IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 1, June 2022
Impact Factor: 6.252

Identification of Plant Leaf Disease by CNN Learning Techniques

Sri Dharshini S[1], Udita S[2], Dr. G Ayyappan[3], Reena R[4]
Students, Prince Shri Venkateshwara Padmavathy Engineering College, Ponmar, Chennai[1,2]
Associate Professor, Prince Shri Venkateshwara Padmavathy Engineering College, Ponmar, Chennai[3,4]

Abstract: *Plant diseases are one of the most important factors that seriously threaten agricultural production. These diseases on plants lead to a significant reduction in both the quality and quantity of agricultural products. Hence, Early detection and identification of these diseases can effectively reduce the agricultural and economic losses. Detection of these diseases depended on manpower; however, automatic detection of diseases has been advanced to reduce human efforts and errors. In this paper, plant leaf images are used to detect the diseases present. This is done by using images of plant leaves with disease and studying the visually observable patterns in the images. This study uses various image processing techniques to detect and classify the disease. The proposed model uses Contrast stretching to enhance the contrast in an image to improve image quality. The model Converts the RGB image to a grayscale image. Filters (Gaussian, canny edge detector, median) are used to pre-process and enhance the images. Image segmentation is done with the help of K-Means clustering. Feature extractions using algorithms such as Discrete wavelet transform, Principal component analysis, and grey level co-occurrence matrix are used to extract the informative features of the images and for image classification, a CNN classifier is applied.*

Keywords: Plant Disease, Discrete Wavelet Transform, Principal Component Analysis, Grey Level Co-occurrence Matrix, CNN Classifier, K-Means Clustering, Gaussian, Canny Edge Detector, Median Filters, Feature Extraction, etc.

I. INTRODUCTION

The largest part of the Indian economy depends on agriculture for food and livelihood. Due to various factors such as climate changes, environmental factors, insects, and pests the plants get affected greatly leading to various diseases. Due to a huge number of agricultural activities and cultivation, the agriculturist often fails to identify the diseases in the plants in the early stages itself. Since in rural areas these activities are done manually it can lead to errors which lead to cultivation failures. Hence, to overcome these issues, the automated detection of diseases in plants based on the images of plant leaves is a huge advancement in the field of agriculture. The timely identification of plant disease impacts agricultural productivity and quality. Today's advanced technologies have enabled agriculturists to detect these diseases in the earliest [1,2].

At present automatic disease detection based on the visually observable patterns in the plant leaves offers fast and accurate results to these issues [3]. In this model image processing techniques are used. Image processing is a technique in which the image is given as an input to perform some operations on it to gather some useful and important information from the image. The detection of plant disease is done in four major sections such as image pre-processing, segmentation, feature extractions, and classification.

Machine learning is a branch of artificial intelligence that allows computer systems to predict accurate outcomes being programmed explicitly. Machine learning is used to teach the computer system how to handle data efficiently. There are various machine learning algorithms used to solve data problems such as supervised learning, unsupervised learning, semi-supervised learning, reinforcement learning, multi-task learning, ensemble learning, neural network, and instance-based learning [4].

The convolutional neural network is a deep learning algorithm that is used for image-based classifications, recognition, and processing designed to process the pixel data. The use of CNN algorithms has led to various achievements in various fields, for example, pothole detection, traffic detection, speech recognition, expression recognition, Face recognition,

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 1, June 2022
Impact Factor: 6.252

Fingerprint recognition, and much more. The plant disease detection done using the CNN classifier has a very good result and accuracy than the disease detection done using an SVM classifier [5]. This proves that the convolutional neural network is the best method for object recognition in images. The CNN classifier classifies the features of the leaf images to detect the disease.

II. LITERATURE REVIEW

The detection of plant disease has been done a lot in the past with lots of work devoted to identifying the disease using image processing techniques. It continues to attract a lot of researchers to carry out their research in this field. Automatic disease detection in image processing using CNN has been gaining attention in recent years.

Geetha et al., (2020) [6] proposed the plant leaf disease classification and detection using machine learning. Image pre-processing to remove noise, segmentation to part the affected area of the leaf, and k-nearest neighbors (KNN) algorithm for classification.

Gayathri et al., (2021) [7] used the internet of things (IoT) to recognize and monitor crop disease. Machine learning algorithms such as SVM and CNN are used. This work performs a comparative analysis between SVM, CNN, naïve Bayes, and KNN.

Jun Liu and Xuewei Wang (2021) [8] proposed plant disease and pests' detection in digital image processing using deep learning. CNN algorithms are used for classification along with feature extractions. They evaluated the performance of the algorithm using evaluation indices such as precision, recall, mean average precision, and mean F1 score.

Vijay Singh and A.K. Misra (2016) [9] proposed plant leaf disease detection using image segmentation and soft computing techniques. They proposed an algorithm named K-Means clustering for image segmentation. They used banana, beans, jackfruit, lemon, mango, potato, tomato, and sapota plant leaves samples for disease detection.

Sunil et al., (2022) [10] performed plant leaf disease detection using computer vision models and machine learning algorithms. This paper is based on the diseases detected in tomato leaves. Histogram equalization and K-means clustering are used to increase image quality.

K. Padmavathi and K. Thangadurai (2016) [11] did a comparative study on the implementation of RGB and Grayscale images in plant leaves disease detection. They analyzed the Grayscale and RGB images using techniques such as pre-processing, segmentation, and classification.

III. PROPOSED METHODOLOGY

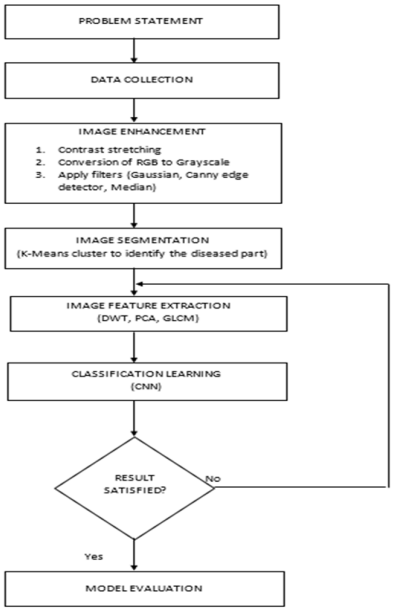


Figure 1: Proposed System Architecture

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 1, June 2022
Impact Factor: 6.252

Since plants are vulnerable to various diseases and infections at a faster rate it is important to detect these diseases in the earlier stages itself. There are various reasons because of why these causalities occur such as temperature and climate changes, quantity, and quality of food, bacteria, and fungus. Farmers can also sometimes fail to identify these diseases in the early stages.

Hence to overcome these the proposed system is executed using image processing techniques that aim to detect and classify these diseases. The proposed system uses 3 filters: Gaussian filter, Canny Edge detector, and Median filter. K-Means clustering is used for image segmentation. Feature extraction is done using algorithms such as Discrete wavelet transform, Principal component analysis and grey level co-occurrence matrix to extract 12 features from the image. The extracted features are classified by applying CNN classifier for identifying plant leaf disease in the collected image dataset. Figure 1 shows the proposed system architecture.

IV. DATA ACQUISITION

We use the plant leaf's images which contain both affected leaves and healthy leaves. All these images are resized to have a uniform dataset. This work considers around 681 images. It consists various types of plant. Namely, Brinjal, Grape, Pepper Bell, Potato, and Tomato. Fig 2 shows the sample images of collected dataset.

Figure 2: Sample Image of Collected Dataset

V. MATERIALS AND METHODS

The disease detection system is a combination of various steps, techniques, and algorithms which are combined in a controlled manner. The proposed system has various modules through which the images travel for the disease to be detected in the final stage. All these modules are performed using MATLAB.

VI. IMAGE ENHANCEMENT

Image enhancement is the procedure of improving the quality of the images before processing is done. It is done to bring the images to the desired quality in terms of color and size. Contrast stretching also known as normalization is an enhancement technique used to improve the image contrast by stretching the range of intensity values the image contains. The plant leaf image is converted from an RGB image to a grayscale image. Noise in an image is a type of visual distortion that causes variations in the brightness and color of the image which makes image processing difficult. These noises can be removed using filters. The filters used are:

- GAUSSIAN filter which is a low pass filter used to blur the images to reduce the image size and remove noise and detail.
- CANNY EDGE DETECTOR filter is a multi-stage process used to detect a wide range of edges in images while suppressing the noise to reduce the amount of data to be processed.
- MEDIAN filters are non-linear filters used for noise removal and image smoothening.

These filters can emphasize or remove certain features [12]. Figure 3 shows the RGB and Grayscale images.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 1, June 2022
Impact Factor: 6.252

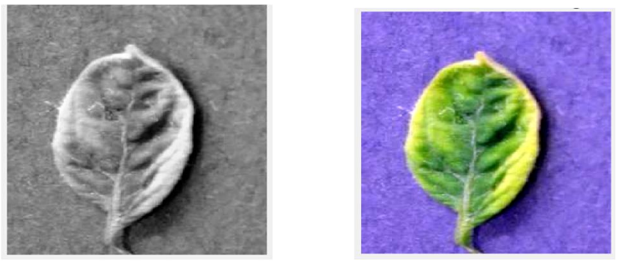


Figure 3: RGB and Grayscale Image

VII. IMAGE SEGMENTATION

Image segmentation is a method in which an image is partitioned into various segments according to their similar features and properties. Segmentation helps in reducing the image complexity so that further processing of the image can be done easily. These techniques can be used to divide and group pixels from an image and to assign labels to pixels. Thresholding is a type of image segmentation where the pixels of a Grayscale image is changed to convert it into a binary image, i.e., a black and white image. Otsu's strategy is utilized to perform a clustering-based image Threshold. In leaf images, the disease parts are highlighted and shown separately with the help of segmentation techniques such as K-Means clustering. K-Means clustering is an unsupervised algorithm used to segment the diseased area from the image. This algorithm is used when the data used is without any defined group or category. It identifies the patterns and clusters the data into k-clusters where k is the value of total clusters. The clustered data is then used for feature extraction. Figure 4 shows the leaf image after segmentation.

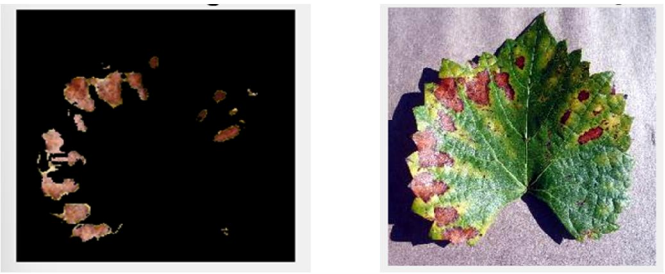


Figure 4: Input Image after Segmentation

VIII. FEATURE EXTRACTION

Feature extraction is a process that helps to reduce the amount of unwanted and redundant data from the dataset. It is used to transform the raw dataset into the desired form. It reduces the amount of features/information in a dataset by creating new features from the existing ones and then discards the original features. The reduction of these features helps to classify the images quickly without much effort. The feature extraction is performed with the help of algorithms such as:

- Discrete Wavelet Transform (DWT) is widely used in feature extraction to reduce the image size without compromising the image quality thus increasing the resolution.
- Principle Component Analysis (PCA) is used to reduce the dimensionality of the large dataset by transforming the large set of variables into a smaller one which retains most of the Information from the large dataset.
- Gray Level Co-Occurrence Matrix (GLCM) is used for second-order statistical texture analysis of an image. It analyses the textural features present in the images.

With the help of these 3 algorithms, a total of 12 features are extracted such as Contrast, Correlation, Energy, Homogeneity, Mean, Standard Deviation, Entropy, RMS, Variance, Smoothness, Kurtosis, and Skewness [13].

IX. IMAGE CLASSIFICATION

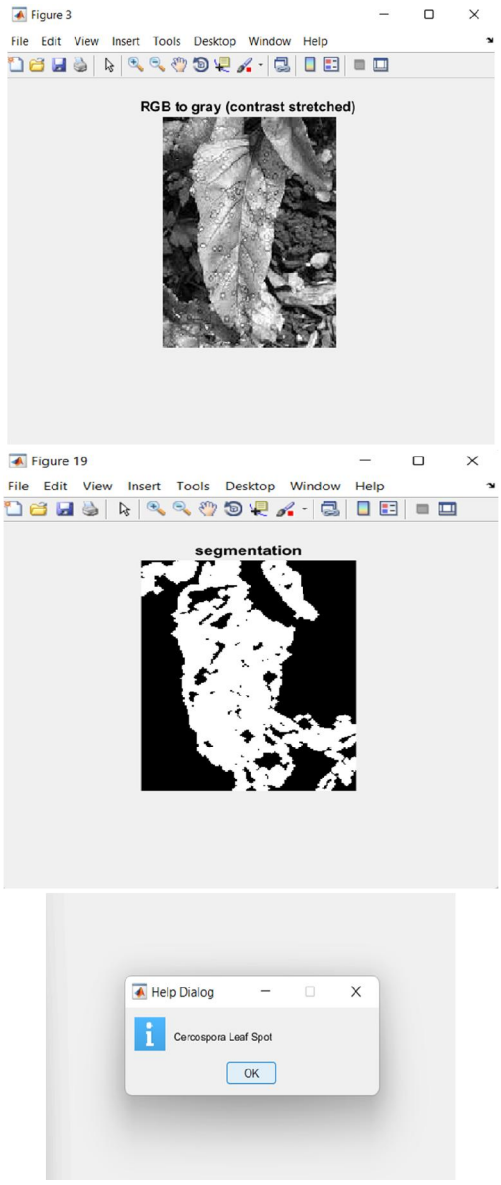
Image classification is the process where the computer can analyze an image and identify under which class the image falls where classes refer to the labels such as the names of the disease. It labels the image by categorizing and labeling groups of pixels or vectors within an image. Classification is of two methods: supervised which is human-guided and

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 1, June 2022
Impact Factor: 6.252

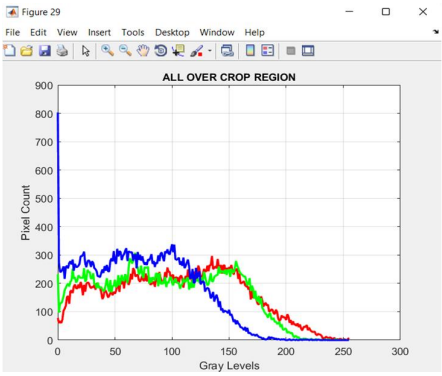
unsupervised in which outcomes are calculated by the software. The image classification is achieved using the Convolutional Neural Networks (CNN). The CNN algorithm takes an image and assigns a class and a label to make it unique. CNN has had amazing performance results in various fields related to image recognition, pattern recognition, speech recognition, emotion recognition, traffic detection, and more. CNN has multiple layers, including a convolutional layer, ReLu (activation) layer, pooling layer, and fully connected layer. In CNN the convolution layer is the most important and is the building block of CNN. Both convolutional and fully connected layers have parameters whereas ReLu and pooling layers do not have any parameters [14].

X. RESULT

Figure 5 shows the results of the proposed disease detection model. The proposed model for disease detection executed with the help of image processing techniques and CNN learning techniques shows higher accuracy for the borrowed plant leaf image dataset.



IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 1, June 2022
Impact Factor: 6.252



XI. CONCLUSION

Protecting crops and plants in agriculture is not an easy task to do. It requires complete knowledge about the type of plants being grown and the possible disease the plants can attain. In our work, an automatic disease detection model using image processing techniques such as enhancement, segmentation, feature extraction, and classification is used to get the desired results.

The use of the convolutional neural network to detect whether the plant leaf is affected or not has been proven to have a higher rate of accuracy. These techniques help the farmers to identify the diseases at the initial stages itself so that they can be controlled and prevented. Hence the proposed model is very efficient and reliable in detecting diseases in plant leaves and also helps the farmers in maintaining the plants and improving the agricultural cultivation.

FUTURE ENHANCEMENT

The proposed system can be upgraded into a hardware model with a real-time entry system that helps the farmers to monitor and maintain the plants so that the diseases can be prevented from occurring. The future enhancement is to help the farmers by providing great plant care. Once the disease is detected the solution to handle these diseases can also be included in a future enhancement.

REFERENCES

[1] Malti K. Singh, Subrat Chetia (2017) "Detection and Classification of Plant Leaf Diseases in Image Processing using MATLAB". International journal of life sciences research vol. 5, issue 4, pp:(120-124)

[2] Sk Mahmudul Hassan, Arnab Kumar Maji, Michał Jasinski, Zbigniew Leonowicz and Elzbieta Jasinska (2021) "Identification of Plant-Leaf Diseases Using CNN and Transfer-Learning Approach". Electronics 2021,10,1388, MDPI.

[3] Sumit Kumar, Veerendra Chaudhary, Ms. Supriya Khaitan Chandra (2021) "Plant Disease Detection Using CNN". Turkish Journal of Computer and Mathematics Education vol.12 no.12 (2021), 2106-2112.

[4] Batta Mahesh (2018) "Machine Learning Algorithms - A Review". International Journal of Science and Research (IJSR) ISSN: 2319-7064 ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

[5] Mehmood ul Hasan, Saleem Ullah, Muhammad Jaleed Khan, Khurram Khurshid (2019) "Comparative analysis of SVM, ANN and CNN for classifying vegetation species using hyperspectral thermal infrared data". The international archives of the photogrammetry, remote sensing, and spatial information sciences, volume XLII-2/W13,2019.

[6] Nageshwar Jaiswal, and Vivek Sarnaik (2021) "Detection of Plant Leaf Disease Using CNN Algorithm". International Journal of Research in Engineering and Science (IJRES) ISSN (Online): 2320-9364, ISSN (Print): 2320-9356 www.ijres.org Volume 9 Issue 9 ǁ 2021 ǁ PP. 35-44

[7] Ramya R, Kiran M, Marimuthu E, Naveen Kumar B, Pavithra G (2020) "Plant Monitoring and Leaf Disease Detection with Classification using Machine Learning-MATLAB". International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Published by, www.ijert.org RTICCT - 2020 Conference Proceedings.

[8] Naveen Kishore Gattim, Subba Reddy Pallerla, Polaiah Bojja, Tallem Pavan kumar Reddy, Vempati Nikhil

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 1, June 2022
Impact Factor: 6.252

Chowdary, V Dhiraj, Sk Hasane Ahammad (2019) "Plant Leaf Disease Detection Using SVM Technique". Volume7, No.11 November 2019 International Journal of Emerging Trends in Engineering Research https://doi.org/10.30534/ijeter/2019/367112019

[9] Vijay Singh, A.K. Misra (2016) "Detection of plant leaf diseases using image segmentation and soft computing techniques". Elsevier, Information processing in agriculture 4, issue 1.

[10] Salwa Khalid Abdulateef, Mohanad Dawood Salman (2021) "A Comprehensive Review of Image Segmentation Techniques". Iraqi Journal for electrical and electronic engineering 17(2):166-175 DOI:10.37917/ijeee.17.2.18

[11] K. Padmavathi, K. Thangadurai (2016) "Implementation of RGB and Grayscale Images in Plant Leaves Disease Detection-Comparative study". Indian journal of science and technology, vol 9(6), DOI: 10.17485/ijst/2016/v9i6/77739, February 2016

[12] Angalaparameswari Rajasekaran, Senthilkumar. P (2014) "Image Denoising Using Median Filter with Edge Detection Using Canny Operator". International journal of science and research ISSN (online): 2319-7064

[13] L. Malliga (2019) "A Novel Statistical Based Methodology for the Feature Extraction of both MRI and CT images". International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-8, Issue-6S3, September 2019

[14] Saad Albawi, Tareq Abed Mohammed (2017) "Understanding of a Convolutional Neural Network". The International Conference on Engineering and Technology 2017 At: Antalya, Turkey

[15] Saranya. G, Pravin. A (2020) "A comprehensive study on disease risk predictions in machine learning". International Journal of Electrical and Computer Engineering (IJECE), 10(4), 4217

[16] Sharada P. Mohanty, David P. Hughes, Marcel Salathe (2016) "Using Deep Learning for Image-Based Plant Disease Detection". METHODS article Front. Plant Sci., 22 September 2016

[17] L. Sherly Puspha Annabel, T. Annapoorani, P. Deepalakshmi (2019) "Machine Learning for Plant Leaf Disease Detection and Classification – A Review". IEEE international conference on communication and signal processing.

[18] Ashutosh Kumar Singh, SVN Sreenivasu, U.S.B. K. Mahalaxmi, Himanshu Sharma, Dinesh D. Patil, Evans Asenso, "Hybrid Feature-Based Disease Detection in Plant Leaf Using Convolutional Neural Network, Bayesian Optimized SVM, and Random Forest Classifier", Journal of Food Quality, vol. 2022, Article ID 2845320, 16 pages, 2022. https://doi.org/10.1155/2022/2845320

[19] Kartika Firdausy, Tole Sutikno, Eko Prasetyo (2007) "Image Enhancement Using Contrast Stretching on RGB and IHS Digital Image". Telecommunication computing electronics and control 5(1):45 DOI:10.12928/telkomnika. v5i1.1335