JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

LEAF DISEASE DETECTION AND CLASSIFICATION USING CONVOLUTIONAL NEURAL NETWORK

Aashritha H.H
Information Science and engineering
Jyothy Institute of Technology
Bangalore, India
Email: raoaashritha27@gmail.com

Bhoomika B.V
Information Science and engineering
Jyothy Institute of Technology
Bangalore, India
Email: bhoomikabv2k@gmail.com

Chitrashree P
Information Science and engineering
Jyothy Institute of Technology
Bangalore, India
Email: chitrashree1011@gmail.com

Rachana A
Information Science and engineering
Jyothy Institute of Technology
Bangalore, India
Email: rachanaanandaraju30@gmail.com

Prof. Rakshatha S
Information Science and engineering
Jyothy Institute of Technology
Bangalore, India
Email: rakshatha.s@jyothyit.ac.in

Abstract:

When plants are infected it affects the crop yield and It is important to detect the disease at an early stage for effective crop yield. The different types of diseases like bacterial, fungal, Septoria, leaf mold and viral diseases affect the crop quality of tomatoes. Usually farmers observe the plants and identify diseases alternatively we can use Automatic methods for classification of plant diseases which helps in taking action after detecting the symptoms of leaf diseases. In this paper we present a Convolutional Neural Network (CNN) model algorithm-based method for tomato leaf disease detection and classification. The dataset contains 2500 images of tomato leaves with 5 symptoms of diseases. We have modeled a CNN for automatic feature extraction and classification. Color information is actively used for plant leaf disease researches. In our model, the filters are applied to three channels based on RGB components.
The experimental results validate that the proposed method effectively recognizes 5 different types of tomato leaf diseases.

***Index Terms*: CNN, early stage, automatic feature extraction, classification, leaf disease.**

I. INTRODUCTION

Agriculture plays a very important role in the development of economic and ecological infrastructure of our country. It is one of the main sources of income in some parts of the country. As the farmers in rural regions dedicate their whole life in producing the yield throughout the year. The whole of the population either depends on this directly or indirectly. Consumption of products derived from agriculture is being consumed at a large rate and because of this the production of these products must also be done in large scale. One of the major challenges that the farmers in the rural places face during cultivation is that of the cultivation which are infected by certain diseases. Crop diseases can affect and damage the balance of the ecology as well as the economy. Diseases can be of many types such as viral, bacteria, fungi infections which can be caused by insects or any other aspect of nature. These need to classified properly so as to get the proper remedies and get better and faster yield. These crop diseases reduce the quality of the yield and might sometimes destroy the whole cultivation. Plants nowadays are affected by many diseases such as they cause devastating economic, social and ecological losses and many more. Also, to identify the disease of the plant farmers have to take the sample to the designated labs. The amount of money and resources spent to set up these labs is not economically viable, and those resources could be better used to make other investments to improve the yield. In this era of modern technologies, there are various ways to overcome this problem. Machine learning in this field plays a very important role in developing these technologies for plant disease detection and diagnosis. Different algorithms can be used for different approaches such as support vector machine (SVM), K-Means method, Artificial Neural Networks, etc. Recently there has also been use digital image processing for the detection of diseases since it is not possible for the human eye to identify the disease extent accurately. In this paper we mainly use convolutional Neural Networks (CNN) to develop a technology that can detect what type of disease the crop has and gives out remedies related to that particular disease using datasets. CNNs also help in efficient image processing as kernels take much less space compared to feedforward layers. Many variations in occurrences can be seen in multiple CNN architectures. The rest of the paper is divided into many sections and each of this section explains the workflow of the process of the study. Section II consists of related work

that is done in this particular study. Section III consists of the methodology which is used to solve the problem. Section IV deals with the testing of the model and the results obtained for the same. Finally, the results are concluded with comparison of different models.

II. RELATED WORKS

This paper presents the various methods that can be utilized for identifying the plant leaf disease. Omkar Kulkarni in his research work has used Deep Convolutional Neural Network to classify the crop species and identify the diseases on them. He tested that methodology on five different classes of crops and three types of diseases for each class of crop. According to his experiment, the inception V3 model performed better than the Mobile Net model in terms of accuracy [1].

In paper [2], KNN classifier is used over SVM classifier to make an improvement in the existing classification technique for plant leaf disease detection. The algorithm was tested on five different diseases on plants which resulted in improved accuracy than the existing system.

Convolutional Neural Network has played a vital role in performing tasks related to image processing. In paper [3], visual transformers are used for performing tasks related to computer vision. The Small Transformer Network (STN) has been used in the application as it requires a model suitable for minimal resources. This paper proves that other than CNN, visual transformers is the next best thing.

In paper [4], Deep learning techniques is used on sufficient amount of dataset for recognizing the leaf disease with high accuracy, this main idea is to use huge amount of dataset with high variability, data augmentation and visualization of CNN which improves the classification accuracy. And also, the paper tells the importance of hyper-spectral imaging for detection of plant disease at an early stage.

In this paper [5] a system is proposed that identifies disease in grape leaves using global thresholding technique and semi supervised learning technique. The texture and color features of the diseased part are identified and trained using different classifiers.
Global thresholding technique and semi supervised learning technique are the two methods used in the process of identification of the diseased region from the segmented leaf's section. Texture and color features are extracted from the diseased section and are trained using classifiers later the results are compared.

In paper [6], Random Forest classifier is used to train the model using images of papaya leaves. The RGB images are converted to gray scale to calculate Hu moments shape descriptor features over a single channel. Then the histogram of the image is calculated by converting the RGB image to an HSV image.
In paper [7], an artificial intelligence technique for detecting plant disease has been presented, it uses Convolutional Neural network for classification purpose. They have built a system that uses image processing technique along with k means clustering.

In paper [8], a tomato leaf disease detection and classification method has been presented based on Convolutional Neural Network with Learning Vector Quantization algorithm.
This paper tells us how using advanced technologies and algorithms like ReLu, one can detect and analyze any sort of diseases at the early stages of spreading of the infection. By doing so and following the right remedies given by these technologies and algorithms, we can overcome this problem.

In paper [9], this system is mainly proposed to improve the efficiency of automatic plant disease detection. The results show that the system successfully identify and classify the disease with the accuracy of 98.2%. As the training data is increased, the accuracy will be high.

This paper [10], identifies and detects 10 different diseases of the tomato leaf. This method uses convolutional neural network for classification of tomato leaf diseases from the dataset. In this architecture, convolutional network with minimum number of layers for classification of tomato leaf diseases into 10 different classes is used. This method gives us an accuracy of 94 to 95% in detection of leaf diseases.

In paper [11], they have concentrated on the part where plants which are infected by diseases can be easily identified by advanced image processing. They have further explained how different types of image processing can be used to help the farmers identify the diseases in the early stages of the infection. These could be identified and classified by processing it in different phases.

III. METHODOLGY

A. Describing the Datasets

The dataset used in this study are the image which contains different variety of leaves with different varieties of diseases infected to them. This contains 5 classes of plant diseases including the healthy leaves and is classified into training and testing. Images of the following datasets aims to investigate the effect that image size comparing it that the performance of the actual model.

B. CNN Algorithm Approach

In CNN approach by default of transfer learning, except for the last two layers al other layers are frozen. By applying CNN to the TensorFlow library we are just importing the functions for pooling and convolution. New weights are contained in this to the specific plant disease. Freezing allows these layers to be trained separately. We are also importing fully connected and regression. We load the data and reshape the given data from here. We have started by building the convolution neural network starting with the input.
In the next phase we can see 2 layers of convolution and pooling. To this we add a fully connected network layer. For the output layer we use an activation function that predicts the probability distribution of the diseases. That is SoftMax which has the ability to classify multiple classes. The model is created and then finally trained. The model is then saved and is ready for set up (.load) method restore the weights hence the model should have the same layers and neurons. Finally, this model is deployed to create a web application.

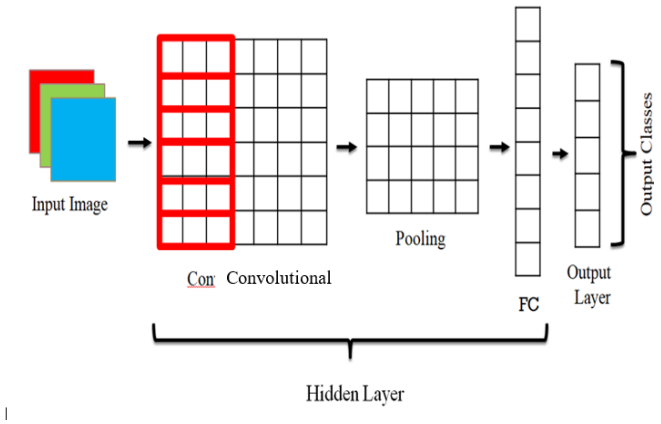

Figure 1.Typical CNN architecture

C. Results

Detection and identification have been made easy by using convolution Neural Networks. Since the accuracy is high and allows the model to work more efficiently. Hence the main objective of this module to identify the type of a particular disease and provide the related remedy to overcome this problem diseases. The approximation of the accuracy lies between 95%and 97% (~97.5%).

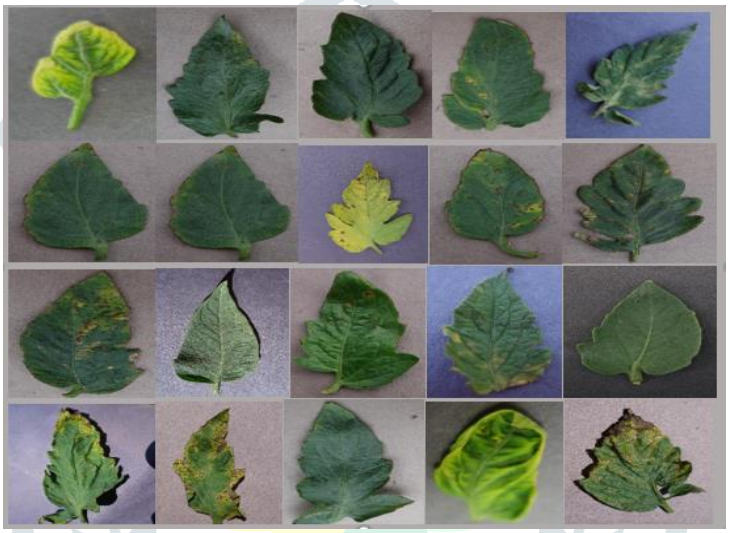

Figure.1. Dataset of leaves

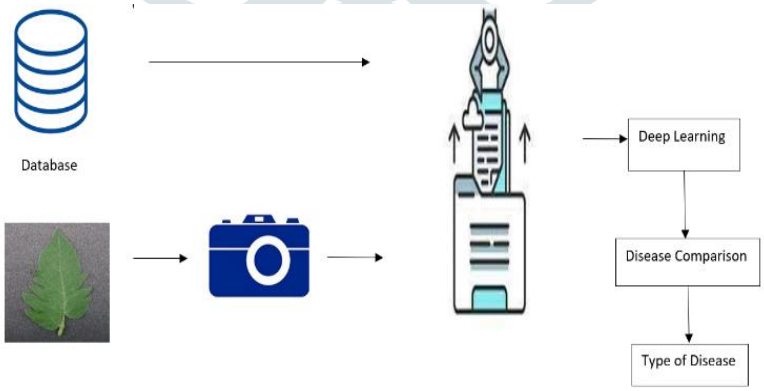

Figure.2. Model Overview

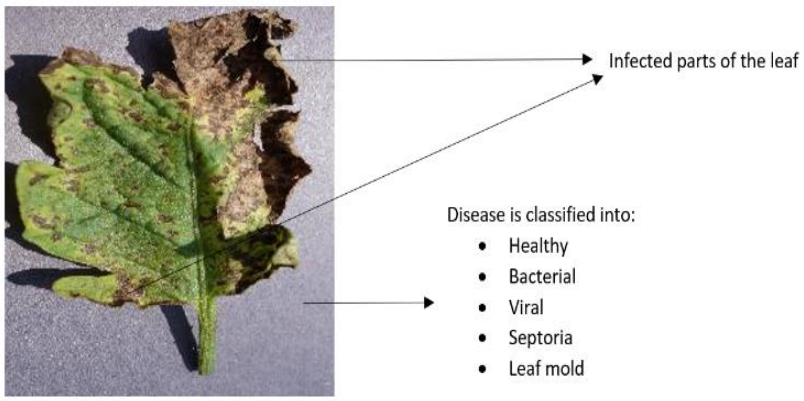

Figure.3. Types of Diseases

Table.1. Batch size vs Accuracy

Batch Size	Accuracy (%)	Loss Value
4	94.03	0.49
8	95.22	0.49
16	97.31	0.36
32	97.61	0.35
64	97.01	0.37

IV. CONCLUSION

Optimisation of the model is done using the suitable image size. This model focuses on how an original image from a given dataset and the reshaped data set used to predict pattern of diseases using convolution neural network model. This model helps the farmers know about the type of diseases the yield has been infected with and also gives out remedies depending on the type of diseases. Since there are many crops grown throughout the year, it helps the farmers to categorise and help in improving the cultivation of crop. The main objective of this study was to identify the crop diseases and classify them accordingly which is achieved at the end of the study.

V. REFERENCES

1. Kulkarni, Omkar (2018). [IEEE 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA) - Pune, India (2018.8.16-2018.8.18)] 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA) - Crop Disease Detection Using Deep Learning. , (), 1–4. doi:10.1109/ICCUBEA.2018.8697390
2. Tulshan, Amrita S.; Raul, Nataasha (2019). [IEEE 2019 10th International Conference on Computing, Communication and Networking Technologies (ICCCNT) - Kanpur, India (2019.7.6-2019.7.8)] 2019 10th International Conference on Computing, Communication and Networking Technologies (ICCCNT) - Plant Leaf Disease Detection using Machine Learning. , (), 1–6. doi:10.1109/ICCCNT45670.2019.8944556
3. Hirani, E., Magotra, V., Jain, J., & Bide, P. (2021). Plant Disease Detection Using Deep Learning. 2021 6th International Conference for Convergence in Technology (I2CT). doi:10.1109/i2ct51068.2021.941791
4. Li, L., Zhang, S., & Wang, B. (2021). Plant Disease Detection and Classification by Deep Learning—A Review. IEEE Access, 9, 56683–56698. doi:10.1109/access.2021.3069646
5. Jaisakthi, S.M.; Mirunalini, P.; Thenmozhi, D.; Vatsala, (2019). [IEEE 2019 International Conference on Computational Intelligence in Data Science (ICCIDS) - Chennai, India (2019.2.21-2019.2.23)] 2019 International Conference on Computational Intelligence in Data Science (ICCIDS)
6. Maniyath, S. R., P V, V., M, N., R, P., N, P. B., N, S., & Hebbar, R. (2018). Plant Disease Detection Using Machine Learning. 2018 International Conference on Design Innovations for 3Cs Compute Communicate Control (ICDI3C). doi:10.1109/icdi3c.2018.00017
7. Sharma, Pushkara; Hans, Pankaj; Gupta, Subhash Chand (2020). *[IEEE 2020 10th International Conference on Cloud Computing, Data Science & Engineering (Confluence) - Noida, India (2020.1.29-2020.1.31)] 2020 10th International Conference on Cloud Computing, Data Science & Engineering (Confluence) - Classification of Plant Leaf Diseases Using Machine Learning and Image Preprocessing Techniques., (), 480–484.* doi:10.1109/Confluence47617.2020.9057889
8. Sardogan, Melike; Tuncer, Adem; Ozen, Yunus (2018). *[IEEE 2018 3rd International Conference on Computer Science and Engineering (UBMK) - Sarajevo, Bosnia and Herzegovina (2018.9.20-2018.9.23)] 2018 3rd International Conference on Computer Science and Engineering (UBMK) - Plant Leaf Disease Detection and Classification Based on CNN with LVQ Algorithm., (), 382–385.* doi:10.1109/UBMK.2018.8566635
9. Jasim, Marwan Adnan; AL-Tuwaijari, Jamal Mustafa (2020). *[IEEE 2020 International Conference on Computer Science and Software Engineering (CSASE) - Duhok, Iraq (2020.4.16-2020.4.18)] 2020 International Conference on Computer Science and Software Engineering (CSASE) - Plant Leaf Diseases Detection and Classification Using Image Processing and Deep Learning Techniques. , (), 259–265.* doi:10.1109/CSASE48920.2020.9142097

10. Tm, Prajwala; Pranathi, Alla; SaiAshritha, Kandiraju; Chittaragi, Nagaratna B.; Koolagudi, Shashidhar G. (2018). *[IEEE 2018 Eleventh International Conference on Contemporary Computing (IC3) - Noida, India (2018.8.2-2018.8.4)] 2018 Eleventh International Conference on Contemporary Computing (IC3) - Tomato Leaf Disease Detection Using Convolutional Neural Networks., (), 1–5.* doi:10.1109/IC3.2018.8530532
11. Ahmad Supian, Muzaiyanah Binti; Madzin, Hizmawati; Albahari, Elmaliana (2019). *[IEEE 2019 2nd International Conference on Applied Engineering (ICAE) - Batam, Indonesia (2019.10.2-2019.10.3)] 2019 2nd International Conference on Applied Engineering (ICAE) - Plant Disease Detection and Classification Using Image Processing Techniques: a review. , (), 1–4.* doi:10.1109/ICAE47758.2019.9221712