International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-9 Issue-1, May 2020

Deep Learning Model for Plant Disease Detection

D.Raghunath Kumar Babu, M.Chaithanya, M.Sandhya, G.Shireesha

Abstract: ***Food is one of the basic needs of human being. We know that the population is rising enormously.so it is more important to feed such a huge population. But nowadays plants are largely affected with various types of diseases. If proper care should not be taken then it will show effect on quality of food products, quantity and finally on productivity of crops.. so, Early detection of plant disease is very essential, but it is very hard to farmers to monitor the crops manually it takes more processing time, huge amount of work, expensive and need expertised persons. Automatic detection of plant diseases helps the farmers to monitor the large fields easily,because our approach of using convolution neural networks provides a chance to discover diseases at the very early stage. By using Image Processing and machine learning models we can detect the plant diseases automatically but the accuracy is very less, early detection is also a major challenge. With the modern advanced developments in deep learning, in our project we have implemented the convolution neural networks(CNN) which comprises of different layers,by using those layers we can automatically detect and classify the diseases present in the plants. High Classification accuracy and more processing speed are the main advantages of our approach. After training the model on color, grayscale and segmented datasets our deep learning model will be capable of classifying a large number of different diseases and our project gives us the name of the disease that the plant has with its confidence level and also provides remedies for corresponding diseases.***

Keywords : Deep Learning, Convolution Neural Network, Accuracy, Confidence,Image Processing

I. INTRODUCTION

In India, Mostly people depends on Agriculture for their survival. Farmers cultivate different types of crops. Major factors like soil conditions, climatic conditions, different types of diseases affect the crop productivity .In our project, we focused on the plant diseases to find them automatically at the earlier.

Manuscript received on April 02, 2020.
Revised Manuscript received on April 15, 2020.
Manuscript published on May 30, 2020.
* Correspondence Author
D.Raghunath Kumar Babu, Department Of CSE,JNTUACEP **Badvel**,India. raghunath.d29@gmail.com
M.Chaithanya, Department Of CSE,JNTUACEP, Madanapalle,India. chaithanyamodem@gmail.com
M.Sandhya, Department Of CSE,JNTUACEP, Nellore,India. marellasandhya13@gmail.com
G.Shireesha, Department Of CSE,JNTUACEP, Jammalamadugu,Indiasirireddy2662@gmail.com

Detection of diseases through naked eye observation is also possible but it needs more man power, costly equipment and more time. Some diseases have symptoms which are easily identified by farmers and act properly. Most of the diseases requires trained professionals to detect the disease. Some diseases do not show the symptoms at the earlier. If proper care is not taken at the early stage, It affects the entire crop.

Through Manual detection sometimes there is a chance of improper detection of disease which may be lead to inexperienced pesticide usage causes reduction in the ability of the crops to resist against the diseases.

To overcome all these problems, various automatic approaches are used for fast and accurate detection of the diseases present in plants. Many approaches have been used previously, Commonly used approaches are K-Means clustering ,Support vector machines along with the techniques of Image processing. The method used in our project is a different technique in plant disease detection by using the convolutional neural network algorithm and fit accurately to the database which consists of different plant's leaves that were collected from fields for various plant diseases.There are many convolutional neural networks models like GoogleNet,AlexNet,VGG16 etc.Among them vgg16 gives the better results.so in our project we used the vGG16 model to increase the accuracy.

II. LITERATURE SURVEY

Implementing the suitable management approaches like Application of fungicides,chemical applications for a specific disease,pesticide application leads to early gathering of information,based on that we can estimate the crop health and easily detect the disease. There is a lot of research that has made in the area of detection of plant diseases.After extracting the features of shape and texture,by passing those features as input to CNN model,we can easily detect the disease.

[1] Bodhe and Patil used the approach of threshold segmentation to detect the disease in sugarcane leaves.

[2] Kumar and Patilenvironment used another method for detecting the diseases in plants by using features of texture like inertia and correlation find by measuring the gray level cooccurrence matrix on the image.

[3] R.N.kadu et al Rmade a research for detecting the leaf diseases by using Otsu threshold and Support Vector Machine(SVM).In that research, Contrast adjustment is done in the preprocessing phase, later images of RGB were converted to YCbCr. Otsu threshold was used to separate the affected part of the leaf from the healthy part. Features were extracted from the textual features. Finally the obtained features were given as input to the SVM algorithm.

[4] A model for detecting the grape leaf disease was proposed by using K-means algorithm.The proposed model consists of three parts.they are segmentation,Features Extraction and finally grape leaf disease detection.

[5] Godliver o womugisha, John A Quin ernest Mwebaze and James lwasa proposed Automated Computer vision Based Techniques to detect Banana Bacterial wilt disease and Black sigatoka Disease.They used the techniques of Decision tree,nearest neighbours,Randomized tree naivebayes and SV Classifier,Among the above techniques,randomized trees gave the better results,provide information to work in a flexible environment with the application.

III. PROPOSED SYSTEM

K-Means clustering for plant disease detection is very time consuming process and the accuracy is also very less.The Main disadvantage of Support Vector Machine is it is too hard to decide optimal parameters from the information obtained after training if they should not be divisible linearly.So accurate prediction is not possible.In our project,we use the convolution neural networks for fast and accurate disease detection.

OBJECTIVES

Our Main Objective is to reduce the attack of pests by using appropriate pesticides and remedies for those attacks.We can decrease the size of the images by using suitable size reduction techniques and make sure that the quality is not compromised to a large extent.We can improve the projects of the previous mentioned authors by increasing the accuracy and also by providing the remedy to the disease.Along with these Objectives,disease detection using CNN is very time saving method.The budget of this model is somewhat high for small scale farming but it will be more useful in large scale farming.

The main objectives are:

1)To design the model that can detect the disease accurately and provide remedy for the corresponding disease.

2)Create a database of pesticides for respective diseases.

3)To Obtain more accuracy compared to the methods used earlier.

IV. METHODOLOGY

A. Dataset Description:

Images used in our project were acquired from the dataset of Plant Village.

This dataset has leaf images of both healthy and infected plants divided into 38 class labels (54,300 images, 25 diseases, 13 crop species). If we are using convolution neural network algorithm , we need three different datasets to build our model.

Initially we train the dataset , which includes the gathering of images to be given to the network as input, using those images our model will automatically find the parameters like weights and biases which were hidden.

Then we validate the dataset ,which is needed to analyse the parameters manually, because those were not automatically learned during training.

Finally we train our dataset, which is used after the training for finding the model's final accuracy.

In our project, we use three separate versions of the entire dataset .First of all we work with the color images, then made experiments with the gray-scale images. finally works with the segmented images.

Diseases of different plants :

- Apple Scab
- Cherry healthy
- Corn_(maize)_Cercospora_leaf_spot
- Grape Black Rot
- Peach bacterial spot
- Potato early blight
- Blueberry healthy
- Tomato early blight
- Tomato bacterial spot

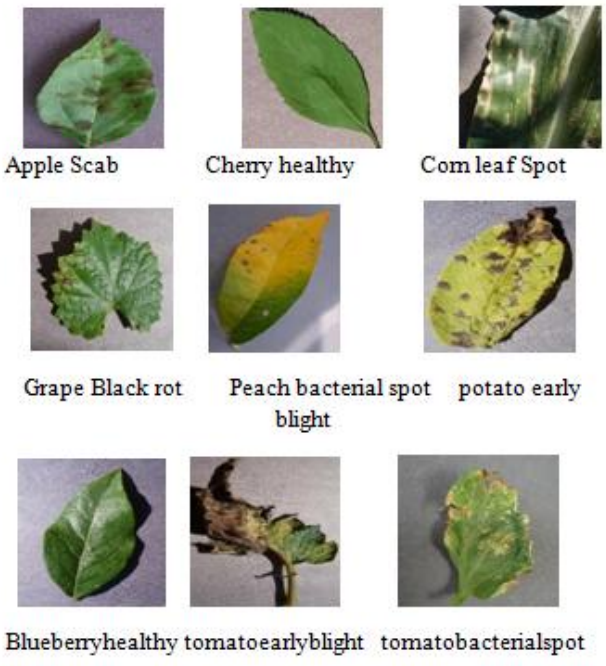


Fig-1: Leaves of different Plants

B. Architecture

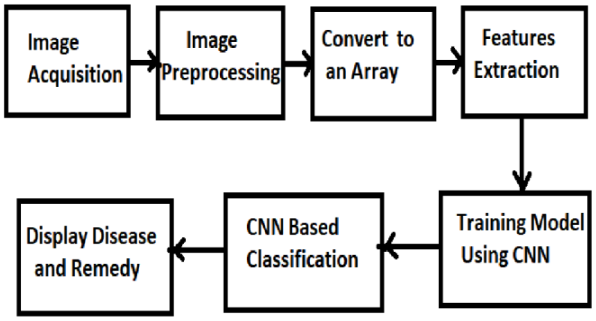


Fig-2: System Architecture

1. Image Acquisition

Initial process is to collect the data from the repository.It takes the Image as Input for further processing.

2. Image Preprocessing

Images collected from real fields were in different sizes.If we want to get the better featuresusing feature extraction method, leaf images which we take as input for deep neural network classifier were cleaned by using preprocessing techniques for better results

In our project we collect some images from the real field. They may have dust, water spots, notion etc. These are all considered as noise. The main aim of preprocessing is to remove the noise in the images by adjusting the pixel values so that we increases the quality of the image. In image preprocessing we crop the leaf images by making the square shape around the leaves for the sake of highlight the part of the leaf which was infected.

While gathering the leaf images, images with smaller resolution were not considered in to the dataset, only the leaf images having higher resolution were treated as valid images. Images in the dataset were mimimized to 256 x 256 size to decrease the time needed to train the model,which was by automatically enumerated by python by utilising OpenCV framework

3. Converting the Image to an Array

When we read in digital images using the library, they are represented as Numpy arrays.The Array Representation has pixel values as Numpy matrix which can be used as features for any machine learning Algorithm.with Numpy we can make blazing fast operations on numerical arrays, no matter which dimension,shape etc they are.

4. Features Extraction

Extracting the features is the method of reducing the dimensions,as a result the original data is minimised to different groups for further Analysis.It is the very important step to accurately predict the infected region of the leaf.

Here we extract the shape and textual features. The shape oriented features are Eccentricity, S0licity, Perimeter, Area etc.. Similarly the Texture oriented

features are Contrast, Correlation, Energy, Homogeneity, Mean etc..

Features extraction is more useful when you want to decrease the requirement of resources for further processing without fail of accessing important or essential data.

V.IMPLEMENTATION

In our project,we proposed a CNN model, through which we got the accuracy greater than 93% for 13 different plant species. We have used Tensorflow and Keras as backend and front-end to train our CNN model.CNN is an artificial neural network deep learning algorithm.

For Pre-processing compared with other classification algorithms it takes less time.Mainly it is very useful for Computer Vision,Image Pre-processing problems.It gives high accuracy for predicting the objects in images.

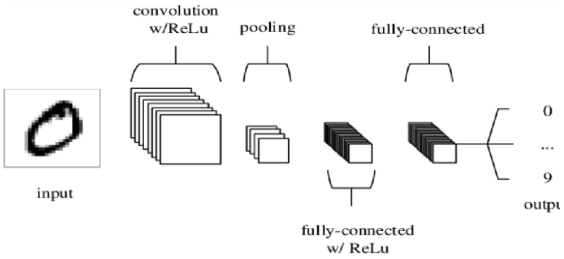


Fig-3:Architecture Of CNN

We are creating the CNN network to identify the infected parts of the leaves from the leaf images.We used Tensor Flow which is used to create the sequential model for our network.

CNN has many layers like A Convolution layer, A MaxPooling layer, A Fully Connected Layer,A Flatten layer,A Softmax layer.

Convolution layer- This layer takes leaf images as input and applies m number of n*n filters to obtain a feature map.

MaxPooling layer – It is used for the purpose of reducing dimensions of the image i.e it takes the required features from the feature map which is given by the Convolution layer and reduces the obtained size by eliminating unwanted features.

Fully Connected layer- It is used to give the output based on the features given by the pooling layer.It also classifies the images into the labels.

Flatten layer – It applies the Flatten function to convert the pooled feature map to a single column which is then passed to the fully connected layer to predict the output.

Softmax layer- It applies a Softmax function to the input. It allows the neural network to run the Multiclass function.

VI.RESULT ANALYSIS

After converting the image to array we get the output like this.

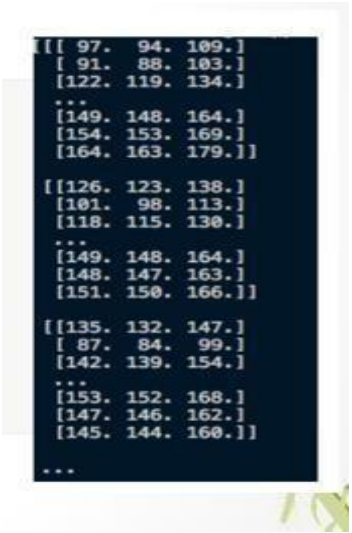


Fig-4:Array representation of images

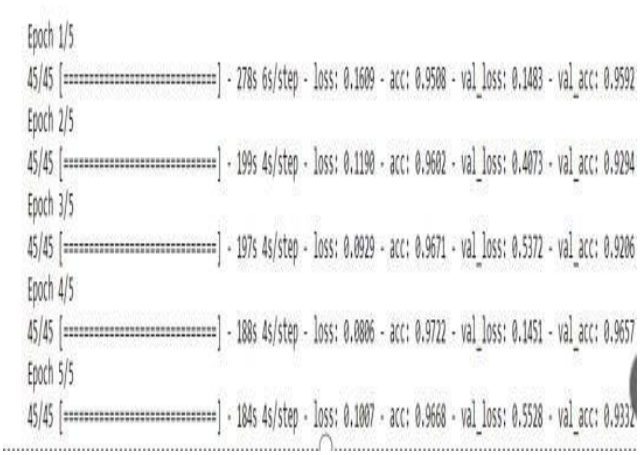


Fig-5: Epoch Data for further Analysis

The above figure shows the data collected by using the history object.We can use this data to create plots.
The following table shows the accuracy and loss values.

EPOCH	LOSS	ACCURACY	VAL_LOSS	VAL_ACC
1	0.1609	0.9508	0.1483	0.9592
2	0.1190	0.9602	0.4073	0.9294
3	0.0929	0.9671	0.5372	0.9206
4	0.0806	0.9722	0.1451	0.9657
5	0.1007	0.9668	0.5528	0.9332

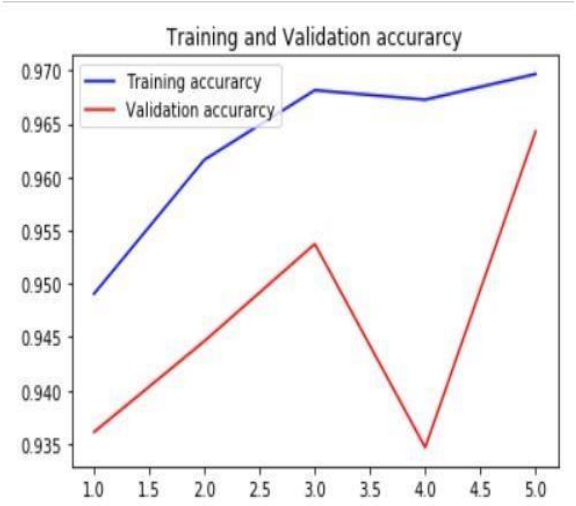


Fig-6:Plot of Accuracy

From the above accuracy plot,we can see that in our model,training accuracy increases as the number of epochs increases.At first validation accuracy increases then decreases and finally increases.

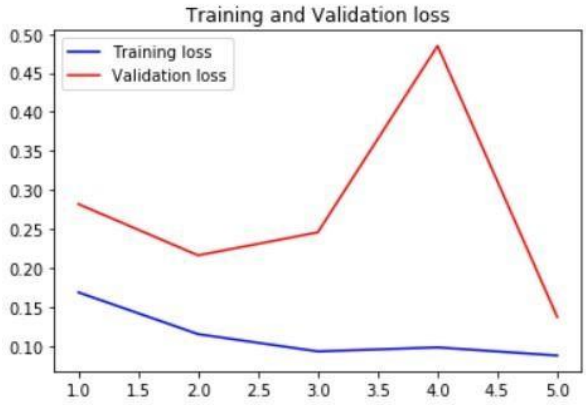


Fig-7: Plot of Loss

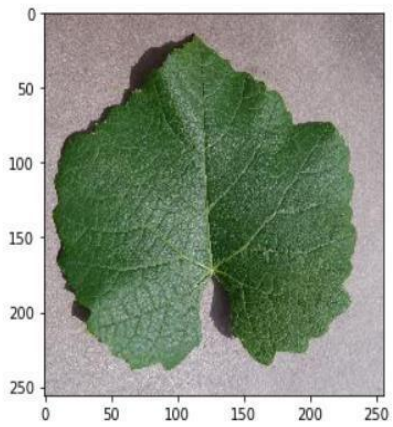
From the plot of training and validation loss we can see that the model has better performance on both the train and validation datasets.
By Using the CNN algorithm we got the accuracy of 93% compared to previous algorithms like SVM,random forests,K-means,CNN is the best algorithm,which gives the more accuracy.

```
[INFO] Calculating model accuracy
364/364 [==============================] - 39s 108ms/step
Test Accuracy: 96.42857175606949
```

Fig-8:Model Accuracy

Finally we predict the disease and display with the image.

```
Out[24]: (('Potato___healthy', 0.24588805437088013),
          <matplotlib.image.AxesImage at 0x1b9edf9ee88>)
```



VII. CONCLUSION

There are many methods for automatically finding the disease of plant through Image processing,computer vision and segmentation methods by giving the leaf image as input ,but still ,there are some drawbacks in this area. In this paper, for automatically finding the diseases of plants from images of leaves ,we proposed an approach of convolution neural networks.

The complete procedure was explained clearly, from image gathering for training the whole data and validate the trained data to image preprocessing for cleaning the data and features extraction and at last trained deep CNN model. In order to find the accuracy level of our newly proposed model we performed many tests.We got the final accuracy of 96.3% for our trained model.

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AUTHORS PROFILE

D.Raghunath Kumar Babu, Assistant Professor (Adhoc), Department. of Computer Science and Engineering, JNTUACEP. Specialized in Computer Networks and Artificial Intelligence.

M.Chaithanya, Student, Department Of Computer Science and Engineering, IV B.Tech

M.Sandhya, Student, Department Of Computer Science and Engineering, IV B.Tech

G.Shireesha, Student, Department Of Computer Science and Engineering, IV B.Tech