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Review of Plant Disease Detection and Diagnosis Using Deep Learning Model

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Abstract

Crop diseases are responsible for the significant economic losses in agricultural industry worldwide. Monitoring the health status of plants is difficult to control the spread of diseases and implement efficient management. There are various types of disease present on leaves such as bacterial, fungal, viral etc. In our project we are using concepts of deep learning. Deep learning provides an opportunity for detectors to recognize crop diseases in a timely and accurate manner, which will not only upgrade the accuracy of plant protection but also expand the scope of computer vision in the field of precision agriculture. Convolutional neural network (CNN) model is developed to perform plant disease detection and diagnosis using healthy and diseased plants leaves, through deep learning methods. It detects the plant disease from the picture of the plant leaf. All farmer has to capture the plant leaf image from app in his mobile. The app send this images to our designed AI system. Our AI system will detect the disease form the image and send back the disease name and diagnosis to user.

Keywords *- Convolutional neural network, Crop dataset, Deep learning, Diagnosis, Plant disease detection, Tomato Leaves.*

I. INTRODUCTION

Crop disease diagnosis is of great significance to prevent the spread of diseases and support the sustainable development of agricultural economy. In general, the crop disease diagnosis is performed manually by visual observation or microscope techniques, which are proven to be time consuming and have the huge risk of error due to subjective perception and human error. In this context, various imaging techniques have been studied for identifying crop disease symptoms [11]. Although these techniques can make a relatively quick diagnosis for crop diseases, they can't be separated from the support of expensive and bulky sensors. But recent development in smartphones and computer vision would make their advanced HD cameras very interesting tool to identify diseases [12]. With the development of computer vision, concerns are growing about the image-based detection technologies for crop disease [13].

To make an automatic crop disease diagnosis system that can be applied to in-field images, one has to face some unmanageble challenges and complex image backgrounds, e.g. soils, leaves, stones, and even the people's hands, uncontrollable capture conditions, e.g. camera angle and image quality, illumination, co-occurrence of multiple disease areas in one image, various characterization for different stages of disease development, similarities in appearance between different disease categories. Some challenging samples, which are selected from our collected dataset of tomato diseases, are demonstrated in Fig1. To our best knowledge, few researches have been done to eliminate the above challenges for crop disease diagnosis. The overall objective of this work is to develop an automatic tomato disease diagnosis system to identify

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Fig.1 Picture of Diseased and Healthy Leaves

disease categories and locate corresponding disease areas simultaneously for in-field tomato images. Here, we demonstrate the technical feasibility using a deep learning approach utilizing 16,012 images of Tomato species with 9 diseases (one healthy) available on Kaggel.

II. LITERATURE SURVEY

A. A Fungus Spores Dataset and Convolutional Neural Networks based Approach for Fungus Detection

In this paper they used convolutional neural network (CNN) approach. As a result, 40,800 labeled images were used to develop fungus dataset to precise fungus detection and classification. The other main objective of this research was to develop a CNN based approach for the detection of fungus and distinguish different types of fungus
A CNN architecture was developed, and it showed the results with an accuracy of 94.8%. This project require proper image acquisition setup for capturing images. So, it is not flexible for everyone [1].

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B. Diagnosis of Diseases on Cotton Leaves Using Principal Component Analysis Classifier

In this paper the main focus is given to find out mostly occurring diseases on the cotton leaves. By choosing appropriate classifier technique like PCA will provide good results to detect the various diseases on leaves of cotton. The main goal of PCA is to extract the important features, which may be vary accordingly with respect to types of diseases. The accuracy of detected diseases on cotton leaves are 28%. It was found that similar pattern diseases are having more cosines distances during KNN classification due to which there will be chance of misclassification some diseases are having similarities in their color patterns due to which disease patterns are not well recognized [3].

C. Plant Disease Detection using CNN & Remedy

In this project we are using CNN algorithm. This proposed system helps in identification of plant disease and provides remedies against the disease. A prototype drone model is also designed which can be used for live coverage of large agricultural fields to which a high resolution camera is attached and will capture images of the crops which will be act as input to our software, based of which the software will tell us whether the plant is healthy or not. With our code and training model we have achieved an accuracy level of 78%. The accuracy and the speed can be again increased by use of Googles GPU for processing. The system can be installed and fit on Drones so that aerial monitoring of fields can be done easily [7].

D. Classification of Rubber Tree Leaf Diseases Using Multilayer Perceptron Neural Network

This paper presents about classification of rubber leaf diseases through automation and utilizing primary RGBcolor model. This system involved the process of image classification by using artificial neural network where 600 samples used for training while another 200 samples for testing. The optimized ANN model in this work has two method which based only on the dominant pixel RGB (mean) and applying principle component analysis (PCA) on the pixel gradation values of each image. In order to increase the effectiveness of this classification system, it is recommended to use a high pixel of digital camera for higher accuracy of capturing color images [5].

III. BLOCK DIAGRAM

In our project, we have collected dataset from kaggle website. Convolutional Neural Network (CNN) models were developed to perform plant disease detection and diagnosis using simple leaves images of healthy and diseased plants, through deep learning methodologies. First of all user has to capture the plant leaf image from app. The app will send this image to our AI system. The image goes through number of processing steps like preprocessing, feature extraction, selection of feature etc.

In preprocessing, distortion in the input image is removed. CNN algorithm contains steps such as convolution, pooling, ReLU, fully connected layer. The model is properly trained using CNN and classification take placed. The comparison of test image and trained model takes place followed by display of the result. It detects the plant disease from the snapshot of the plant leaf**.** Our AI system will detect the disease form the image and send back the disease name and diagnosis to user.

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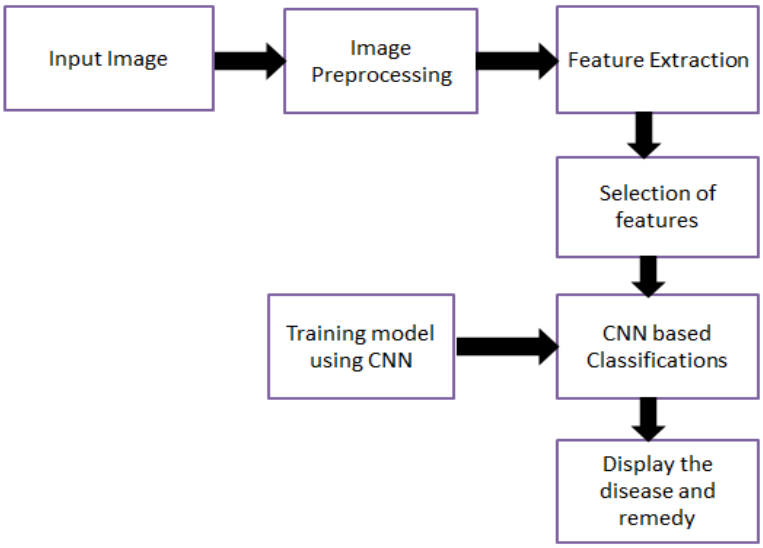

Fig. 2 Block diagram

Convolutional: Convolutional layers apply a convolution operation to the input, passing the result to the successive layer. The convolution emulates the response of an individual neuron to visual stimuli. Every convolutional neuron processe data only for its receptive field. Though fully connected feed forward neural networks are often used to learn features as well as classify data, it's not sensible to use this design to images. A large number of neurons would be necessary, even in shallow (opposite of deep) architecture, because of the very large input sizes related to images, where each pixel is a relevant variable. For example, a fully connected layer for a (small) image of size 100 x 100 has 10000 weights for every neuron within the second layer. The convolution operation brings a answer to this problem as it reduces the number of free parameters, permitting the network to be deeper with fewer parameters [14].
Pooling: Convolutional networks may contain local or global pooling layers, which combine the outputs of neuron clusters at one layer into a single neuron in the next layer. For instance, max pooling uses the maximum value from every cluster of neurons at the previous layer. Another example is average pooling, that uses the average value from each of a cluster of neurons at the previous layer.
Non-linear layers: Neural networks normally and CNNs in particular rely on a non-linear "trigger" function to signal distinct identification of likely features on every hidden layer. CNNs could use a variety of specific functions such as rectified linear units (ReLUs) and continuous trigger (non-linear) functions—to efficiently implement this non-linear triggering.

ReLU: A ReLU implements the function y = max(x,0), therefore the input and output sizes of this layer are the same. It increases the nonlinear properties of the decision function and of the overall network without affecting the receptive fields of the convolution layer. As compared to the other non-linear functions used in CNNs (e.g., hyperbolic tangent, absolute of hyperbolic tangent, and sigmoid), the advantage of a ReLU is that the network trains over and over faster. ReLU functionality, with its transfer function plotted above the arrow.
Fully Connected: Fully connected layers connect each neuron in one layer to every neuron in another layer. It's in principle the same as the traditional multi-layer perceptron neural network (MLP).

IV. CONCLUSION

Image processing technique-based approach is proposed and useful for plant disease detection. The main purpose of the proposed system is to recognize the leaf diseases with little computational effort. Accuracy is again enhanced by the using different image processing techniques such as feature extraction, image analysis, pre-processing and classification. Speed and accuracy are the two main characteristics of plant disease detection using machine-learning methods that must be achieved. In

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the proposed paper the concepts of deep learning provide an opportunity for detectors to recognize crop diseases in a timely and accurate manner. It also expands the scope of computer vision in the field of precision agriculture. Convolutional neural network (CNN) model need to perform plant disease detection and diagnosis using healthy and diseased plants leaves, through deep learning methods.

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