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Plant Disease Detection Using CNN : Overview

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ABSTRACT

Agriculture is one area that has a significant influence on people's lives and economic conditions. Improper management results in agricultural produce losses. Diseases are harmful to the health of the plant, affecting its growth. It is important to keep track of the progress of the cultivated crop to minimize loss. A CNN algorithm can determine the type of sickness in diverse leaves. Convolutional Neural Network is a Deep Learning class that is mostly used for dataset collecting, training, segmentation, feature extraction, testing, classification, and employing CNN to determine damaged or healthy leaves based on data. The primary goal of the proposed effort is to discover a solution to the problem of various kinds of plant diseases.

Keywords **— Deep Learning, VGG16 model, Convolutional Neural Network.**

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I. INTRODUCTION

With the aid of today's more advanced technologies, it is now possible to supply enough food and nourishment for the world's expanding population. In India, 70% of the population is either directly or indirectly involved in the cultivation of land.[3]

The agriculture industry deals with a wide range of issues, including ineffective farming methods, poor use of compost, manures, and fertilizers, inadequate water supplies, various diseases that attack plants, and more. Diseases are incredibly destructive to a plant's health, which affects its growth. The attack of these many illnesses causes a significant loss in yield performance, both in terms of quality and quantity. Disease-affected plants account for 20–30%–or more–of the total crop loss. Thus, it becomes extremely important to identify plant illnesses to prevent any significant reductions in performance, productivity, or the value of the agricultural outcome. Since manual recognition requires a lot of time and is more likely to be inaccurate, improper treatment can result. Technology has advanced recently, and this development has paved the way for plant disease detection and diagnosis as well as improved plant treatment if any plant has diseased conditions.

It is impossible to characterize plant illnesses using the standard human method of visual inspection. Modern computer vision models provide quick, normalized, and precise solutions to these issues.

Deep Learning has recently produced excellent results in several domains, including speech recognition, image recognition, and natural language processing.

The Convocational Neural Network is particularly effective at solving the problem of plant disease detection. The ideal approach for object recognition is known as a convolutional neural network. Pre-processing data is crucial for models to work accurately. Many infections, whether viral or fungus, can be difficult to detect since their symptoms frequently overlap.

This study uses a Deep Convolutional Neural Network to distinguish between diseased and healthy leaves as well as to spot illness in affected plants. Healthy and unhealthy leaves can both be used with the CNN model. While conventional algorithms employed different activation functions to train and classify the output, the CNN model learns the filters. The objective of this study is to more accurately predict crop disease early on and stop additional crop loss. To apply fertilizers more effectively, the location of the disease's affected area is also discovered.

II. RELATED WORK

P. SilpaChaitanya, K.Harshini, K.MoniPriyanka, K.Pranavika Sri, and D.Pavani [1] used 3900 images from the dataset to test and train the data. Converted each image into an array, to resize the image the function convert_image_to_array is used.

To get the default size they use DEFAULT_IMAGE_SIZE, then they build a model. 80% of the data is utilized to train the model, whereas 20% is used to test it. The network begins with compiling the model and then the model.fit_generator function. The goal was to add data, train-test data, and plot the training and validation graphs to compare the performance and loss. After that, they evaluate the data, which gives the test accuracy as 98.7475 and we save the model.

Prakash Srivastava, Kritika Mishra, VibhavAwasthi, Vivek Kumar Sahu, and Mr.Pawan Kumar Pal [2] used an available dataset from Kaggle called the Plant Village dataset, and the code was written such that it could be run well and analyze training loss and validation.

The authors worked on image preprocessing and labeling with neural network training which includes Amended Linear Units (ReLU) utilized, the rectifier is an enactment work characterized as f(x)=max (0, x). Where x represents a neuron's contribution. As the convolutional networks are ready to learn features when trained on larger datasets, the parameters of the network show, an overall accuracy of 88% was achieved.

Sumit Kumar, Veerendra Chaudhary, and Ms.SupriyaKhaitan Chandra [3] used Plant Village Dataset. The 54303 healthy and unhealthy leaf photos in the Plant Village dataset are grouped into 38 groups by species and disease. We evaluated over 50,000 photos of plant leaves with distributed labels from 38 classes in order to predict disease class.Resize the image to 256 256 pixels and use this compressed image to do optimization and model predictions.

They only selected 400 images from each folder. Each image is converted into an array. In addition, we processed the input file by scaling the info points from [0, 255] (image minimum and most RGB values) to the vary [0, 1]. We then split the dataset into 70% of the training images and 30% for testing.

S.YegneshwarYadhav, T. Senthilkumar, S.Jayanthy, J.Judeson Antony Kovilpillai [4] used a trained dataset used for the CNN model. It consists of 100 leaf images infected with the disease. Similarly, separate datasets of 100 images each are created for each disease. As the number of iterations increases the accuracy of parameters for feature extraction increases. The total number of extracted parameters is 813,604, and the same number was trained. Parameters in various layers are: 896 parameters were used in convolutional layer 1, 9248 parameters in layer 2, 802944, and 516 parameters in fully connected dense layers. The CNN algorithm alters the input and clustered output image with the disease-related portion. And also the output terminal of disease detection with a message displayed as "ANTHARASIS BACTERIAL BLIGHT" with an accuracy of 92% is displayed.

Pranesh Kulkarni, AtharvaKarwande, TejasKolhe, SohamKamble, Akshay Joshi, and MedhaWyawahare [5] used a public dataset for plant leaf disease detection called Plant Village. The dataset contains 87000 RGB photos of healthy and diseased plant leaves divided into 38 groups, of which only 25 were chosen for algorithm testing. The performance matrices for each model were developed for each of the plants. This is because of a balanced number of false negative and false positive predictions. This is considered the best case for any machine learning algorithm. The average accuracy was 93%.

III. KEY TECHNOLOGIES

A. Deep Learning

Farmers' inability to recognize the disease type in the early stages causes a significant fall in production performance and crop losses in the agriculture sector every year. Farmers have noted that leaves cannot frequently identify the disease type and frequently require the assistance of an expert to make forecasts. These losses have a significant effect on output and, consequently, on farmers' livelihoods. The automated system created and established by the proposed model is used to identify plant diseases and determine whether a plant is infected or not.

B. CNN

Convolutional neural networks (CNN) are a subtype of deep neural networks. A CNN makes this architecture more suitable for processing 2D data, such as images, by combining well-read features with input data and using 2D convolutional layers. CNNs do away with the need for manual feature extraction and removal during picture classification. The CNN model itself pulls features directly from pictures. The characteristics that are retrieved are well-read while the network is being trained on a small number of image groups; they are not pre-trained. The Input Layer, Output Layer, Convolutional Layer, Fully, Soft-max layer, Connected layer, and Pooling Layer are just a few of the layers that make up the Convolutional Neural Network (CNN) model.

C.VGG-16 Model

- *Input Layer*

It has information in the form of pictures. The image's height, breadth, depth, and RGB color information are among the properties. Fixed 224 × 224 RGB picture input size. Two sections of the input data are utilized to train and test the model, respectively. Data is mostly used for training, and just a small portion is used for testing.[6]

- Convolution Layer

A CNN's "eyes" can be compared to convolutional layers. The input image serves as the input for the first convolutional layer. The input for VGG-16 is a color image with the following dimensions: (224x224x3). Filters are used by convolutional layers to process the input data. Each time the filter traverses over the input, a convolution operation is carried out, yielding a single number. This value is then sent through an activation function, and the activation function's output, also known as an activation map (224x224x1), populates the matching entry in the output.[6]

- Pooling Layer

Because the input size to future layers is smaller, the pooling layer will result in a decrease in the number of parameters in the network. A 2D sliding filter is used in the shrinking technique known as pooling. A programmable parameter known as the stride determines how the filter iterates through the input slice.

Average pooling and maximum pooling are the two different kinds of pooling processes. The max() action is applied to the corresponding values in the input slice. The output is then updated with the maximum value. We have a 4x4 input slice, a 2x2 filter, and a stride of two, as demonstrated in the example above. Therefore, the input slice is represented as a 2x2 downsized version of the matching output.[2]

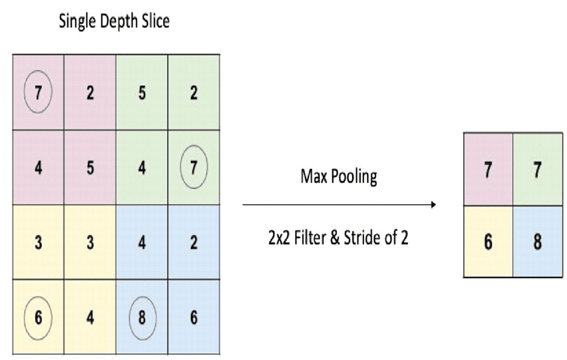

Fig 1: Pooling layer

- Fully Connected Layer

To calculate the probabilistic value, a flattening layer is employed to reduce an image's three dimensions to one. This is followed by two dense, fully linked layers that include a suggested activation function. The completely linked layer is the name of the ultimate classification scheme.

- Softmax Layer

Multi-classification is carried out using Softmax. The binary categorization is carried out by the Softmax layer. It establishes the likelihood that a specific object will appear in the image. The probability is '1' if the object is visible in the image and '0' otherwise.[3]

- Activation Function- ReLU:

The node is activated after the node transforms the total weighted input and passes it into the operation. An activation function used in neural networks for convolutional operations is the Rectified Linear Unit (ReLU).[2,3]

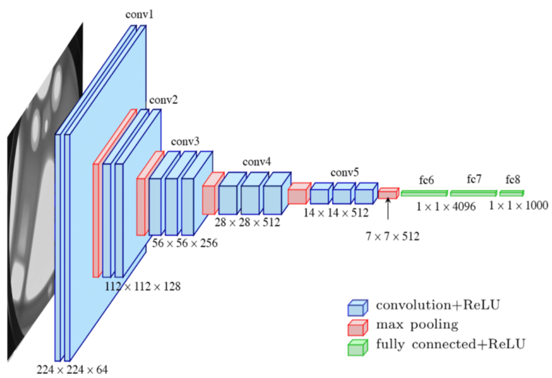

Fig 2:VGG-16 Model

IV. PROPOSED MODEL

Farmers' inability to recognize the disease type in the early stages causes a significant fall in production performance and crop losses in the agriculture sector every year. Farmers have noted that leaves cannot frequently identify the disease type and frequently require the assistance of an expert to make forecasts. These losses have a significant effect on output and, consequently, on farmers' livelihoods. The automated system created and established by the proposed model is used to identify plant diseases and determine whether a plant is infected or not. The following are the steps in which is carried out:

1. Obtaining the plant image collection from various plant images that contain various plant diseases.
2. Convolutional layers are used for the image's pre-processing.
3. Plant disease classification indicating whether the provided plant leaf image is infected or healthy.

V. CONCLUSION

Since a significant portion of the Indian population depends on agriculture for its economic prosperity, it is crucial to identify and diagnose the leaf diseases that cause losses. A Deep Learning computation is used to find viruses in yields, such as a Convolutional Neural Network. A limited number of plant species are used to test the model for various plant diseases. This is based on a deep learning technique called CNN that is used to create a system for identifying, detecting, and recognizing various plant leaf diseases. A convolutional neural network (CNN) technique is used in this situation. This includes a layer hierarchy that aids in effective detection. It begins with a sizable collection of datasets used for training and testing, moves through the pre-processing stage, and concludes with further training of the CNN method and optimization. We can correctly identify and categorize a range of leaf diseases using these image-processing techniques. The Plant Village dataset is used to train the neural network. A graphical user interface will be provided for this system. Using this GUI, the user can select images from the dataset. The user can choose any image from the collection, and after the image has loaded, the User Interface will display the disease prediction. A convolutional neural network that has been trained to identify and recognize plant leaf diseases can accurately categorize and predict diseases. The work that is now being done can benefit the agricultural industry, benefit individuals, and assist farmers keep track of their crops. This technique might be developed further to create an app that would also reveal a plant's cure. Overall, this paper is convincing in showing how CNN was used to empower farmers in their battle against leaf disease.

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