Convulational neural networks for identification of disease in cotton plant

Suguna G C, S T Veerabhadrappa, Srushti S
JSS Academy of Technical Education, Bengaluru

Abstract—**The Agriculture makes a major contribution to a country's GDP (Gross Domestic Product). Plants are extremely essential since they provide a supply of nutrition for humans. Farmers in the majority of developing nations utilize manual agricultural methods. Late diagnosis of plant diseases can result in economic losses for farmers, affecting the state and country's economies on a big scale. Image acquisition, segmentation, and classification pose a number of issues. Control strategies can be used once diseases have been recognized based on symptoms and characteristics. There are some difficulties in identifying and classifying diseases, such as an uneven background and insufficient illumination. The disease detection and classification of cotton plant diseases using conventional machine learning and deep learning are discussed in depth in this article (conventional neural networks). To obtain the test dataset, the database retrieved from the virtual source is fragmented and then renamed in the proper format. The classifier is trained with the aid of the training data set, and the output is predicted with the finest accuracy. With our code and training model, we were able to achieve a 96 % accuracy rate.**

Keywords— cotton plant, CNN, test data, train data, data base etc. *(key words)*

1. INTRODUCTION

Agriculture is the economic backbone of any country. Many farmers desire to adopt modern agriculture, but many are unable to do because of variety of reasons, including lack of knowledge about new technology, excessive technological costs, and so on. Farmers in developing nations adopt a traditional approach that demands more labor and consumes more time. It's also conceivable that manual detection or observation with the naked eye won't contribute efficient results. Many farmers are also spotted using pesticides to eliminate the effects of disease without verifying the specific diseases. Farmers use pesticides indefinitely, which can have an impact on plant quality and human health. Farmers may use machine learning and deep learning to detect disease in plants and classify it, which helps them diagnose diseases and take necessary action. Machine learning-based approaches have shown to be effective in a variety of image processing applications in recent years. Machine learning is a branch of artificial intelligence and computer science that focuses on using data and algorithms to mimic how people learn in order to improve accuracy over time. Deep learning is a type of machine learning that concentrate on learning data representations instead of task-specific methods. It is a more particular class of machine learning algorithms that are based on artificial intelligence applications and have demonstrated promising outcomes. Machine learning techniques teach the system to learn on its own and improve its results depending on its own data. Plant diseases are difficult to control since their populations fluctuate depending on the environment A range of illnesses, including fungal, bacterial, and viral infections, can infect them. Fungal-like organisms have been identified to infect 88 percent of plants. As a result, early detection of the sickness can let the formers take the necessary precautions to avert large-scale losses.

Emma Harte worked on the Plant Disease Detection Using CNN, in this work the ResNet34 model is trained and tested to see how it performs in detecting crop diseases. The web-based diagnosis program, which has been developed to detect plant diseases in healthy leaf tissue, offers 97.2% accuracy when tested in a controlled setting. The accuracy of the model depends on a variety of parameters, including disease stage, disease type, background information, and object composition [1].

Hardikkumar S. Jayswal and Jitendra P. Chaudhari worked on Plant Leaf Disease Detection

Suguna G C ,JSS Academy of Technical Education,Benagaluru affiliated to VTU university, Belagavi,Karnataka. (e-mail: sugunagc@jssateb.ac.in).

S T Veerabhadrappa JSS Academy of Technical Education,Benagaluru affiliated to VTU university, Belagavi, Karnataka.
(e-mail: veerabhadrappast@jssateb.ac.in).

Srushti S JSS Academy of Technical Education, Benagaluru affiliated to VTU university, Belagavi, Karnataka. (e-mail: 1srushti.s.p00@gmail.com)

and Classification using Conventional Machine Learning and Deep Learning here Plant diseases, disease detection and classification using traditional methods, machine learning, and deep learning are all discussed in depth. When compared to previous approaches, deep learning algorithms produced improved outcomes for disease detection and classification [2].Shruthi U, Dr. Nagaveni V, Dr. Raghavendra B K worked on A Review on Machine Learning Classification Techniques for Plant Disease Detection Here Machine learning algorithms are used to identify diseases since they are based on data and prioritise the outcomes of certain tasks. This article outlines the procedures of a comprehensive plant disease detection system and evaluates the effectiveness of several machine learning classification algorithms in detecting plant diseases. The study's findings indicate that Convolutional Neural Networks are the most effective approach. Networks exhibit a notable degree of precision and are capable of identifying a greater range of diseases across various crops [3]. The authors conducted a study on the classification and recognition of diseased portions of cotton plants using Convolutional Neural Networks. The results demonstrate that the utilized model accurately differentiates between sound and flawed cotton leaves [4].M. Sheshikala, D. Ramesh, P. Kumara Swamy, R. Vijaya Prakash worked on a survey paper on convolution neural network in identifying the disease of a cotton plant here one can identify the disease in the early stage and rectify before it affects the entire crop. This can be done by looking into images collected from the crop and given it as a test sample to the convolution neural network, where we test the sample with the existing training data and identify the major areas that are affected with the disease [5].The research proposes a method called "Diseased Portion Classification & Recognition of Cotton Plants using Convolution Neural Networks," authored by Prashant Udawant and Pravin Srinath. This paper proposes a Deep Convolutional Neural Network (CNN) model to accurately classify Cotton Leaf images as either diseased or healthy. It surpasses the Regular Neural Network approach in performance. The model's results demonstrate a notable degree of precision in discerning between robust and ailing cotton plants [6]. The research study titled "Plant Disease Detection using CNN & Remedy" presents a Python-based method that achieves a 78 percent accuracy. Utilizing Google's GPU for processing can enhance both accuracy and speed. Drones have the capability to be fitted with the system, enabling the monitoring of agricultural areas from the air [7].

In this paper, Section II is concentrated on the Conventional Neural Network's basics and its layer description. In Section III the methodology of the project is explained in detail.

2. CONVULTION NEURAL NETWORKS

Convolutional Neural Nets (CNN) is a Deep Learning procedure that tracks an input image and imparts significance to multiple areas of it while also distinguishing between them. A CNN requires far less pre-processing than other various classifiers. While fundamental techniques require hand-engineering of filters, CNN can acquire such similar filters/characteristics with enough training. Due to their greater performance, convolutional neural networks surpass classic neural networks with picture, speech, or audio signal inputs. They're broken down into three sections: -

- ✦ Convolutional Layer
- ✦ Pooling Layer
- ✦ Fully Connected Layer

A. Convolutional layer

The convolutional layer is the main layer of a convolutional network. This layer, appearing to be the central component of a Convolutional Neural Network (CNN), is responsible for performing the majority of the computational tasks. It comprises input data, a filter, and a feature map, among other components. Unlike complete coupling, a neuron in a convolutional layer is selectively connected to a subset of input neurons. This reduces the number of parameters that need to be learned and allows for the development of deeper networks with fewer parameters. The system consists of several filters, each of which requires a thorough examination of its features. The height and weight of the filters are smaller than the volume provided as input. The input volume is convolved with each filter to produce a map of neuron activations. To put it another way, the filter is moved across the width and height of the input, and the dot products between the input and filter are computed at each spatial position. The layer's output volume is calculated by stacking the activation maps of all filters along the depth dimension. Each neuron in the activation map is only linked to a tiny local region of the input volume since each filter's width and height are supposed to be less than the input volume. In other words, each neuron's receptive field is small and equal to the filter size.

B. Pooling Layer.

Pooling layers also recognized as the Down sampling layer, which reduces the dimensionality by reducing the number of parameters in the input side. The pooling operation sweeps a filter across the input which is similar to the convolutional layer, where the filter has no weights. Alternatively, the kernel employs a clustering method to populate the output array from the values in the receptive field.

Types of pooling methods: -

- **Average pooling:** The average value inside the receptive field is calculated as the filter travels over the input and sent to the output array.
- **Max pooling:** This filter selects the pixel with the highest value to transmit to the output array as it travels across the input. In comparison to average pooling, this method is utilized more frequently.

While the pooling layer loses a lot of information, it also provides a number of advantages for the Conventional Neural Nets. They contribute in the reduction of complexity, the enhancement of efficiency, and the prevention of overfitting.

C. FC Layer.

The fully connected layer, also known as the FC layer, is in charge of connecting the input layer to the following layer through the activation unit. The pixel values of the input image are not directly connected to the output layer. Each node in the output layer connect to a node in the preceding fully-connected layer. FC layer performs categorization tasks using the information gathered by the previous layers and their filters. While convolutional and pooling layers often use ReLu functions to classify inputs, FC layers typically use a SoftMax activation function to provide a probability from 0 to 1.

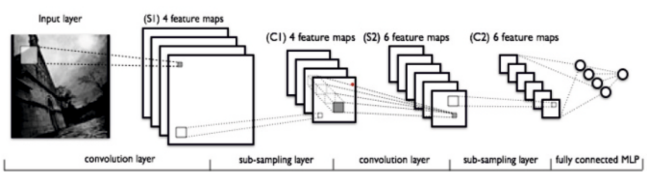

Figure 1: - CNN Architecture

3. METHODOLGY

In this section of the article, the methodology for implementing the CNN model has been discussed. The following are the steps that is been utilized for the implementation.

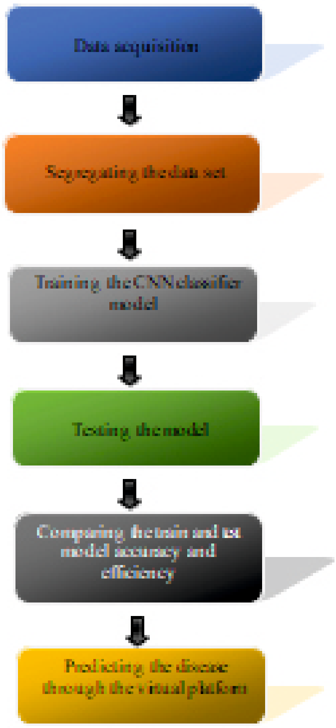

Figure 2: Approach flow

A. Database collection

The first step in every image processing project is to acquire a valid database. We received a database of cotton plant leaf images from Kegel for this study, and the data was separated based on the health condition of the cotton plants. After obtaining the database, it is separated into train data and test data. During training, the model is fed enough data and the machine is trained to learn the data set. After training, the model is evaluated to see whether it is operating properly.

B. The Model Training.

The trained dataset images are transformed to array form and reshaped and resized during model training. A database of around 2000 distinct cotton plant leaf images is obtained, from which any picture may be used as a test image for the software. To detect the test image and the disease it includes, the training dataset is utilized to train the model (i.e., CNN model). CNN includes multiple layers, including Dense, Dropout, Activation, Flatten, Convolution2D, and MaxPooling2D. Average pooling does not extract useful features since it counts everything and returns an average value, which may or may not be significant for object identification tasks. Max pooling recovers the most essential features, such as edges, but average pooling does not. The kernel size (it specifies the height and width of the 2D convolution window) used here is 3, which requires less training time. The pixel with the highest value from a group of pixels within the kernel is returned by maximum pooling of layers. The larger the filter size, the more the pooled pictures blend into one continuous vector. It unstacks the volume into an array and belongs to four classes: diseased cotton leaf, diseased cotton plant, fresh cotton leaf, and fresh cotton plant. Dropout is used to train a specific mode in a hidden layer, and a suitable value for dropout in a hidden layer is between 0.5 and 0.8. Pooling decreases the size of each feature map by a factor of two, whereas max-pooling determines the maximum value for each. It learns over several epochs of background propagation and forward propagation. If the plant species is in the database, the virtual page can identify the disease once the model has been properly trained. After successful training and preprocessing, the test image and trained model are compared in order to identify the disease.

C Testing the model

The train dataset is used to train the CNN model so that it can recognize the test image and hence the disease. Dense, Dropout, Activation, Flatten, Convolution2D, and maxpooling2d are some of the layers of CNN. If the plant species is included in the dataset, the software may identify the disease once the model has been properly trained. The test image and trained model are compared in order to anticipate the disease after successful training and preprocessing.

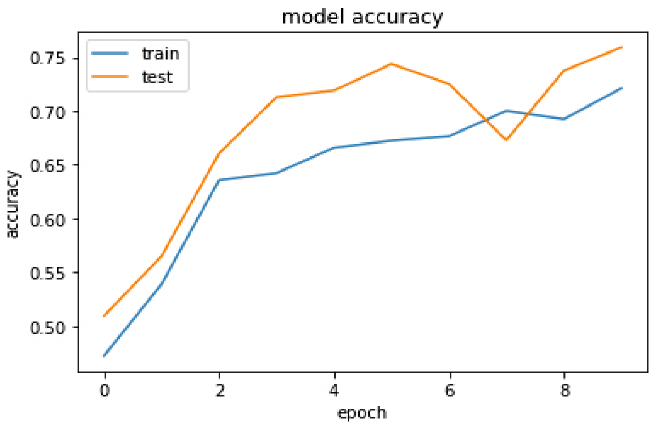

Figure3: - Model accuracy

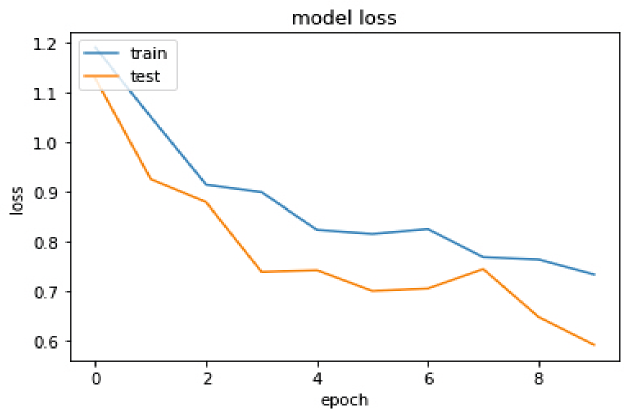

Figure 4: - Model loss

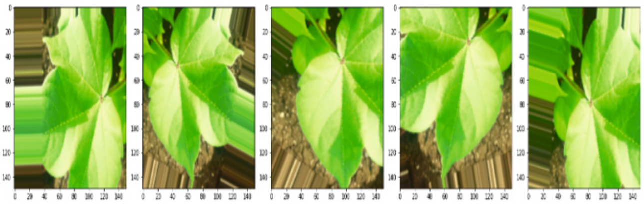

Figure 5: Augmented Images

Figure 6: - Detection of healthy cotton in web page

Figure 7: - Detection of unhealthy cotton in web page

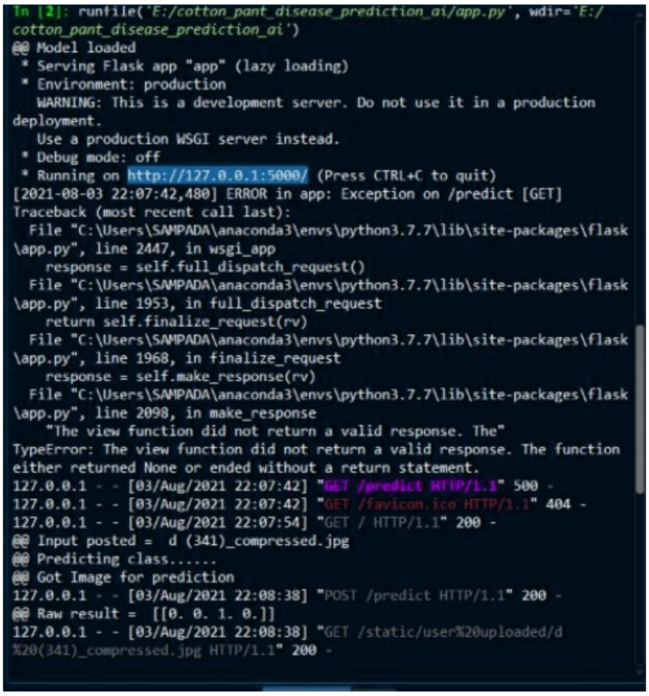

Figure 8: -Detection based on max array index value in test code

3. CONCLUSION

As previously stated, agriculture is the most important sector of any country, so this paper proposes a deep CNN model for reliably detecting if a Cotton Leaf image is diseased or healthy. It is a better approach for predicting the outcome than the Regular Neural Network. Cotton Leaf is classified with excellent accuracy using this model. The model's results show a high level of accuracy in distinguishing between healthy and diseased cotton plants. The presented framework is implemented in Python and has a 96 percent. Future direction is hardware development of an algorithm which can help famers to detect and classify diseases.

REFERENCES

1. Harte, Emma. Plant disease detection using CNN. Diss. Ph. D. thesis, 2020.
2. Jayswal, Hardikkumar S., and Jitendra P. Chaudhari. "Plant Leaf Disease Detection and Classification using Conventional Machine Learning and Deep Learning."
3. Shruthi, U., V. Nagaveni, and B. K. Raghavendra. "A review on machine learning classification techniques for plant disease detection." 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS). IEEE, 2019.
4. Udawant, Prashant, and Pravin Srinath. "Diseased portion classification & recognition of cotton plants using convolution neural networks." Int. J. Eng. Adv. Technol (IJEAT) 8.6 (2019).
5. Sheshikala, M., et al. "A SURVEY PAPER ON CONVOLUTION NEURAL NETWORK IN IDENTIFYING THE DISEASE OF A COTTON PLANT."
6. Udawant, Prashant, and Pravin Srinath. "Diseased portion classification & recognition of cotton plants using convolution neural networks." Int. J. Eng. Adv. Technol (IJEAT) 8.6 (2019).
7. Karol, Adnan Mushtaq Ali, Drushti Gulhane, and T. Chandiwade. "Plant Disease Detection using CNN & Remedy." International Journal of Advanced Research of Electrical, Electronics and Instrumentation Engineering 8.3 (2019): 622-626.
8. BANU, T. SHAMYUKTHA, and DRVRS MANI. "COTTON CROP MONITORING SYSTEM USING CNN."
9. Iyswariya, A., et al. "Identification and Detection of Plant Diseases by Convolutional Neural Networks." European Journal of Molecular & Clinical Medicine 7.4 (2020): 2200-2205.
10. Satapathy, Shashank Mouli, Challa Karthik, and Nagul Ulaganathan. "Application for Plant's LeafDisease Detection using Deep Learning Techniques."
11. Jayswal, Hardikkumar S., and Jitendra P. Chaudhari. "Plant Leaf Disease Detection and Classification using Conventional Machine Learning and Deep Learning."
12. Pantazi, Xanthoula Eirini, Dimitrios Moshou, and Alexandra A. Tamouridou. "Automated leaf disease detection in different crop species through image features analysis and One Class Classifiers." Computers and electronics in agriculture 156 (2019): 96-104.
13. Jayswal, Hardikkumar S., and Jitendra P. Chaudhari. "Plant Leaf Disease Detection and Classification using Conventional Machine Learning and Deep Learning."
14. Al-bayati, Jalal Sadoon Hameed, and Burak Berk Üstündağ. "Evolutionary feature optimization for plant leaf disease detection by deep neural networks." International Journal of Computational Intelligence Systems 13.1 (2020): 12-23.
15. Al Bashish, Dheeb, Malik Braik, and Sulieman Bani-Ahmad. "A framework for detection and classification of plant leaf and stem diseases." 2010 international conference on signal and image processing. IEEE, 2010.
16. Bajpai, Govind, Aniket Gupta, and Nitanshu Chauhan. "Real Time Implementation of Convolutional Neural Network to Detect Plant Diseases Using Internet of Things." International Symposium on VLSI Design and Test. Springer, Singapore, 2019.
17. Badnakhe, Mrunalini R., and Prashant R. Deshmukh. "An application of K-means clustering and artificial intelligence in pattern recognition for crop diseases." International conference on advancements in information technology. Vol. 20. 2011.
18. Cartwright, Hugh, and MARTON. Artificial neural networks. Ed. Hugh Cartwright. Humana Press, 2015.
19. Soni, Priya. "Review on plant disease identification using image processing techniques." International Journal of Research in Medical and Applied Sciences 1.4 (2015): 46-49.
20. Fuentes, Alvaro, et al. "Spectral analysis of CNN for tomato disease identification." International Conference on Artificial Intelligence and Soft Computing. Springer, Cham, 2017

***