International Journal of Electronic Devices and Networking

E-ISSN: 2708-4485
P-ISSN: 2708-4477
IJEDN 2021; 2(2): 13-16

www.electronicnetjournal.com
Received: 06-05-2021
Accepted: 10-06-2021

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Plant disease detection using deep learning and image processing

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Abstract
Plant disease, especially crop plants, may be a major threat to global food security since many diseases directly affect the standard of the fruits, grains, and so on, resulting in a decrease in agricultural productivity. Farmers need to observe and determine whether a leaf was infected by naked eyes. This process is unreliable, inconsistent, and error prone. Several works on deep learning techniques for detecting leaf diseases had been proposed. Identification of disease is extremely difficult in agriculture field. If identification is wrong then there's an enormous loss on the assembly of crop and economical value of market. Leaf disease detection requires huge amount of labor, knowledge within the plant diseases, and also require the more time interval. Leaf disease detection requires huge amount of labor, knowledge within the plant diseases, and also require the more time interval. So, we will use image processing for identification of plant disease in MATLAB. Identification of disease follows the steps like loading the image, contrast enhancement, converting RGB to HSI, extracting of features and deep learning technique. Most of them built their models supported limited resolution images using convolutional neural networks (CNNs). In this research, we aim at detecting early disease on plant leaves with small disease blobs, which may only be detected with higher resolution images, by a man-made neural network (ANN) approach. After a preprocessing step using a contrast enhancement method, all the infested blobs are segmented for the whole dataset. A list of several measurement-based features that represents the blobs are chosen and then selected based on their influence on the model's performance using a wrapper-based feature selection algorithm, which is made supported a hybrid metaheuristic. The chosen features are used as inputs for an ANN. We compare the results obtained using our methods with another approach using popular CNN models (Alex Net, VGG16, ResNet-50) enhanced with transfer learning. The main objective of the system is used to detect the disease in the leaf by using Image Processing. Experimental results obtain the Better Performance, when compared to other system.

Keywords: neural network, image classification, plant disease, feature selection

1. Introduction
India is fast developing country and agriculture is the back bone for the country's development in the early stages. Due to industrialization and globalization concepts the field is facing hurdles. On top of that the awareness and the necessity of the cultivation need to be instilled in the minds of the younger generation. Now a day's technology plays vital role in all the fields but till today we are using some old methodologies in agriculture. Identifying plant disease wrongly leads to huge loss of yield, time, money and quality of product. Identifying the condition of plant plays an important role for successful cultivation. Plant diseases are the main cause of quantity and quality losses in agricultural production. These losses negatively impact the production cost as well as the profit of the stakeholders in agriculture. However, tools for quick and accurate recognition remains scarce. The welfare and livelihoods of farmers as well as the food supply and the nutrition security of a nation are severely threatened should any kinds of disease outbreaks happen. Traditionally, farmers and plant pathologists use their eyes to detect diseases and make decisions based on their experiences, which is often not accurate and sometimes biased since in the early stage many types of diseases appear to be the same. Also, their experiences need to be passed down generations by generations. This approach leads to the Plant diseases are the main cause of quantity and quality losses in agricultural production. These losses negatively impact the production cost as well as the profit of the stakeholders in agriculture. However, tools for quick and accurate recognition remains scarce. The welfare and livelihoods of farmers as well as the food supply and the nutrition security of a nation are severely threatened should any kinds of disease outbreaks happen.

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2. Proposed Approach

Plant diseases are the main cause of quantity and quality losses in agricultural production. These losses negatively impact the production cost as well as the profit of the stakeholders in agriculture. However, tools for quick and accurate recognition remains scarce. The welfare and livelihoods of farmers as well as the food supply and the nutrition security of a nation are severely threatened should any kinds of disease outbreaks happen. Traditionally, farmers and plant pathologists use their eyes to detect diseases and make decisions based on their experiences, which is often not accurate and sometimes biased since in the early stage many types of diseases appear 15 to be the same. Also, their experiences need to be passed down generations by generations. This approach leads to the unnecessary use of pesticides, which in turn results in higher production cost. Based on these pieces of evidence, the need for an accurate disease detector associated with a reliable database to help farmers is necessary, especially for the case of young and inexperienced ones. Advances in computer vision pave the way for this with the state-of-the-art Deep learning (DL) or machine learning (ML) algorithms. There is also a need for an early disease detection system to protect the crop in time. In our proposed method, the specialized deep learning models were developed, based on specific convolutional neural networks architectures, for the detection and classification of plant diseases through leaves images of healthy or diseased plants. Our detector applied to the images captured in place by various camera devices/images taken from dataset and also collected from various resources. Our experimental results and comparisons between various deep architectures with dwt feature extractors that demonstrated how our deep-learning based detector is able to successfully recognize different categories of diseases in various plants using CNN classification and segmented the leaves using k mean clustering technique to identify the diseases.

A. Image Pre-Processing

Since the leaves have different sizes, it's necessary to perform rescaling to make sure the training and testing image have an equivalent dimension. Rescaling is performed to compress the first images to lower resolution ones, 256 256 pixels to be exact. First, the first image is segmented and converted to binary one to seek out the minimum bounding box. The vertical size of the bounding box was wont to rescale to 256 pixels to make sure the highest and bottom leaf fit exactly to the highest and bottom of the scaled image. The horizontal size of the bounding box are going to be wont to shift the leaf image into the precise center of the scaled image.

Due to various contrasts within the leaf region, the contrast enhancement method is employed to vary pixel intensities which benefit just in case of providing more information in some areas of a picture.

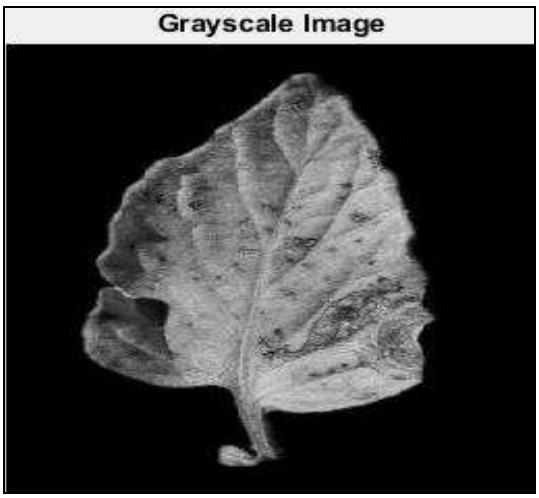

Fig 1: Pre Processed image

This Fig 1 is the sample of Pre-processed image

B. Segmentation

Segmentation means representation of the image in additional meaningful and straightforward to analyse way. In segmentation a digital image is partitioned into multiple segments can defined as super-pixels. Image segmentation is that the process of separating or grouping a picture into different parts. There are currently many various ways of performing image segmentation, starting from the straightforward thresholding method to 19 advanced color image segmentation methods. These parts normally correspond to something that humans can easily separate and consider as individual objects. Computers haven't any means of intelligently recognizing objects, then many various methods are developed so as to segment images. The segmentation process is predicated on various features found within the image. This could be color information, boundaries or segment of a picture. Segmentation of leaf image is vital while processing image from that Segmentation means partitioning of image into various a part of same features or having some similarity. The segmentation are often done using various methods like k-means clustering.

FCM clustering

Fuzzy clustering (also mentioned as soft clustering or soft k-means) may be a sort of clustering during which each datum can belong to quite one cluster. Clustering or cluster analysis involves assigning data points to clusters such items within the same cluster are as similar as possible, while items belonging to different clusters are as dissimilar as possible. Clusters are identified via similarity measures. These similarity measures include distance, connectivity, and intensity. Different similarity measures could also be chosen supported the info or the appliance. One among the foremost widely used fuzzy clustering algorithms is that the Fuzzy C-means clustering (FCM) Algorithm. The fuzzy c-

means algorithm is extremely almost like the k means algorithm: Choose variety of clusters. Assign coefficients randomly to every datum for being within the clusters. Repeat until the algorithm has converged (that is, the coefficients' change between two iterations is not any quite, the given sensitivity threshold): Compute the centroid for every cluster. For each datum, compute its coefficients of being within the clusters.

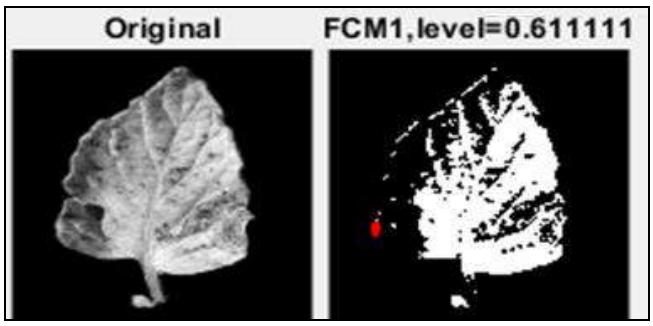

Fig 2: FCM clustering

C. Feature Extraction

The feature extraction is done in Images. The feature extraction from image is added in the suggested system. A new automatic method for disease symptom segmentation in digital photographs of plant leaves. The diseases of different plant species has mentioned. Classification is completed for few of the disease names during this system. The disease recognition for the leaf image is performed during this work. Feature extraction plays a crucial role for classification of a picture. In many applications feature extraction of image is employed. Color, texture, morphology, edges etc. are the features which can be used in plant disease classification, texture means how the color is distributed in the image, the roughness, hardness of the image. In this paper considers color, texture and morphology as a feature for disease detection. They have found that morphological result gives better result than the opposite features. It can use 21 for identify the infected plant leaf of classification plant image. A Feature Extraction can be obtained in the DWT model.

D. Classification

A classification can be obtained in the CNN models, namely AlexNet, VGG16, ResNet (ResNet-50 variant). In this work, we kept the first architecture of those CNN and only modified the last fully-connected layer of them to four nodes, consistent with the four classes in our problem. We also perform transfer learning to fine-tune the models to reinforce their performances. Transfer learning (TL) may be a solution for the shortage of coaching data in deep learning. TL means using the knowledge from a selected task to unravel another correlated task. In deep learning, TL helps the model learn the features from an outsized dataset in order that it performs better on a relevant dataset but could also be smaller in size, and this method has shown effectiveness in image classification task. In our work, the models are first trained on the Plant Village dataset. This dataset has a huge amount of data and allows the convolutional layers of the models to learn similar features effectively. Based on the Plant Village dataset, pre-trained models are created, then the models are trained one more time on our dataset to calibrate the models. The cross-entropy is applied as a loss function to estimate the error prediction after the classification layer. An identification of sort of leaf diseases using various data processing techniques is that the potential research area. The diseases of different plant species has mentioned. Classification is completed for few of the disease names during this system. The concept CNN network for classification is used in this system. Finally, the Performance analysis can be obtained. The Experimental results shows the better results, when compared to other system.

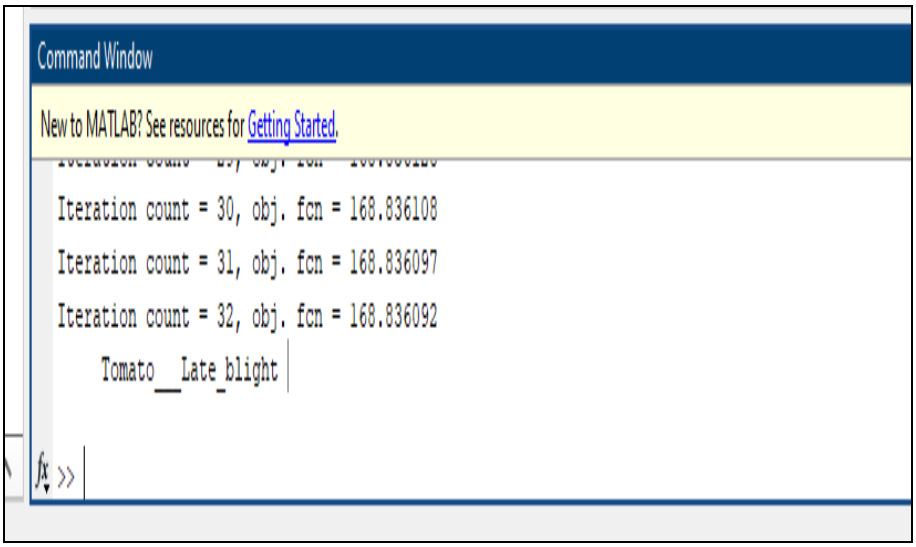

Fig 3: Result this is the sample output after applying classification.

3. Conclusion

This study summarizes major image processing used for identification of leaf diseases are k-means clustering, deep learning. This approach can significantly support an accurate detection of plant disease. There are five steps for the leaf disease identification which are said to be image acquisition, image pre-processing, segmentation, feature extraction, classification. By computing amount of disease present within the leaf, we will use sufficient amount of pesticides to effectively control the pests successively the

crop yield are going to be increased. We can extend this approach by using different algorithms for segmentation, classification. By using this idea, the disease identification is completed for all types of leafs and also the user can know the affected area of leaf in percentage by identifying the disease properly the user can rectify the problem very easy and with less cost. The approach developed outperformed deep learning models such as VGG, Alex Net, Res Net-50 obtain the result. Furthermore, the MLP network is much smaller, therefore, leads to faster performance. This is preferable since we want to implement this algorithm on resource-constrained devices such as smartphones. The Experimental results obtain the better results, when compared to the other system.

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