International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2020 IJSRCSEIT | Volume 6 | Issue 3 | ISSN : 2456-3307
DOI : https://doi.org/10.32628/CSEIT20636

# Deep Learning Models for Leaf Disease Detection for Crops in Agriculture Field : A Survey

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## ABSTRACT

Crop and plant Diseases are the common problems in the food production fields. This is necessary for the improvement of the food production in agriculture and for fulfills the need of the society to solve these problems. In India most of the part of the country based on the production of food as a tradition. To solve these problems some advanced image processing, machine learning, computer vision etc. advancements included. This survey research on the identification of all that kind of technologies and the existing work also has done using them. How many kinds of models are proposed and what amount of success they have achieved by utilizing them. Image processing techniques provides the automatic disease detection technique to detect and identify the diseases in plants. Deep learning techniques are very good at prediction of the growth of plan and possibility of having disease within them. A comparison study also performed of several machine and deep learning techniques based on their accuracy.

Keywords : Deep learning, Plant leaf Disease Detection, Image processing, Machine Learning, Agriculture field.

## I. INTRODUCTION

Plant diseases treated as a major reason of the reduction in the quality of the plant and crop. Most of the countries economically dependent on the food production so it has been consider as a serious issue in this field. Various kinds of diseases are detected in the different kind of plants and leaf. Before this disease can damage all the region of any leaf, it is better to be identified at the initial stage. Various image processing, soft computing, machine learning and deep learning technique has developed. All are achieved the success to detect the disease at their level. Before to identify the techniques of the leaf disease, how many kind of disease is their should be identified. [1]

Some basic concepts of leaf disease and their symptoms classified into the following categories:

### A. Different Types of Plant Disease:

In this section all main types of disease will be identified how many kind of disease are there in the plant leaf based on their image. Different kinds of disease are there on the different kind of plants. Various image-processing techniques can be applied to identify the disease by following some automatic detection technique [2].

1. Leaf spots: leaf spots can also called as anthracnose, scab, leaf blotch, shot hole are identified as the holes of different sizes on the leaf region. And also in the different shapes and colors. These kind of spots may be caused by bacteria and fungus.
2. Leaf Blight: leaf blights are another kind of spots on the leaf there are can be any shape and color. It can be identify as the blighting appearance of any leaf.

3. Rusts: Rusts often look like leaf spots, these kind of called "pustules." Rust pustules are bright yellow, orange-red, reddish-brown or black in color. The pustules are usually raised above the leaf surface, and, when rubbed with a white cloth, a colored deposit the same color as the pustule can usually be seen on the cloth.
4. Powdery Mildew: Powdery mildew is a superficial, white to light grayish, powdery to mealy growth on leaves, but can also be found in the stems and flowers. Damaged leaves usually transformed yellow, wither and die rapidly. The problem is common on cucurbit-type vegetables and on small grains.
5. Downy Mildew Downy mildew symptoms are pale yellow green to yellow areas on the upper leaf surface; light gray to purplish moldy growth on the under surface of the leaf. Blue mold of tobacco is a downy mildew disease.

Leaf Spot

Leaf Blight

Rusts

Powdery Mildew

Downy Mildew

Baterial Leaf Spot

**Figure 1 :** Leaf diseases caused by Fungi and Bacteria

TABLE I

PLANT DISEASE WITH SIGN AND SYMPTOMS

| # | Disease | Sign | Symptoms |
|---|---|---|---|
| 1 | Fungal disease | Powdery mildew, Sclerotinia (white mold), Stem rust (wheat stem rust), Leaf rust (common leaf rust in corn) | Chlorosis (yellowing of leaves), Leaf spot (septoria brown spot), Damping off of seedlings (phytophthora), Birds-eye spot on berries (anthracnose) |
| 2 | Bacterial disease | Bacterial streaming in water from a cut stem, Water-soaked lesions, Bacterial ooze | Leaf spot with yellow halo Sheperd's crook stem ends on woody plants, Crown gall , Canker , Fruit spot |
| 3 | Viral disease | None | Mosaic leaf pattern Plant stunting, Yellowed leaves, Crinkled leaves |

## II. LITERATURE SURVEY

All previous work done in the field of agriculture to detect the plant disease going to be explain in this section. Most of work already performed by using

advanced technology, some main methods and their related works are as follows:

### A. Traditional Machine Learning Techniques

A machine learning technique was traditionally used to detect and identify the leaf diseases. Traditionally machine-learning techniques processed by following some simple steps described below:

1) Image Acquisition

This is the first step in the process of detecting the diseases of the plant. in this step dataset containing images taken by digital camera will be utilized. With the help of this dataset, training process will be performing to identify leaf disease.

2) Image Pre-processing

All the techniques for improving the quality of the images will be utilize here. For example image smoothening, image enhancement, noise removal etc.

3) Image Segmentation

Segmenting technique to segmenting an image into multiple segments identify the disease. Clustering is most commonly used technique in this phase.

4) Feature Extraction

Some Color, texture, shape and many another features of an image can extract by using the technique. This phase followed by the feature selection stage.

5) Classification

Last step is classification, used to classify the dataset to identify the healthy and diseased leaf various classification methods utilized until now for example, KNN, CNN, SVM etc.

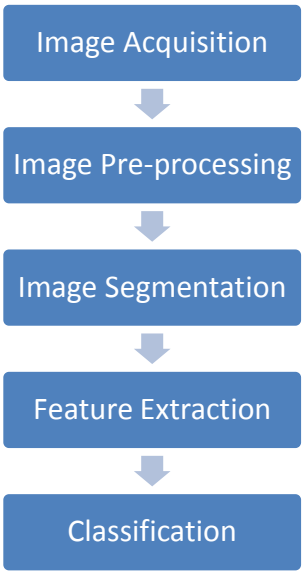


**Figure 2 :** Basic steps in traditional machine learning techniques.

kharide et. al proposed a paper which is based on the plant disease detection using the traditional machine learning methods. author utilized the all the steps of basic image processing. Methods are used for the segmentation and feature extraction for achieving the better accuracy. [4]

Shah et. al. Proposed work is based on the image processing techniques. They have mainly focused on the rice plants for the disease detection. a survey of all the related work for the rice plant disease detection has also been done. [5]

Singh and Misra Proposed an algorithm for the plant disease detection including the image processing tech nique. SVM based classification has been performed over the segmented data. they have utilized the concept of the optimization algorithm over the segmented result by the k-mean clustering for achieving the better accuracy in the results. [6]

### B. *Deep* learning *techniques for plant disease detection*

Deep learning techniques are the advancement in the methods of the plant disease detection. it will work like the branch of the machine learning techniques. these techniques are able to extract features from the input images by using the CNN then fed to fully connected layers for the classification. these features are more powerful than the traditional one.

The difference between the machine and deep learning methods can be understand with the help of this figure:

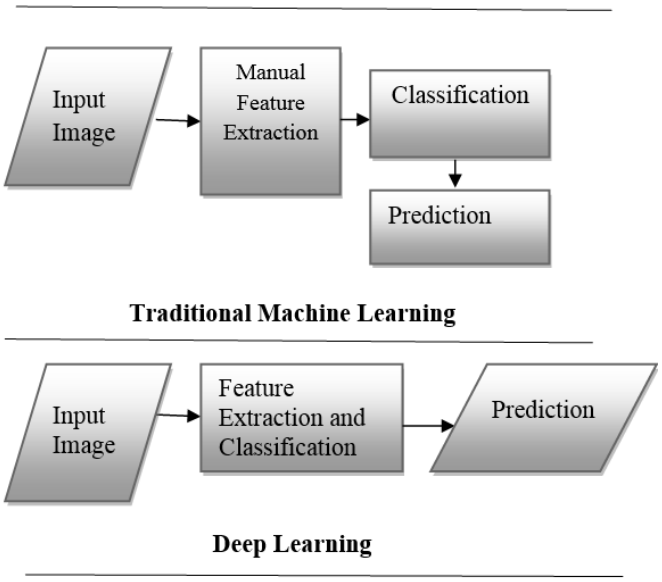


**Figure 3 :** Difference between deep leaning and traditional machine learning

Following work has been done by utilizing the deep learning methods for the plant leaf disease detection.

Zhang et al. plant leaf disease detection by utilizing the GoogLeNet Cifar10 with hyperparameter changing model on the 500 images of Maize. the images are classified using 9 number of classes by taking the dataset of plant form the plant village websites. 98.9% and 98.8% of accuracy has achieved by following this method. [7]

Too et. al proposed another model for the plant leaf disease detection called VGG16, Inception V4, ResNet with 50, 101 and 152 layers and DenseNets with 121 layers on the 54300 image those are classified into 38 classes. 99.75% highest accuracy has been achieved over the 14 crop species. [8]

Rangarajan et al. proposed AlexNet model with transfer learning for the plant leaf disease detection on the tomato leafs. 13262 images are taken in the dataset those are classified into 7 no of classes. 97.49% accuracy achieved. [9]

Picon et al. proposed ResNet50 with transfer learning for the detection of the plant disease. on the wheat leaf by taking images dataset of 8178. Data is classified into 4 no. of classes. the average balanced accuracy of 87% for early and late disease. [10]

Ma et. al proposed custom DCNN, pretrained Alexnet model on the cucumber leaf. by taking the dataset of 1184 images and classified into four classes. dataset are collected from the Plant village websites and own. 93.2% and 94% accuracy achieved. [11]

Gandhi et. al proposed inception v3, MobileNet model for the plant leaf disease detection. the dataset is trained by utilizing the 56000 images. 19 crops types are used as the leaf type, 88.6% and 92% level of accuracy achieved. [12]

Sardogan et al proposed RGB based CNN model as feature extractor, LVQ as classifier utilized for plant leaf disease detection. by taking 500image dataset for the training and classified into 5 classes. the research has been done by taking tomato leaves. 86% lwvwl of accuracy has been produced. [13]

Kawasaki et. al proposed custom based CNN model for the disease detection of the cucumber leafs. the 800 images are takes in the dataset for the analysis. the data is classified into three classes. dataset is designed by the author own by taking pictures from the digital

camera. 94.9%accuracy under 4 fold cross validation strategy has been achieved. [14]

Fujita et al. proposed CNN1 for dataset of good condtion images , CNN2 for bad ones. 7250 image dataset is used for the training process data is classified into seven classes. 83.2% accuracy has been achieved which is a average classification accuracy for the plant leaf disease detection. cucumber leaf dataset is used for the analysis.[15]

Sladojevic et al proposed caffeNet model with transfer learning. 3000 image dataset has been utilized for this analysis. data are classified into fifteen classes. 96.3% accuracy has been achieved in the process of plant leaf disease detection. [16]

Mohanty et al. proposed Alexnet anf googlenet with and without transfer learning for disease detection. 54300 leaf images are utilized as the dataset. classification of images is classified into 38 classes. 99.43% with googlenet and transfer learning has been achieved. [17]

Fuentes et al. proposed alenet, ZFnet , VGG16, GoogLeNet, ResNet50 with R-FCN model. 5000 images are taken for the training dataset, classification has been done bu classifying the images into 9 no of classes. the experiment has been done over the tomato leafs. 86% minimum when using the ResNet-50 with a R-FCN model [18]

Amara et al proposed LeNet model with different train/test split ratio , 3700 image dataset has been utilized for the training and testing. data are classified into the three classes. Banana leaf are utilized for the training and testing purpose. 99.72% accuracy is achieved with 50% train/test split . [19]

Wang et. al. proposed VGG16, VGG19, Inception-v3, and ResNet50 model for the plant leaf disease detection on the basis of the deep learning techniques. 2086 image dataset has been utilized for the analysis purpose. 90.4% classification accuracy has been achieved with fine tuned VGG16 model. [20]

J.Lu. et al proposed two baseline conventional CNN models and two proposed DMIL-WDDs models for the disease detection. 9320 no of images are utilized for the dataset. data is classified into seven classes . analysis has been done over the wheat leaf images. accuracy 93.2%,73% for the conventional 97.95%, 95.12% for proposed model has been achieved. [21]

Ramcharan et. al proposed pre-trained inception v3 with siftmax, KNN, SVM as final layer model for the leaf disease detection. 2756 imagges are utilized for the analysis for the classfifcation 6 classes has been utilized. analysis has been done over the cassava leaf. 93% maximum when using leaflet dataet with SVM. [22]

Cruz et al. proposed LeNet with transfer learning and context injection model is used for the leaf disease detection. 299 images are used as the dataset ,3 claases classification has been done. 98.6+- 1.47% true positive rate achieved as the accuracy.[23]

## III. CONCLUSION

In this paper plant and crop disease issue has been discussed. how many kind of diereses area there in the plants are present and how many techniques can be utilized for them to identified the specific disease. the paper introduces all kind of diseases and their signs and symptoms. Mainly two kind of techniques are used for the disease detection. Traditional machine learning technology and he advanced deep learning technology. Survey based on the previous work has been done by utilizing both of these techniques is described. as the future study comparison study can be done and more advance scopes in this area for achieving the better accuracy can be identified.

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**Cite this article as :**

Sunidhi Shrivastava, Pankaj Gugnani, Neha Garg, "Deep Learning Models for Leaf Disease Detection for Crops in Agriculture Field : A Survey", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 6, Issue 3, pp.104-110, May-June-2020. Available at doi : https://doi.org/10.32628/CSEIT20636
Journal URL : http://ijsrcseit.com/CSEIT20636