IOSR Journal of VLSI and Signal Processing (IOSR-JVSP)
Volume 13, Issue 5 (Sep. - Oct. 2023), pp.01-06
e-ISSN: 2319-4200, p-ISSN: 2319-4197
www.iosrjournals.org

Leaf Disease Detection and Classification based on Machine Learning

M.Tech Student Pooja Sasane[1], Prof. V. V. Yerigeri[2]
[1]*Student of Department of Digital Communication, M. B. E. Society's College of Engineering, Ambejogai, Maharashtra, India*
[2]*Professor of Department of Digital Communication, M. B. E. Society's College of Engineering, Ambejogai, Maharashtra, India*

Abstract:
Plant disease identification by visual way is increasingly difficult and simultaneously less accurate. However in the event that disease detection technique is used, it will take less time and processing power and proves to be progressively exact. Some broad maladies in plants appear dark coloured, yellow spots, and some are infectious, viral and bacterial diseases. Image processing is being used for estimation of infected area. Image segmentation is the process of collecting images into different parts. Now a day there are various strategies used for preforming image segmentation, stretching out from the fundamental threshholding procedure to forefront concealing picture division systems. A computer does not any special technique for intelligent objects recognition, so a great number of techniques have been developed. The segmentation procedure relies upon various features found in the image. This might be shading data, limits or fragment of an image Plant disease identification by visual way is increasingly difficult and simultaneously less accurate. However in the event that disease detection technique is used, it will take less time and processing power and proves to be progressively exact. Some broad maladies in plants appear dark coloured, yellow spots, and some are infectious, viral and bacterial diseases. Image processing is being used for estimation of infected area. Image segmentation is the process of collecting images into different parts. Now a day there are various strategies used for preforming image segmentation, stretching out from the fundamental threshholding procedure to forefront concealing picture division systems. A computer does not any special technique for intelligent objects recognition, so a great number of techniques have been developed. The segmentation procedure relies upon various features found in the image. This might be shading data, limits or fragment of an image.

Key Word*: Multi Leaf Disease Detection, Pre-processing, Classification algorithms, Feature Extraction, Convolutional Neural Network (CNN) etc.*

I. Introduction

Agriculture is an important source of livelihood and agricultural production depends on the Indian economy. In order to increase crop yield and benefit, the identification of plant leaf diseases at an early stage is critical. This paper offers an overview of different types of plant diseases and various machine learning algorithms used for disease detection in agricultural fields. India ranks second in total farm yields. As indicated by 2018, more than 50 c/o Indian manpower was used by the agribusiness section and contributed 18 percent to total national production. For farmers, continuous monitoring of the plant according to human standards can be expensive. By using distinctive AI algorithms for plant disease detection, automatic image recognition is performed. Agriculture is a major source of income in India, and the country's economy is heavily reliant on it. To maximize agricultural productivity and profit, it is critical to diagnose plant leaf diseases early on. Because naked eye observation of diseases does not always yield reliable results, especially during the early stages, an image processing technique is utilized to detect leaf diseases accurately. It consisted of five steps: image acquisition, pre-processing of the acquired image, feature extraction, disease classification, and display of the results. This work offers a thorough examination of the categorization of agricultural illnesses using the Support Vector Machine classifier.

II. Literature Survey

- Sanjay B. Patil, Dr.Shrikant K. Bodhe, "Leaf Disease Severity Measurement Using Image Processing"[1]. Leaf Disease Severity Measurement Using Image Processing" mentioned in their research that Fungi-caused diseases in sugarcane are the most predominant diseases which appear as spots on the leaves. If not treated on time, causes the severe loss. Excessive use of pesticide for plant diseases treatment increases the cost and environmental pollution so their use must be minimized. This can be achieved by targeting the diseases places, with the appropriate quantity and concentration of pesticide by estimating disease severity using image processing technique. Simple threshold and Triangle thresh holding methods are used to segment the leaf area and lesion region area respectively. Finally diseases are categories by calculating the quotient of lesion area and leaf area. The accuracy of the experiment is found to be 98.60 %. Research indicates that this method to calculate leaf disease severity is fast and accurate. Disease symptoms of the plant vary significantly under the different stages of the disease so to the accuracy with which the severity of the disease measured is depends upon segmentation of the image. Simple threshold segmentation is used to calculate the leaf area but this method is not suitable to calculate the area of the lesion region because of varying characteristics of the lesion region. Triangle method of the thresh holding used here to segment the lesion region. The average accuracy of the experiment is 98.60 %. Thus image processing technology to measure plant disease severity is convenient and accurate. This eliminates subjectivity of traditional methods and human induced errors. It will helps to farmers to decide the specific quantity for pesticide application which reduces the cost and environmental pollution.

- JundareManisha, JundarePallavi, JundarePragati, Prof. C.S.Aryan, "Plant Disease Detection and its Treatment using Image Processing"[2]. mentioned in their research that India is farming nation, Approx. 20 % of harvest yield is missing universal due to pest attack every year which is valued around Rs. 90,000 million. Saving 5 Rs. is like earning 5 Rs. farmers have been using a pesticide, which increases the crop yield to avoid loss. Remains problems in environment due to large use of pesticides harms to soil, sharp toxicity to humans and natural world, change in insect type in agro ecosystems, high cost of control practices etc. Fungus are very known dangerous insects there on grass of plant, send out steamy honeydew, reason loss of leaves and harm the harvest surrender. The visual judgment of farmers is counting of whiteflies has been mostly relied. The illustration decision by farmers for bulk of whiteflies has been less accurate Because of the identification skills has different levels. In laboratory also detection of present whiteflies on leaves, it takes extended time for detection of whiteflies at early on stages has become important because off inimical importance of harvests and strong impacts of damage levels. In proposed solution, using web application, whiteflies on leaves of plant at early stages we are calculating no. of eggs also. Farmers to use pesticide as early as possible It will give correct idea. They can avoid damage and controls whiteflies, By this technique, farmers are capable of improve 80 % of lost that will cause due to pest occurrence. Thus, is important to correctly diagnose a disease before proffering management options. Diagnosis, being the process of determining the cause of a problem requires the attention of an expert. extract the features of infected leaf and the classification of plant diseases From these methods, we can accurately identify and classify various plant diseases and provide suitable treatment using image processing techniques.

- Prakash M. Mainkar, ShreekantGhorpade, MayurAdawadkar, "Leaf Disease Detection And Classification Using Image Processing"[3], mentioned in their research that Agriculture is the mainstay of the Indian economy. Almost 70% people depend on it & shares major part of the GDP. Diseases in crops mostly on the leaves effects on the reduction of both quality and quantity of agricultural products. Perception of human eye is not so much stronger so as to observe minute variation in the infected part of leaf. In this paper, we are providing software solution to automatically detect and classify plant leaf diseases. In this we are using image processing techniques to classify diseases & quickly diagnosis can be carried out as per disease. This approach will enhance productivity of crops. It includes several steps viz. image acquisition, image pre-processing, segmentation, features extraction and neural network based classification. The study reviews and summarizes image processing techniques for several plant species that have been used for recognizing plant diseases. The major techniques used are K-means clustering, GLCM and BPNN. Some of the challenges in these techniques are optimization of the technique for a specific plant, effect of the background noise in the acquired image and automation technique for a continuous automated monitoring of plant leaf diseases under real world field conditions. The proposed approach is a valuable approach, which can significantly support an accurate detection of leaf diseases in a little computational effort. Further future work can be extended by developing better segmentation technique; selecting better feature extraction and classification algorithms and NNs in order to increase the recognition rate of final classification process. Also by computing severity and amount of disease present on the crop, only

necessary and sufficient amount of pesticides can be used making agriculture production system economically efficient. So there is a scope of improvement.

III. METHODOLOGY

On the yearly basis the agriculture field witnesses' major reduction in productivity performance and crop losses since farmers are unable to identify the disease type in the initial stages. The farmer's naked eye observations of leaves are often not capable of identifying the disease type and often need an expert to make predictions.

These losses have a major impact on the production and thus on the lives of farmers. The proposed model designed and developed an automated system which is used for identification of plant diseases that helps to determine if the plant is infected by a disease or not. The following are the steps in which the process is carried out:

1. Acquiring of the plant image dataset 14 different varieties of plant images containing 38 different classes of plant diseases.
2. Pre-processing of the image in different convolutional layers.
3. Classification of plant diseases stating if the given plant leaf image is diseased or healthy.

A. System Architecture:

The proposed System architecture comprises of data acquisition from a huge dataset, processing at different convolutional layers and then the classification of plant diseases which declares if the plant image is of a healthy class or diseased class.

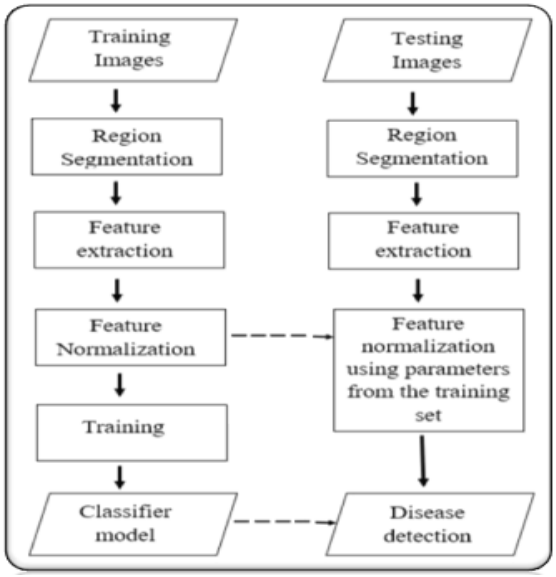

Fig.1: Proposed System Architecture

B. Deep Learning:

Deep learning, a category of machine learning algorithms which uses various layers to do the extraction of higher level from the raw input. Deep learning is a machine learning method that instructs a computer to do filtration of inputs across the layers Deep learning illustrates the way human brain does the filtration of information. Many deep learning techniques utilises the neural network architectures. The term "deep" cite to the various hidden layers present inside neural network. In contrast to this conventional neural network that consists of 2-3 hidden layers, the deep neural networks can have as much as one hundred and fifty.

C. Convolutional Neural Network:

One variant of deep neural networks is called asconvolutional neural networks (CNN). A CNN combineswell-read features with input data, and then it uses 2Dconvolutional layers, and hence makes this architecture moresuitable for processing 2D data, like images. CNNs abolishthe demand for manual feature removal and extraction for theclassification of the images. The CNN model of its ownextracts features straight from images. The features that areextracted aren't pre-trained; they are well-read while thenetwork is trained on few groups of images. The CNN model has seven different layers.Each layer has certain information processed in them. Thoseseven layers are as follows: Input layer, Output Layer,Convolutional Layer, Fully, Soft-max layer, connected layer,Pooling Layer.

- **Input layer:** It contains data in the form of image. The parameters include height, width, depth and color information of the image (RGB). Input size is fixed to 224 X 224 RGB image.
- **Convo layer:** Convolutional layer is also called as feature extraction layer. This layer extracts the prominent features from the given collection of images using dot products of theimage dimensions.
- **Pooling Layer:** The pooling layer helps to reduce the computational power in order to process the data by decreasing (or) reducing the dimensions of the featuredmatrix obtained by using the dot products.
- **Fully connected layer:** It comprises of loads, neurons and biases. It connects neurons from one convolutional layer to another.
- **Softmax Layer/ Logistic Layer:**Softmax executes multi-classification. Logistic layer executes the binary classification. It determines the probability of the presence of a given object in the image. If the object is present in the image, then the probability is '1'otherwise it is '0'.
- Activation Function- ReLU: It transforms the total weighted input through the node and puts it into the operation, activates the node. Rectified Linear Unit (ReLU) is an activation function used in the neural networks forconvolutional operations.

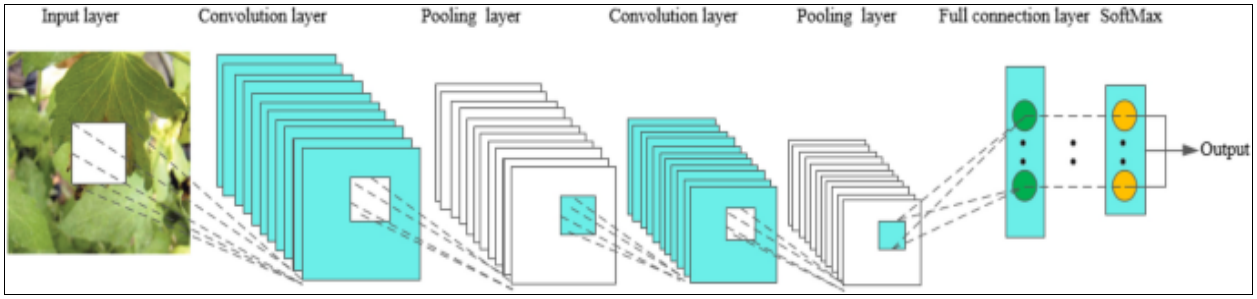

Fig.2: Convolutional Neural Network

IV. RESULT AND DISCUSSION

A. Dataset:

The dataset that is used in this proposed system project isthe Plant Village dataset and it was downloaded from theKaggle website; the dataset consisted of images of diseasedand healthy plant leaf images. Upon exploration, we found that the dataset did not haveany missing values. The dataset was further explored tounderstand the various spices and diseases of plant leaf. Thedataset consisted of 14 different plant varieties. The trainingdataset has a total of 54305 images in total.

B. Expected Result:

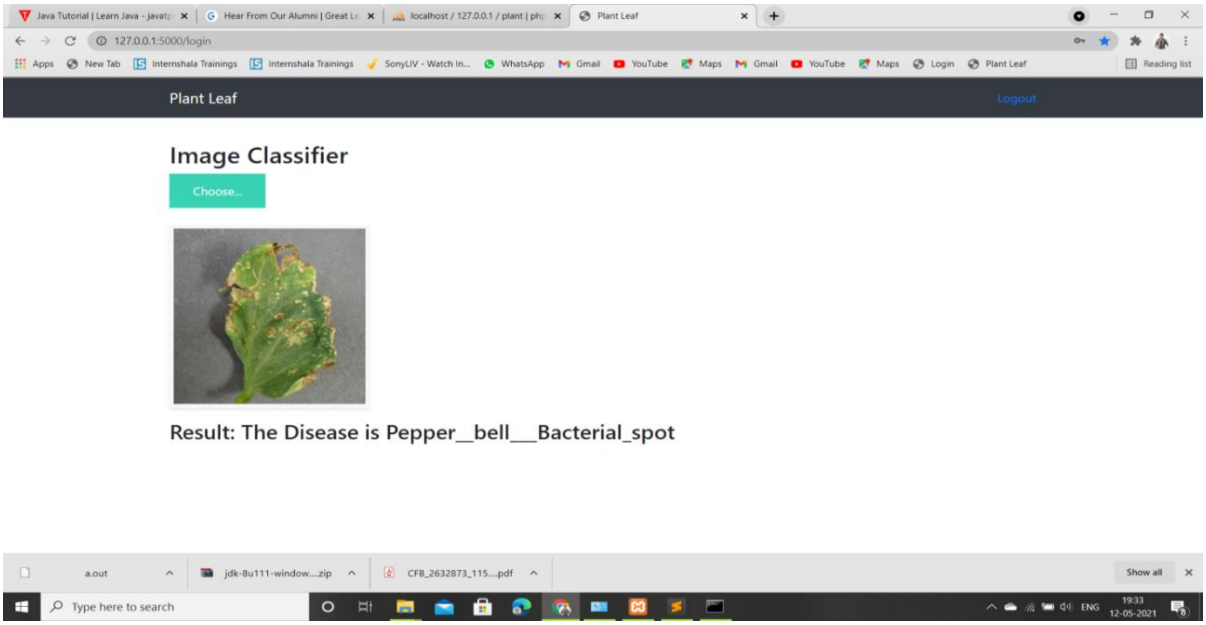

Fig.3: Result Snapshot

C. Accuracy:

```
Epoch 1/10
313/313 [==============================] - 1017s 3s/step - loss: 4.6694 - accuracy: 0.5424 - val_loss: 1.7792 - val_accuracy:
0.7681
Epoch 2/10
313/313 [==============================] - 1104s 4s/step - loss: 2.0807 - accuracy: 0.7520 - val_loss: 1.3459 - val_accuracy:
0.8314
Epoch 3/10
313/313 [==============================] - 1058s 3s/step - loss: 1.9009 - accuracy: 0.7981 - val_loss: 1.5886 - val_accuracy:
0.8308
Epoch 4/10
313/313 [==============================] - 1059s 3s/step - loss: 1.4913 - accuracy: 0.8446 - val_loss: 2.3742 - val_accuracy:
0.7823
Epoch 5/10
313/313 [==============================] - 1117s 4s/step - loss: 1.7274 - accuracy: 0.8347 - val_loss: 1.8801 - val_accuracy:
0.8287
Epoch 6/10
313/313 [==============================] - 1018s 3s/step - loss: 1.4440 - accuracy: 0.8603 - val_loss: 0.9611 - val_accuracy:
0.9005
Epoch 7/10
313/313 [==============================] - 985s 3s/step - loss: 1.4149 - accuracy: 0.8682 - val_loss: 1.8072 - val_accuracy: 0.
8467
Epoch 8/10
313/313 [==============================] - 1060s 3s/step - loss: 1.5133 - accuracy: 0.8729 - val_loss: 0.8496 - val_accuracy:
0.9128
Epoch 9/10
313/313 [==============================] - 1156s 4s/step - loss: 1.3017 - accuracy: 0.8896 - val_loss: 2.1176 - val_accuracy:
0.8533
Epoch 10/10
313/313 [==============================] - 1157s 4s/step - loss: 1.5604 - accuracy: 0.8749 - val_loss: 1.4297 - val_accuracy:
0.8762
```

D. Graph:

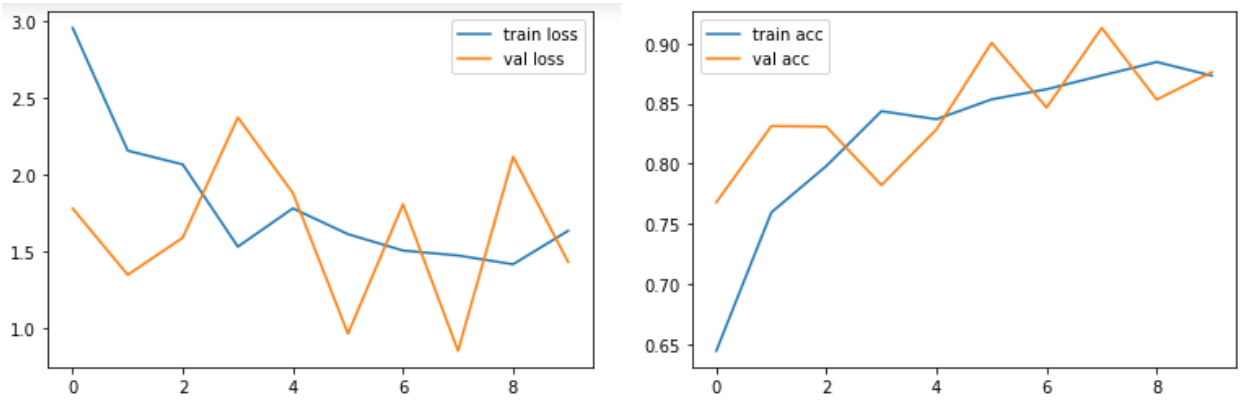

Fig.4: Accuracy Graph

V. Conclusion

A large part of the Indian population relies on agriculture, hence it becomes very essential to detect and recognize the leaf diseases that results in losses, since agriculture is critical to the growth of the economy. This proposed system based on deep learning approach called CNN is utilized to build different plant leaf disease identification, detection and recognition system. This approach utilized a minimum set of layers to identify the diseases of seven classes. The neural network is trained with Plant Village dataset. A Graphical User Interface is designed for this system. This GUI permits the user to choose the images from the dataset. User can select any image from the dataset and the image gets loaded, following which the prediction of the disease will be shown on the User Interface. Convolutional neural network, trained for identifying and recognizing the plant leaf disease, could classify and predict the diseases correctly for almost all the images with few anomalies thus and obtained 94.8% accuracy.

References

[1]. Sharada P. Mohanty, David P. Hughes and Marcel Salathé, "Using deep learning for image-based plant disease detection", *Frontiers in plant science*, vol. 7, pp. 1419, 2016. Show Context CrossRef Google Scholar

[2]. Robert M. Haralick, KarthikeyanShanmugam and Its' HakDinstein, "Textural features for image classification", *IEEE Transactions on systems man and cybernetics*, vol. 6, pp. 610-621, 1973.

[3]. Savary Serge et al., "The global burden of pathogens and pests on major food crops", *Nature ecology & evolution*, vol. 3, no. 3, pp. 430, 2019.

[4]. Hanson, A.M.J.; Joy, A.; Francis, J. Plant leaf disease detection using deep learning and convolutional neural network. Int. J. Eng. Sci. Comput. 2017, 7, 5324–5328.

[5]. Lu, Y.; Yi, S.J.; Zeng, N.Y.; Liu, Y.; Zhang, Y. Identification of rice diseases using deep convolutional neural networks. Neurocomputing 2017, 267, 378–384.
[6]. Hamuda, E., McGinley, B., Glavin, M., et al., 2017. Automatic crop detection under field conditions using the HSV color space and morphological operations. Comput. Electron. Agric. 133, 97–107.
[7]. Sharada P Mohanty, David P Hughes , and MarcelSalathé , "Using Deep Learning for Image-Based PlantDisease Detection," *Frontiers in Plant Science*, vol. 7, September 2016.
[8]. Rahib H. Abiyev, Mohammad KhaleelSallamMa'aitah. "Deep Convolutional Neural Networks for Chest Diseases Detection", Journal of Healthcare Engineering, vol. 2018, Article ID 4168538, 11 pages, 2018.
[9]. Rahib H. Abiyev, Mohammad KhaleelSallamMa'aitah. "Deep Convolutional Neural Networks for Chest Diseases Detection", Journal of Healthcare Engineering, vol. 2018, Article ID 4168538, 11 pages,2018.
[10]. ZubairHasan K.M., ZahidHasan M., Performance Evaluation of Ensemble-Based Machine Learning Techniques for Prediction of Chronic Kidney Disease. In: Shetty N., Patnaik L., Nagaraj H., Hamsavath P., Nalini N. (eds) Emerging Research in Computing, Information, Communication and Applications. Advances in IntelligentSystems and Computing, vol. 882. Springer, Singapore, 2019