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**Mona Deshmukh**
Associate Professor, Department of Master of Computer Applications, Vivekanand Education Society's Institute of Technology, (VESIT), Mumbai, Maharashtra, India

**Dr. Girish Deshmukh**
Professor, Department of Mechanical Engineering, AC Patil College of Engineering, Navi Mumbai, Maharashtra, India

**Correspondence**
**Mona Deshmukh**
Associate Professor, Department of Master of Computer Applications, Vivekanand Education Society's Institute of Technology, (VESIT), Mumbai, Maharashtra, India

# Plant disease prediction using machine learning

**Mona Deshmukh and Dr. Girish Deshmukh**

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**Abstract**
Nowadays keeping our immune system strong is very important for our health. For the same, we just have to get fresh and healthy food. Human society needs to increase food production to feed an expected population size that is predicted to be over 9 billion people. Currently, infectious diseases reduce the potential yield by an average of 40% with many farmers in the developing world experiencing yield losses as high as 100%. The widespread distribution of smartphones among crop growers around the world with an expected 5 billion smartphones by 2020 offers the potential of turning the smartphone into a valuable tool for diverse communities growing food. Farmers across the world are dealing with difficulties because of disruptions, illness, or inadequacies in their equipment. For the assurance of plant leaf contamination, they rely on the information they receive from the cultivating divisions. This engagement is complicated and lengthy. The main purpose is to achieve more consistent execution in the detection of infections.

**Keywords:** e-Learning, disruptions, illness or inadequacies

## Introduction

Agriculture is, without a doubt, one of the most important jobs in the world. Food is a basic requirement for all living things on this earth, hence it plays a crucial role. As a result, improving the quality of farming products has become critical. It is critical to administer these crops in a legal manner right from the start. A plant's lifespan has a lot of different stages. It includes soil planning, cultivating, adding faeces and manures, water system measures, infection detection (if any), pesticide use, and produce harvesting. Plants have been infected with a variety of illnesses that have resulted in significant losses in the production of high-quality agricultural products. To address this problem, it is critical to do plant disease identification and prevention. In general, plant diagnostics are carried out by professionals through visual inspection and, if necessary, assessment of the concentration or potency of a virus or bacteria through its effect on living cells or tissues of plant leaves. Plant diseases have been identified using a variety of computer-based methods based on leaf pictures. Many techniques look at not just the spread of plant diseases, but also the location of their affected areas. Object detection and location have recently received a lot of attention in the deep learning and image processing domains, and numerous interesting algorithms have been suggested. The leaves of the plants are harmed by diseases and pests that must be discovered. These adverse consequences alter the physical look of the leaf, allowing the cause of the harm to be identified using photos captured by the cameras. In this scenario, a mobile computer and a typical RGB camera are required for disease diagnosis, and deep learning, a recent machine learning trend, produces excellent accuracy in classification jobs.

Technology and the rise of both deep and machine learning came as a benefit in various fields, most importantly medicine. Nonetheless, advanced technological approaches can also be implemented for the purpose of detecting diseases in plants. Thus, machine learning and deep learning approaches can be considered non-destructive disease detection methods since they are based on image-processing techniques. Artificial intelligence, computer vision and machine learning utilizations can greatly enhance the process of plant disease detection, and is already applied in multiple research papers. Such technologies are capable of not only detecting the presence of a disease, but it is also possible to determine its severity, and to classify exactly which kind of disease is present in a given plant sample.Based on their depth, the plant disease detection methods can be divided into shallow architectures and deep architectures. Basic machine learning methods like Random Forest (RF), Support Vector Machine (SVM), Naïve Bayes (NB), and K-Nearest Neighbor (KNN) rely on specific design intended for features such that good features and patterns must be recognized.

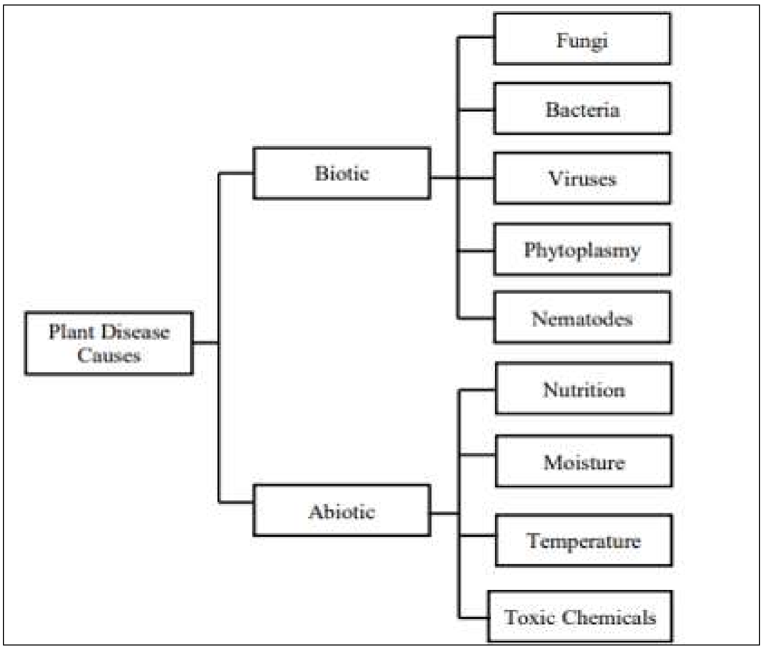



**Fig 1:** Plant Disease Causes Detailed

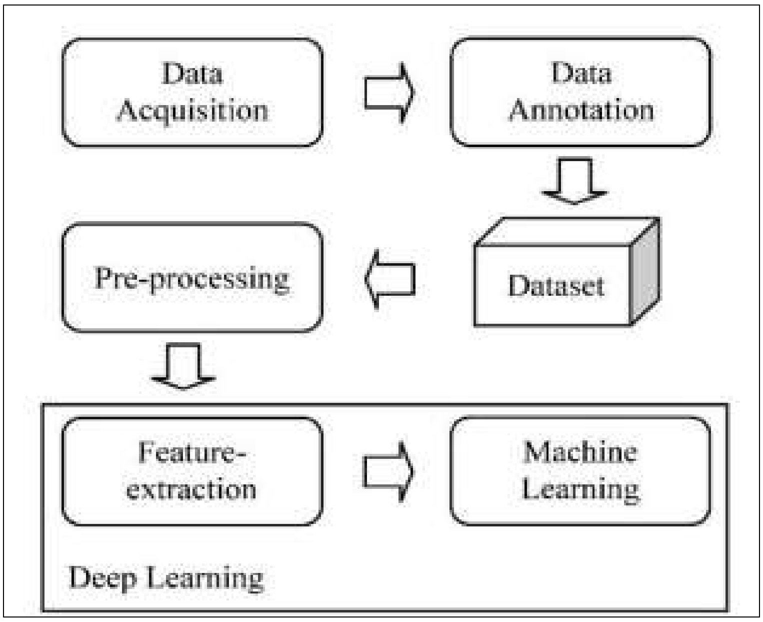



**Fig 2:** Steps in the Implementation of Learning Models

On the other hand, deep architectures like CNN (Convolutional Neural Networks) have also been heavily used in studies that are concerned with plant disease detection. These deep architectures differ from the shallow ones by not requiring hand-designed features since deep learning algorithms are able to learn the features themselves. Thus, deep learning approaches undergo three basic stages in detecting plant diseases: classification, detection, and segmentation.

**Convolutional Neural Networks**

A CNN is a multilayer feed-forward neural network consisting of learnable parameters such as weight and bias. In each layer the neurons receive a huge number of inputs and weights and then forwarded the weight to the activation mode. It works on the principle of convolution. Each neuron in this layer is bound to a parts of the actual input image.

**Pooling layer**

A pooling layer can reduce the size of the previous layer without any additional parameters, so you just shrink your data without adding any cost to the training model.

**Activation Layer**

The purpose of this layer is to generate some amount of non-linearity between the input and output. This layer's main job is to transform a node's associated signal degree into a signal that can be used by the next layer in the stack.

**Sigmoid**

This function takes any real value as input and outputs values in the range of 0 to 1.

The Sigmoid is a non-linear AF used mostly in feedforward neural networks. It is a bounded differentiable real function, defined for real input values, with positive derivatives everywhere and some degree of smoothness. The Sigmoid

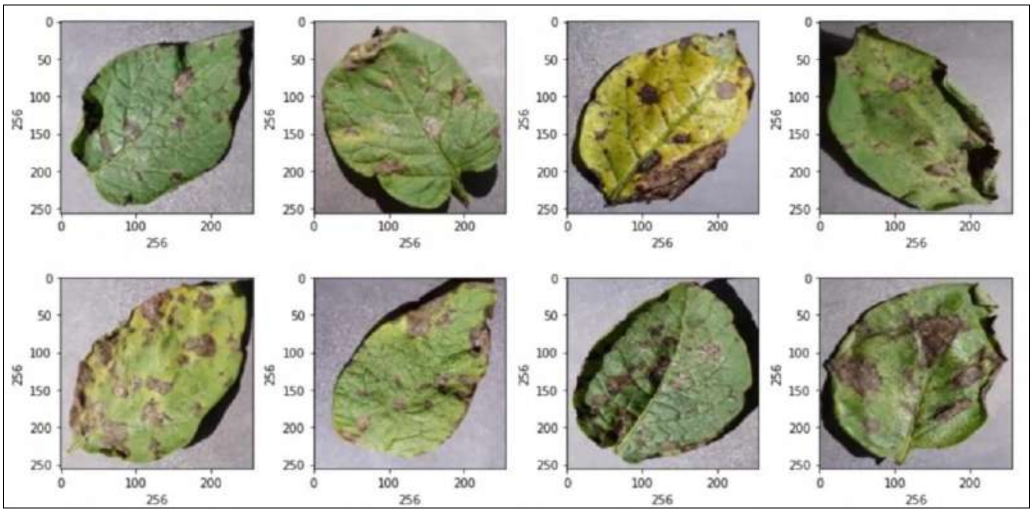
function is given by the relationship
f (x) = 1/ (1 + exp−x ) − (1.4)

**Tanh**
The hyperbolic tangent function known as tanh function, is a smoother zero-centred function whose range lies between -1 to 1, thus the output of the tanh function is given by
f (x) = e^ x − e ^−x /e^ x + e^ −x − (1.10)
The tanh function became the preferred function compared to the sigmoid function in that it gives better training performance for multi-layer neural networks.

**Softmax**
The Softmax function is another type of activation function used in neural computing. It is used to compute probability distribution from a vector of real numbers. The Softmax function produces an output which is a range of values between 0 and 1, with the sum of the probabilities been equal to 1.

**Rectified Linear Unit**
Rectified Linear Unit is a form of activation function used commonly in deep learning models. In essence, the function returns 0 if it receives a negative input, and if it receives a positive value, the function will return back the same positive value. The function is understood as:

f(x)=max(0,x)



**Result and Discussion**

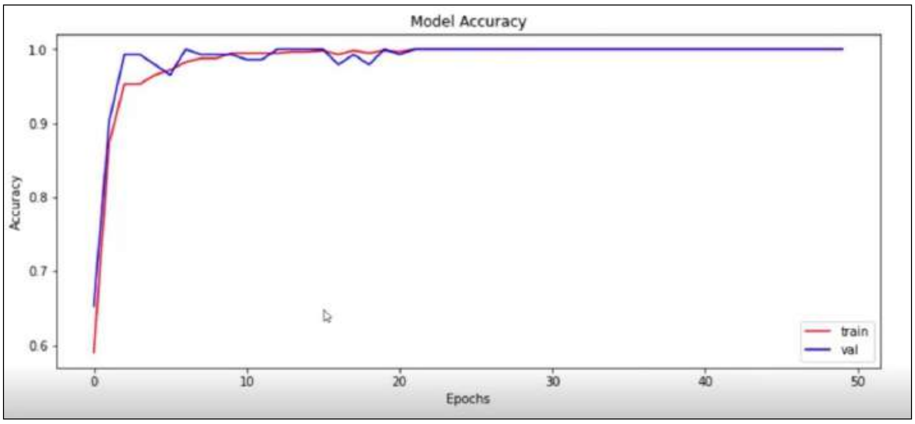



**Fig 3:** Model Accuracy


**Fig 4:** This is tomato leaf with bacterial_spot

**Confusion Matrix**
A confusion matrix is a table that shows how many right and incorrect predictions a classifier made. It's a metric for evaluating a classification model's results. It can be used to calculate various metrics to determine the performance of a classification model. The matrix is used to measure the following parameters:

- **Error rate:** The total number of incorrect predictions divided by the whole dataset.

Error rate = (False Positive + False Negative)/(Positive + Negative)

- **Accuracy:** A measure of total number of correct predictions made.

Accuracy = (No. of true positive + No. of true negative)/ (Tot. no of positive + Tot. no of Negative)

- **Sensitivity:** A measure of the fraction of actual positives ranging from 0 to 1.

Sensitivity or Recall=True Positive/Positives

- **Precision:** A measure of the fraction of actual positives predicted as positive.

Precision = No of True Positive/ (Tot. no of True Positive+Tot.no of False Positive)

**Conclusion**

The deep feed-forward artificial neural network known as the convolution neural network is used to detect leaf disease. Because the adjacent leaves may have the same or a different disease, it will be difficult to detect precisely, we are considering one leaf per photograph. We undertake a series of stages in the suggested technique, such as data pre-processing to increase detection accuracy and other image processing methods to improve our result accuracy. If this strategy is fully applied, the disease will be recognized at an early stage, reducing the cost and time spent manually.

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