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Plant Disease Detection Using CNN: A Review

Mr. Deshmukh Akshay S.[1] and Prof. Dr. Yerigeri V. V.[2]
M.Tech Student, College of Engineering Ambajogai, Beed, India[1]
Professor, College of Engineering Ambajogai, Beed, India[2]

Abstract: *Agricultural productivity is a key component of Indian economy. Therefore the contribution of food crops and cash crops is highly important for both the environment and human beings. Every year crops succumb to several diseases. Due to inadequate diagnosis of such diseases and not knowing symptoms of the disease and its treatment many plants die. This study provides insights into an overview of the plant disease detection using different algorithms. A CNN based method for plant disease detection has been proposed here. Simulation study and analysis is done on sample images in terms of time complexity and the area of the infected region. It is done by image processing technique. A total of 15 cases have been fed to the model, out of which 12 cases are of diseased plant leaves namely, Bell Paper Bacterial Spot, Potato Early Blight, Potato Late Blight, Tomato Target Spot, Tomato Mosaic Virus, Tomato Yellow Leaf Curl Virus, Tomato Bacterial Spot, Tomato Early Blight, Tomato Late Blight, Tomato Leaf Mold, Tomato Septoria Leaf Spot and Tomato Spider Mites and 3 cases of healthy leaves namely, Bell Paper Healthy, Potato Healthy and Tomato Healthy. Test accuracy is obtained as 94.80%.Different performance matrices are derived for the same.*

Keywords: Powdery Mildew, Downy Mildew, Blight etc.

I. INTRODUCTION

Agriculture is a sector which has a huge impact on life and economic stature of humans. Agriculture proves to be a primary source of livelihood, for about 58% of India's population. India ranks second globally in terms of farm yields. It was reported in the year 2018 that agriculture opened the doors of employment for more than 50% of the employees, hence contributing to 18–20% to country's GDP. India has thus proven to be one of the leading nations in term of agricultural yield and productivity. With this majority of population rely on agriculture, it is very crucial to recognize the problems faced in this sector. There are a numerous of problems that the agriculture field faces such as inefficient farming strategies and techniques, inadequate use of compost, manures and fertilizers, insufficient water supply, various diseases attack on plants and so on.

Diseases are exceedingly harmful to the well-being of plants which in turn influence its growth. The attack of these numerous types of diseases on plants results in a huge loss in the yield performance in terms of quality as well as quantity. Plants affected by diseases add up to for about 20-30% of the entire crop deprivation. Thus, recognizing diseases in plant becomes very crucial in order to avoid any massive losses in production, performance and in the amount of the agricultural outcome. Since manual recognition is extremely time consuming and more prone to inaccuracy, leading to wrong treatment.

II. LITERATURE REVIEW

- Usama Mokhtar presented Gabor wavelet transform techniques to extract tomato leaf features. They used SVM to detect leaf diseases. For experiments real sample images of tomato leaf have been considered and two types of disease in tomato leaves including early blight and powdery mildew have been observed. In preprocessing, phase images are resized to 512*512 resolutions to deduce the computational time. Background subtraction method has been applied to remove the background of the image. In the classification, using kernel function the SVM was trained and tested[3].
- Ganesan proposed a fuzzy-based segmentation method with computer vision for the early identification of plant leaf diseases. Image segmentation is also applied to extract the diseased part of the plant leaf from the input image. Color space segmentation is also applied to identify the color of the fruit or disease affected area [4].
- Arthit Srikaew, Kitti Attakitmongcol, and Prayoth Kumsawat proposed a leaf disease diagnosis method using neural networks. An unsupervised method is implemented using color imagery. Color and texture, both the

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features of the image are processed . The proposed system is consist of two parts. One is extraction of disease feature and the other one is classification of the same. Former one emphasizes on feature appearance based on a co-occurrence matrix depend on gray level along with texture feature equations. Later one deploys the fuzzy ARTMAP neural network which is basically an unsupervised method to categorize different types of diseases. Healthy plant with no disease ,rust, scab, downy and mildew are the five classes are considered in this work. With this variations of grape leaf diseased images the proposed system's classification performance is examined in terms of accuracy and a desirable score of 90% is obtained for the same[5].

- The study is presented by H. Sabrol and K. Satish where five kinds of tomato diseases is considered for classification for example tomato late blight, bacterial spot, Septoria spot, bacterial canker, tomato leaf curl. The classification is carried out by extricating the following features color, texture and shape of the plant leafs . Pictures are taken for both healthy and diseased tomato plants . The extricated features ,after segmentation ,are provided as input to the classification tree . The Overall classification accuracy is obtained as 97.3% is obtained with these six kinds of tomatoimages [6].
- N. Petrillis has reported a smart phone based diagnosis application for plant disease detection. Color normalization has been used for the same[7-8]. Multiclass plant diseade detection using SVM is implemented by M. Islam[9].
- Haiguang Wang, Guanlin Li, Zhanhong Ma, and Xiaolong Li developed a method to realize image recognition of plant diseases, four kinds of neural networks including backpropagation (BP) networks, radial basis function (RBF) neural networks, generalized regression networks (GRNNs) and probabilistic neural networks (PNNs) were used to distinguish wheat stripe rust from wheat leaf rust and to distinguish grape downy mildew from grape powdery mildew based on color features, shape features and texture features extracted from the disease images [10].
- K.K. Singh has proposed an cloud based collaborative platform for plant disease identification. So that it can be forecasted to farmers for better prevention purpose[11]. Various procedures for the segmentation method are discussed further which can be applied for detection of various lesion disease. To identify various ailments in plant leaf several algorithms were used such as K-means cluster, thresholding etc. For the different inputs, k figures depict the original images followed by the output of thresholding and K-means cluster for segmented images. Although the algorithm of k means clustering needs a prior information of specification around a few several cluster centers.

III. PROPOSED SYSTEM

A. Deep Learning

Deep learning, a category of machine learning algorithms which uses various layers to do the extraction of higher level from the raw input. Deep learning is a machine learning method that instruct a computer to do filtration of inputs across the layers Deep learning illustrates the way human brain does the filtration of information. Many deep learning techniques utilizes the neural network architectures. The term "deep" cite to the various hidden layers present inside neural network. In contrast to this conventional neural network that consists of 2-3 hidden layers, the deep neural networks can have as much as one hundred and fifty.

B. Convolutional Neural Network

One variant of deep neural networks is called as convolutional neural networks (CNN). A CNN combines well-read features with input data, and then it uses 2D convolutional layers, and hence makes this architecture more suitable for processing 2D data, like images. CNNs abolish the demand for manual feature removal and extraction for the classification of the images. The CNN model of its own extracts features straight from images. The features that are extracted aren't pre-trained; they are well-read while the network is trained on few groups of images. The Convolutional Neural Network (CNN) model has numerous of layers which execute the processing of image in convolutional layers include- Input layer, Output Layer, Convo Layer, , Fully, Soft-max layer, Connected layer, Pooling Layer.

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C. VGG 16 Model

VGG16 is a CNN model used for Large-Scale Image. There are two tasks to be performed for best recognition of plant diseases. The first is to detect objects within an image coming from *several* classes, which is called object localization. The second is to classify images, each labelled with one of *several* categories, which is called image classification. The CNN model has seven different layers. Each layer has certain information processed in them. Those seven layers are as follows: Input layer, Output Layer, Convolutional Layer, Fully, Soft-max layer, connected layer, Pooling Layer.

Input layer:

It contains data in the form of image. The parameters include height, width, depth and color information of the image (RGB). Input size is fixed to 224 X 224 RGB image.

Convo layer:

Convolutional layer is also called as feature extraction layer. This layer extracts the prominent features from the given collection of images using dot products of the image dimensions.

Pooling Layer:

The pooling layer helps to reduce the computational power in order to process the data by decreasing (or) reducing the dimensions of the featured matrix obtained by using the dot products.

Fully connected layer:

It comprises of loads, neurons and biases. It connects neurons from one convolutional layer to another.

Softmax Layer/ Logistic Layer:

Softmax executes multi-classification. Logistic layer executes the binary classification. It determines the probability of the presence of a given object in the image. If the object is present in the image, then the probability is '1'otherwise it is '0'.

Activation Function- ReLU:

It transforms the total weighted input through the node and puts it into the operation, activates the node. Rectified Linear Unit (ReLU) is an activation function used in the neural networks for convolutional operations.

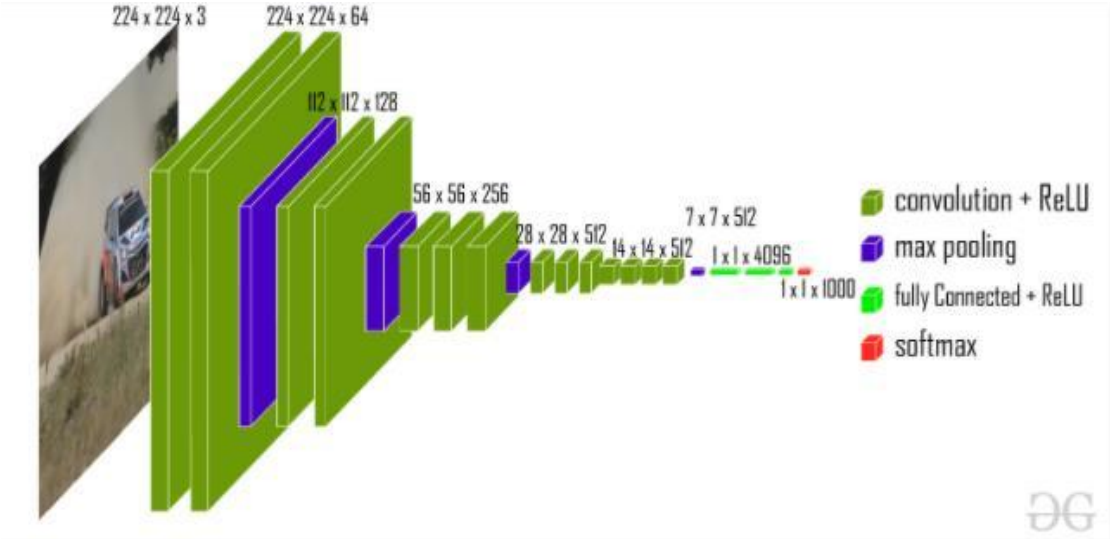

Figure 1: VGG 32 Model

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IV. FACILITIS REQUIRED FOR PROPOSED WORK

A. System Architecture

The proposed System architecture comprises of data acquisition from a huge dataset, processing at different convolutional layers and then the classification of plant diseases which declares if the plant image is of a healthy class or diseased class

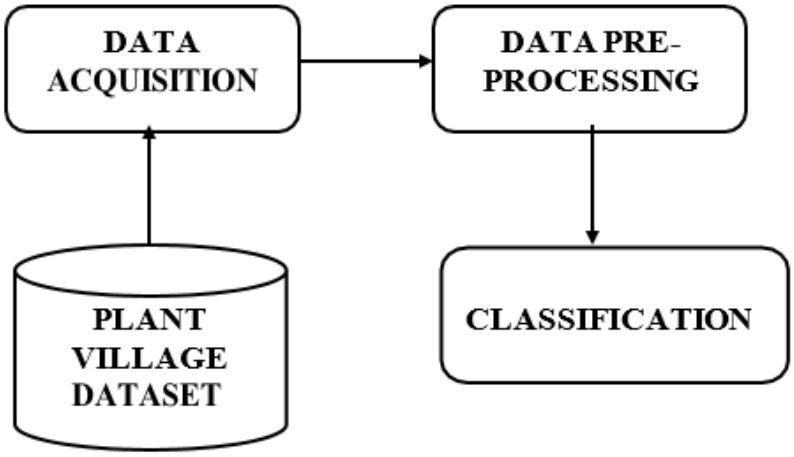

Figure 2: System Architecture

B. Data Flow Diagram

Data Flow Diagrams (DFDs) describe the processes of how the transfer of data takes place from the input till prediction of the corresponding output.

1. Data Flow Diagram – Level 0

The DFD Level 0 depicts the users to input the image of the plant leaves. The system in turn detects and recognizes the plant leaf disease

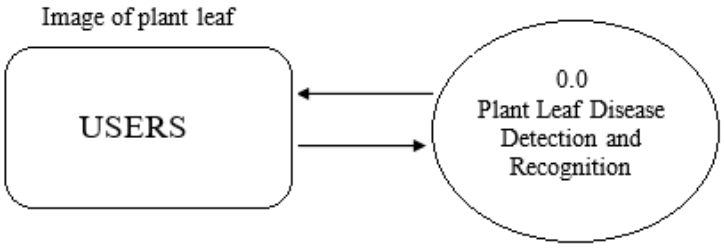

Figure 3: Level 0 Data Flow Diagram

2. Data Flow Diagram – Level 1:

The Figure 4 displays the DFD Level 1, where the CNN model takes the image frrom the training dataset and then CNN model predicts the type of disease of the leaf.

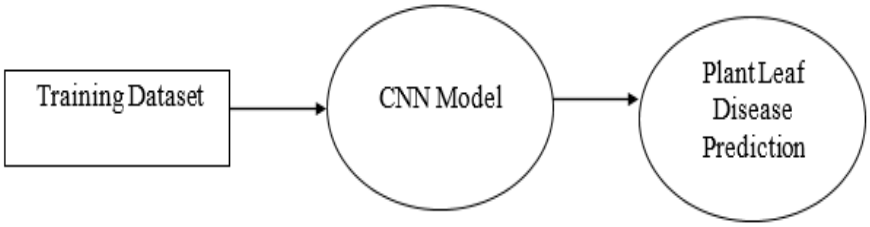

Figure 4: Level 1 Data Flow Diagram

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3. Data Flow Diagram – Level 2:

DFD Level 2 goes one step deeper into parts of 1-level DFD. It can be used to plan or record the specific/necessary detail about the system's functioning.

IV. CONCLUSION

The proposed algorithm is implemented successfully to train the system. The accuracy percentage on the test set is 88.80% with no overfitting There is still room for improvement as the remaining 12.20% is covered. This present work can contribute to agricultural domain and can be used to help people for tracking their house plants and also enables the farmers to keep a track of the harvest. This work can be expanded into further to develop an app through which one would also know the remedy to a plant disease.

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