2022 International Conference on Computer Communication and Informatics (ICCCI -2022), Jan. 25-27, 2022, Coimbatore, INDIA

PLANT DISEASE DETECTION USING CONVOLUTION NEURAL NETWORK

M.Shobana[1]
Assistant Professor
Dept of CSE
SNS College of Tech
Coimbatore,India

Vaishnavi S[2]
Assistant Professor
Dept of IT
Sri Ramakrishna Engineering College
Coimbatore,India

Gokul Prasad C[3]
Assistant professor
Dept of ECE
SNS College of Engg
Coimbatore,India

Pranava Kailash SP[4]
III year CSE
SNS College of Tech
Coimbatore,India

Madhumitha K P[5]
III year CSE
SNS College of Tech
Coimbatore,India

Nitheesh C[6]
III year CSE
SNS College of Tech
Coimbatore,India

Kumaresan N[7]
Associate Professor
Dept of ECE
Sri Sakthi Institute of Engineering
Coimbatore, India

Abstract - **Agriculture is the backbone of civilization. It has equal importance like the technological growth. Major challenge in agriculture is prevent the plant from getting diseases by insects and natural enemies of plants. Till date man has to see in his naked eye to verify the integrity of the plant by himself. Modern age technologies and advancements in Data Science industry has brought us many way to know whether the plant is Diseased or not. CNN (Convolution Neural Network) is one of the methods to detect whether the plant has a particular disease by taking a picture of the plant leaves and feeding it to a model to know the results. Using CNN the disease in the plants is identified and has proven the results are 86% correct. There are various other methods to find the same but we try to simplify the process of the same.**

Keywords: ANN, CNN, Deep Learning, Machine Learning, Data Science, Image processing

I. INTRODUCTION

India a very vast country and 70 % people here depend on the agricultural job. Farmers have a wide range of options to choosing appropriate crisp and insecticides. Disease in plants here is very common and frequent. Modern Technology has made it possible to produce abundant of food in a short span of time for the masses. The same technology has given us a way to automate to see whether the plant is infected with a disease or not. That can save us a lot of time and effort that humans put into the soil. This plant disease detection can be done using image recognition methods that have been into the technological markets recently. This study provides an overview of the image processing techniques for detecting plant diseases.

Deep learning is a simple but complex process to understand, but we are trying it to keep that same as simple as possible to the farmers who are willing to use the same. Deep learning is a particular kind of machine learning that achieves great power and flexibility by learning to represent the world as a nested hierarchy of concepts, with each concept defined in relation to simpler concepts, and more abstract representations computed in terms of less abstract ones. In human brain approximately there are 100 billion neurons, all together this is a picture of an individual neuron and each neuron is connected through thousands of their neighbours. The question here is, how it recreates these neurons in a computer. So, it creates an artificial structure called an artificial neural net where we have nodes or neurons.

It has some neurons for input value and some for output value and in between, there may be lots of neurons interconnected in the hidden layer.

Smartphones are the way to reach even a simple person on earth as every individual possesses the same. Through this method, new farmers into the field of farming can identify the disease easily without the knowledge of it.

II. RELATED WORK

There are many ways to do the recognition, RNA method, the ANN method, Alex Net, Google Net, SFLA-PCNN which helps in identification of plant disease.Many researchers worked on potato crops diseases but also trained the models on a specific dataset Plan Village.

978-1-6654-8035-2/22/$31.00 ©2022 IEEE

2022 International Conference on Computer Communication and Informatics (ICCCI) | 978-1-6654-8035-2/22/$31.00 ©2022 IEEE | DOI: 10.1109/ICCCI54379.2022.9740975

Khalifa et al. used the CNN model for identifying the late blight and early blight infection in the plants. The data set was considered from the plant village where a particular regions crop was taken into account.

Rozaqi and Sunyoto used CNN model to distinguish the early blight and late blight infection of potato, and a fit class. They trained the model on the Plant Village dataset to detect the diseases of a specific region. Sanjeev et al. proposed a Feed-Forward Neural Network (FFNN) to notice early blight, late blight infections beside with healthy leaves. The proposed method was trained and tested on the Plant Village dataset.

Narendran pal and Lalji Prasad used CNN in identifying the disease in rice plant. The dataset from kaggle with 1000 samples was considered as leaf-blast and healthy and trained using the RGB model. The 80 percentage of data was used for training and 20 percentage was used in testing and results shows a predictive accuracy of 99.6%. The future plan is to use the auto-encoder to improve the accuracy level in detecting the plant disease.

Konstantinos P Ferentinos has presented the concepts of several deep learning techniques in spotting the disease in plants. 87,848 images of plants which encompasses of 25 plant species is considered here which is taken in both cultivation field and laboratory conditions are considered and tested. It is proven that CNN is giving a high performance rate in diagnosis of plant disease.

Serawork Wallelign et al, used the CNN with three layers in detecting the disease present in soybean plant. They took up around 13,000 samples of 4 different classes including the healthy leaves and made produced around classification accuracy of 99%. The images considered were taken in uncontrolled environmental situations. From this it is clear that CNN could classify the healthy leaves of the plant from a set of unhealthy leaves by extracting the major features of the leaf exactly.

Shruthi et al, has reviewed various machine learning algorithms that could be used in the plant disease detection. The machine learning algorithm considered for review process is: SVM classifier, ANN classifier, CNN classifier, Fuzzy classifier and Deep learning. From the review conducted on several algorithms it is clear from those results shown that CNN gives a better performance when compared to the other algorithms in detecting the disease in plants among the consideration of multiple plants. The results generated have proven that CNN provides more accuracy.

Thus from the survey made through several research articles it shows CNN performs better in many scenarios than other techniques. Thus have considered CNN in identifying the plant disease in three group of plants namely: potato, tomato and pepper bell. Have downloaded dataset from “Plant village dataset” of Kaggle.

III.CONVOLUTION NEURAL NETWORK IN IDENTIFYING PLANT DISEASE

CNN is a deep learning algorithm which practices the image and recognizes the innumerable constraints in it to categorize the leaves of the plants and therefore distinguish whether the plant is affected or not. This method can handle the images of resolution 256x256. This is a basic CNN model with very minimal number of nodes which requires very less computation power to find the result. The images can be of any category like apple orange potato tomato grape etc., but must be of size 256x256 so that the processing can be done fast enough for the user to get the results. Figure 3.1 gives the categories of tomato leaves. This will help in detecting the affected plants easily when the training is done.

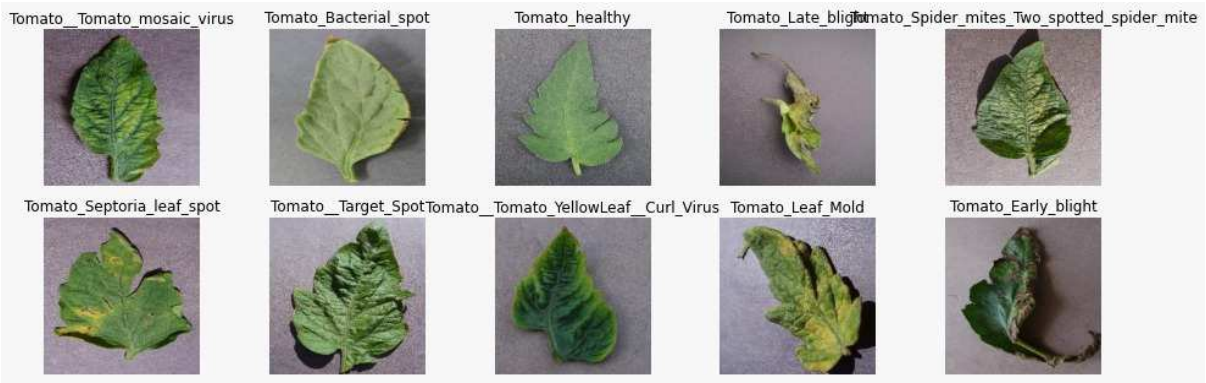


Figure 1: Tomato plant leaves

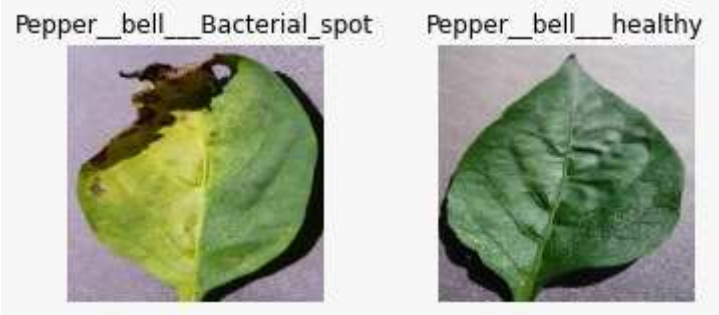


Figure 2: pepper bell plant leaves

Figure.3: Potato plant leaves

Figure 3.2 and 3.3 gives how the leaf will be in pepper bell and potato plants during various situations respectively.

A. PRE PROCESSING OF THE IMAGE

- First the collected images are segregated into their categories i.e. Whether they are in health condition or not, what kind of disease it has been affected with , in their respective folders
- Then if the image are not in a proper resolution as the model expects, they are resized in their respective folders
- For labels , we convert the categorical data i.e. name of the disease , to a numerical data for the model to understand

B.CONVERTING IT INTO ARRAYS OF NUMBERS

- Since DL model understands only numbers , the images are converted into RGB arrays of 0 to 255 shades of color
- After conversion these arrays are stored in the RAM temporally for immediate usage

Data has been split always into 20 % for test and 80 % for train set. Before we start to train our CNN algorithm, we do need to create the framework i.e. the model layers.

We generally did two set of layers test:

- With 1 2D Convolution , 1 Max_pooling 2D , 1 Flattern and 1 Dense Layer
- With 2 2D Convolution , 2 Max_pooling 2D , 1 Flattern and 2 Dense Layer

The results of these layers will be given below in training of model and also conclusions

The activation function that we used here was ReLu , which is commonly used by every DL Engineer. For the 2nd set we used both ReLu and Softmax functions as our activation functions

After deciding the model layers, we started to compile the model, the first model had no much of a callback function or it can be said that there were no conditions given to the callbacks to improve the model further.

```
model.summary()

Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 62, 62, 16)        448
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 31, 31, 16)        0
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 29, 29, 16)        2320
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 14, 14, 16)        0
_________________________________________________________________
flatten (Flatten)            (None, 3136)              0
_________________________________________________________________
dense (Dense)                (None, 64)                200768
_________________________________________________________________
dense_1 (Dense)              (None, 15)                975
=================================================================
Total params: 204,511
Trainable params: 204,511
Non-trainable params: 0
_________________________________________________________________
```

Figure 4 : Predefining Model

C.TRAINING OF MODEL

After all the pre-processing and the model layer selection, we started to train the model to get our results. The train went on with 20 epoch with batch size of 16 in it, The validation set used here was the test set which has been previously undergone the pre-processing and spilt from the train set.

- The model with the First set of specification gave us a accuracy if 0.63 which is 63% accuracy

- The model with the Second set of specification gave us an accuracy of 0.95 which is 95% of accuracy

We also did a random state split test, which we didn't mention the random split state which affected the results a bit by 3.5% accuracy difference , still model with second set of specification gave us 94.7% accuracy. In train set we were able to to get about 91 % accuracy, without complexion our layers. We also hit the over fitting spots occasionally as we had less amount of data to be feed in, but we are confident that this model would perform better.

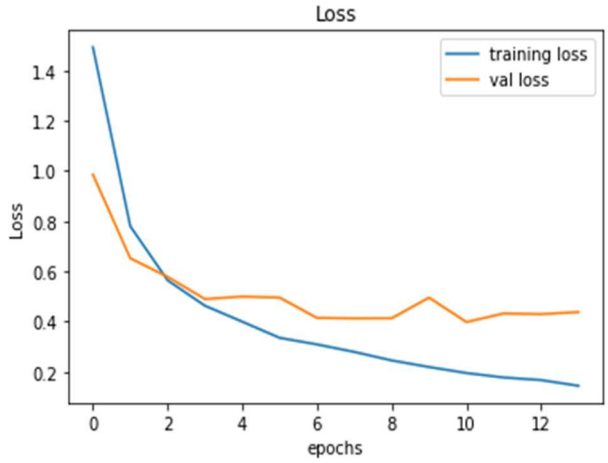


Figure 5 Training and Validation Loss

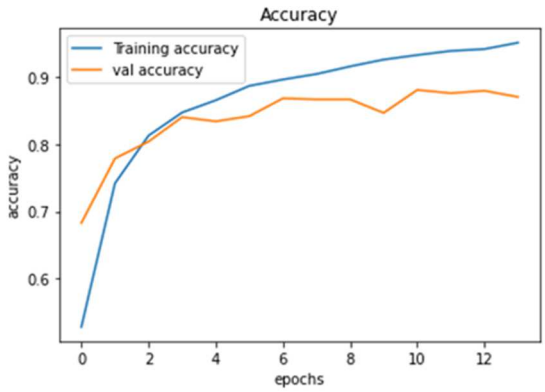
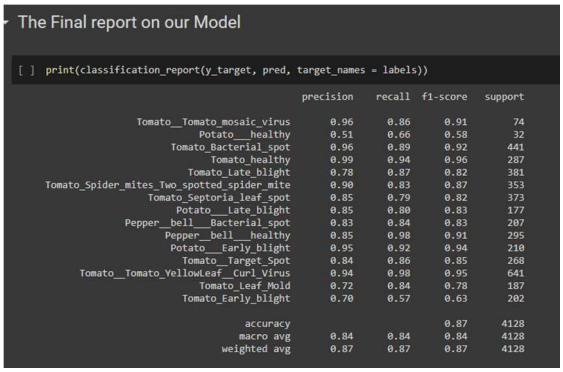


Figure 6: Training and Validation Accuracy

The above graphs in the figure 3.3.1 and 3.3.2 gives a clear view of decrease in loss and increase in accuracy which depicts that the model is trained better.

IV.RESULTS

- The model with the First set of specification gave us a accuracy if 0.74 which is 74% accuracy
- The model with the Second set of specification gave us an accuracy of 0.95 which is 95% of accuracy
- Overall Average accuracy with this simple model is 0.87 which is 87 % after several randomizing of pictures
- For the sake of simplicity, we have taken CNN as our primary method to get most out of the dataset that we have downloaded. All the other methods are very very efficient and accurate, but ours is simple and accurate and efficient enough to work with a smartphone or a cloud server.


The Final report on our Model

```
[ ] print(classification_report(y_target, pred, target_names = labels))
```

	precision	recall	f1-score	support
Tomato__Tomato_mosaic_virus	0.96	0.86	0.91	74
Potato___healthy	0.51	0.66	0.58	32
Tomato_Bacterial_spot	0.96	0.89	0.92	441
Tomato_healthy	0.99	0.94	0.96	287
Tomato_Late_blight	0.78	0.87	0.82	381
Tomato_Spider_mites_Two_spotted_spider_mite	0.90	0.83	0.87	353
Tomato_Septoria_leaf_spot	0.85	0.79	0.82	373
Potato___Late_blight	0.85	0.80	0.83	177
Pepper__bell___Bacterial_spot	0.83	0.84	0.83	207
Pepper__bell___healthy	0.85	0.98	0.91	295
Potato__Early_blight	0.95	0.92	0.94	210
Tomato__Target_Spot	0.84	0.86	0.85	268
Tomato__Tomato_YellowLeaf__Curl_Virus	0.94	0.98	0.95	641
Tomato_Leaf_Mold	0.72	0.84	0.78	187
Tomato_Early_blight	0.70	0.57	0.63	202
accuracy			0.87	4128
macro avg	0.84	0.84	0.84	4128
weighted avg	0.87	0.87	0.87	4128

Figure 7: Results

All the above has been achieved by kaggle dataset and some helpful papers and codes.

V. CONCLUSION

CNN is a model which was used to train the 3 class of plant species such as potato, tomato and pepper bell. It is shown from the results that the accuracy is better than the other existing techniques. As a future enhancement, this model can be converted into a pickle file and be using or integrated into a mobile application which would be useful, also keeping it simple. Our goal is to keep it simple and efficient as possible. We would also import even more dataset into this model to improve the classification of the model. Also if the algorithm needs a shift of layers it would be done.

REFERENCES

[1] Acharjya D, Anitha A (2017) A comparative study of statistical and rough computing models in predictive data analysis. Int J Ambient Comput Intell (IJACI)

[2] Konstantinos P Ferentinos, "Deep learning models for plant disease detection and diagnosis", Elsevier, 2017.

[3] Manogaran G, Lopez D (2017) Disease surveillance system for big climate data processing and dengue transmission. Int J Ambient Comput Intell (IJACI)

[4] Narendra Pal Singh Rathore and Lalji Prasad, "Automatic Rice Plant Disease Recognition and Identification using Convolution Neural Network", Journal of critical reviews, Volume 7, No.15,2020.

[5] Pragati pukkela and Surekha Borra, 'Machine Learning Based plant Leaf Disease Detection and Severity Assessment Techniques: State-of-the-Art", Springer,2018.

[6] Prasad S, Kumar PS, Ghosh D (2017) An efficient low vision plant leaf shape identification system for smart phones. Multimedia Tools Appl 76(5):6915–6939

[7] Serawork Wallelign, Mihai Polceanu, Cedric Buche, "Soybean Plant Disease Identification using Convolution Neural Network", Association for the Advancement of Artificial intelligence, 2018.

[8] Sharma K, Virmani J (2017) A Decision Support System for Classification of Normal and Medical Renal Disease Using Ultrasound Images: A Decision Support System for Medical Renal Diseases. Int J Ambient Comput Intell (IJACI) 8(2):52–69

[9] Shruthi U, Nagaveni V, Raghavendra B K, "A review on Machine Learning Classification Techniques for Plant Disease Detection", IEEE, 2019.

[10] Vaishnavi S, Shobana M, Sabitha R, Karthik S, "Agricultural Crop Recommendations based on Productivity and Season", IEEE, 2021.