An Automatic Plant Disease Detection System Using Deep Learning Technique

A. Mallikarjuna Reddy[1], Salma Samreen Shaik[2]
[1] Associate Professor, Computer Science and Engineering, Anurag University, Hyderabad
Email: mallikarjunreddycse@cvsr.ac.in
[2]M .Tech , Computer Science and Engineering , Anurag University, Hyderabad
Email: salmasamreen1890@gmail.com

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Abstract
Plant diseases generate significant losses in terms of productivity, economics, quality, and quantity of agricultural produce, among other things. The fact that the majority of the Indian population is reliant on agricultural output indicates that it is necessary to manage the loss caused by plant diseases. In order to prevent such illnesses, it is necessary to monitor the plants from the beginning of their life cycle. The usual form of supervision for this is by naked eye observation, which is more time-consuming and requires a high level of skill. As a result, in order to accelerate this procedure, we need an autonomous plant disease detection system that can both identify and deliver cures for infections. Beginning with the collection of photographs in order to establish a database, the necessary steps for putting this concept into action are laid out below. It is possible to do image preprocessing, which is used to load and train the datasets of an image, as well as classification by using Multi-class classification in Support Vector Machine (SVM), since this technique trains the samples of two or more classes in the same amount of time.KNN algorithm at the training phase just stores the data ,it will predict features and identify whether it is healthy or unhealthy .We build a model for CNN for detecting the disease through the datasets and compared the algorithms with CNN model to find out the algorithm performance of each algorithm. By training CNN model we obtain the train and validation accuracy and loss curves. The Experimental model show the accuracy of SVM with 94 %,KNN with 82% & CNN with 96 %.

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I. INTRODUCTION

India is an agrarian nation, and the agricultural industry accounts for a significant portion of the country's GDP. According to the most recent available data, Indian agriculture accounts for up to 16% of GDP and 10% of total exports. Approximately half of India's population is reliant on agriculture, either directly or indirectly, for their livelihood. It is thus necessary for the country's economy to grow that disease-free, high-quality agricultural output be produced. For decades, human beings have been responsible for diagnosing and treating illnesses. The process of recognising and diagnosing a problem is subjective, error-prone, expensive, and time-consuming to complete. In addition, new illnesses might emerge in previously undetected sick areas, increasing

the likelihood of disease spreading throughout the plant as a result of the occurrence of new diseases. As a result, an automated identification approach for plant disease detection is required to address this problem. A few machine learning procedures have gained valuable experience in the field of crop disease identification and diagnosis. These procedures include image segmentation (such as the clustering method, threshold method, and so on), feature extraction (such as shape, texture, and colour identification, among others), pattern recognition (such as the k-nearest neighbour method (KNN)), and back propagation neural network (BPNN), among others. In order to select and extract the visible pathological features, it is extremely difficult for a layperson to do so because it necessitates the use of highly skilled engineers and experienced experts. This is considered an expansive subject and results in a significant waste of manpower and financial resources. As an additional benefit of using deep learning methods, it is possible to automatically learn the deep characteristics of plants without the requirement for a human design process for feature extraction. A number of fields, including medical fields, autonomous cars, agriculture fields, natural language recognition, and others, have benefited from the deep learning method's good performance in the past. As this SVM model has one drawback, it takes only single class at a time and training phase will be slower, So to overcome this we use Multi class SVM, this model classifies two classes at a time which consume less time and training process will be faster.

The proposed approach, which is based on a significant breakthrough of CNN-based techniques in image classification, provides an image processing-based strategy that aids in the rapid recognition of plant illness and the recommendation of medicines to cure the condition. This model can also identify whether the plant is healthy or unhealthy one and gives efficient and accurate algorithm performances accuracies and trained the model to find out the Training and validation curves of both Accuracy & Loss. Classification method can be done by using Multi class classification in SVM approach. It can classify three types of diseases namely Apple-Black-Rot, Corn-Common Rust, Grape-Leaf-Blight .The Disease Detection steps followed by image processing , and classification which can be done by using SVM, after the classification process we undergoes Feature Extraction through images by using CNN, after extracting the features ,CNN model detect and identify the plant disease and KNN will maps the with the dataset and gives result ,to which plant disease it belong to.(E.g. whether its corn, grapes, apple). This model can easily identify the effected area of leaf and identifies the disease properly. It can rectify the problem very easily and with less cost.

II. RELATED WORK

In order to better understand plant leaf diseases, researchers performed a study of the literature on the subject. Among them are some of the pieces that are being shown here.

1.1 Deep Learning Based Identification

Shradha Verma.et.al. [1] Author identify and detect the disease of plant by using CNN that has been utilized for image classification. The author had implemented and trained five CNN models namely Inception Res Net v2, VGG 16,VGG 19, Res Net 50 xception, on plant village dataset for tomato leaf image. After comparing the model performance measures, Res Net50 proved to be the most accurate prediction tool. KR Aravind.et.al.[2] used to identify 10 different diseases in plants. pretrained VGG16 as the feature extractor and SVM were used to classify different eggplant diseases. Different color spaces RGB,HSV, YCbCr, and gray scale were used to evaluate

performance of accuracies; by using RGB images, the highest accuracy of 99.4% was achieved. K. Zhang.et.al.[3] based on deep weaving neural networks. The networks used are based on a pre-trained model from Alex Net, Google Net and Res Net.The performance of these networks using SGD and Adam optimization methods show that Res Net optimization using SGD has the highest accuracy of 96.51%.

1.2 Shape- and Texture-Based Identification

Chit Su Hlaing.et.al.[4] author classify plant disease using two different features: texture and colour. For this Scale invariant Feature Transform (SIFT) feature & Johnson SB distribution has been used to extract features. Nikos Petrellis.et.al.[5] author recognizes a disease based on symptoms.The images of infected plant parts, used for the extraction of variant features like area of the spots, colour histogram. The results show that the disease recognition can be achieved with accuracy between 80% and 90%.Chaitra K M.et.al.[6-10] author used Gray-Level Co-occurrence Matrix (GLCM) and EDGE detection for shape and texture features. SVM algorithm is used for image segmentation and classification technique for the detection of plant disease [11-16].

III. MATERIALS AND METHODS

We know that Deep learning is currently used in most common Image/face Recognition tools, Natural Language (NPL), Auto-encoders etc. As this image recognition required massive data storage ,the recognition techniques requires powerful data storage that may not be available to all uses, detection is vulnerable. In Auto-encoders are not much good at extracting the features of an images. As the complexity of the images increases, auto –encoders struggle to keep up and images start to get blurry.

As Deep Learning technique CNN are good at extracting the features of images without any human supervision. The role of Conv-Net is to reduce the images into a form which is easier to process, without losing of features which are critical for getting a good prediction. As this technique play a major role in predicting the diseases of plant, whenever we predicit more number of crops , we required more number of training sets this leads to a time consuming process so to overcome this we use Multi class classification in SVM which classify an instance as one of three classes[17-19] or more at a time which reduces the time consumption and obtains results as fast. This approach is quite flexiable, since the feature vector may contain less ,or different features, that helps in easily detecting the diseases.

A. Convolution Neural Network(CNN)

For the identification of a plant health whether the plant is healthy one or diseased one. To identify diseases of plants and suggest the pesticides for curing the diseases of plant. By using CNN model, the features are extracted easily and the main advantages i.e. it reduce the images into a form which is easier to process, without losing any features which are critical for getting a good prediction. It has the highest accuracy among all algorithms that helps in predicting of images. The image processing which is used for loading and training the datasets, after training the samples it undergoes Multi class classification in SVM for training two or more classes at a time. The diseases detection by using CNN , CNN model consists of layers like convolution, pooling, RELU ,fully connected layer which help to extract the features deeper [20,21]. As it contains more layers there is no loss of features while extraction, this features are helpful for plant disease detection. After

detection of diseases of plant the KNN algorithm at the training phase just stores the datasets and when it gets new data, then it classifies that data into a class which is similar to the new data. It will identify the plant is belongs to healthy class.By training CNN model we obtain algorithm performances and train & validation curves of both accuracy and loss curves.

B. Dataset Discussion

Two datasets are used to perform plant disease detection. One dataset for train and other for valid phase. First dataset consists of 6 classes and second one consists of 6 classes. Both databases contain more number of images of each plant.First dataset have total 1,1175 images and second dataset with 2794 images. For training CNN here we used dataset of plant with 37 classes. Description of these classes and dataset given in the following table.

class	Plant name	Healthy/Diseased	Disease Name	Image Number	Remedie
C_0	Apple	Healthy	-	2,008	Healthy Crop
C_1	Apple	Diseased	Apple_Black-rot	1,987	Burn/Bury them
C_2	Corn	Healthy	-	1,859	Healthy Crop
C_3	Corn	Diseased	Corn_Commonrust	1,907	Spray fungicides
C_4	Grape	Healthy	-	1,692	Healthy Crop
C_5	Grape	Diseased	Grape_leaf_blight	1,722	Dormant spray

By using this table we can knew the number of images in each classes. Most of these images belongs to Apple, Corn, Grape with healthy and diseased images along with remedies based on diseases.

C. Model Description

Firstly we apply pre processing on images which is used to load and format images before they undergoes training process. The image are reduced to 128 X 128 pixel size and undergoes feature extraction which train the images as (X_train,Y_train). The obtain training images, we build a model in which this images are trained with an algorithms and later it is for detection purpose. The trained images are classified by using Multi-class classification in Support Vector Machine (SVM) as it will classify into two group one is healthy class and diseased class, this SVM training algorithm train the samples two or more at a time which reduce training process time. KNN algorithm at the training phase just stores the datasets and when it gets new data, then it classifies that data into a category based on healthy or diseased ;if it is healthy KNN will give result as healthy crop; if it is diseased one CNN algorithm predict the diseases and provide remedies to it. Lastly we compare the algorithm performance to find out the accuracies between them and train CNN to find out accuracies and loss curvers.

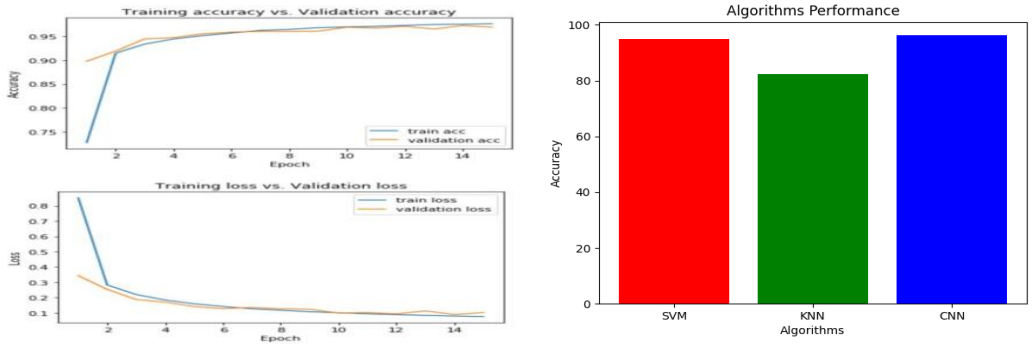
Training Parameters of CNN:

Parameters	Values
Epoches	5
INIT_LR(Learning Rate)	1e-3
Batch Size(Bs)	32
Activation in middle layer	Relu
Activation last layer	Softmax

At training phase we set activation function with Relu for not losing any data/features. The learning rate set to 1e-3 which help to tuning parameter with an algorithm. when we set Batch_size to 32 which is suitable for large datasets with epochs 5 we get the accuracies and loss curvers.

IV. Result and Discussion

This paper shows that the importance of plant disease detection in this days. This model is developed by using Deep Learning in Python.(11,175) images were used to test the accuracy of these model. The images are divided into 6 classes for train and testing phase. The images are at different rotation, folded , healthy and diseased one. This model gives us 96.24 % of accuracy based on images as well as it indicates that the leaf is healthy or diseased and suggest the remedies to it. The algorithm performance of SVM,KNN,CNN are showed by plotting a graph and training and validation accuracy graph can be generated by this model as given below:



V. Conclusion and Future Work

In this work, we have developed an efficient solution for automatic diseases identification based on CNNs. We have proposed a model which can identify diseases based on SVM ,CNN and KNN and can be used to classify images of grapes ,corn and apple into 6 classes, including 3 different symptoms images of Grape leaf blight, corn common rust and apple black rot and healthy images.The CNN model makes use of the combination of SVM and KNN, allowing it to learn more representative features than the SVM and KNN models alone. It is expected that the representational capabilities of the CNN model would improve the method of extracting features at a higher level, allowing it to achieve the highest performance in the identification of plant diseases. In the experiments, the findings show that our model outperforms the best basic CNNs available today, including SVMs, kernel neural networks (KNNs), CNN algorithms, and more. The proposed model has achieves an average accuracies of performance of algorithms with SVM accuracy 94 %, KNN with 82 % and CNN with 96 % as a result the CNN model get highest rate as compare to other algorithm in diseases detection. By using multi –class classification in SVM, the classification and training process can be done easily and quickly , it take two or more classes at a time. Image processing converts raw data into clean data, whenever the data is gathered from different sources. Classification will divide the model into two class train and validation which is later used for validation accuracy and loss curve. This support tool help the farmer to identify the health of plants and to identify the diseases of the plants.

VI. Future Work

Future work is that we can add some Audio Clip from GUI which helps farmer to decide the specific quantity for pesticides application , other one we can collect more data set to increase the performance of our model to classify the unseen images.

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