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Plant disease identification using image processing

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Abstract: *Detection of plant disease in an early stage is highly crucial. Disease symptoms are seen in different parts of a plant; however plant leaves are found to be the most commonly observed part of plant for detecting an infection. We have thus attempted to automate the procedure of plant disease detection identification. Faster the disease are identified , faster the measures can be taken. Several works utilized computer technologies and contributed a lot in this domain. A study on commonly studied infections and research scenario in different phases of a disease detection system is presented. . The dataset contains many images of leaves with their commonly observed diseases. We have used a CNN for automatic feature extraction and classification. Diseases are distinguishable on the basis of their appearance like size, shape, color etc. Identification these features as soon as possible is essential.*

Keywords*: Image processing, infections,Convolutional Neural Network (CNN)*

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I. Introduction

India is a highly cultivated country and majority of its population depends on agriculture. Many farmers have large range for selecting various suitable crops that we want to cultivate. They also have to find proper and efficient pesticides to keep the crops of diseases. An infected plant yields low fruit which may affect the economy of farmer and the health of the consumer. The studies of plant disease refer to the studying of visually patterns on the plants. Keeping tracking of health and disease on plant plays an vital role in successful cultivation of crops in the farm. In initial years, the monitoring and analysis of plant diseases were done manually by the expert in that field. This requires plenty amount of work and also requires massive processing time. Plant disease identification can be done using Image processing. In many of the cases disease symptoms are seen on the stems, fruit and leaves. Enhancement in artificial intelligence researches now make it possible to make automatically detect plant disease from raw images . Deep learning can be considered as a learning method on neural networks one of the biggest pros of deep learning is that it can extract features from images automatically the neural network learns how to extract features while training[1]. CNN is a multi-layer feed-forward neural network and is the popular deep learning model. Plant leaf images are difficult with its background and the color information extracted from a single color component is restricted. It causes the feature extraction method to give low accuracy results. Using different color components is better instead of single one.

II. Literature Review

In 2018 Melike Sardogan , Yunus Ozen, and Adem Tuncer[1] presented a paper on Convolutional Neural Network (CNN) model and Learning Vector Quantization (LVQ) algorithm based method for tomato disease identification and its classification. Their dataset consisted of 500 images of tomato leaves with four symptoms of tomato diseases. They had modeled a CNN for automatic feature extraction and classification. Color information was actively used for plant leaf disease researches. In their model, the filters were applied to three channels based on RGB components. The LVQ had been supplied with the output feature vector of convolution part for training the network. Their experimental results validated that the proposed method effectively recognizes four different types of tomato leaf diseases.

In 2017 ,V Pooja ; Rahul Das ; V Kanchana [2] proposed a disease detection and classification technique with the help of machine learning mechanisms and image processing tools. In the earlier stages, identifying and capturing the infected region is done and latter image preprocessing is performed. Later on, these segments are obtained and the area of interest is identified and the feature extraction is done on the same. Finally the obtained outputs are sent through SVM Classifiers to get the results. The Support Vector Machines

has the task of classification of diseases, results show that the method put forward in this paper provides considerably better results than the previously used disease detection techniques.

In 2015 Sachin.D.Khirade and A.B.Patil [3] proposed a paper that discussed the methods used for the identification of plant diseases using their leaves images. Health monitoring and disease detection on plant is very important for proper agriculture. It is very complex to monitor the plant diseases manually. It requires massive amount of work, experts in the plant diseases, and also require the huge amount of processing time. Hence, image processing is used for the identification of diseases on plants. Disease identification involves the steps like image acquisition, image pre-processing to clean the image, image segmentation, feature detection and classification.. This paper also discussed some segmentation and feature extraction algorithm used in the plant disease detection.

In 2019 Mercelin Francis and C.Deiscy[4] developed a model that consists of four convolutional layers each followed by pooling layers. Two fully connected dense layers and sigmoid function was used to identify the probability of presence of disease or not. Training of the model was done on apple and tomato leaf image dataset which contained 3663 images getting an accuracy of 87%. The over-fitting problem was detected and removed setting the dropout value to 0.2. As the model allowed parallel processing, it is also ran on GPU Tesla to evaluate its agility of performance and accuracy. Hence the paper provides an insight of creativeness to the people to develop an integrated plant disease detection system that gives successful output in real-time.

In 2016 R Anand , S Veni and J Aravinth[5] presented a method for detecting plant leaf disease and an approach for careful identification of diseases. The main aim of proposed project is to detect the disease of brinjal leaves using image processing and neural techniques. The diseases on the brinjal are crucial issue which makes the decrease in the production of brinjal. The study is carried out in the leaf rather than whole brinjal plant because about 85-95 % of diseases are observed on the brinjal leaf.The procedure is to detect brinjal leaf disease in this project with the help of K-means algorithm for clustering , segmentation and Neural-network for classification. The proposed identification model based on artifical neural networks are very effective in recognizing leaf diseases.

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III. Research Methodology

In our proposed system, the main core of our project is Convolutional Neural Networks.Deep Learning (DL) is a subset of Machine Learning (ML) which is a subset of Artificial Intelligence (AI) which plays a vital role in developing human intelligible and independent systems also DL mimics the functionality of human brain which consists of enormous number of neurons controlled by a central nervous system and DL is also composed of several number of neural networks, where each neuron is represented as a single node and the entire activity is controlled by Central Processing Unit (CPU) or Graphics Processing Unit (GPU) [4].Main components of deep learning, designed for various purposes, is the multilayered hierarchical representation of data in the form of a Neural Network (NN) for processing data. Among various learning techniques, currently various supervised models are created and deployed for image classification and disease detection in agriculture as well as in many other fields like video surveillage, medical diagnosis, etc.. Most of the models developed works with the principle of Convolutional Neural Network ie., extracting appropriate features automatically. Deep learning does not have to divide the feature extraction and the classification because the model automatically extracts the features while training the model. It is used in many researchareas such as image processing, image restoration, speech recognition, natural language processing and bioinformatics. Each layer uses the output of the preceding layer as input.

Convolutional Neural Networks

Convolutional Neural Networks makes great use of the input consists of images and they constrain the architecture in a more sensible way than the regular Neural Network, the layers of a CNN have neurons arranged in 2 or 3 dimensions: width, height, depth[6].

Convolutional layer

CNN takes its name from the convolution layer. In this layer, a mathematical operations are performed to detect the feature map of the input image. In Image processing, convolution is closely similar to another process called correlation. Correlation is the process of shifting a filter mask over the image and computing the sum of products at each location. Convolution differs a little as it uses an inverted filter. The input image is reduced to a minor size using a filter. The filter is moved step by step starting from the upper left corner of the image. At each step, the values in the image are multiplied by the values of the filter and the result is summed. The output of convolution layer will go to an activation process depending on the type of activation selected for the application.

The activation function provides a relationship between the input and output layers. Non-linear learning of the model occurs through the activation function. Several activation functions, such as linear, sigmoid, hyperbolic tangent, exist, but the nonlinear ReLU (Rectified Linear Unit) activation function is usually used in CNN.[7]

Pooling layer

Pooling layers are used to greatly scale down the size of the representation to reduce the number of parameters in the network, and also to control over-fitting[8]. Pooling layer reduces the parameters of the feature , i.e., length and width is reduced but not the depth. This reduces the number of divisons and weights, reduces the training time and also reduces the cost of processing. This also deals with overfitting.Overfitting is a scenario where the model achieves 100% or 99% on the training set but on an average of 50% on the test information. This can be dealt by introducing dropout layers where a random set of activations are dropped out by setting the value to 0. Dropout is a function that enhances generalization by learning many different representations of patterns.

Fully-connected layer

The fully-connected layer is a same to the way that neurons are arranged in a traditional neural network.Hence, each node in a fully-connected layer is directly connected to every node in the previous and in the next layer[9].This layer identifies very big level features that highly correlate to an object or class.. Many of the models uses two fully connected layers. Output of fully connected layer is a 1D vector generated by flattening the output. Flattening is a technique of arranging 3D volume into a 1D vector.The major setback of a fully-connected layer, is that it includes a lot of parameters that need diificult processing in training examples. Therefore, we try to eradicate the number of nodes and connections. The eliminated nodes and connection can be completed by using the dropout technique

First we have to collect the input image of leaves infected with some disease for testing . Acquired images can in different format such as different in dimensions or they have some impurities in the image so we need to perform pre-processing in next step to remove the impurities and reshaping the image, also we need to perform the pre-processing such as Image reshaping ,resizing . We cannot compare the image directly with the dataset as images are stored in matrix number, hence we need to convert them to an array for further comparison . A dataset we used had many images of different plant species. The Datasets which we collected are used to train the CNN model so that it can identify the test image and the disease it has or not.CNN has different layers that are Dense, Dropout, Activation, Flatten,Convolution1D, MaxPooling1D,Convolution2D, MaxPooling2D,Convolution3D, MaxPooling3D using these layers the cnn model can be trained. After the model is trained successfully the software can identify the disease if the plant species contained . After successful training and pre-processing ,comparison of the test image and trained model is done to predict the disease. In that comparison if the leaf is infected from some disease then it shows the name of that disease and if leaf is not infected then it shows that the leaf is healthy.

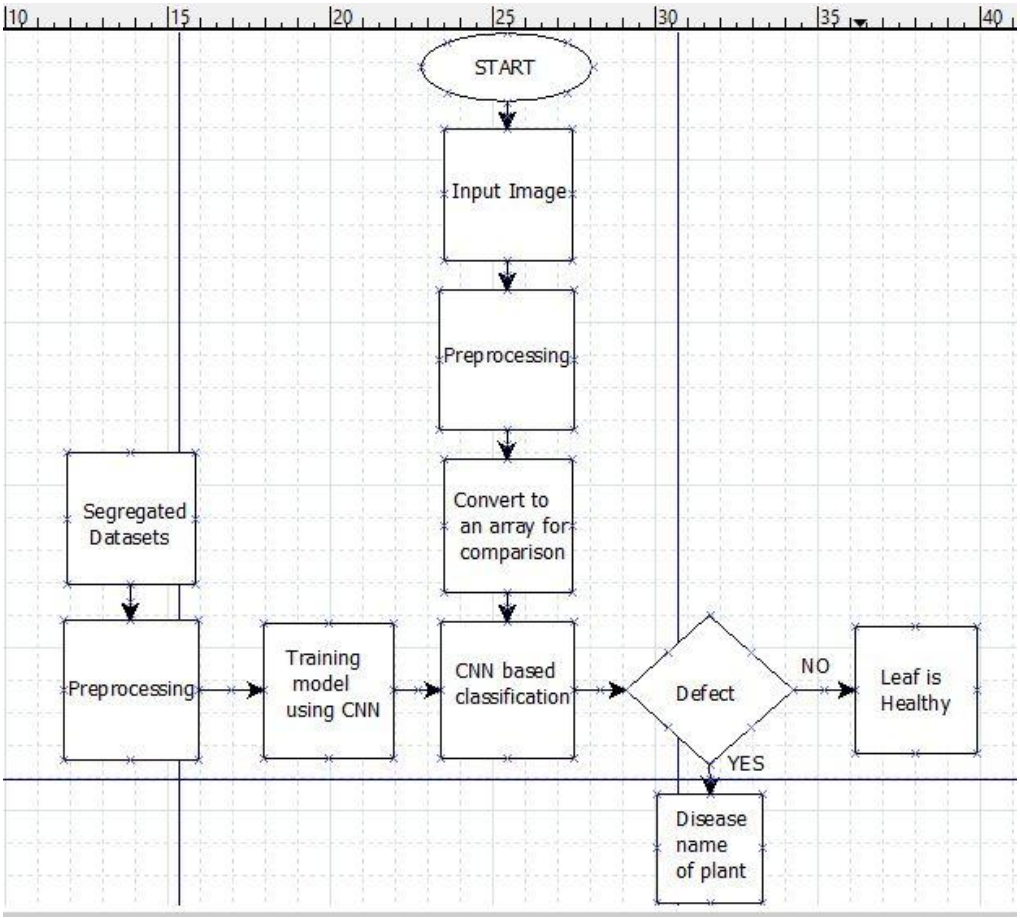

FIG 1:- Architecture of our proposed system

IV. Experimental And Results

FIG 2:- Dataset of different leaf images

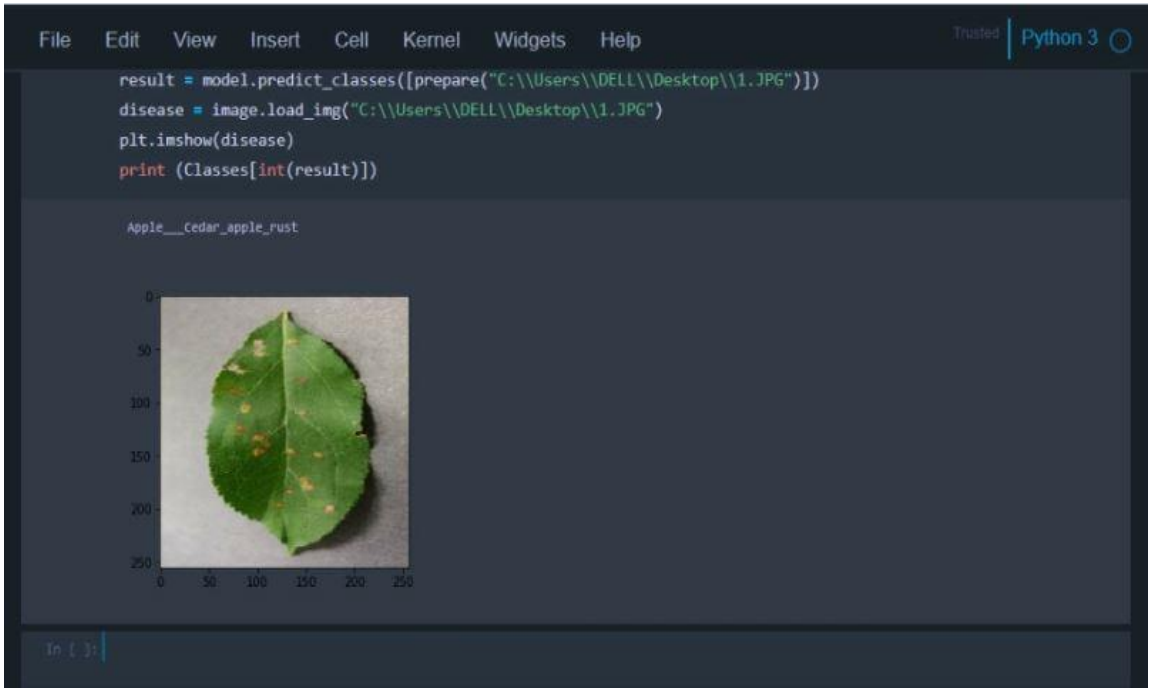

FIG 3 :- Result generated after giving input image

V. Conclusion and Future Scope

In this paper, leaf diseases detection and classification method is presented based on Convolutional Neural Network. Three various input matrices have been obtained for R, G and B channels to start convolution for every image in the dataset. Each input image matrix has been convoluted. RLU activation function and max pooling have been implied to the output matrix. The experiments have been carried out on healthy and diseased leaf images to perform classification. It is concluded that the proposed method effectively recognizes different types leaf diseases. To improve recognition rate in classification process different filters or different size of convolutions can also be used.The achieved accuracy is 88% with minimum number of parameters .Creating and training a CNN model from scratch is a tedious process when compared to the usage of existing deep learning models for various applications to achieve maximum accuracy. Therefore in the future work, it is planned to utilize a model efficient than existing architectures, such that it gives higher accuracy with minimum size and complexity, so that it can be used in mobile or any other embedded applications

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