Plant Disease Detection Using Deep Learning

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Lakshmi G Pillai
dept. Computer Science
Artificial Intelligence
lakshmigpillai@am.students.amrita.edu

Nithin Sylesh
dept. Computer Science
Artificial Intelligence
nithinsylesh@am.students.amrita.edu

Ritika R Prasad
dept. Computer Science
Artificial Intelligence
nithinsylesh@am.students.amrita.edu

Vysakh S Nair
dept. Computer Science
Artificial Intelligence
vysakhsnair@am.students.amrita.edu

***Abstract*—Agriculture is one of the world's key developing area in economies and a major source of revenue.The cultivation of plants is a source of income for many people. Pant illness is one of the most difficult problems in this profession. In recent years, plant pathology has received a lot of attention and had a significant impact on the economic and production sectors.As a result, it has a dramatic impact on the quantity and quality of the crops.To prevent disease transmission, it is necessary to monitor plant health and detect disease early on.Manually monitoring and detecting plant disease is immensely difficult. Furthermore, there is a vast number of areas that will necessitate effort and time.We have mentioned effective solution in this paper that will benefit the society. In this project we intend to implement a Plan Disease Detection model using VGG 16 and resnet 50 architecture and compare the results to analyse which model predicts more accurately**

***Index Terms*—Deep Learning, Vgg16, resnet 50, architecture**

I. Introduction

Agriculture has a great importance in the economy's everyday existence. Taking any country into mind, the majority of countries have agriculture as their economic backbone for a certain geographic area. In this modern era, agriculture's current production struggles to maintain and supply the world's rapidly rising population. Plant diseases have a significant impact on modern society, resulting in lower food quality and output. Such losses might have a direct impact on society. In the field of machine vision, plant diseases are a very important research topic. It is a technology that uses machine vision equipment to acquire images in order to determine whether the collected plant images contain diseases or pests. Machine vision-based plant disease detection equipment is currently being used in agriculture and has partially replaced traditional naked eye identification. Conventional image processing algorithms or manual feature design plus classifiers are frequently used for traditional machine vision-based plant disease detection methods. This method typically employs the various properties of plant diseases and pests to design the imaging scheme and selects an appropriate light source and shooting angle, resulting in images with uniform illumination.While carefully constructed imaging schemes can greatly reduce the difficulty of designing traditional algorithms, they also increase the cost of application. At the same time, it is often unrealistic to expect traditional algorithms to completely eliminate the impact of scene changes on recognition results in a natural environment . Plant diseases and pests detection in a real complex natural environment faces a number of challenges, including a small difference between the lesion area and the background, low contrast, large variations in the scale of the lesion area and different types, and a lot of noise in the lesion image. There are also a lot of distractions when collecting images of plant disease in natural light. With the successful application of the deep learning model represented by the convolutional neural network (CNN) in many fields of computer vision (CV, computer-vision), such as traffic detection, medical image recognition, scenario text detection , expression recognition, face recognition, and so on in recent years. Several deep learning-based plant disease detection methods are used in real-world agriculture, and some domestic and international companies have developed a variety of deep learning-based plant disease and pest detection Wechat applets and photo recognition APP software. As a result, a deep learning-based method for detecting plant diseases and pests has significant academic research value. In actuality, manually detecting plan diseases is really tough and takes a lot of time and effort.Monitoring and detecting plant disease is important to the production of healthy crops.
In this paper, we discuss an effective and productive method for detecting plant diseases early on and preventing disease spread using image processing. And it demonstrates the image processing techniques that were applied. Computational accuracy is then used to obtain the best possible prediction accuracy.

II. Related Works

- Image-Based Detection of Plant Diseases: From Classical Machine Learning to Deep Learning Journey

Rehan Ullah KhanShape ,Khalil KhanShape ,Waleed Al-battahShape ,and Ali Mustafa Qamar
Plant disease automation in agriculture science is a major worry for many countries, as food consumption is growing at a rapid rate due to population growth. Furthermore, modern technology has improved the efficacy and precision of disease detection in plants and animals. The detection procedure is the first step in a sequence of operations aimed at combating infections and limiting their spread. Some diseases are spread between animals and humans, making it difficult to combat them. Scientists have been researching methods to treat common diseases that affect humans and plants for many years. In this work, they examined how machine learning in general and deep learning in particular have aided in the identification of plant diseases. If illnesses are not adequately identified, they have an impact on crop productivity and can lead to long-term problems like global warming and even famine. Multiple investigations on plant disease automation and identification using various machine learning algorithms are summarised in the proposed study. The proposed publication also demonstrates that a variety of CV approaches are well-accepted in this domain, indicating that there is a large area of research to be investigated in the near future.

- Leaf Disease Detection Using Deep Learning
  T. S. M, S. K. S, S. M. S and P. R. Devi, "Leaf Disease Detection Using Deep Learning,"2021 Second International Conference on Electronics and Sustainable. We can detect tomato leaf diseases by identifying or spotting them for surveillance and monitoring experts, which is the typical strategy for detection. If sufficient control is not exercised, the plants will be severely harmed, and this will have an impact on the quality of the plants' produce. Disease detection using an automated technology and methodology is effective and beneficial since it reduces the amount of time and effort required to monitor a large crop. We can detect the symptoms of plant illnesses in the early stages, when they first develop on the leaves of the plants. Plants are sampled for allied diseases in order to identify them. It expresses the competence of the provided algorithm to identify and classify tomato leaf illnesses by estimating the lesser attempts of the superlative outcome that are created. Convolution algorithms can be used to improve the accuracy of the identification rate in the classification process.
- Plant Disease Detection using Deep Learning
  Chohan M, Khan A, Chohan R, Katpar SH, Mahar MS. Plant disease detection using deep learning. International Journal of Recent Technology and Engineering.
  This paper proposes a deep learning-based model named plant disease detector. Using images of plants' leaves, the model can detect a variety of ailments. Plant disease detection model is developed using neural network. First, augmentation is used to increase the sample size of a dataset. Later, with several convolution and pooling layers, a Convolution Neural Network (CNN) is utilised. This method is built on a basic categorization process that takes advantage of CNN's feature extraction capabilities. Finally, the model employs fully connected layers for prediction. The study used 70295 photos from a publicly accessible collection of dataset, as well as 100 images from experimental conditions and the real world. On publicly available datasets, the system obtained a testing accuracy of 98 percent. CNN is extremely ideal for automatic detection and diagnosis of plants, based on its accuracy. This technique can be implemented with mini-drones to identify diseases in farmed regions in real time. Furthermore, new real-world photographs of leaves can be added to the dataset to enhance accuracy on real-world images of leaves and categorise more plant and disease categories.
- Plant Disease Detection Using Machine Learning
  S. Ramesh et al., "Plant Disease Detection Using Machine Learning,
  Crop diseases are a significant threat to food security, yet identifying them quickly remains difficult in many regions of the world because to the absence of the necessary foundation. In the realm of leaf-based image categorization, the development of precise approaches has yielded excellent results. The data sets developed in this paper are used to identify healthy and sick leaves using Random Forest. This algorithm's goal is to detect anomalies on plants in their greenhouses or in their natural environment. To avoid occlusion, the image is normally taken with a plain background. For accuracy, the algorithm was compared to other machine learning models. The model had a classification accuracy of about 70

III. Methodology

A. Data visualization and transformation

We've used methods like resize, centercrop, toTensor, and normalize to change the images we got from the dataset plant village in this section. We used these transformations to separate the training and testing data.

- Random Resized Crop
  Each architecture has its own input size, which we must scale regardless of the size of the input image to the architecture size that corresponds to it.The steps invloved in this methods are determining the size randomly and resizing it.
- Center Crop
  Given a single input parameter, which is the size in which we want to crop the given image to the centre.
- To Tensor
  The ToTensor function is to convert a PIL picture or a numpy array to a tensor.
- Normalize
  The normalize function normalizes all RGB intensity values between 0 and 1. This is accomplished by the

usage of the two parameters in this function, namely mean and standard deviation.

B. Denormalization

Denormalization is a method for enhancing the performance and productivity of image processing by applying it to normalised data.

C. Models Approached

A convolutional neural network (CNN) is a type of deep learning method. In the field of image processing, CNN is generally implemented.CNN is a feed-forward multilayered hierarchical network in which each layer uses a bank of convolutions kernels to perform numerous transformations.The key achievement of CNN is that it can instantly recognize image features that are otherwise impossible to detect. The detection of features includes things like bright or dark spots, colour spot boundaries, orientations, and more.
The following are the five major steps involved in convolution neural networks:

- Step 1:Convolution Operation
- Step 2:ReLU Layer
- Step 3:Pooling
- Step 4:Flattening
- Step 5:Full Connection

There are a range of CNN architectures available, all of which have contributed a role in developing algorithms that power and will continue to power AI in the near future. The following are a few of them:

- LeNet
- AlexNet
- ResNet
- GoogleNet/InceptionNet
- MobileNetV1
- ZfNet
- Depth based CNNs
- Highway Networks
- Wide ResNet
- VGG

In this study, we implemented two architectures, VGG and Resent, to perform computational accuracy for plant disease prediction and compared the results to the accuracy created.

- VGG-16
  The input to the network is image of dimension (224,224,3). The first two layers have 64 channels of 3*3 filter size and same padding .Then after a max pool layer of stride (2,2), two layers which have have convolution layers of 256 filter size (3,3). This followed by a max pooling layer of stride (2,2) which is same as previous layer . Then there are 2 convolution layers of filter size (3,3) and 256 filter. After that there are 2 sets of 3 convolutional layer and a max pool layer. Each have 512 filters of (3,3) size with same padding . This image is then passed to stack of two convolutional layer . In these convolutional layers and max pooling layers , the filters we use is of the size 3*3 instead of 11*11 in alexnet and 7*7 in ZF-Net . In some of the layers , it also uses 1*1 pixel which is used to manipulate the number of input channels. There is a padding of 1-pixel done after each convolutional layer to prevent the spatial feature of the image
- ResNet
  This works dor less number of layers , but when we increase the number of layers , there is a common problem in deep learning associated with that called Vanishing ?Exploding gradient. Thsi causes the gradient to become 0 or too large . Thus when we increase number of layers , the training and test error rate also increases. In order to solve the problem of vanishing gradient, this architecture introduceed the concept of residual network. In this we use a technique called the skip connection . It skips training from a few layers and connects directly to the output. The architecture has 48 convolutional layers along with 1 MaxPool and 1 Average Pool layer .It is widely used resnet model.There is one major difference between the Resnet50 architecture and the above model. Due to concerns about the time required to train the layers, the building block was modified into a bottleneck design in this case. Instead of the previous two layers, this used a three-layer stack. As a result, each of Resnet34's two-layer blocks was replaced with a three-layer bottleneck block, resulting in the Resnet 50 architecture. The accuracy of this model is much higher than the 34-layer ResNet model. The 50-layer ResNet achieves 3.8 billion FLOPS of performance.

IV. Evaluation

A. Data sets

The data set that we used for our project was PlantVillage datasets.It was created to bring efficient solution in order to detect 38 different diseases.It contains 54,303 images of healthy and unhealthy plant leaves and backgrounds.It was created with six different augmentation techniques for creating more diverse data sets with different background conditions.The augmentations used in this process were scaling,rotation,noise injection,gamma correction,image flipping,and PCA color augmentation

B. Results

The images of diseased leaves was successfully obtaioed from both the models however when we look at the accuracies we find thath the resnet 50 architecture gives us 98.78 percent accuracy while vgg16 gives us only 54.45 percent. Because all plants have similar symptoms, it was able to determine whether a plant had a disease or not. Additionally, more real-world images of leaves can be added to the dataset to improve accuracy and classify more plant and disease types. The model is primarily tested on plant species that have some sort of disease. Tensorflow was used to create the model, which increased the number of plant classes and diseases.

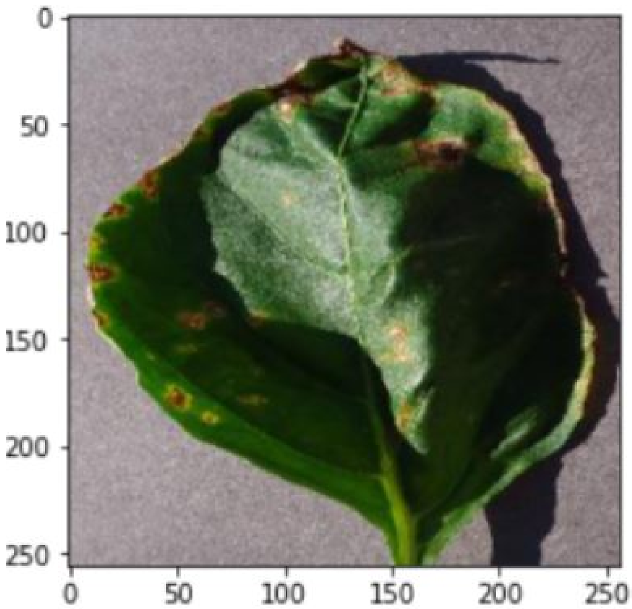

Fig. 1. Output Image of Resnet-50 Architecture

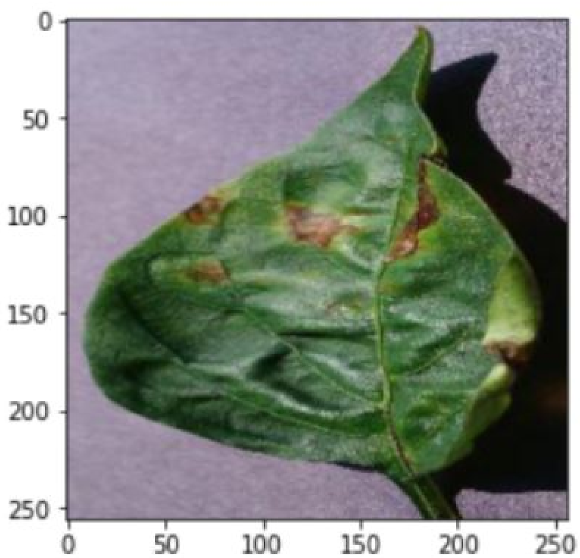

Fig. 2. Output Image of VGG-16 Architecture

V. Conclusion

Compared with the traditional image processing methods which deals with the plant disease detection in several steps and links ,the plant disease detection methods based on deep learning unify them into an end to end feature extraction, which has a broad development prospect and great potential.Although plant disease detection technology is developing rapidly,it has been moving from academic research to agriculture development and application ,there is still a certain distance from the mature application in the real natural environment and there are still some problems to be solved.In this paper the deep learning algorithm ie Convolutional Neural Network is used with a goal to detect the disease in crops .It is concluded that CNN is highly suitable for automatic detection and diagnosis of plants, according to accuracy. This system can be integrated into mini-drones to detect diseases in cultivated areas in real time. Despite the fact that this system was trained on the Plant Village dataset with only 38 classes, it was able to determine whether a plant had a disease or not because symptoms are similar in all plants. Furthermore, more real-world images of leaves can be added to the dataset to improve accuracy on real-world images of leaves and classify more plant and disease types.The model is basically tested on some types of plant species with some sort of disease.The model was made using tensorflow as an extension to the project the number of classes of plants and its disease will be increased .Also the model will be further improved by increasing the parameters of training and testing

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