

Crop Disease Detection using Machine Learning-Neural Networks

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Abstract- Our crop pests are a major agricultural problem because the severity and extent of their occurrence threaten crop yield. Manual detection of diseases takes additional time and effort on the larger area of the farm. Identification of plant diseases is important in order to prevent losses within the yield. It needs a tremendous quantity of labor, and expertise within the plant diseases, and conjointly need excessive time interval. Detection of diseases in the fields is a major challenge in the field of agriculture as in India “agriculture” is the prime occupation of many people. Therefore effective measures should be developed to fight those while minimizing the use of pesticides. In this project, we have described the technique for the detection of plant diseases with the help of pictures. The techniques of ML- Neural Networks are used to yield better crop management and production. Monitoring of these diseases relies on manpower, however automatic monitoring has been advancing in order to minimize human efforts and errors. So, the proposed system provides a simple, efficient, and fast solution to detecting pests in rice fields.

Keywords- *Neural Network, Classification, Image Preprocessing, Feature Extraction*

I. Introduction

In India, farming is still the main source of employment, and 70% of rural households make their living exclusively from farming. However, because of how seriously and widely they affect crop productivity, our crop pests constitute a significant agricultural issue. On the greater area of the farm, manual disease detection requires more effort and time. After seeing all of these circumstances, we developed a new strategy in which we plan to apply cutting-edge technological advancements like AI-ML to the agriculture sector in order to increase production and benefit farmers.

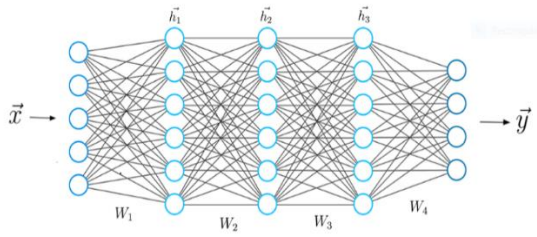
On leaves and other sections of the crop, a deep learning approach can be used to detect diseases and pests. A significant challenge in the realm of agriculture is the detection of illnesses in the fields. Thus, efficient strategies should be created to

combat those while reducing the use of pesticides. The science of agriculture makes substantial use of machine learning and neural network approaches to safeguard crops to the fullest extent possible, which can ultimately improve crop management and output. Although manual monitoring of these diseases still needs to be done, advances in automatic monitoring have reduced the need for manual labour and human error. Additionally, it is crucial to have automatic disease detection systems for plants since they may be used to monitor vast agricultural areas and automatically identify disease symptoms as soon as they manifest on plant leaves. Thus, the suggested technique offers a quick, easy, and effective means of identifying pests. Our model will identify the ailment, classify it in accordance with its traits, and offer the best solution to the issue.

II. Deep Learning

Deep learning is a subset of machine learning, which is essentially a neural network with three or more layers. These neural networks attempt to simulate the behavior of the human brain—albeit far from matching its ability—allowing it to “learn” from large amounts of data. While a neural network with a single layer can still make approximate predictions, additional hidden layers can help to optimize and refine for accuracy.[1]

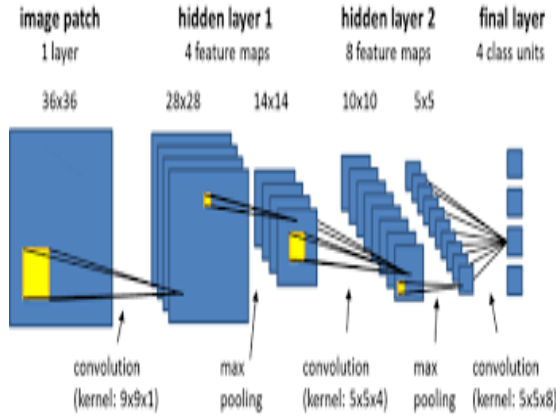
Deep Learning, on the other hand, is just a type of Machine Learning, inspired by the structure of a human brain. Deep learning algorithms attempt to draw similar conclusions as humans would by continually analyzing data with a given logical structure. To achieve this, deep learning uses a multi-layered structure of algorithms called neural networks.



a. Typical neural networks

A. Convolutional Neural Network

The Convolutional Neural Network is composed of various convolution and pooling layers, lastly ends with the fully connected layers. The advantage of CNN is that, it automatically extracts the features of the input images. CNN has three main components, which are convolution layer, pooling or subsampling layer, and fully connected layer as shown in the Fig. 2. [2]



b. Convolutional Neural Network[4]

The input is a $(h \times h \times r)$ dimension image to the convolutional layer. Here, h is the height and width of the image and r is the number of channels. For example, the value of r is 3 when the image is RGB image. The image is given as an input in the convolution layer, the layer extracts the features of the image by applying various filters. It produces the feature maps at each convolution layer in the model. A filter is a matrix of values, known as weights, which is trained to detect specific features of the input image. The filter moves over each part of the image to detect whether the feature is present or not. Convolution operation consists of element-wise product and sum between two matrices, which are input image and filter. The output of this matrix multiplication is the matrix which stores convolutions of the filter over various parts of the image.[2]

The architecture of CNN is basically a list of layers that transforms the 3-dimensional, i.e. width, height and depth of image volume into a 3-dimensional output volume. for the implementation of these CNN architectures, we note that traditional algorithms such as, for example, AlexNet, VGG, ResNet, LeNet, InceptionV3, GoogLeNet are predominant in the investigated studies. One important point to note here is that, every neuron in the current layer is connected to a small patch of the output from the previous layer, which is like overlaying a $N \times N$ filter on the input image. Following is table which shows accuracy and few other parameters of CNN Architecture.

Model	Size	Top-1 Accuracy	Top-5 Accuracy	Parameters	Depth
VGG16	528 MB	0.713	0.901	138,357,544	23
InceptionV3	92 MB	0.779	0.937	23,851,784	159
ResNet50	98 MB	0.749	0.921	25,636,712	-
Xception	88 MB	0.790	0.945	22,910,480	126
InceptionResNetV2	215 MB	0.803	0.953	55,873,736	572
ResNeXt50	96 MB	0.777	0.938	25,097,128	-

The top-1 and top-5 accuracy refers to the model's performance on the ImageNet validation dataset.

Table 1. [8]

III. Literature Review

In this project, we aim to forecast plant leaf disease (Quantification) as soon it appears on plant leaves. In addition to this, we want to increase the accuracy so that even using a large dataset we can train the algorithm and maximize the epoch values. The main advantage of automatic plant disease detection is to protect crop production from quantitative losses. Thus, implementing the idea using the deep learning method increases its efficiency as well as reliability. This system can work as a universal detector, recognizing general abnormalities or the leaves such as scorching or mold, etc. It can be implemented to increase crop productivity by ensuring the quality and quantity of the food product.

IV. Methodology

Crop Disease Detection model is a model based on neural networks which comes under machine learning. This model is developed to help farmers identify, analyse and treat the disease appeared on the crops. The methodology goes as:

1)Data Collection: The first and most important part of the process is data collection. Here, data is

collected from various sources that include Kaggle, and other online platforms.

2)Data Sorting: After collection, we need to sort and analyse the data as per the requirement of the model.

3)Data Analyzation: In this step, data visualization techniques are used to analyze and draw meaning conclusions from the set of collected data.

4)Data training: Data training is most important step where we train the model and based on this we can predict the right output.

5)Output: The model can predict if the crop is infected or not and even if it is then it can analyze it in a right way.

Conclusion

In India, agriculture is the prime occupation, and 70% of its rural households still depend primarily on agriculture for their livelihood. Crop pests are a major agricultural problem because the severity and extent of their occurrence threaten crop yield. The techniques of ML- Neural Networks are extensively applied to agricultural science, and it provides maximum protection to crops, which can ultimately lead to better crop management and production. Monitoring of these diseases relies on manpower; however automatic monitoring has been advancing in order to minimize human efforts and errors. Also, automatic detection of plant disease is essential as it may prove beneficial in monitoring large fields of crops and thus automatically detect the symptoms of diseases as soon as they appear on plant leaves. So, the proposed system provides a simple, efficient, and fast solution to detecting pests in rice fields. Our model will detect the disease and

then will classify it based on its characteristics and provide an optimal solution to the problem.

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