DETECTION OF VARIANT DISEASES IN PLANTS USING DEEP LEARNING

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Abstract-Agriculture is the mainstay of the Indian economy. Almost 64% people depend on it & shares major part of the GDP. Diseases in crops mostly on the leaves affects on the reduction of both quality and quantity of agricultural products. As we know perception of human eye is not so much stronger so as to observe minute variation in the infected part of leaf. We are providing software approach to detect and classify plant leaf diseases. The approach that is proposed in this paper will enhance productivity of crops. It includes several steps viz. image acquisition, image pre-processing and trained Convolutional Neural Network (CNN) model.
Index Terms—Bacterial Spot, CNN, Deep Learning, Late Blight, Yellow curl Virus

I. INTRODUCTION

Agriculture is the science, art, and practice of cultivating crops, livestock, and other renewable resources. Over one-third of the world's workers are employed in agriculture. India ranks second worldwide in farm outputs. As per 2018, agriculture employed more than 50% of the Indian work force and contributed 17–18% to country's GDP.Plants nowadays are affected by many diseases, the diseases cause devastating economic and ecological losses and many more. Hence, Appropriate and timely disease identification in very initial stage, use of automatic disease detection technique is beneficial. The problem of efficient plant disease detection is closely related to the problems of sustainable agriculture.

Diseases results in the destruction of crops or part of the plant resulting in decreased food production leading to food insecurity. Also, knowledge about the pest management or control and diseases are less in various less developed countries. Toxic pathogens, poor disease control, drastic climate changes are one of the key factors which arises in dwindled food production.

Initially, the observations done by the naked eye are usually used to decide diseases severity in the area of production. Various Laboratory based approaches such as polymerase chain reaction, gas chromatography, mass spectrometry, thermography and hyper spectral techniques have been employed for disease identification. However, these techniques are not cost effective and are highly time consuming. Modern approaches such as machine learningand deep learning algorithm has been employed to increase the recognition rate and the accuracy of the results.

Advances in artificial intelligence researches now make it possible to make automatic plant disease detection from leaf images. Deep Learning is a community under Machine Learning. Deep Learning has its application under Computer Vision. With the availability of high-end computational power, DL has gained a boost towards its computation task. One of the advantages of deep learning is that it can extract features from images automatically. The neural network learns how to extract features while training. In order to train our model we use convolutional neural networks (CNN) technology. In deep learning, a convolutional neural network is a class of deep neural networks, most commonly applied to analyzing visual imagery problems.

II. LITERATURE SURVEY

Farhana Tazmim Pinki, et al. [1], proposed an automated system for diagnosis of three common paddy leaf diseases (Brown spot, Leaf blast, and Bacterial blight) using SVM and pesticides are advised according to the severity of the diseases. Shima Ramesh, et al. [2], makes use of Random Forest in identifying between healthy and diseased leaf from the data sets created. The proposed system includes various phases of implementation namely dataset creation, feature extraction, training the classifier and classification. Prajwala TM, et al. [3], adopts a slight variation of the convolutional neural network model called LeNet to detect and identify diseases in tomato leaves. Neural network models employ automatic feature extraction to aid in the classification of the input image into respective disease classes. Omkar Kulkarni, et al. [4], proposed a deep learning-based model which is trained using public dataset containing images of healthy and diseased crop leaves. The model serves its objective by classifying images of leaves into diseased category based on the pattern of defect. Kawcher Ahmed et al. [5], presents a rice leaf disease detection system using machine learning approaches. Three of the most common rice plant diseases namely leaf smut, bacterial leaf blight and brown spot diseases are detected. Md. Asif Iqbal, et al. [6], proposes an image processing and machine learning-based automatic system that will identify and classify potato leaf diseases. Ch. Usha Kumari, et al. [7], proposed a system to identify the leaf spot using image processing techniques. Disease detection is done in four stages, image acquisition, image segmentation, feature extraction and classification. Divyansh Tiwari, et al. [8], a model is presented that uses pre-trained models like VGG19 for fine-tuning (transfer learning) to extract the relevant features from the dataset. Then, logistic regression is used for classification. Melike Sardogan, et al. [9], presents a Convolutional Neural Network (CNN) model and Learning Vector Quantization (LVQ) algorithm based method for tomato leaf disease detection and classification.

III. PROPOSED SYSTEM

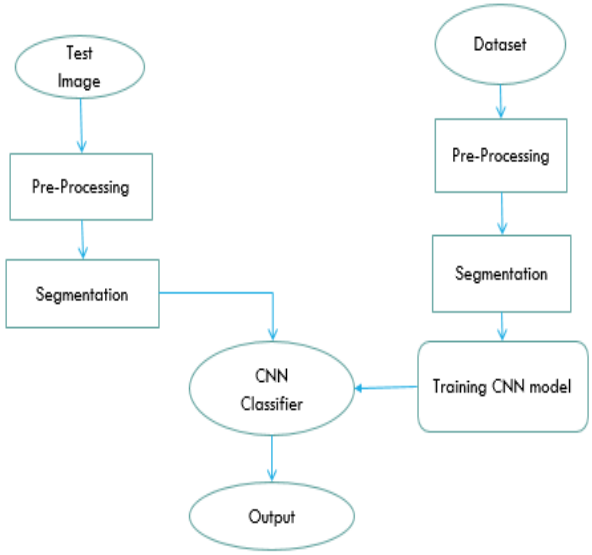

Fig 1. System Design

The various phases involved in detection of disease in plants are

Data Set Acquisition

The dataset required is collected from PlantVillage dataset which consists of potato, tomato and bell pepper leaf images. The total number of plant leaf images are 8000.

Pre-processing

Once the datasets are acquired, it is pre-processed to convert it into an array of size 50*50. The images are converted to RGB format. Label Binarizer is used to binarize the array depending upon the label classes provided.

Segmentation

Image segmentation is the division of an image into regions or categories, which correspond to different objects or parts of objects. Every pixel in an image is allocated to one of a number of these categories. The partitioning of image into healthy and infected areas based on similarity of features is done in this phase.

Training the Model

Once we have the pre-processed data, the model is trained using CNN algorithm.

IV. CNN ARCHITECTURE

CNN is used in this paper to detect diseases in tomato, potato and bell pepper leaves.A convolutional neural network (CNN, or ConvNet) is a class of deep neural network, most commonly applied to analyze visual imagery.CNN is one of the major categories of image recognition, image classification, in neural networks. Detection of objects, identification, etc. are some of the fields in which CNNs are commonly used. The identification of objects by CNN takes, processes and classifies an input image into some categories.

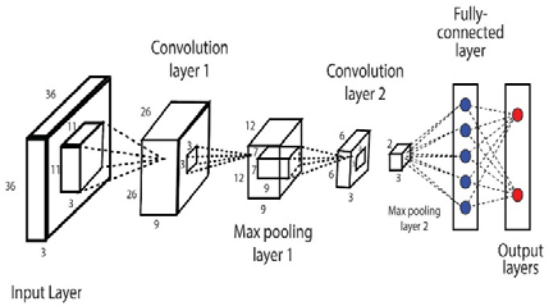

Fig 2. CNN Architecture

Convolution Layer

Convolutional layers are the major building blocks used in convolutional neural networks. A convolution is the simple application of a filter to an input that results in an activation. Repeated application of the same filter to an input results in a map of activations called a feature map, indicating the locations and strength of a detected feature in an input, such as an image. In the context of a convolutional neural network, a convolution is a linear operation that involves the multiplication of a set of weights with the input, much like a traditional neural network. Given that the technique was designed for two-dimensional input, the multiplication is performed between an array of input data and a two-dimensional array of weights, called a filter or a kernel. Fig.3 shows the convolution operation in the convolution layer for a 5x5 input image and a 3x3 filter.

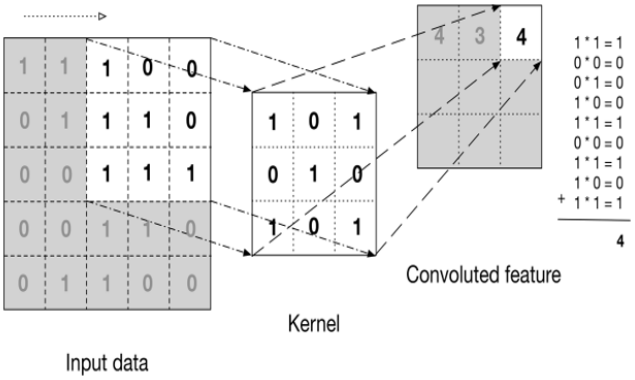

Fig 3. Convolution Layer

Activation Layer

In a neural network, the activation function is responsible for transforming the summed weighted input from the node into the activation of the node or output for that input. Several activation functions, such as linear, sigmoid, hyperbolic tangent, exist, but the nonlinear ReLU (Rectified Linear Unit) activation function is usually used in CNN.

The ReLU function returns 0 if it receives any negative input, but for any positive value x it returns that value back. So it can be written as

$$f(x)=max(0,x)$$

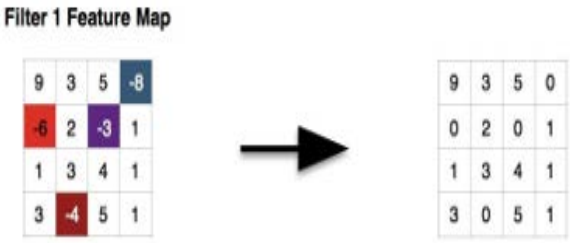

Fig 4. ReLU

Pooling Layer

A pooling layer is a building block of a CNN. Its function is to progressively reduce the spatial size of the representation to reduce the amount of parameters and computation in the network. The pooling layer operates upon each feature map separately to create a new set of the same number of pooled feature maps.

Pooling involves selecting a pooling operation, much like a filter to be applied to feature maps. The size of the pooling operation or filter is smaller than the size of the feature map. It is almost always 2×2 pixels applied with a stride of 2 pixels.

Two common functions used in the pooling operation are:

Average Pooling: Calculate the average value for each patch on the feature map.

Maximum Pooling (or Max Pooling): Calculate the maximum value for each patch of the feature map. The most common approach used in pooling is max pooling

The result of using a pooling layer and creating down sampled or pooled feature maps is a summarized version of the features detected in the input. Fig. 5 shows an example pooling operation.

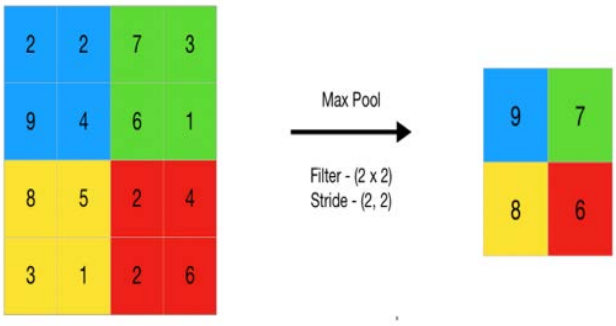

Fig 5. Max Pooling

Fully connected Layer

Fully Connected Layer is simply, feed forward neural networks. Fully Connected Layers form the last few layers in the network. The input to the fully connected layer is the output from the final Pooling or Convolutional Layer, which is flattened and then fed into the fully connected layer.

V. RESULTS

OpenCV and tflearn (tensor flow library) were used to analyze the images. Eight thousand leaf images have been used for testing in this work. The algorithm uses convolutional neural networks to classify two types of leaves whether it is heathy or infected and also if the leaf is diseased then the corresponding remedy is displayed for that particular disease. The disease occurs throughout the world where pepper and tomato are grown in dry, moist areas. Most of the disease are found in leaves so if we will successfully classify the healthy and infected leaves. It will increase our crop production. We got test accuracy of around 97%.

VI. CONCLUSION

The proposed system attempts to forewarn the concerned authorities by detecting the variant diseases of the plants as early as possible. This gives the authorities ample opportunity to take the necessary actions.In future, we can try to implement the model in smartphones as an application. With that the image can directly and instantly taken by the farmer and will be analyzed on field.The enhancement will also include the increasing in number of detected diseases and the remedies.The size of the dataset will be increased.

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