Detection and Classification of plant Diseases using Deep Learning Techniques

Dr DINESH KUMAR

M.Tech student, Department of Computer Science and Engineering

Bangalore Institute of Technology, Bangalore, Karnataka, India

PROF.MUSILEK

Associate Professor, Department of Computer Science and Engineering

Bangalore Institute of Technology, Bangalore, Karnataka, India

Abstract: **In agricultural sector disease infection to plants lead to loss of productivity and crop yield. If these diseases are identified at an early stage, the proper remedies can be taken against disease caused. For this purpose we can use machine learning approaches in order to detect and classify the various diseases. In our work we implement a Convolutional neural network for disease detection and classification, we have considered three crops that is potato, rice, bell pepper. In case of rice there is categories like Brown spot, Leaf blast, Hispa and healthy. In case of Bell pepper there is Bacterial spot and healthy. In case of potato there are Early blight, Late blight and healthy. The classification model initially make analysis of input leaf image and classify it into healthy or unhealthy, if it is healthy then crop name and its recognition that is as healthy is returned or if input image is unhealthy then crop name and its disease associated with it is returned. Initially the images are pre-processed to enhance the image quality. The dataset is split into train and test data respectively and train data is utilized to build the model. The trained CNN model is excepted to efficiently classify and recognize the crop name and affected disease to it after differentiating between healthy and unhealthy inputs.**

Keyword: crop disease, disease detection, leaf image, pre-processing, classification, Convolutional neural network, early stage disease detection.

I. INTRODUCTION

In agricultural sector the disease infection to crops leads to loss of productivity and quantity which effect financial aspects of farmers. As we know in India agriculture is major sector in building economy, so proper techniques in identifying diseases that are infected to plant is necessary. At early detection of disease infected to plant will help in increase its productivity and quantity. Deep learning techniques can be utilized for this essence. The traditional approaches require continues monitoring and observation it is time consuming. Therefore, machine learning approaches may help to classify and detect the various plant diseases.

At early stage if the disease infected is recognized then the proper remedies can be taken against it and save the plant status. This can be derived as help in green assistance. Which increases in overall quantity and productivity also yield of crops.

On this end, the crop's leaf images as per our considered requirement regarding three crops that is potato, rice and bell pepper are obtained from plant village dataset. The images are preprocessed to increase the image quality and brought into uniform size before it fit into model. There are so many classification techniques available, in this study we utilize Convolutional neural network as classification model. CNN is one of the popular techniques used for classification. CNN model is expected to classify and recognize the crop and the associated disease. The model

must recognize the healthy crop and unhealthy crop as well and also identify the disease associated with the unhealthy crop.

The crop may have multiple diseases infected to it. The model must be able to recognize each category of the infection affected along with the crop. In our case the crops chosen are rice, bell pepper, and potato. In case of rice we have considered categories like Brown spot, Leaf blast, Hispa and healthy. In case of Bell pepper the categories like Bacterial spot and healthy. In case of potato there are Early blight, Late blight and healthy. Model must analyze input image is healthy or not and detect each category of disease associated with the crops. To do so the multiple datasets of crop leaf images containing our requirement is used to train and build the model.

II. Literature Survey

R.Meena et al., [1] proposed the method where the raw Images of citrus leaves obtained is initially pre-processed and then subjected for segmentation. The segmentation of the diseased part is done using K-Means clustering. The Texture features are extracted using statistical Gray-Level Co-Occurrence Matrix (GLCM) features and for classification the support vector machine (SVM) is applied. The feature vector extracted are given as input to classifier. The performance of the SVM classifier is measured by comparing the predicted labels and the actual target values.

Sachin B et al., [2] proposed method deals with recognition and severity estimation of disease. The images are preprocessed with image resizing and thresholding. The color based segmentation technique based on incremental K-means clustering is applied to obtain the diseased region from image which is required region of interest. Texture features are extracted using GLCM method and color features are extracted from segmented diseased leaf region using RGB color space to form a feature vector. Then SVM and KNN classification techniques are applied, in experimental results says that SVM perform well when compared to KNN and SVM achieved more accuracy than KNN classifier, the proposed method deals in indentifying diseases from soybean crop which include classification and severity estimation.

Amrita S. Tulshan, et al., [3] proposed a plant leaf disease detection technique using K-Nearest Neighbour (KNN) classification to detect a disease from the input images. The RGB images are converted to gray scale also in this work, the region based k-mean segmentation technique is applied for image segmentation. Feature Extraction is done by gray level co-occurrence matrices (GLCM). This work is influenced classification task with K-Nearest Neighbour classifier.

Mrs. Shruthi U et al., [4] presented overview on the stages of general plant disease detection system and comparative study on machine learning classification techniques for plant disease detection. One major effect to low crop yield is disease caused by bacteria, virus and fungus. It can be prevented if disease is detected so that proper remedies and actions can be taken on disease caused. This study presented about the stages of general plant diseases detection system like image acquisition and preprocessing, feature extraction and finally classification. It also presented a comparative study on different machine learning classification techniques with respect to plant disease detection.

Sumair Aziz, et al., [5] this study presents computer vision framework for plant disease identification and classification. The proposed system extracts Local Tri-directional Patterns (LTriDP) from plant leaf images of different classes. LTriDP features efficiently extracts discriminant information and represent each class with reduced dimensions. The proposed framework is capable of extracting useful features from image and perform classification task through multiclass support vector machine.

Agrawal et al., [6] proposed a method initially the images before passing to a model is pre-processed to obtain the better results. Image Color Transform involves the HSI Color Model and LAB color space. This study used a K-means as a clustering Procedure for segmentation. This study considered crop that is grape for classification support vector machine is applied, this study aimed to provide an attempt for improvement in classifying the various plant leaf diseases.

III. Methodology

As shown in Figure 1, defines the architectural design of plant disease detection from leave images, the entire schema can be summarized in step by step process as follows:

Dataset: The crop images containing our requirement of various disease classes and healthy leave images are obtained with respect to rice, bell pepper and potato crops from plant village dataset in kaggle an online repository.

Pre-processing: Initially pre-processing is carried out for raw data before fitting it into model. Pre-processing is carried out in order to enhance the image quality required for further processing. All the images is brought into reduced uniform size.

Classification: The classification module includes building the CNN model which recognize crop is healthy or unhealthy and detect the associated diseases with unhealthy crops. This will have two phases that is training phase and testing phase. For this purpose Convolutional neural network is trained and tested with respect to considered crops that is potato, rice and bell pepper. At training phase the crop leave images obtained are used to train and build the CNN model. In testing phase the results are evaluated against the target data and validate its consistency and performance.

Detection and recognition: The model accepts the crop leave image as input and analyze it for further classification task. Using validation data in testing phase the trained CNN model is expected to classify healthy and unhealthy leave and recognize disease associated with unhealthy input image. The CNN model classify and recognize input crop name and disease infected to it.

User interface: To the user for easy communication with software an Graphical User Interface is developed where user can browse the files and upload input image view result and then exit. A GUI is a form of user interface that allows users to interact with electronic devices through graphical icons and elements. Using Tkinter we can create fast and easy way in building GUI application.

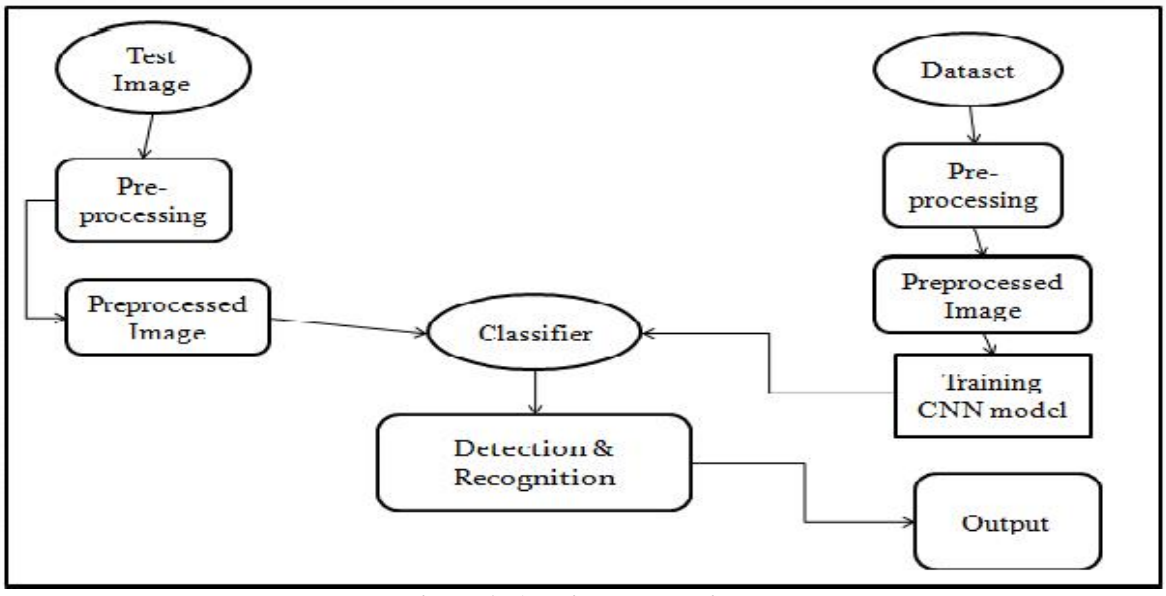

Figure 1: Architectural design.

The architectural design shows that after image acquisition the images in the dataset are pre-processed before fitting it to model. The preprocessing is a step which increases overall image quality. Pre-processed image is subjected to training the CNN model for classification, once the model is trained at evaluation phase the test image is pre-processed and given for detection and recognition. The user can upload the image and interact with sample GUI

created, user browse the image and submit to know the prediction value. The trained CNN classifier is able to classify between healthy and unhealthy input when it is found unhealthy, the crop and infected disease with it is recognized.

IV. Algorithm

In this project the Convolutional neural network (CNN) model will be trained and build for classification task. The considered crops are rice, potato and bell pepper. CNN model is expected to classify and recognize the crop and the associated disease. CNN is popular technique used in classification. There will be different convolution operations performed in several layers of the Deep CNN. They generate various representations of the training data when passed into layers it becomes more detailed in the deeper layers. These Convolutional layers are the fundamental building blocks in constituting the Deep CNN. At initial the Convolutional layers perform the task like feature extractation from the training data and this dimensionality is reduced using the pooling layers. The pooling layer conducts the down-sampling operation along the spatial dimensions. It supports reducing the number of parameters. Similar to the Convolutional Layer, the Pooling layer is responsible for reducing the spatial size of the Convolved Feature. This decrease and controls over-fitting and computational power required to process the data through dimensionality reduction. The activation function used in our case is ReLu which stands for Rectified Linear Unit. Another important layer is dropout, which refers to removing entities from the network. It is a regularization technique for reducing overfitting. Fully Connected Layers form the last few layers in the network. Dense or fully connected layer is the final layer responsible for predicting the class of an image. Training the model with train dataset and results will be evaluated against the target value using test dataset.

V. Experimental Process and Result

In agricultural sector the disease infection to crops will degrade the crops quality and productivity which effect in financial terms, so the proper machine learning approaches can be used to recognize and classify various diseases affected. We chosen three types of crops they are rice, bell pepper and potato. In case of rice there are Brown spot, Leaf blast, Hispa and healthy. In case of Bell pepper there are Bacterial spot and healthy. In case of potato there are Early blight, Late blight and healthy. The Convolutional neural network (CNN) model is trained for classifying the the multiple crops and the associated disease with it. The input crop is classified healthy or unhealthy if it is found unhealthy then the disease affected is recognized. For training the CNN model the crop leave images is obtained from plant village dataset. Initially these images are preprocessed before subjecting it to model, once the model is trained then the results are evaluated against target value to check its performance. Figure 2 shows the screenshot of user log in, where the options are like the user can choose the crop need to recognized and exit. The GUI (graphical user interface) is a form of user interface that allows users to interact with electronic devices through graphical icons and elements. The user can browse the input, select the input and submit to know the prediction.

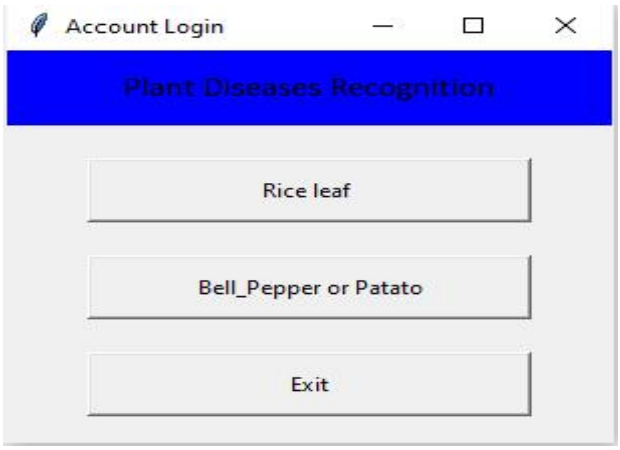

Figure 2: User login.

Once the user log in with any chosen crop then the following web page is displayed where there is an option for user to browse the input and predict the results as shown in figure 3.

Figure 3: Front web page

User can browse the input interested and subject the crop leave image as an input for prediction as shown in figure 4. Once the input is selected the user can choose the predict option to know the outcome result.

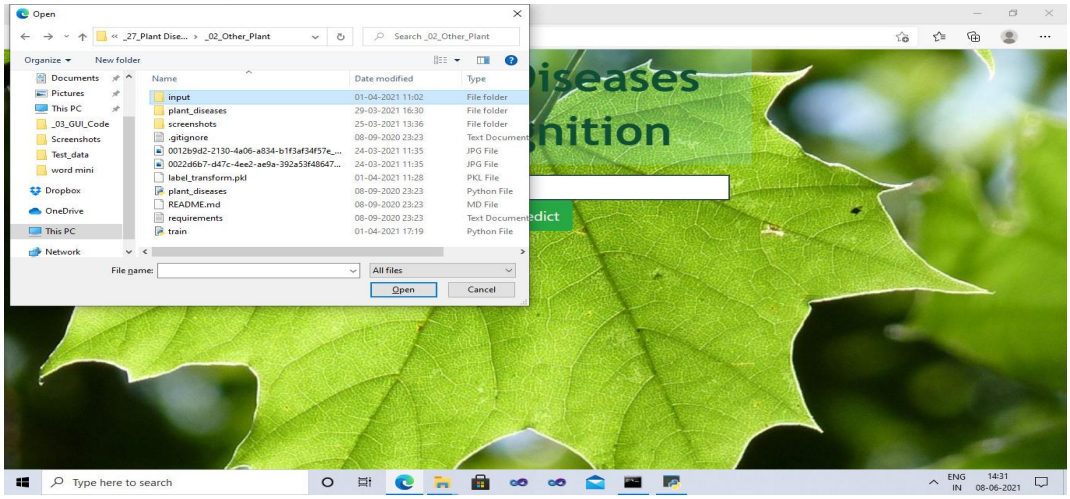

Figure 4: Browse input.

As shown in the figure 5, the results are presented to user view as follows, the CNN model analyse the input image then classify and be able to recognise the disease affected with crop. Similarly the results are obtained for the considered three type of crops rice, bell pepper and potato. In case of rice there is categories like Brown spot, Leaf blast, Hispa and healthy. In case of Bell pepper there are Bacterial spot and healthy. In case of potato there are Early blight, Late blight and healthy. Here figure 5 shows the result of pepper bell with bacterial spot.

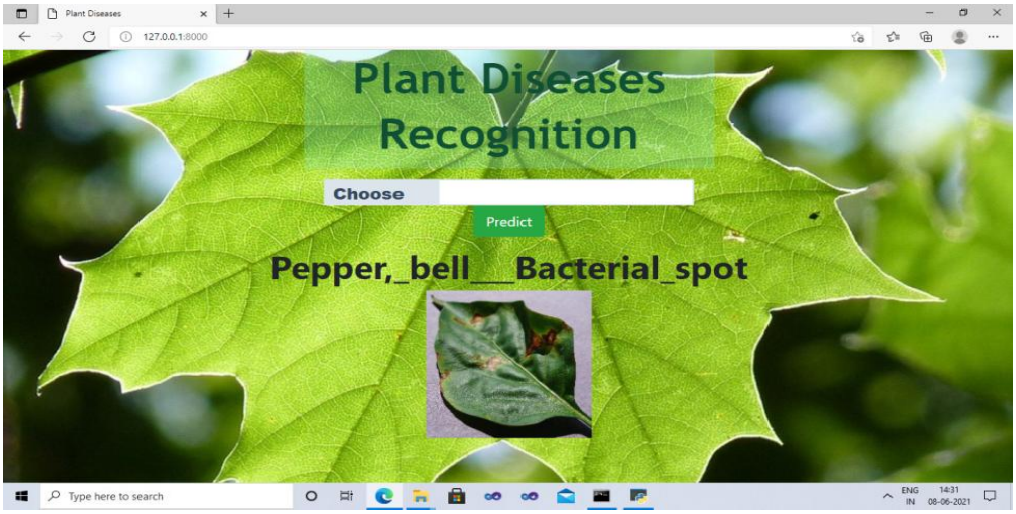

Figure 5: Result showing for pepper bell.

VI. Conclusion

The proposed model is efficiently able to recognize and classify the diseases affected to crops at early stage, with the use of deep learning technique. The disease infection to crops will degrade its quality and quantity, also crop yield it will eventually effect farmers so it is necessary to detect disease at an early stage. In this study, the crops chosen are rice, bell pepper, and potato. In case of rice there is categories like Brown spot, Leaf blast, Hispa and healthy. In case of Bell pepper there are Bacterial spot and healthy. In case of potato there are Early blight, Late blight and healthy. The dataset used is plantvillage dataset obtained from kaggale an online repository. The crop leaf images obtained are pre-processed before subjecting it into model. The Convolutional neural network (CNN) is used for classification, initially the input image is analysed whether it is healthy are diseased if it so diseased then the particular disease class affected as to be identified. For user interaction the GUI interface is developed for easy interaction. This can be derived as help in green assistance. In future work, the work can be extended by providing suggestions or proper remedies can be taken for disease caused after detection.

VII. References

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