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# Review Paper on Plants Diseases Detection Using Image Processing

**Aditya Mali[1], Pranav Charate[2], Siddhant Keste[3], Shreyash Gaikwad[4], Priyanka Chougule[5]**
Students, Department of Computer Engineering[1, 2, 3, 4]
Faculty, Department of Computer Engineering[5]
Sharad Institute of Technology, Polytechnic Yadrav, Ichalkaranji, Maharashtra, India

**Abstract:** *When plants and crops are suffering from pests and diseases it affects the agricultural production and overall development of the country. Often, farmers or specialists monitor plants for healthiness and diagnose diseases. Diagnosis of plant diseases is key to preventing crop losses and agricultural product value. Plant Disease studies refer to studies of the visible patterns observed in a plant. It requires tremendous amount of work, expertise in the plant diseases, and this method is often time processing, expensive and inaccurate. Automatic identification of diseases using image processing algorithms provide fast and accurate results. This paper reviews the techniques and methods used earlier by various researchers in this field. Accuracy of their models and comparative summary is shown below.*

**Keywords:** Artificial Intelligence, Machine Learning, Deep Learning, Convolutional Neural Networks, Image Processing, Image Classification, Pest Detection, Plant Diseases, Farmers, Image Datasets, InceptionV3.

## I. Introduction

India is well-versed in agricultural and about 70% of the population depends on agriculture. Farmers have a great deal of variety in choosing the right variety of crops and finding the right pesticides for the plants. Therefore, crop damage can lead to significant productivity losses and ultimately disrupt the economy. The leaves are part of the most sensitive plants that show signs of disease immediately. Plants need to be protected against disease from the earliest stages of their life cycle until they are ready to be harvested.

In recent years, a number of techniques have been developed to develop automated and slow-growing plant diagnostic programs and automatic diagnostic tests by making the leaves on the leaves make it easier and less expensive. These programs have so far resulted in them being faster, less expensive and more accurate than the traditional way of looking at what farmers do. In many cases symptoms of the disease appear on the leaves, stem and fruit. It also directs the user directly to the e-commerce website where the user can purchase the diagnostic drug by comparing prices and using it properly according to the guidelines provided.

Various studies have been conducted under the field of plant-based disease diagnostic and diagnostic methods, traditional machine learning method random forest, neural artificial network, vector support machine (SVM), abstract brain, K method, Convolutional neural networks etc. . The whole informal forest, the learning method of separation, retreating and other activities that work on building a forest of logging trees during training. Unlike decision-making trees, Random Forests overcome the corruption of over-entry of their training data set and manage both numerical and category data.

Unlike other machine learning methods, Convolutional Neural Networks is a complex neural feed network. CNNs are used for image classification and image processing because of their high accuracy and popularity. It was proposed by computer scientist Yann LeCun in the late 90's, when he was inspired by the human concept of cognition. CNN follows a hierarchical model that works to build a network, as it should, and eventually produces a fully connected layer where all neurons are connected to each other and output is processed.

## II. Literature Review

CNNs have been widely used in plant diseases image analysis, image recognition, and other fields. In the area of plant diseases picture classification, CNNs have already shown impressive results, such as potato fungus diseases image classification, apple fruit diseases image classification and corn diseases classification.

In article[1], authors used AlexNet and GoogLeNet CNN algorithms in the identification of 38 different plant diseases from PlantVillage dataset [4]. They used training from scratch approach on AlexNet and transfer approach on GoogLeNet and got overall accuracy of85.53% (in case of AlexNet) to 99.34% (in case of GoogLeNet).

In article [2], authors used CNN image classification algorithm. They tested it on various diseases of tomato [4] like Septoria leaf spot, lead mold, and target spot. Their model achieved an overall accuracy of 88%.

A NASNet-based deep CNN architecture was used in [3] to identify leaf diseases in plants, and an accuracy rate of 93.82% was achieved.S. Sladojevic et al. [5] designed a DL architecture to identify 13 different plant diseases. They used the Caffe DL framework to perform CNN training.

Rice and maize-leaf diseases were identified by J. Chen in [4]. They applied transfer learning the deep CNN in the identification of plant diseases.In their approach, they replaced the last convolutional layer of VGG19 with two inception layers and one global average pooling layer. These extended layers was used for high-dimensional feature extraction and classifying.

A.Ramcharan et al. [6] applied transfer learning to train a deep convolutional neural network to identify three diseases and two types of pest damage of the Cassava Plants. Their best trained model accuracies were 98% for brown leaf spot, 96% for red mite damage, 95% for green mite damage, 98% for cassava brown streak disease, and 96% for cassava mosaic disease. The best model achieved an overall accuracy of 93.

In article [7], authors considered three main families of detectors: Faster Region-based Convolutional Neural Network (Faster R-CNN), Region-based Fully Convolutional Network (R-FCN), and Single Shot Multibox Detector (SSD). They combined each of these with "deep feature extractors" such as VGG-Net and Residual Network (ResNet).Their comparative results between three models shown that, plain networks perform better than deeper networks, such as the case of Faster R-CNN with VGG-16 with a mean AP of 83%, compared with ResNet-50 that achieves 75.37%. In contrast, SSD with ResNet-50 performed at 82.53% and R-FCN with ResNet-50 as feature extractor achieved a mean AP of 85.98%, which is slightly better than Faster R-CNN overall and is comparable in some classes.

| **Authors** | **CNN Algorithm Used** | **Results (Accuracy)** |
|---|---|---|
| S. P. Mohanty et al. [1] | AlexNet and GoogLeNet | 85.53% in AlexNet<br>99.34% in GoogLeNet |
| P. Srivastava et al. [2] | CNN | 88% |
| A. Adedoja et al. [3] | NASNet | 93.82% |
| J. Chen et al. [4] | INC VGGN | 92% accuracy |
| S. Sladojevic et al. [5] | Fine-tuned CNN architecture | 96.3% |
| A. Ramcharan et al. [6] | Inception V3 based on GoogLeNet | 93% |
| A. Fuentes et al. [7] | Faster R-CNN | 83% |

**Table 1:** Summary of related work on plant-disease detection

## III. General Methodology

Image classification is not about selecting best algorithm and feeding large amount of data only. To make your model best among others, there are some steps involved in image processing for detection of plant diseases like image acquisition, image pre-processing, image segmentation, feature extraction and classification. Let's see about them one by one:

### 3.1 Image Acquisition

Image acquisition is the action of retrieving an image from a source, usually hardware systems like cameras, sensors, etc. It is the first and the most important step in the workflow sequence because, without an image, no actual processing is possible by the system.[9]As most of the plants are planted in open sunlight, capturing such images is very crucial. These images can be affected by direct sunlight on camera lens. Also, the diseased spots on plant could be small in size. Hence to get a detailed image, a proper image acquisition should be followed.

### 3.2 Image Pre-Processing

Image preprocessing are the steps taken to format images before they are used by model training. It does not increase image information content but decreases any unwanted or noisy data if present. The aim of pre-processing is an improvement of the image data that suppresses undesired distortions or enhances some image features relevant for further processing and analysis task. Steps in image pre-processing includes image scaling, resizing, recoloring, changing orientation and tuning various factors like brightness, contrast, saturation etc. [10]

### 3.3 Image Segmentation

Image segmentation is a method in which a digital image is broken down into various subgroups called Image segments which helps in reducing the complexity of the image to make further processing or analysis of the image simpler. Segmentation is nothing but assigning labels to pixels or group of pixels in an image. Pixels belonging to the same category have a common label assigned to them. [11] For example, if we capture image of a plant's leaf then there could be some background area other than leaf area. This background is completely unnecessary because all the processing we'll do is that on leaf area only. Hence, the group of pixels showing the leaf area will be assigned a label as 'leaf-area' and remaining pixels will be assigned a label as 'not-a-leaf-area'. After this, the color of pixels labelled as 'not-a-leaf-area' will change to black. And hence, the unnecessary part of the image will not have any impact on the further processing.

### 3.4 Feature Extraction

Feature extraction is a process of dimensionality reduction by which an initial set of raw data is reduced to more manageable groups for processing. A characteristic of these large data sets is a large number of variables that require a lot of computing resources to process. Feature extraction is the name for methods that select and /or combine variables into features, effectively reducing the amount of data that must be processed, while still accurately and completely describing the original data set. It helps to reduce the amount of redundant data from the data set. In the end, the reduction of the data helps to build the model with less machine effort and also increases the speed of learning and generalization steps in the machine learning process. [12]

### 3.5 Image Classification

Image classification is where a computer can analyse an image and identify the 'class' the image falls under. A class is essentially a label, for instance, 'car', 'animal', 'building' and so on. For example, the classes would be 'healthy-tomato-plant', diseases-tomato-plant', etc. This is the final step in image processing. [13]

## IV. Conclusion

This paper reviews and summaries techniques used in image processing for plant leaf diseases. Generally implemented techniques are SVM, BPNN, SGDM and K-means Clustering, Random forest, Artificial Neural Network, Support Vector Machine (SVM), fuzzy logic, Convolutional Neural Networks (CNN). Various algorithms based on CNN are AlexNet and GoogLeNet, NASNet, INC VGGN, Fine-tuned CNN architecture, Inception V3 based on GoogLeNet, Faster R-CNN, etc. Comparison between these algorithms is shown in this paper.

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