Sooty Mould Mango Disease Identification Using Deep Learning

Priyadharshini M. K, R. Sivakami, M.Janani

Abstract: ***In India, half of the population depends on agriculture to lead their life. Our country is the largest producer of Mangoes. The scientific name of the plant is Mangiferae. Mango plants are affected by the fungus and pests which reduces the quality and quantity of the product. Already farmers are suffering from lot many problems and we have to support them to improve their economy. Our project aims to increase the mango fruit productivity by controlling the plant disease by early identification through deep learning. We have taken a major disease that affects the mango plant in Tamil Nadu- Sooty Mould In places like Dharmapuri and Triuvallur as the varieties of Mangoes such as Neelum, Alphonso, Bangalora are mostly affected by this disease and the yield drops out. Plants infected by Sooty Mould have a velvety coating over the leaves. It is due to the honey dew secretions. The insects stick to leaf surface and lead to fungal growth. But no direct damage is done by the fungus. The photosynthetic activity is affected adversely due to the blockage of stomata. We propose a solution for detection and classification of plant leaf disease in early stage itself. Deep learning constitutes a modern technique for image processing and data analysis. Deep learning technique has lot of applications in agricultural domain. The Deep Learning methodology, CNN model is developed to perform plant disease detection from leaves images.***

Keywords: ***Deep Learning, CNN, Machine Learning, Agriculture, Sooty Mould, Mango.***

I. INTRODUCTION

Deep learning is a class of machine learning algorithm; it has multiple layers of processing units and feature extraction. Deep learning model is an artificial neural network. In deep learning each layer will take input from the previous layer. In image recognition, the input image will be processed in the matrix using the pixel. There are different forms of Neural Network: CNN, ANN, and Feed forward Neural Network (FNN). We have chosen CNN for this project. Convolution Neural Network is used to study the image in depth like how the pixels are arranged. The several layers of Convolution Neural Network are convolution layer, pooling layer and fully connected layer. Neural Network involves trial and error process. It needs large amount of data to train the network. The ratio of the training and testing phase will be 80:20. The training set should be large compared to testing to obtain maximum accuracy. CNN model works similar to the human brain.

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Priyadharshini M. K, PG Scholar, Department of CSE, Sona College of Technology, Salem

R. Sivakami, Associate Prof, Department of CSE, Sona College of Technology, Salem

M.Janani, Asst.Prof, Department of CSE, Sona College of Technology, Salem

A. Convolution Layer

The convolution layer in the Convolution Network will do most of the computation work. The image will be the input to the convolution layer; it will convert the image into matrix form based on the pixel value of the leaves. In this layer there is a filter, at the top left corner move around the image, it will multiply the filter with the pixel value. After sliding the filter overall we will obtain an activation map. The activation map is the input to the next layer of Convolution Neural Network.

B. Pooling Layer

Pooling layer will do the process called as Dimensionality Reduction, which means reducing the size of the images can increase the computational complexity. It controls the over fitting.

There are different types of pooling such as max pooling and average Pooling. Max pooling operation will choose the maximum value in the filter matrix. Max pooling has the translational invariance. The term translational invariance means that it will work based on the feature extraction, the feature is presented exactly or rather.

Average Pooling is known as sub sampling. The sub sampling helps with the over fitting of the data.

C. Fully Connected Layer

In fully connected layer, the neuron in one layer will connect to neuron in other layer. This layer will be same as the traditional multi perception layer.

D. Mango Diseases

The Scientific name of the mango is Mangiferae indica. India is the number 1 country in the world. It reaches 50% of the global supply. In Tamil Nadu major mango growing districts are Dharmapuri, Krishnagiri, Vellore and Theni. The window planting is prone to wind, it reduces the effect and damage caused by the pest and disease. The planting is done during the July to December. The important pests are hopper mealy bug and fruit fly. The following table summarizes the major diseases affecting mango in this region.

Table. 1 Major Diseases affecting Mango

S.NO	Disease Name	Mode of Attack	Symptoms	Control
1.	Sooty Mould	Pest	Black velvety coating	Spraying Phosphamidon 40 SL @ 2 ml/ litre
2	Mango Hopper	Pest	MaliolaMangiferae	Phosphamidon-neem oil
3	Powdery Mildew	Fungus	White superficial powdery fungal growth on leaves	Chemical spray during the flowering time and favourable weather
4	Anthracnose	Fungus	Produces leaf spot, blossom blight Black spots develop on panicles' as well as on fruits	Sprayed twice with Bavistin (0.1%),Spraying of copper fungicides(0.3%)
5	Phoma Blight	Fungus	Dark margins and dull grey necrotic centre	Spraying Bavistyl (0.2%)+0.3% Milton (Copper Oxychloride + Zineb) at 20 day interval.
6	Red Rust	Algae	Rusty red spots mainly on leves	Three sprays of copper oxychloride(0.3%)
7	Die Back	Pathogens	It is evident by discoloration and darkening of the bark	Spraying Copper Oxychloride (0.3%)
8	Bacterial Canker	Bacteria	Lesions are light yellow in colour, patches with dark brown colour.	Steptocycline (0.01%) or Agrimycin-100 (0.01%) at 10 days interval.

The major disease affecting mango in this region is Sooty Mould. The scientific name of this disease is Meliola mangiferae. The disease is common where mealy bug and hopper are not controlled. The disease is recognizes by the velvety coating. When the presence of mould coating is over the surface of twigs and leaves, then the entire tree will be completely infected and will be black. It is due to the Honey dew Secretions. The insects will be stick to leaf surface and lead to the fungal growth. But no direct damage is done by the fungus. The photosynthetic activity will be adversely affected due to the blockage of stomata.

II. RELATED WORK

There are few works done already related to the project. In the paper authored by Ferentinos (2018), the methods to identify plant diseases from leaf are discussed and also how the Convolution Neural Network is used to identify whether the leaves are affected are healthy one is presented. By using 25 different distinct plants, they trained the network to classify the plants with success rate of 99.53%.They also use 2 different types of CNN models such as VGG and AlexNet and compare the success rate. In which VGG provide the high accuracy. Kaur(2018) has proposed a survey on plant disease identification and classification through leaf images. This paper gives information about how the plants are affected by the bacterial, fungal and viral diseases. They mainly focus on spots, mildew and rust. In this paper they also discuss about the performance of the classifier such as random forest tree, feature based, Naive Bayes, probabilistic neural network, k-nearest neighbor classifier. Beyene (2018) has proposed a survey on plant disease prediction using Image processing and machine learning by using various Machine Learning technique such as Convolutional Neural Network, Artificial Neural Network, K Nearest Neighbour algorithm to classify the images whether they are affected or not. Fuentes (2017) used a Convolutional Neural Network model for identification of diseases in the tomato leaves caused by the pest for various distinct species. Kamloris (2017) research works (17 papers, 42%) use popular CNN architectures such as AlexNet, VGG16 and Inception-ResNet. 14 papers has developed their own CNN model, 2 papers adopted a first-order Differential Recurrent Neural Networks (DRNN) model, 5 papers preferred to use a Long Short-Term Memory (LSTM) model in one paper used deep belief networks (DBN) and one paper employed a hybrid of PCA with auto-encoders (AE).

Pujari (2017) presents a study on the image processing techniques used to identify and classify fungal disease symptoms affected on different agriculture or horticulture corps. The average classification accuracy is 91.37% and 86.71% for GLCM and GLRM features. The classification accuracies of over 83.17% are obtained using Mahalanobis distance classier and 86.48% are obtained using PNN classifier. The classification algorithm for cereals plant disease will be HIS, CCM.SVM, the accuracies of over 85, 33% are obtained using HIS color feature. They propose architecture to identify the disease as early as possible using GSM, to remotely monitor the plants. Singh (2017) presents an image segmentation technique to identify the disease using the Machine vision technique. The classification is done through the Minimum Distance Criterion with K-Mean clustering has efficiency of 93.6% but the classification using the SVM will provide accuracy of 95.71%. Kim(2017) presents basic Machine vision system consist of camera, a host computer with image acquisition board and lightening system. The host computer board communicate with the PCI bus at a speed of 132Mbytes/sec.

III. DISEASE DETECTION USING DEEP LEARNING

Plant disease identification through the human eye is based on the visible symptoms on the leaves. The disease will affect the quality and quantity of the products. If we use Convolution Neural Network model can able to identify the disease in the early stage, so that we can be able to prevent the disease from spreading into other parts of the tree. We proposed an architecture that will process the Mango leaves using the CNN model .We train the model using the images which are publically available and with the PLANT VILLAGE, LEAF SNAP and also with real images. If we train the model with the high number of images then the test accuracy will increase. The model will give the output that the leaf is healthier or diseased one. If the leaf is diseased then it will provide disease name and the controlling tips.

A. System Overview

The input to the system is the image of width and height with the colour channels. The CONV layer computes the output and the computation is the dot product between the weight of 3*3 matrix moving from the top left corner to the full matrix and the image size is reduced. The weights are used to extract the feature from the images. As a result of the Convolution layer we get the feature maps. The output of the CONV is the input of the next layer.

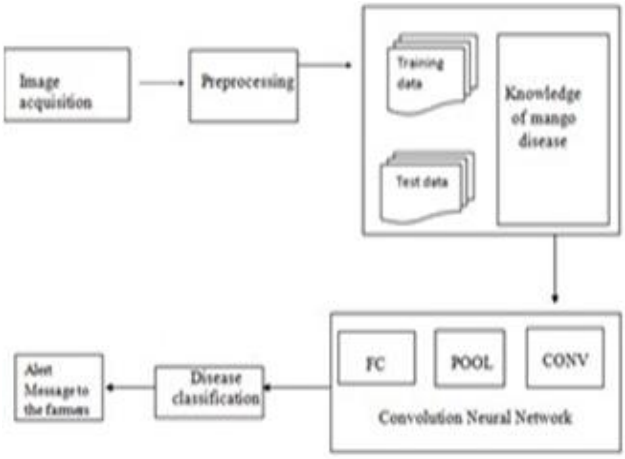


Fig. 1 System Architecture

RELU is known as Rectified Linear Unit, the activation function will take place where we will break the linearity of the images. The formula will be written as f(x)= max(0,x)

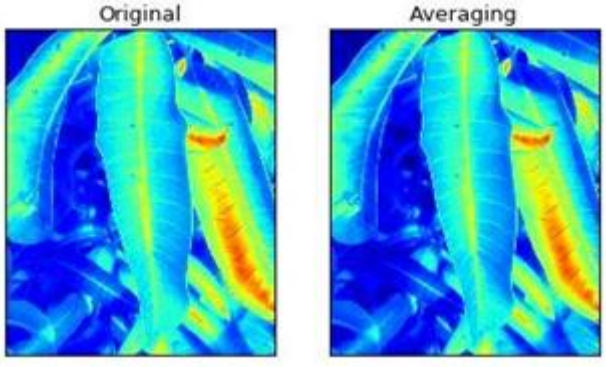
POOL layer performs the sampling. The main advantage of the pooling layer is Dimensionality reduction. It provides the network with spatial invariance. The pooling process will end with the feature map. Before it is given to the FC layer the feature map is flattened.

FC layer provides the output based on the classification using the features. The output size is based on 3 parameters such as filters, stride and padding. The spatial size is calculated as ([W-F+2P]/S)

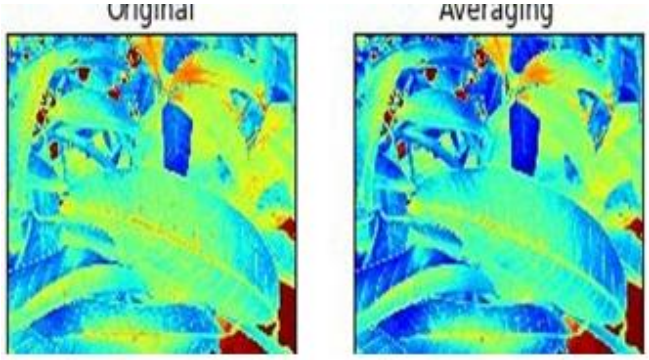
B. Implementation Details

The tool used for implementation is Anaconda Navigator. Anaconda Navigator is a desktop Graphical User Interface (GUI), that allows you to launch applications and easily manage packages, environments without using command-line-commands. Spyder is a powerful scientific environment written in python, we use python version 3.4.

Sample Screenshot



Sample 1



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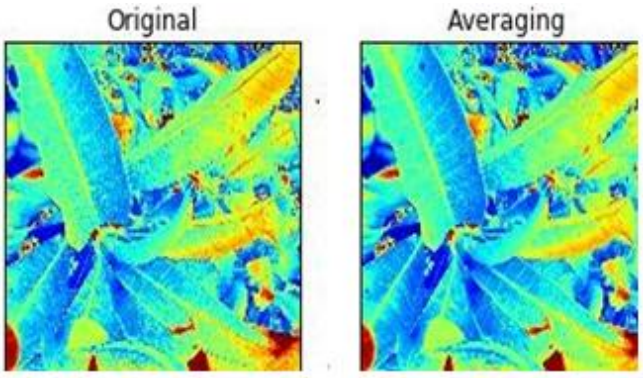
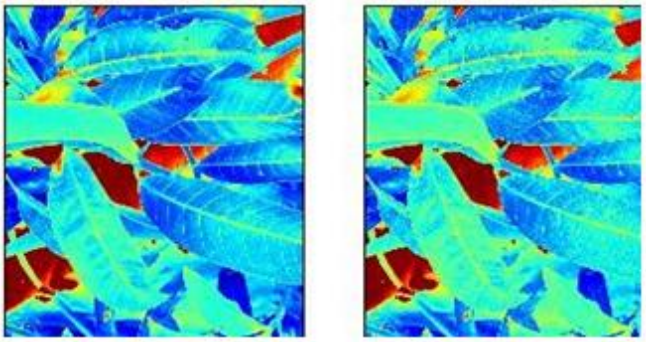


Sample 3



Sample 4

C. Performance Evaluation

The Performance are measured based on their accuracy, precision, recall, throughput and speed rate. The Accuracy of finding the disease is high when the quality of the images is high. Based on the clarity of the images the accuracy differs.

IV. CONCLUSION

In this we have developed a Convolution Neural Network, for the identification of plant disease identification using leaf images. The trained model required a low computational power to classify the images, make it feasible to integration into the mobile application. The DL takes longer time to train but its testing is more efficient compared to traditional method. We are working on improving the accuracy of findings even in the presence of low quality images of leaves.

REFERENCES

1. Andreas Kamilaris, Francese X. PrenafetaBold "Deep Learning in agriculture:A Survey". Journal on Computer and Electronics, vol 147,published on Elsevier 2018.
2. Barbaedo, Garcia, "Digital Image Processing Technique for Detecting, Quantifying and Classifying plant diseases" IEEE journal, published on February 2017
3. Beyene, Narayan A. "Plant Disease Prediction Using Image Processing and Machine Learning Technique:Survey". IEEE journal of computer application. published on February 2018.
4. Chen, Kuanglin Chao, Moon S. Kim," Machine Vision Technology for Agricultural Applications", published on 2016 Elsevier.
5. Ghazala yasin, Asit Kumar Das, "A Hierarchical Strategy for Rice Leaf Disease Detection". IEEE on Intelligent Computing. Published on July 2017.
6. Jagadeesh D. Pujari, Rajesh Yakkundimath Abdulmunaf S. Byadgi " Image Processing Based Detection of Fungal Disease in Plants". Conference on Information and Communation Technology. Published on 2015 Elseiver.
7. Jayaprakash, Sethpathy, Veni.S "Opencv Based Disease Identification of Mango Leaves", IJET 2017.
8. K. Bharathi, D. Srunitha, "Mango leaf unhealthy Region Detection and Classification. Published in Computational vision and Bio Inspired computing. Published on 2018.
9. Konstantinos P. Ferentinos, "Deep Learning modesl ofr plant disease detection and diagnosis" Elsevier 2018
10. Sukhvir Kaur, Shreelekha Pandey, Shivani Goel, "Plants Disease Identification and Classification through leaf images: A Survey" Achieves on computation method Springer . Published on January 2018.
11. T. Rump, U. Steiner, " Early Detection and Classification of plant disease with Support Vector Machine based on hyper spectral reflectance", volume 74, issue1,published on October 2010.

Website

http://vikaspedia.in/agriculture/crop- production/integrated-pest- managment/ipm-for-fruit-crops/ipm- strategies-for-mango/mango-diseases- and-symptoms
http://agritech.tnau.ac.in/horticulture/hor ti_fruits_mango.html
http://horticultureworld.net/mango- india2.html