International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 – 5161
©2021 INPRESSCO®, All Rights Reserved
Available at http://inpressco.com/category/ijcet

Research Article

An Automatic Approach for Leaf Disease Detection Using Deep Learning Algorithm

Miss.Kishori B. Patil Prof. Dr.Santosh V. Chobe

Department of Computer Engineering Dr. D. Y. Patil Institute of Technology, Pimpri,Pune Savitribai Phule Pune

Received 10 Nov 2020, Accepted 10 Dec 2020, Available online 01 Feb 2021, **Special Issue-8 (Feb 2021)**

Abstract

India is an agriculture country and above seventy percent of our population depends on the agriculture. One-third of our national income comes from agriculture. Agriculturalists are facing loss due to various crop diseases and it becomes tedious for cultivators to monitor the crop regularly when the cultivated area is huge. So the plant disease detection plays an important role in agriculture field. Timely and accurate disease detection is important for the loss caused due to crop diseases which affects adversely on crop quality and yield. Early diagnosis and intervention can reduce the loss of plant due to disease and reduce the unnecessary drug usage. Earlier, automatic detection of plant disease was performed by image processing. For disease detection and classification, the machine learning mechanism and image processing tools are proposed. Crop disease will be detected through various stages of image processing such as image acquisition, image pre-processing, image feature extraction, feature classification, disease prediction and fertilizer recommendation.Here the result obtained by usage of CNN algorithm is more accurate in detection of leaf disease.

Keywords: *Classification, Feature Extraction, Image Global Features, Image Processing, Machine Learning.*

Introduction

Farmers' economic growth depends upon the quality of the product that they grow, which is directly dependent on the plants' growth and yield they get. Plants are attacked by the different diseases that target different parts of plant body such as leaf, stem, seed, and fruit and so on. To solve this problem machine learning seems to be a better option. Various machine learning techniques are recently proposed for identification and classification of plant disease from plant images. Many crops, most importantly cash crops play a dominant role in the Industrial and Agriculture Economy of the country. India provides direct livelihood to 6 million farmers. Various image processing concepts such as image filtering, segmentation, image feature extraction have emerged to detect the leaf diseases. There are various image segmentation methods available such as k-means clustering, Canny and Sobel segmentation, and Otsu thresholding. Techniques such as Neural Network, Support Vector Machine and Homogeneous Pixel Counting technique for Cotton Diseases Detection can be used for classification. Features play an important role in the classification process. Previous work for detecting disease have some limitations such as low resulting accuracy and less number of images used to detect disease. The main source for the disease is the leaves of the plant. About 80 to 90 % of disease on the plant is on its leaf. Hence, the study of interest is the leaf of the tree rather than whole plant. The leaves are mainly suffered from diseases like insecticide (tudtude, mawa), fungus, foliar leaf, and Alternaria leaf spot.

A. Motivation

- Plants are attacked by the different disease which target different parts of plant body such as leaf, stem, seed, and fruit and so on.
- Agriculturalist is facing loss due to various crop diseases and it became difficult for cultivators to monitor the crop regularly when the cultivated area is huge. As crop disease affects adversely on crop quality and yield, timely and accurate disease detection may provide proper solution to prevent these disease.

B. Objectives

- To train classifier based on deep learning algorithm.
- To analyse the result of detection and classification Phases.
- To identify the disease with the help of Image Processing.
- Try to improve detection accuracy using deep learning algorithm.

C. Problem Statement

The identification and classification of plant diseases using some automatic intelligence approach for leaf disease detection using deep learning algorithms.

Review of Literature

Wan Mohd Fadzil et al. [1], discussed a disease detection method for orchid plant leaves. The orchid plant leaflet images are received using digital camera. For classifying input images into two different disease class as solar scorch and black leaf spot, aggregate of several strategies like morphological processing ,filtering technique and border segmentation method are used by the algorithm . However, the segmentation technique proposed and used in this can only distinguish two different types of orchid leaf disease. For classification of other types of leaf disease present on orchid, new or other segmentation technique have to develop. This is because there need many combination of the processing techniques to find robust for border segmentation techniques.

Aditya Parikh et al [2] primary focuses on to detect disease and estimate its stage for a cotton plant using images. Most disease symptoms are reflected on the cotton leaf. The proposed work uses two cascaded classifiers, first classifier segments leaf from the background for which local statistical features are used . Then making use of hue and luminance from HSV color space another classifier is trained so that it can detect disease and find its stage. The developed algorithm is a generalized as it can be applied for any disease. However, cascaded classifiers depends on various conditions i.e. border of the leaves are viewable, Leaves are big size for analysis and the probing requires controlled environment.

Bhumika S.Prajapati et al [3] presents a survey on cotton leaf disease detection and classification. It is hard for human eyes to identify the type of leaf disease exactly which exist on the plant leaf. Thus, the use of image processing and machine learning techniques can be helpful so that the cotton leaf diseases are identified accurately. The images which are used for this task were acquired using digital camera from the cotton field . In order to remove background from the image the background removal technique is applied in pre-processing step. Then, the background removed images are processed further for image segmentation which is done by otsu thresholding technique. However, this work describe only general and different approaches for detection and classification of cotton leaf diseases and describe segmentation and background removal techniques.

P. R. Rothe et al [4] presents a pattern recognition system which identify and classify three cotton leaf diseases which are Bacterial Blight, Alternaria and Myrothecium. The images used for this work are captured from the cotton fields in Buldana and Wardha district and the fields at Central Institute of Cotton Research Nagpur. For image segmentation active contour model is used and for the training of adaptive neurofuzzy inference system,Hu's moments are extracted as features. However, neuro-fuzzy inference neural network depends on the training is performed by extracting seven invariant features from three kinds of diseased leaves images. Neural network classification is depends on invariant features.

Melike Sardogan et al [5] presents a Convolutional Neural Network algorithm and Learning Vector Quantization algorithm based method for leaf disease detection and classification of tomato plant. The dataset contains 500 tomato plant leaves images with four symptoms of diseases. They have modeled a CNN for automatic feature extraction and classification. However, for this study one of the main challenges is that the leaves with different diseases are very similar to each other. Therefore, this similarity can cause some leaves to be folded into to wrong classes.

Norfarahin Mohd Yusoff et al [6], proposes a realtime technique of edge detection for identifying Hevea leaves diseases (rubber tree leaves) in images and its hardware implementation. Three major Hevea leaves diseases which are

Corynespora Leaf Spot, Bird's Eye Leaf Spot and Collectotrichum Leaf Disease used in this study for image comparison. The disease on the leaves can be detected through edge detection by using Sobel edge detection algorithm. The real-time edge detection result generated by FPGA Cyclone IV E which is displayed through a monitor is compared to Sobel edge detection algorithm that is generated with MATLAB. However, Sobel edge detection algorithm execution depends on MATLAB and FPGA hardware and display the output on the VGA monitor.

Indumathi.R et al [7], finds the area of leaf that has been affected and also the disease that attacked the leaf. This is achieved by using Image Processing; there are systems that predict the diseases in the leaf. Our system uses K-Medoid clustering and Random Forest algorithm to produce more accuracy in the detection of disease in the leaf. The image is first pre-processed and then the clustering method is applied to find the affected area of the leaf. However, Random Forest algorithm is decision tree based algorithm. Accuracy is low compared to other algorithms. Basically random forest used with text data.

Gayatri Kuricheti et al [8], develops an algorithm for detecting and preventing the spreading of diseases to the whole crop and results in high quality crop production."The data base of different leaf images was created and processed using kMeans image segmentation and leaf images textural analysis was carried out using GLCM. SVM classifier is used to classify the feature extracted images after ranking their attributes using an information gain algorithm". However, the main disadvantage of K mean clustering algorithm is the need to fix the required number of clusters. For the extraction of part of the leaf which is infected , 3 clusters can be ideal.each cluster will denote background, healthy part and the infected part separately.

Chaowalit Khitthuk et al [9],presents plant leaf disease diagnosis system from color imagery using unsupervised neural network. Images are processed using both color and texture features. The system is mainly composed of two processes: disease feature extraction and disease classification. The process of disease feature extraction analyzes feature appearance using statistic-based gray level co-occurrence matrix and texture feature equations. The disease classification process deploys the unsupervised simplified fuzzy ARTMAP neural network to categorize types of disease. Four types of grape leaf disease images are used to test the system's classification performance which are rust, scab, downy mildew and no disease. However unsupervised feature isn't practically suitable in many classifications systems comparing to traditional backpropagation network and machine learning.

PENG JIANG et al [10] presented the apple leaf disease dataset which is composed of complex images and laboratory images under real field conditions. The dataset is first constructed via image annotation and data augmentation technologies. Based on this, a new model that uses deep-CNNs for apple leaf disease detection is proposed by introducing Rainbow concatenation and the Google Net Inception structure. Finally, under the hold-out testing dataset, using a dataset having 26,377 images of diseased apple leaves, the proposed model is trained. This model detects the five common apple leaf diseases such as Alternaria leaf spot, Brown spot, Mosaic, Grey spot, and Rust. However in this case detection failures are observed. For example an erroneous identification of Alternaria leaf spot and Grey spot. According to the confusion matrix, these two diseases are easily confused, which leads to a low recognition accuracy for both of them. The accuracy reduction is due to the similar characteristics of the diseases. The recognition accuracy is also affected by environmental factors such as complex background, lighting, and blur. In addition, the lesion's small size is one of the factors that leads to an increase in detection failures. If the leaf or the diseased area occupies only a tiny proportion of the image, the extraction and detection of the feature will be difficult.

Malik Braik [12] proposed two steps to identify the affected part of the high-resolution multispectral Sugar beet leaves disease. Initially, segmentation based on the K-means algorithm is performed on the initial image. Secondly, the diseases classification is done using the NN classifier.

Phadikar, Santanu [14] presents a new approach for plant leaf disease classification in which Hue Saturation Intensity (HIS) is used. Initial image is transformed first and then the image will be segmented using the FCM algorithm. Features used are spot color, size, and shape. Finally, classification is based on NN.

Proposed Methodology

The process of diagnosis of leaf diseases involves many tasks, such as image acquisition, preprocessing of image , image feature extraction and classification of leaf diseases is based on image feature that is color features, shape features and texture features. The first stage is the image acquisition . In this phase, image is uploaded from the images of the leaf dataset. In the second stage image preprocessing is performed using different techniques. In the third phase, features are extracted from the image for the infected part of the leaf. this is completed based on specific properties among pixels in the image or their texture. After this step, statistical analysis tasks are completed to classify the features that represent the given image. machine learning is used to compare image features. Finally, classification result shows the identified leaf disease.

A. Advantages of proposed system

- It consist of two algorithms for classification and feature extraction which effectively able to extract disease from image and gives the actual final result.
- This proposed system effectively able to extract all the spatial characteristics of an image.
- the detection accuracy using deep learning can be improved. *B. Architecture*

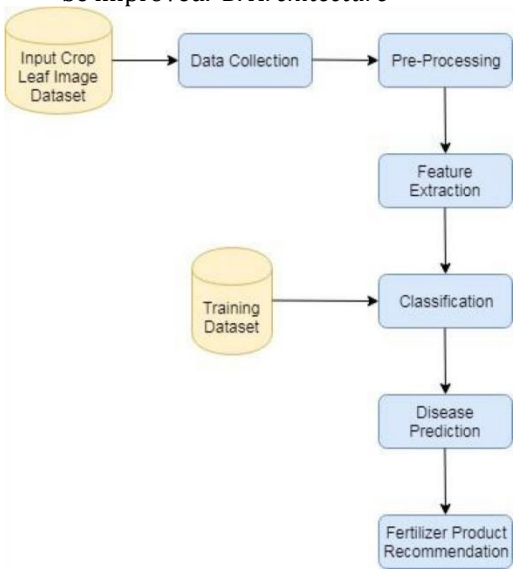

Fig. 1. Proposed System Architecture

1. Input Image:

The Input leaf Image is uploaded.

2. Image Preprocessing:

The image preprocessing methods like grayscale conversion, image noise removal for further processing are applied.

3. Image Feature Extraction:

The image thresholding and edge detection methods are applied to extract the cell nuclei from leaf image and count that.

4. Image Classification:

The image classification methods like CNN algorithm to classify the leaf diseases is applied.

5. Result:

An activation function such as softmax or sigmoid used to classify the outputs i.e. classifiy leaf disease.final leaf disease detection results are shown.

C. Mathematical Model

The mathematical model for Leaf Disease system is as
S = {I, F, O}
Where,
I = Set of image leaf dataset
F = Set of functions
O=leaf disease prediction
F = {F1, F2, F3}
F1=Data Collection,
F2=Data Preprocessing,
F3=Feature Selection,
F4=Classifification
F5=Leaf disease detection .

D. Algorithm

Convolution Neural Network(CNN)

The structure of CNN algorithm includes two layers. First is feature extraction layer, in which the input of each neuron is directly connected to the local ready fields of its previous layer and local features are extracted. Once those local features are extracted, the positional relationship present between it and other features will be displayed. The other layer is feature map layer; Every feature map in this layer is a plane, the weight of the neurons in one plane are same. The structure of feature plan uses the sigmoid function as activation function of the convolution network, which makes the feature map have shift in difference. In the convolution neural network each convolution layer is come after by a computing layer and it is used to find the local average as well as the second extract; this of two feature is unique structure which decreases the resolution..

Step1: Select the dataset.
Step2: Perform feature selection.
Step3: Apply Classification algorithm CNN
Step4: Calculate each Feature fx value of input layer
Step5: Calculate bias class of each feature
Step6: The feature map is produced and it goes to forward pass input layer
Step7: Calculate the convolution cores in a feature pattern
Step8: Produce sub sample layer and feature value.
Step9: Input deviation of the kth neuron in output layer is Back propagated.
Step10: Finally give the selected feature and classification results.

Results and Discussion

The section shows overall accuracy of CNN classification technique . So this works gives better leaf disease prediction compare to existing method.

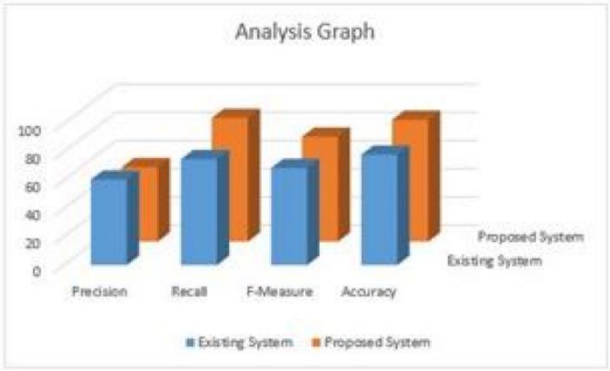

Fig. 2. CNN Classification Accuracy Graph

Table No 1..Method Comparison

	Existing System	Proposed System(CNN)
Precision	60.6	52.70
Recall	75.1	87.64
F-Measure	68.8	74.31
Accuracy	78.29	86.26

Conclusion

Here, how the disease analysis is done for the leaf diseases detection is addressed, the analysis of the different diseases that are present on the leaves can be effectively detected in the early stage before it will damage the whole plant. Here the technique presented can able to detect the disease more accurately, we can say that, we can archive good productivity by preventing the different diseases which are present on the leaves of plant using weather dataset and image processing. Accuracy of the system stands high with the ability of detecting the disease. The usage of classification and feature extraction processes has enhanced the performance of the system which provides better results

[1]. Fadzil, WM N. Wan Mohd, MS B. Shah Rizam, R. Jailani, and M. T. Nooritawati. "Orchid leaf disease detection using border segmentation techniques." In 2014 IEEE
[2]. Conference on Systems, Process and Control (ICSPC 2014), pp. 168-173. IEEE, 2014.
[3]. Parikh, Aditya, Mehul S. Raval, Chandrasinh Parmar, and Sanjay Chaudhary. "Disease detection and severity estimation in cotton plant from unconstrained images." In
[4]. Prajapati, Bhumika S., Vipul K. Dabhi, and Harshadkumar B. Prajapati. "A survey on detection and classification of cotton leaf diseases." In 2016 International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT), pp. 2499-2506. IEEE, 2016.
[5]. Rothe, P. R., and R. V. Kshirsagar. "Cotton leaf disease identification using pattern recognition techniques." In

2015 International Conference on Pervasive Computing (ICPC), pp. 1-6. IEEE, 2015.

[6]. Sardogan, Melike, Adem Tuncer, and Yunus Ozen. "Plant leaf disease detection and classification based on CNN with LVQ algorithm." In *2018 3rd International Conference on Computer Science and Engineering (UBMK)*, pp. 382-385. IEEE, 2018.

[7]. Yusoff, Norfarahin Mohd, Ili Shairah Abdul Halim, and Noor Ezan Abdullah. "Real-time Hevea Leaves Diseases Identification using Sobel Edge Algorithm on FPGA: A Preliminary Study." In *2018 9th IEEE Control and System Graduate Research Colloquium (ICSGRC)*, pp. 168-171. IEEE, 2018. [7] Indumathi, R., N. Saagari, V. Thejuswini, and R. Swarnareka. "Leaf Disease Detection and Fertilizer Suggestion." In *2019 IEEE International Conference on System, Computation, Automation and Networking (ICSCAN)*, pp. 1-7. IEEE, 2019.

[8]. Kuricheti, Gayatri, and P. Supriya. "Computer Vision Based Turmeric Leaf Disease Detection and Classification: A Step to Smart Agriculture." In *2019 3rd International Conference on Trends in Electronics and Informatics (ICOEI)*, pp. 545-549. IEEE, 2019.

[9]. Khitthuk, Chaowalit, Arthit Srikaew, Kitti Attakitmongcol, and Prayoth Kumsawat. "Plant Leaf Disease Diagnosis from Color Imagery Using CoOccurrence Matrix and Artificial Intelligence System." In *2018 International Electrical Engineering Congress (iEECON)*, pp. 1-4. IEEE, 2018.

[10]. Jiang, Peng, Yuehan Chen, Bin Liu, Dongjian He, and Chunquan Liang. "Real-Time Detection of Apple Leaf Diseases Using Deep Learning Approach Based on Improved Convolutional Neural Networks." *IEEE Access* 7 (2019): 59069-59080.

[11]. Chouhan, Siddharth Singh, Ajay Kaul, Uday Pratap Singh, and Sanjeev Jain. "Bacterial foraging optimization based radial basis function neural network (BRBFNN) for identification and classification of plant leaf diseases: An automatic approach towards plant pathology." *IEEE Access* 6 (2018): 8852-8863.

[12]. Al Bashish, Dheeb, Malik Braik, and Sulieman BaniAhmad. "Detection and classification of leaf diseases using K-means-based segmentation and." *Information*

[13]. *Technology Journal* 10, no. 2 (2011): 267-275.

[14]. Jun, Wang, and S. Wang. "Image thresholding using weighted parzen window estimation." *Applied Sci* 8 (2008): 772-779..

[15]. Phadikar, Santanu, Jaya Sil, and Asit Kumar Das. "Classification of rice leaf diseases based on morphological changes." *International Journal of Information and Electronics Engineering* 2, no. 3 (2012): 460-463.