gathered using digital media like camera, mobile phones etc. with desired resolution and size. The image database is responsible for better efficiency of the classifier in the last phase of the detection system.

**Image Segmentation:**

This phase aims at simplifying the representation of an image such that it becomes more meaningful and easier to analyze. As the premise of feature extraction, this phase is also the fundamental approach of image processing. There are various methods using which images can be segmented such as k-means clustering. The k-means clustering classifies objects or pixels based on a set of features into K number of classes. The classification is done by minimizing the sum of squares of distances between the objects and their corresponding clusters.

**Feature Extraction:**

After segmentation, the outcome so far achieved is the area of interest. Hence, in this step the features from this area of interest need to be extracted. These features are needed to determine the meaning of a sample image. Features can be based on color, shape, and texture. There are various methods of feature extraction that can be employed for developing the system such as gray-level co-occurrence matrix, color cooccurrence method, spatial grey-level dependence matrix, and histogram-based feature extraction.

**Classification:**

The classification phase implies to determine if the input image is healthy or diseased. If the image is found to be diseased, some existing works have further classified it into a number of diseases. Several classifiers have been used in the past few years by researchers such as artificial neural network (ANN).

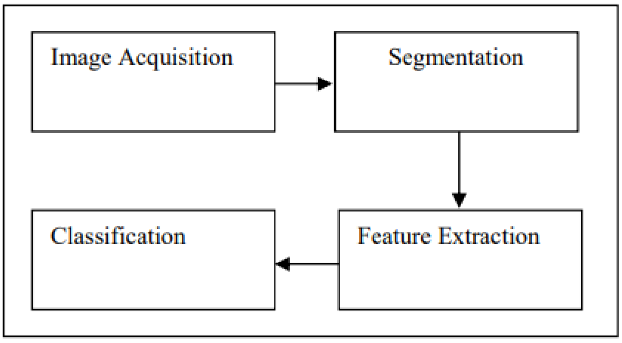


Fig. 1. Phases of plant disease detection system

**Steps Involved:**

We are building a neural network model for image classification. This model will be deployed on the web application for detection of plant leaf disease through an image.

1. The first step is to collect data. We are using the PlantVillage Dataset, which is widely available. This dataset was released by crowdAI.

2. Pre-processing and Augmentation of the collected dataset is done using pre-processing and Image-data generator API by Keras.
3. Building CNN (Convolutional Neural Network) Model for classification of various plant diseases.
4. Developed model will be deployed as a Web Application on local server.

The recognition and classification procedures are depicted below.

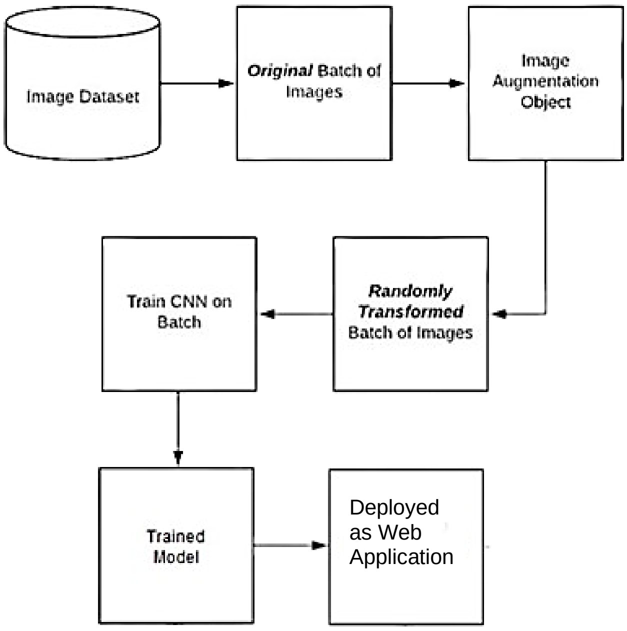


**Fig. 1.** Block Diagram Of Proposed System

## V. CONCLUSION

Agricultural production is a very old means of obtaining food. It is a vital source of income for people all around the world. Plants poor health conditions can lead to lower productivity resulting in failure to meet the increasing demands for food. This paper proposes a CNN and image processing technique for plant disease classification using the leaves of diseased plants. Tomato, potato, & bell Pepper are 3 species on which the proposed model is tested. We were successfully able to work with the image data generator API by Keras. The utilization of these kinds of technologies in agriculture is a must to ensure food security for our future generation.

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