DISEASE DETECTION OF PLANTS USING DEEP LEARNING AND CONVOLUTIONAL NEURAL NETWORKS

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Abstract - *Plants are the part and parcel of human livelihood they give us food, energy and become a part of day to day life. These plants are getting affected with diseases. Leaf diseases and destructive fungi are causing a major problem to Agricultural sector. Disease fungi are responsible for a great deal of destruction of plants. Accurate prediction of the plant disease can help in the treatment of the leaf as early as possible which controls the economic loss. As a human responsibility, we need to take care of plant diseases, as a result this model is proposed which is developed using CNN(Convolutional Neural Networks) through the help of Deep Learning Algorithms. Through Deep learning the accuracy in detecting an object gets increased. This paper deals with the feasible solution to the diseases through which the plants are getting affected by various fungi. The algorithm which is being used is successful in detecting the leaf disease of various plants. Testing Images which we used during this project is taken in natural environment and in a well lighten area.*

Key Words: **Disease, Deep Learning, Convolutional Neural Network, Pooling layer, Le-Net, Convolutional layer, Activation, ReLu, Plants etc**

1. INTRODUCTION

Field Harvesting is one of the main livelihoods for the farmers in India, Fields with different type of crops like tomato, pepperbell and other similar crops will get affected with various viruses and fungi which cause huge economic loss for not knowing what type of disease and what remedies they should take to diminish the effect of disease. The proposed CNN model can work effectively in the field where when a farmer or any individual wants to know which type of disease the plant is affected with. Technologies like Artificial Intelligence which helps in acquisition of image and process it for further analysis. In the world of automation when everything is getting automated, disease detection must be an easier task to the farmer to take necessary steps in the field of farming and to protect their fields.

Fungal diseases like leaf spot, blight in leaves, Rust leaves, Fire Blight which are caused due to the climatic changes or due to the lack of using pesticides and the type of ecosystem they are in. In these cases, it is necessary to perform sophisticated analysis, usually by means of powerful microscopes[1]. This research focuses on detection and classification of plant diseases based on symptoms of the diseases that shows signs on the leaves of the plant. In most cases, trained experts in the disease recognition will not be available, at that time this Convolution neural network (CNN)[2] model will be a great replacement to the experts to be physically there every time. The Image Processing in the field of plant disease detection is first done by in their Research Paper.

Image classification and object detection have been taken care by Convolutional Neural Networks, which is a type of Deep Neural Network which was developed as similar as Human Visual system, Many CNN models was proposed to use it for recognising the object. LeNet[10] has been used in this proposed model. To train the model the dataset that we used is downloaded from an open source dataset[11]. The paper is standardized in a manner that: division II describes the previous work organised in this similar area. Division III shows us the steps and the materials used to perform the experiment. The results acquired is conveyed in division IV and it concludes by concluding how this model can be advance its methods for future improvement.

2. LITERATURE REVIEW

This is the division which is about the recent trend in Deep Learning which deals with Convolutional Neural Networks [3]. Image Processing through Machine Learning is the key role to classify different diseases in plants. Important image features are extracted from the image and is used as input. Image classification is one of the dependent factors on image processing technique [4]. Multi layered networks are the key point that uses its filters to automatically detect images from Datasets. CNNs can act as both image feature extraction and classification being the same architecture. LeNet-5, a pioneering 7-level convolutional network [10]. Evolution of CNNs is described in Table 1.

Year	CNN	Developed by	Place	Top-5 error rate	No. of parameters
1998	LeNet(8)	Yann LeCun et al			60 thousand
2012	AlexNet(7)	Alex Krizhevsky, Geoffrey Hinton, Ilya Sutskever	1st	15.3%	60 million
2013	ZFNet()	Matthew Zeiler and Rob Fergus	1st	14.8%	
2014	GoogLeNet(19)	Google	1st	6.67%	4 million
2014	VGG Net(16)	Simonyan, Zisserman	2nd	7.3%	138 million
2015	ResNet(152)	Kaiming He	1st	3.6%	

Table 1: Evolution of Different types of CNNs and their Error rates

3. MATERIALS AND METHODOLOGIES

To distinguish Plant Diseases a large set of data is needed. These images are gathered from Plant Village Dataset.

3.1 DATASET:

Large Dataset is required during the training and testing phase. We used this dataset which contains distinct classes of diseases and species. A collection of 10000 images is being used out of which some of them are healthy plants as well. The Detailed Dataset is summarized below in Table 2.

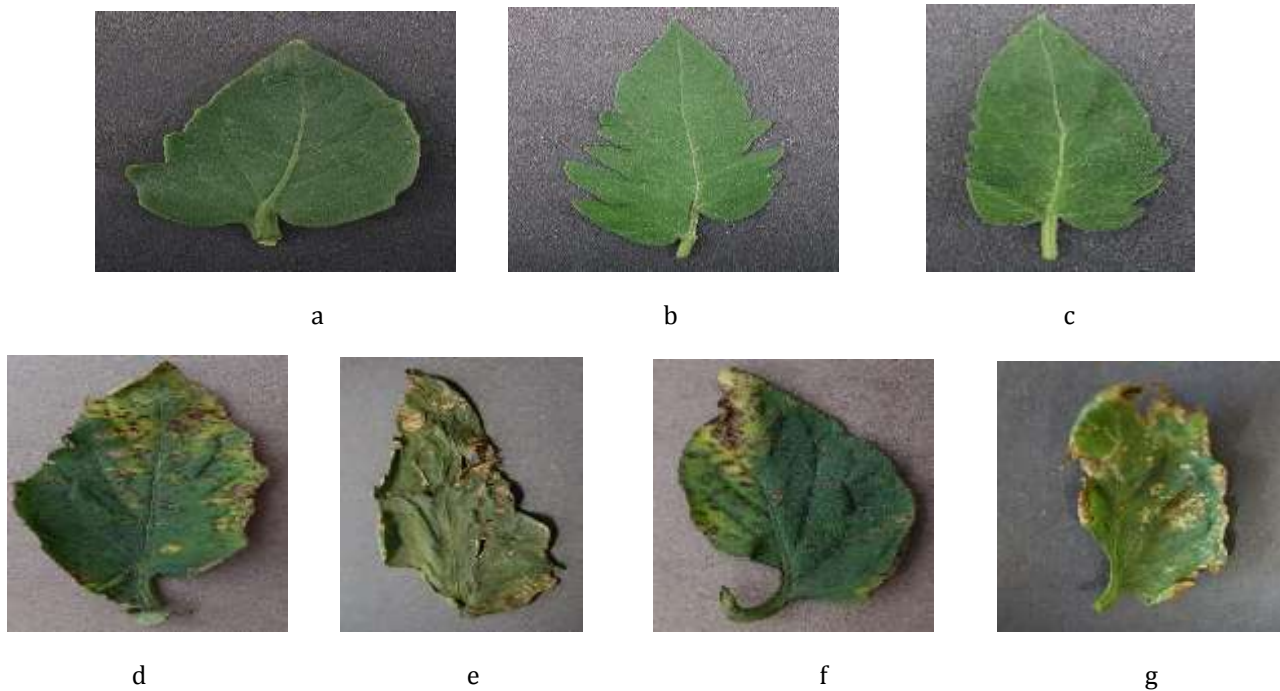| No.	Type of Disease	Number
1	Healthy Leaf	1000
2	Bacterial Spot	1000
3	Early Blight	1000
4	Late Blight	1000
5	Target Spot	1000
6	Mosaic Virus	1000
7	Yellow Leaf Curl Virus	1000
8	Leaf Mold	1000
9	Leaf spot	1000
10	Spider Mites	1000
TOTAL		10000

Figure 1: some of the images from the dataset used to train the model [a-c] healthy leaf image taken under an well-lighten environment [d-g] bacterial spot disease affected leaves

Some of the dataset are shown in fig 1. T train the model, these originally at different resolution are resized to 256 x 256 pixels. Since the images are taken in well-lighted environment and same background in that are used in training the model may not bias the neural network.

4. Proposed CNN model

Proposed CNN design is used with the model of issue explanation we are managing, this model comprises of 3 convolutional layers pursued by a max-pooling layer. The latter is completely associated layer[7]. ReLu is an initiation work that is applied to the yield of each convolutional layer.

First convolutional layer dressings the information picture utilizing 32 kernels of size 3x3 then max-pooling is applied to get yield, it is utilised as a contribution for the second convolutional layer of size 3x3. The following convolutional layer is utilizing 128 kernels of size 3x3 pursued by forth convolutional layer bandages the information picture utilizing 32 kernels of size 3x3 then max-pooling is applied to get the yield, it is utilized as a contribution for the fifth convolutional layer of size 3x3 [8]. The following convolutional layer is utilizing 128 kernels of size 3x3 is associated with a completely associated layer of 1024 neurons. The subsequent yield is given to softmax work which gives a likelihood distribution [2]. The proposed model is prepared with estimation dam of size 8 epochs.

5. Experimental Results

The Dataset is trained with 80% training data while 20% of validation data. Various models are tested. The arguments like kernel size, filter size are selected as trial and error as shown in figure 1. ReLu function is used because recent results proven that ReLu activation is faster (Krizhevsky, 2012).
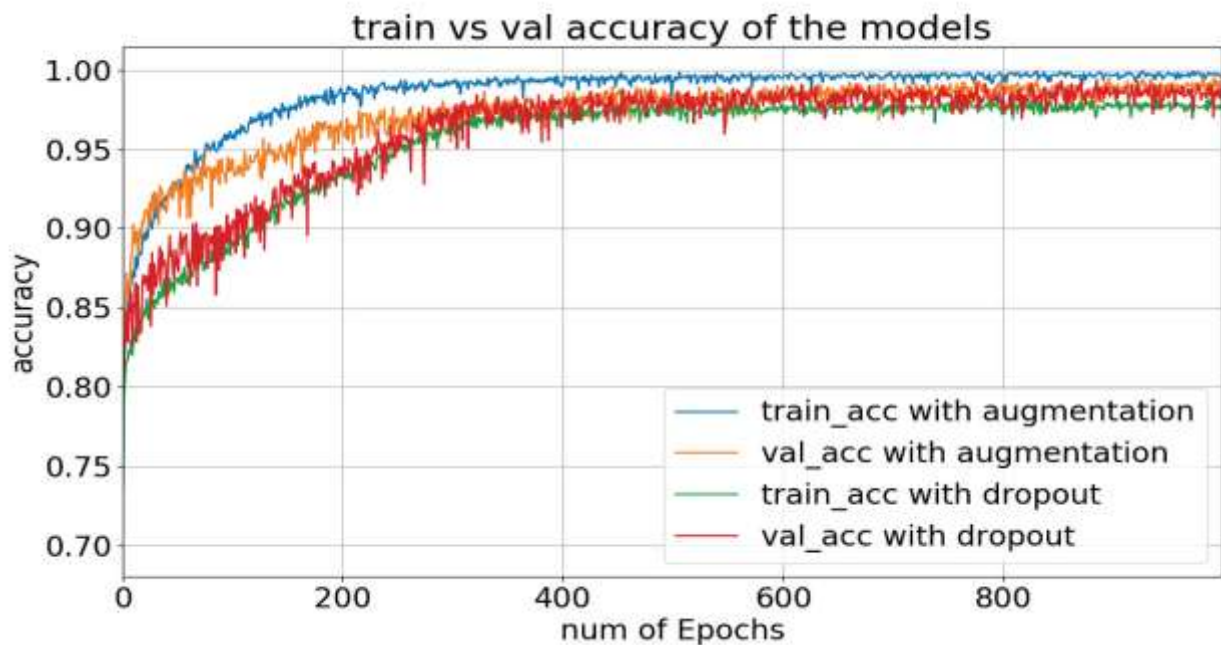
Figure 1: Training vs validation accuracy of the models

Many methodologies have been proposed to overhold overfitting of data. It increases the validation accuracy to 97.6%. Hence with the dropout layer probability results are better as compared with previous experiments.
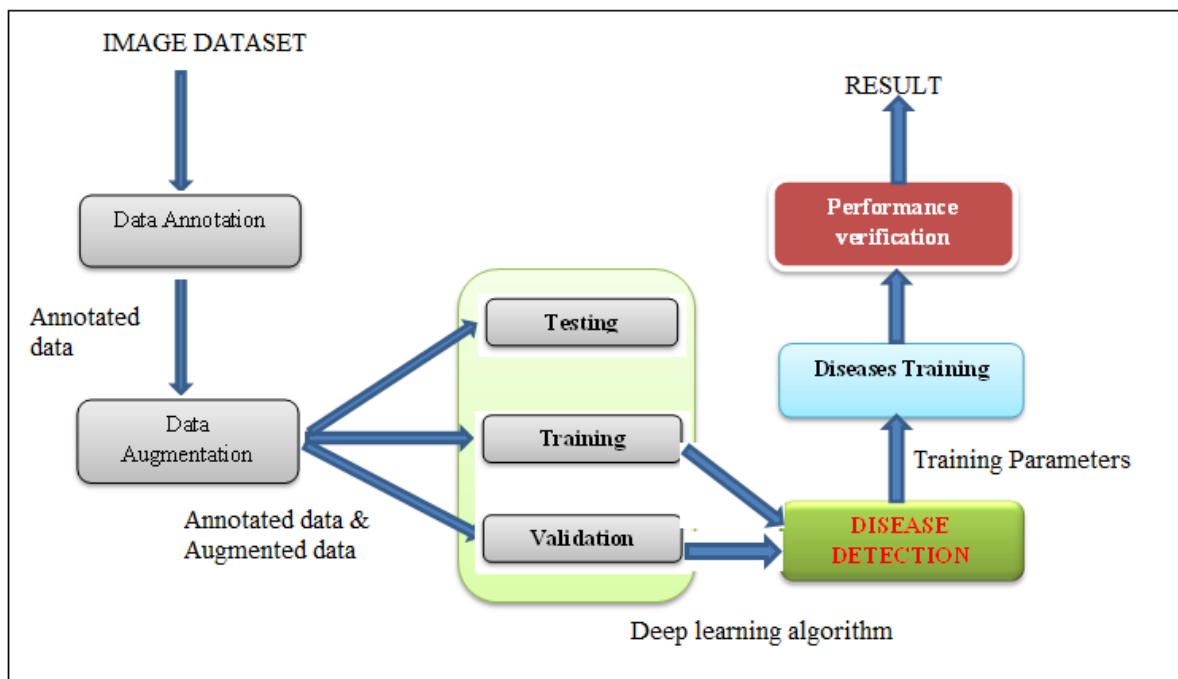

Fig 2: Basic System design of Model working

When an image is taken from the dataset where pre-processed data is available, the system that was processed is explained in fig 3. The skilled version changed into tested on each class individually. Test was performed on each image from the validation set. effects are displayed to emphasise how many images from the total of each class are accurately predicted.

6. Conclusion

The study of Convolutional Neural Network is helped detect and classify plant diseases, the neural networks are trained to achieve 99% ability, with the ability of extracting important features of images this neural networks are step ahead to classify the diseases of plants. With the acquired knowledge we performed using images taken in natural ecology and attained astonishing results.

7. Future Enhancement

Using Deep Learning methods to classify the diseases of plants using batch normalisation to speed up the training process and to strengthen the accuracy, we also willingly investigate and work on batch normalisation.

8. ACKNOWLEDGEMENT

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