# PlantDoc-Plant Disease Detection using AI

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### Abstract

*Gardening is a hobby which requires dedication and consistency. It is something more than just watering a plant. Taking care of Garden plants is very important as most of the plants are prone to diseases frequently. Plant Diseases ruin the plant and ultimately may kill it with time so timely identification and treatment of the disease is required for a healthy plant. This also helps to preserve many threatened species of plants. PlantDoc uses Artificial Intelligence model created on Convolution Neural Network algorithm of Deep Learning to solve this problem. The model is trained with images of different plant leaves to identify defected plants. PlantDoc helps in disease detection. It uses computer vision concept of AI to find the disease of plant and provide solution for that automatically. PlantDoc uses MERN stack. PlantDoc web application successfully helps to identify plant diseases of various plants by analyzing plant leaf image and suggests cure to treat it. This helps in treatment of plants timely which helps to stop the further spread of disease and provides cure.*

### Keywords

*Artificial Intelligence, convolution neural network, Deep learning, plant disease detections.*

## 1. Introduction

Many of us are fond of Gardening. A Garden with plants purifies the air and provides oxygen rich atmosphere to the inhabitants. Many of us realized this importance of plants during Covid 19 which made oxygen levels of many to go down and impact the recovery process adversely. We can keep various Medicinal plants in the garden for everyday use like Tulsi, Aloe Vera, pepper mint, curry leaves, etc. They may be used as nature's store of natural remedy to inhibit and treat various diseases.

We may have a kitchen garden with many vegetable and fruit plants. A garden can be composed of fruit trees like lemon, guava, papaya, etc. It is a small setup of flora and fauna whereby we happen to see birds, bees and butterflies coming in. A garden provides us to experience nature's bliss and instill positivity in inhabitants. Due to deforestation indirectly ozone layer

gets depleted due to increase in the amount of Carbon Dioxide in the atmosphere that allow the harmful Ultraviolet rays to come on Earth's surface which may cause diseases like cancer in humans and UVB radiations can harm plants as well. This loss of forests can be compensated to some extent by planting trees in home gardens.

Many of the plant species are threatened due to global warming and the increase of overall average temperatures year after year resulting in mountains turning into grasslands. Every plant requires specific care like some plants thrive only in sunlight like lemon plants require sunlight to produce flowers and ultimately the fruit whereas some plants die if kept in direct sunlight. Some plants like succulents thrive with less water and some plants require regular watering like rose plant if kept in sun. Some plants are prone to diseases and pests like termites, leaf folders, red pumpkin beetle, etc. The hibiscus and curry leaves to name a few and require treatment frequently by most preferably traditional treatment like neem is used widely as a pesticide that doesn't introduce chemicals to plants which we may use for eating it as food and for other purposes. These diseases are caused due to microorganisms such as bacteria and vi-ruses. If we do not treat this timely the plant may die with time. PlantDoc provides the user to identify the diseases that the plants have and provides a proper guidance to as to how to tackle the same with caring tips handy to the general user to gain knowledge and insights for the control and treatment of the same. PlantDoc utilizes Convolutional Neural Network algorithm of Deep Learning on Artificial Intelligence Model. The model is trained by datasets of various plant leaf disease images.

PlantDoc is built on MERN Stack framework. We can click the images of plant leaves from the camera and upload them and check for type of plant disease they correspond to and the plant is suffering from and how to manage and treat the same and other related caring tips. Convolutional Neural Network has been used widely to detect diseases in plant. In [1], the authors proposed a convolutional neural network-based system with 89.29% accuracy that uses three channels of CNN to detect plant diseases like bacterial spot, target spot, late powdery mildew, early blight, mosaic virus, and Septoria leaf spot.
Convolutional neural networks are used by the authors in [2] to identify plant disease in tomato plants with 98% and 99.23% accuracy on VGG16 and GoogLeNet, respectively, using a dataset of 10735 leaf pictures.

For the detection and classification of tomato leaf disease, [3] uses a Convolutional Neural Network Model (CNN) and learning vector quantization (LVQ) algorithm-based technique. 500 photos of tomato leaves with four disease signs are included in the collection. For automated feature extraction and classification, a modelled CNN is used. Research on plant leaf diseases makes active use of the information's colour. Filters are applied to three RGB-based channel components in the model. The model's accuracy in [4] is 87%. It trains the CNN model using three classes of plant species data, including tomato, potato, and bell pepper. To construct an AI representation, tomato plant images from many sources are collected in [5] and managed and produced on the CNN system. The photographs are controlled using the Python programming language and the OpenCV package. Using two types of datasets, PlantVillage and PlantDoc, and pretrained models like VGG16, Xception, Inception V3, ResNet152, and MobileNetV2, [6] performs multiclass classification of plant diseases. Each dataset has advantages and disadvantages, with CNN having training efficiency of 32% and validation accuracy of 36% for PlantVillage dataset and validation accuracy of 8% and 13% training accuracy for PlantDoc dataset, respectively. In [7], scientists proposed employing machine learning, deep learning, and enhanced deep learning to identify plant diseases. Plant diseases including scab, Early Blight, Leaf scorch, Bacterial Spot, and Black measles are identified and diagnosed using CNN. CNN is used in [8] to identify bacterial spots, leaf mould, yellow curl leaf defects, septoria leaf spots, and healthy leaves, however this approach cannot distinguish between numerous illnesses present on a single leaf. The [9] uses CNN, Inception V3, ResNet 152V2, and pruned and unpruned models to test how well it can identify ill-nesses in cotton plants. The dataset is downloaded from Kaggle in this case. This model aids in the detection, identification, and recognition of plant leaf diseases; it has a 94.8% accuracy rate with a few notable outliers. Paddy leaf diseases like Brown Spot and Blast are mentioned in [10]. The model on the Matlab platform employs CNN with a canny edge detection technique to accurately predict many classifications of disease, including normal, bacterial blight, brown spot, sheath rot, and blast disease.

With digitalization and ever-growing demand towards adoption of AI everyday tasks things are getting automated to save time, effort and increase profitability. Plants are a very integral part of our day-to-day lives. Plant diseases have a devastating effect on garden plants and agricultural plants. The idea was to build a web application to help to make predictions about the various plant diseases by giving plant leaf images as input to the pretrained Convolutional Neural Network based Deep Learning AI model and getting a result whether plant suffers from a diseases and if it suffers then suffers from which disease and what is the cure for the problem .This helps make it handy for the users to predict plant diseases and save the plant from further damage and help to cure it to save garden plants and to save agricultural plants to increase overall profitability .The paper also highlights the various works done by other researchers using Convolutional Neural Network for plant disease detection.

In the organization of the report, Section I of the report introduces us to plants, their importance, plant diseases, our web application, and the works of other researchers in this area. In Section II we have related work from various researchers. Section III gives insights to the proposed work of building this web application. Section IV gives insights about the working of the application. Section V concludes all observations and gives brief information about the future scope of the proposed work.

## 2. Related Work

Plant diseases not only affect the plants in gardens but also affect the agricultural sector plants, which has an impact on a country's productivity. Plant diseases also affect the plants at home Gardens as well. A timely solution to this problem is very important for greater productivity and to take care of plants in the gardens to protect them from dying. The Convolutional Neural Network has been widely used for the detection and identification of disease to make it handy for the public to get an early intimation of problem and treatment is subjected to before a major loss of plant. Convolutional Neural Network is used by the authors of [11] to classify plant diseases using a five-layer, four layers, and three-layer model. Images of plant diseases are used to suggest the appropriate insecticides. Using TensorFlow, the five-layer model has a validation accuracy of 89.67% for 20 epochs and a 95.05% accuracy for 15 epochs. The model's accuracy was 97.32% in [12]. Utilizing CNN aids in the early diagnosis of Brown Spot disease in rice paddies. To train and test models using data that was manually collected, the Tensor-Flow and Keras frameworks have been applied. The AUC in [13] is 96%. It employs a CNN model and contains 21397 labelled photos that were gathered from Uganda with the cassava diseases brown streak, bacterial blight, green mottling, and mosaic. CNN's model, which is employed in [14], has an accuracy rate of about 94.17%. It recognizes and categories eight distinct groups of tomato leaf diseases by extracting picture features that take colour, shape, and texture into account. In [15], the author suggests an optimized suggested logistic decision regression model for effective plant disease pre-diction. It makes use of a few computer vision algorithms to extract characteristics from the leaves of medicinal plants.

The types of plant species have been divided into the relevant categories using CNN-based optimized Logistic Decision Regression. The LDR approach is first used for preprocessing to identify particular features in order to collect a dataset of leaves, assess leaf colour, evaluate results for shape, and remove undesirable noise. To assist Indian farmers in early disease detection, a CNN model is suggested in [16] that has a prediction accuracy of 97.93% in early detection of the most common maize plant leaf disease. CNN has been utilized to enhance classification accuracy in [17]. Row data undergoes data preprocessing, training datasets undergo data augmentation, and a CNN with 28 layers and an Adam optimizer is used to optimize the model. The model has a 99.66% training accuracy and a 98.13% test accuracy. Using this approach, farmers may anticipate plant illnesses. In [18], a CNN-based algorithm with 97.61%b accuracy is suggested to assist Indian coffee plant growers in promptly identifying plant diseases. [19] shows that the model's accuracy can reach 97.90% using a plant village dataset with five classes and 4197 training and 430 test photos. For predicting plant diseases, the model employs a modest variation of a deep convolutional network. Date palm diseases are discovered in Jordan using CNN in [20], and photos dataset are obtained as a result. Over 80% of the time, CNN is accurate

## 3. Proposed Work

Gardening has been a hobby for many people. Applications like the proposed help the user to get insights about the plant disease observed in the plants in the process of taking care of them. If the user watches his plants to be suffering from some kind of disease, he may use the proposed web application for a successful plant disease detection and get details about how to cure the disease and save the plant from dying. Even in the Agricultural sector timely plant disease detection by the farmers helps the farmers to have greater productivity and profits by saving their crops from any type of disease and thus contributing to helping enhance economic growth of the country. Plant diseases ruin plant health and ultimately it slowly and steadily kills the plant. Many times, manual diagnosis is not as efficient as prediction by an AI driven web application due to lack of knowledge by farmers and garden practitioners about all the diseases subjected to different plants and their caring tips too. A timely solution to the problem like applying pesticides and traditional neem products like treatment helps to curb the disease and helps the plant to revive back to its healthy state which helps in protecting garden plants from dying as well as agricultural plants from dying leading to greater productivity and profits from the same within a country. Our idea is to build a web application for early detection of plant diseases using Convolutional Neural Network for the benefit of all. The web application must allow to upload from the device and should test plant leaf disease against various diseases given in the dataset and find out the disease and give the appropriate solution to the problem. That may help in early detection of the disease by the farmer or gardener to detect the disease. Proper internet connection is required on the client and developer side to use and develop the web application respectively.

The web application should be designed in such a way that it is easy to be used by layman like gardener or farmer with reduced level of complexity in its working and should be efficient enough to predict the disease effectively. It would allow user to upload an image by the device storage and the image will be processed by pre trained model loaded by the TensorFlow library and would predict the disease in the given plant leaf sample and would suggest a cure for the same along with the caring tips. The Web Application helps to detect plant diseases and provide solutions to the same. It has provided a way to predict plant diseases easily and get the solution to the same so that the user can apply that solution in the treatment of the plant, thus saving the life of the plants. The web application detects diseases and makes predictions like strawberry healthy leaf, strawberry leaf scorch, peach healthy leaf, peach bacterial spot, potato healthy leaf, potato late blight and potato early blight. This web application helps people who have gardens at home, gardeners, and farmers to protect their plants for greater productivity from the plants and maintenance of the plants. The Web application successfully detects the diseases and provides accurate solutions to the same.

The Web Application uses MERN stack framework for the detection of plant diseases. It uses a pretrained model that uses Convolutional Neural Network for plant disease detection. The user first logs into the web application. There the user gets the option to upload the image. The user uploads the plant leaf image of diseased plant, and the disease is detected using a pre-trained AI model and appropriate cure for the disease is provided and if the leaf is healthy then appropriate message is displayed and after completing his job the user can sign out of his personal account in the application

## 4. Experiments and Results

The web application can be used to predict plant diseases and make the treatment handy for the user. The web application uses a pre trained model of convolutional neural network for this purpose and works on a MERN stack framework. The web application has a humongous amount of applicability in the area of agriculture as well as it helps in providing the general public users to predict the disease accurately and get the solution for the same and use the solution to treat the dis-ease timely to save the plant from dying. This helps the people who have gardens at home to take care of their plants and for a long time preserve the plants in their garden. In Agriculture, it helps the farmers to save their crops from the diseases thus increasing overall productivity

and profits for them and for the economy of the country. Artificial Intelligence is an emerging technology that enables machines to have human like intelligence to accomplish various tasks. Machine learning is the subfield of AI in which machine learns from its experience and is mainly of four types:

- Supervised Learning
- Unsupervised Learning
- Reinforcement Learning
- Semi-Supervised Learning

Deep Learning is the subfield of Machine Learning which is concerned with Artificial Neural Network which tries mimic the working and functionalities of human brain to process information and to give useful insights from the data inserted. Deep learning neural network architectures like the convolutional neural network (CNN) are often utilized in computer vision, image processing, and video processing. Computers can comprehend and interpret visual data thanks to a field of artificial intelligence called computer vision. CNN uses convolutional, pooling, and full-layer techniques to recognize and extract picture information.
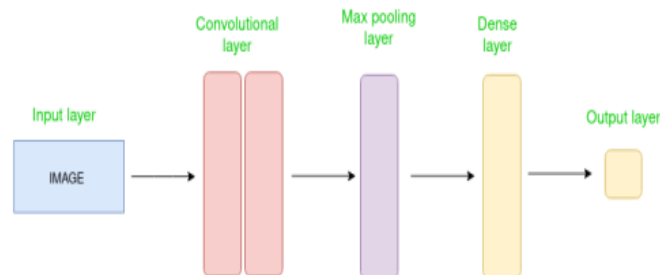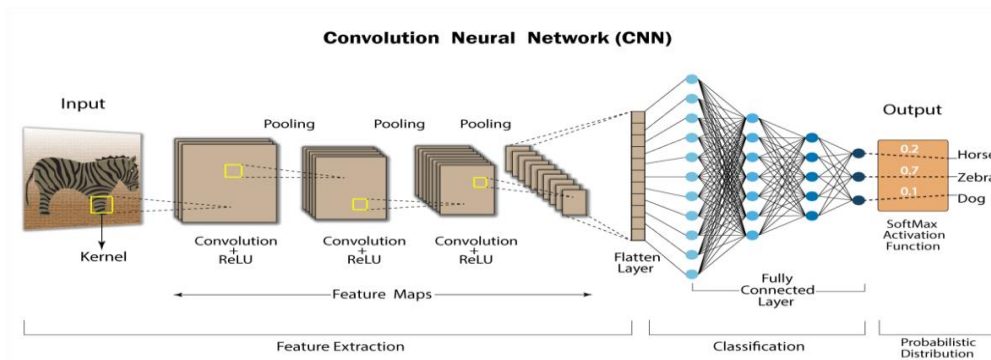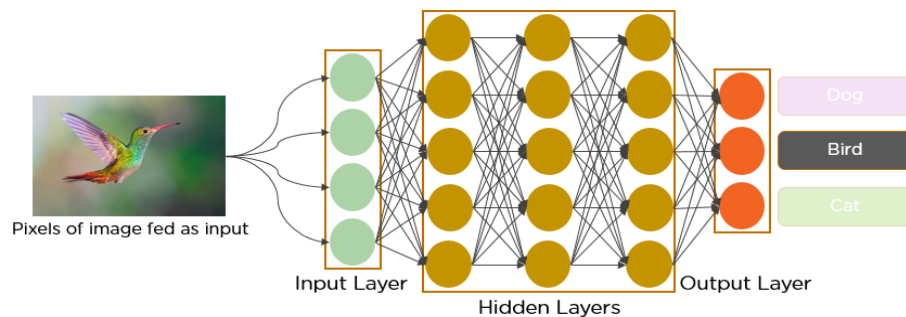


**Figure 1.** Simple CNN Architecture





**Figure 2.** Working of CNN

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The fundamental principle of CNN is to apply convolutional filters also known as kernels to the output picture, which traverses the image and executes parallel and aggregation processes to produce a distinctive map. In order to recognize pat-terns and characteristics in input pictures, such as edges, vertices, and forms, convolutional filters must be trained. Pooling layers are frequently used after convolutional layers to shrink the spatial size of feature maps while maintaining the most crucial data. The supplied picture is then divided into several groups using a complete link layer.

## 4.1. ReLU

It helps in solving problems based on non-linearity in Convolutional Neural Network model based on Deep Learning. It helps to solve the vanishing gradient issue. In many computer vision tasks, such as picture classification, object identification, and image segmentation, CNNs per-form the best. The MERN stack web application uses a pre trained model of Disease prediction.Tensor-flow.js library will load the model and generate the disease name after giving the plant leaf image as input and would provide data to treat it and take care of plant further. The prediction model is based on CNN architecture. The MERN stack application successfully detects the disease and provides the cure for the same. We are using PlantVillage dataset from Kaggle.



(A)Potato Early Blight

(B)Potato Late Blight
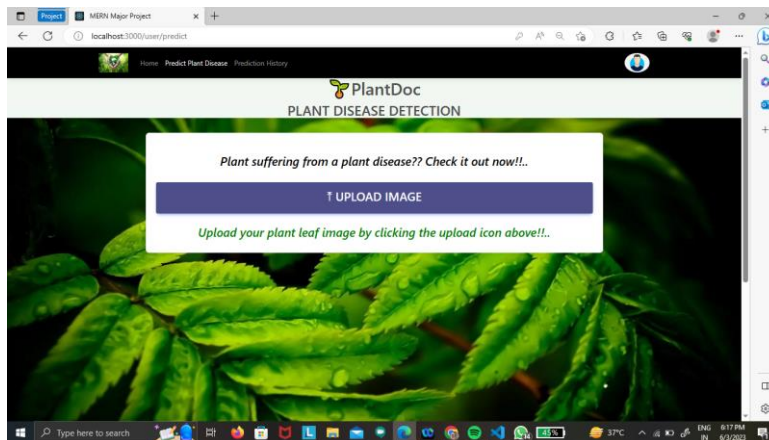
**Figure 3.** Plant Leaf Diseases

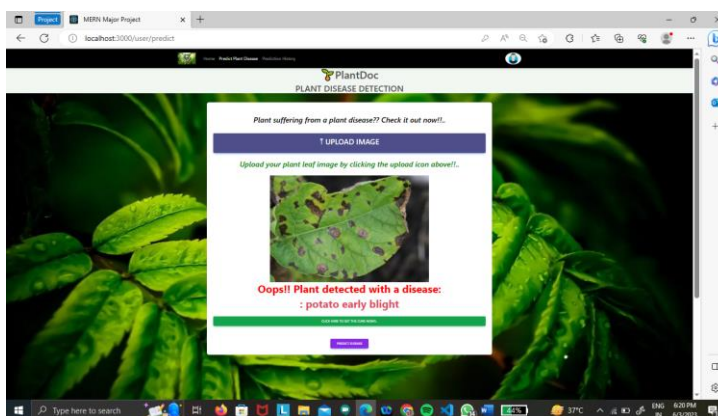**Figure 4.** Uploading the Image for detection of disease



**Figure 5.** Detection of Plant Disease (Plant having disease)
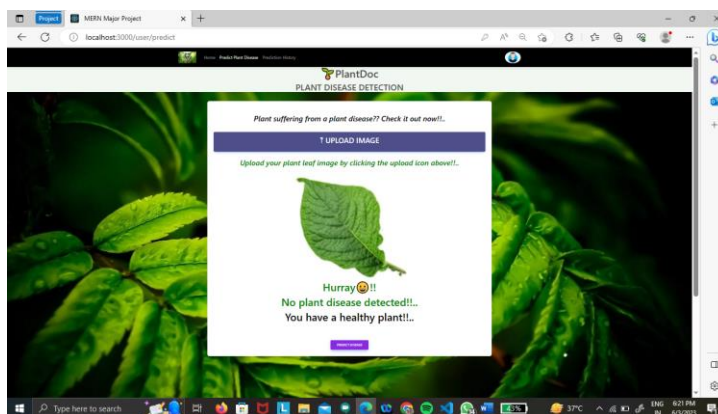


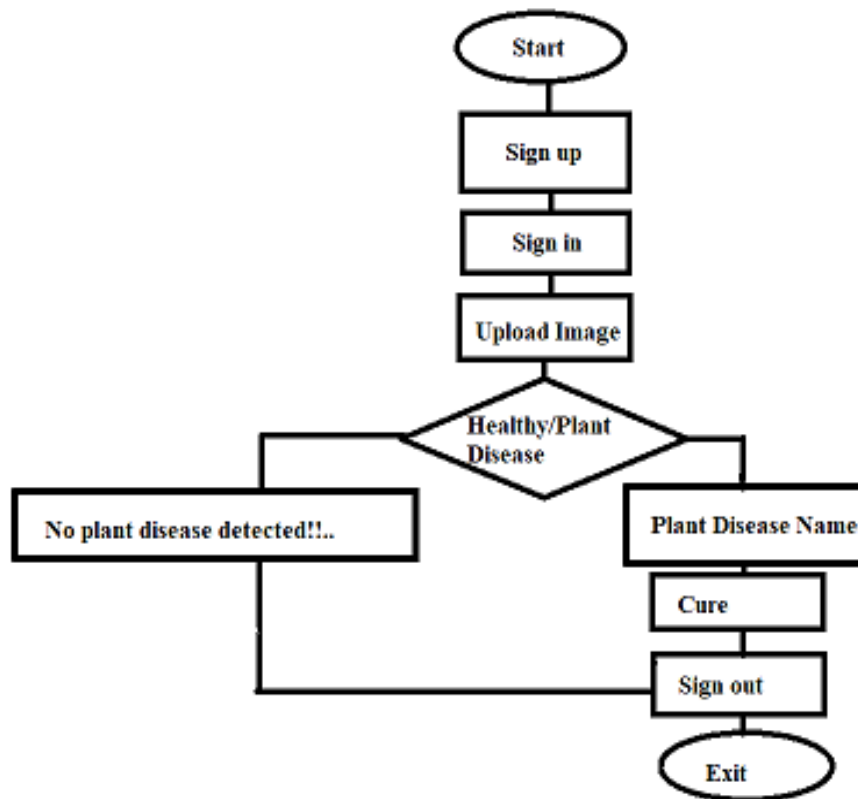**Figure 6.** Detection of Plant Disease (Plant having no disease)

**Figure 7.** Working of the aplication

Steps required to predict plant disease:

a. In the home page Sign up and create an account in the web application.
b. Sign into your created account.
c. Then you will get an option to upload images.
d. Upload plant leaf image from your device and see whether the plant is healthy or not.
e. If it is not healthy then click the given link to get the cure for the same.
f. Then the user may sign out of the application or continue to predict more diseases.

## 5. Conclusion

In Gardening, for healthy long living plants it is the first principle to protect the plant from harm caused from plant diseases. Even for a country's agricultural sector to flourish it is important that the agricultural plants are free from plant diseases. Convolution Neural Network is highly utilized in early detection of plant diseases so that there can be proper management and treatment of the same. Continuous damage done to the plant by various diseases can be tackled by proper applications of pesticides and traditional treatments like neem organic products for the same. The web application helps to predict disease efficiently using Convolution Neural Network as compared manual identification of the plant disease problem and provides best solution to the problem. The web application requires good internet connectivity.

The web application would be a great choice in future to serve the purpose of helping the gardeners and the farmers to protect their plants from various types of plant diseases. It would help the farmers to increase the overall productivity thus

contributing to the growth of the country's agricultural sector. The web application may be further enhanced to add more features to it. The web application can be customized to offer the facility to order and deliver treatment pesticide to the users.

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