



Article Title: Detection of Grape Leaf Diseases Using a Traditional Neural Network

Detection of Grape Leaf Diseases Using a Traditional Neural Network

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ABSTRACT

Having diseases is quite natural in crops due to changing climatic and environmental conditions. Diseases affect the growth and produce of the crops and often difficult to control. To ensure good quality and high production, it is necessary to have accurate disease diagnosis and control actions to prevent them in time. Grape which is widely grown crop in India and it may be affected by different types of diseases on leaf, stem and fruit. Leaf diseases which are the early symptoms caused due to fungi, bacteria and virus. So, there is a need to have an automatic system that can be used to detect the type of diseases and to take appropriate actions. This project proposes an automatic system for detecting the disease in the grape leaf using convolutional neural network. The CNN classified image is fed to the image processing operation. In image processing operation block Gaussian filter is used. The fuzzy inference system segments the processed image using Fuzzy c-means segmentation. A healthy leaf percentage are discovered using the fuzzy inference approach. This project is implemented with MATLAB simulation software and the output reveals the healthy percentage.

Keywords: CNN classification, Fuzzy c-means segmentation.

1 Introduction

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. Farmers and plant pathologists have traditionally relied on their eyes to spot illnesses and made decisions based on their past experiences, which is frequently inaccurate and occasionally biased because many diseases first look similar. This approach leads to the unnecessary use of pesticides, which in turn results in higher production cost. Due to developments in computer vision the most cutting-edge Deep Learning (DL) algorithms or Machine Learning (ML) enable this problems. There is also a need for an early disease detection system to protect the crop in time. A convolutional neural network (CNN) classifier is used, in order to categorize the image and detect different disease kinds.



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2 Related Work

S. Mousaviet *al* [2022] a novel Enhanced VGG16 model for detecting, identifying, and classifying three widespread diseases in grape leaves. Faster R-CNN has the bestm AP, accuracy, and precision among other networks. Small changes in the input value significantly impact the loss function. [1]P. Jianget *al* [2019] a deep learning approach that is based on improved convolutional neural networks (CNNs) for the real-time detection of apple leaf diseases. Apple leaf diseases with high accuracy in real time and provides a feasible solution for the real-time detection of apple leaf diseases. The running speed of Faster R-CNN is slow, thereby weakening the real-time detection performance. [2]T. N. Pham *et al* [2022] a multi-class mango leaf disease classification using deep neural networks is proposed. The MLP network is much smaller, therefore, leads to faster performance. Working with plantations to obtain a more diverse dataset. Needs to build a complete disease monitoring system that can be deployed on several platforms. [4]

H. Amin *et al* [2022] an end-to-end deep learning model is developed to identify healthy and unhealthy corn plant leaves while taking into consideration the number of parameters of the model. Achieve a classification accuracy of 98.56%which shows the superiority of the proposed model over ResNet152 and InceptionV3. The rapid identification of plant diseases are mains challenging and time-consuming. [3]S. Barburiceanu *et al* [2021] a deep-learning-based method for texture classification with performance compatible with real-time processing scenarios is proposed. This method proves to be significantly more efficient in terms of processing times and discriminative power. The size of the corresponding feature vectors is larger, which implies longer processing times. [5]R. R. Patilet *al* [2022] Rice-Fusion framework is an AI-based multimodal data fusion model in the agricultural domain used to diagnose different rice diseases automatically. Early fusion type of multi modal data fusion technique is used to detectriced is eases based on the environmental features extracted from the MLP framework and image features extracted from the CNN framework. The model needs to classify rice diseases accurately by accepting inputs from multiple modes. [6]

3 Proposed Methodology

In this project, a grape leaf disease detection using convolutional neural network is developed. The input image data set is fed to the convolutional neural network classifier. The input image is detected and evaluate specific disease types. In convolutional neural network classifier, the input dataset is converted to Matlab file. Training progress is achieved in the CNN classifier. After identifying the disease and disease types the classified image is fed to the image processing operation block. The processed image is segmented by the fuzzy inference approach. The fuzzy inference approach discovers the healthy leaf percentage. At last, the healthy leaf percentage and disease type is identified.



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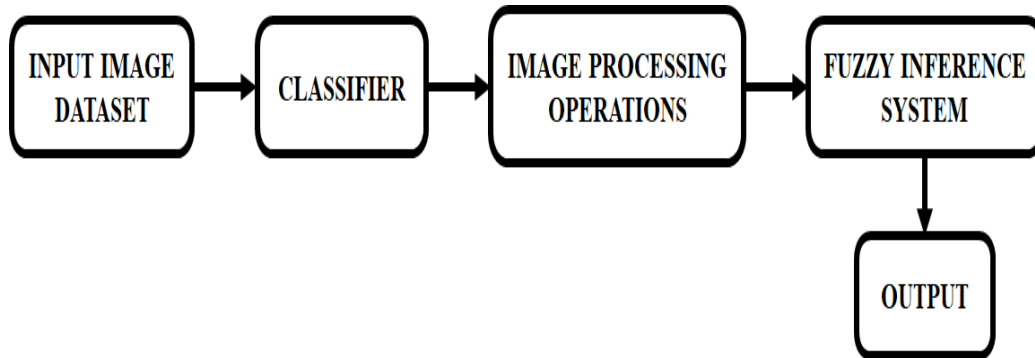


Figure 1: Block Diagram for proposed system

3.1 CNN Classifier

A convolutional neural network can have tens or hundreds of layers that each learn to detect different features of an image. Filters are applied to each training image at different resolutions, and the output of each convolved image is used as the input to the next layer. The filter scan start as very simple features, such as brightness and edges, and increase in complexity to features that uniquely define the object. A CNN is composed of an input layer, an output layer, and many hidden layers in between. Convolution puts the input images through a set of convolutional filters, each of which activates certain features from the images. Rectified linear unit (ReLU) allows for faster and more effective training by mapping negative values to zero and maintaining positive values. This is sometimes referred to as activation, because only the activated features are carried forward into the next layer. Pooling simplifies the output by performing nonlinear down sampling, reducing the number of parameters that the network needs to learn.

3.2 Image Processing Operations

Image processing is the process of transforming an image into a digital form and performing certain operations to get some useful information from it. The image processing system usually treats all images as 2D signals when applying certain predetermined signal processing methods. Segmentation is one of the most difficult steps of image processing. It involves partitioning an image into its constituent parts or objects.

3.3 Fuzzy Inference System

Fuzzy inference is the process of formulating the mapping from a given input to an output using fuzzy logic. The mapping then provides a basis from which decisions can be made, or patterns discerned.



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Figure 2: Training Progress

The CNN learning process is displayed along with its accuracy and loss calculations. The learning process accuracy in this Fig. is greater than 80%, and any loss in image quality is indicated.

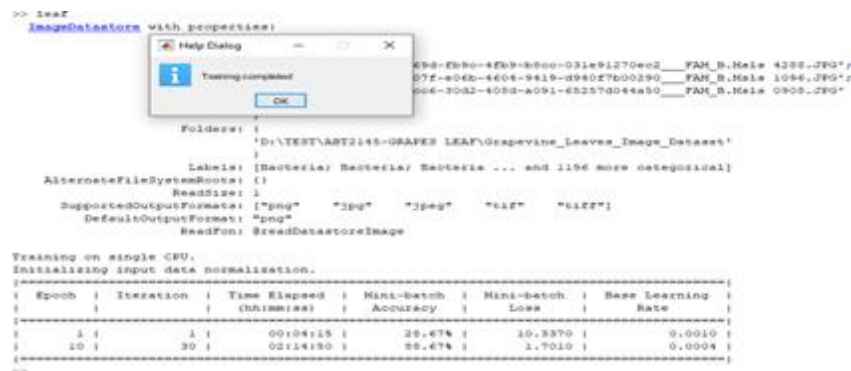


Figure 3: Image data store

The CNN classifier has completed its training. The progress is displayed in the traditional format, with the 1 epoch having 28.67% and the 10 epoch having 88.67%

4 Experimental Results

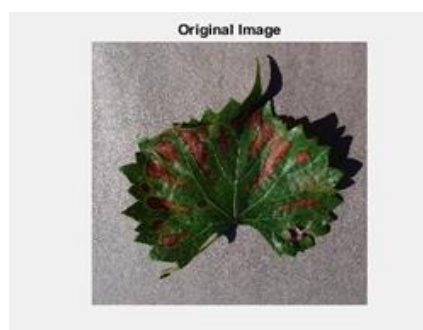


Figure 4(a): Original Image



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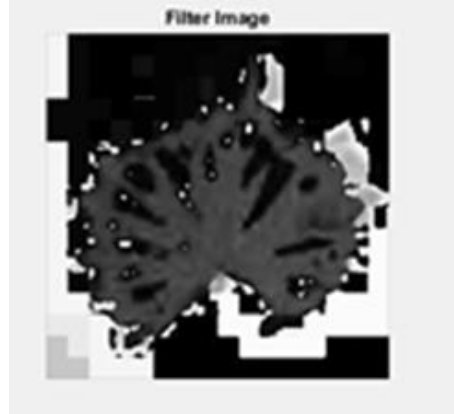


Figure 4(b): *Filter Image*

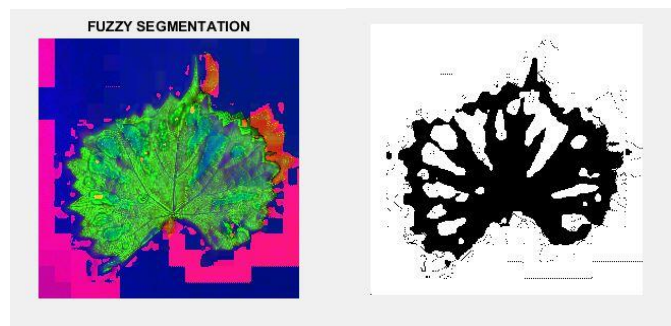


Figure 4(c): *Fuzzy Segmentation*

In FCM segmentation the image is segmented to reduce the complexity of the image.

```
>> Main_Code
    The disease on the leaf is caused by:      Bacteria
    The leaf is 77.7205% Healthy
>> |
```

Figure 4(d): *Output of grape leaf disease*

In the output, it is shown that the disease caused in the leaf is Bacteria and the healthy leaf percentage of the grape leaf is 77.7205%.

5 Conclusion and Future Work

In this project, four types of grape leaves have been categorised. The use of convolutional neural networks is proposed as a method for detecting grape leaf disease. In this process, CNN-classified images are processed efficiently, and a Gaussian filter is employed to detect



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the disease. An image segmentation approach based on fuzzy inference is applied to the processed image. The percentage of healthy leaves on grape leaves is calculated using fuzzy inference. The project is implemented using MATLAB simulation software, and the outcome shows the percentage of healthy leaves. In future work, it would be beneficial to use more types of grape leaf disease, as well as other algorithms and deep learning structures. To improve accuracy, future work will also incorporate transfer learning techniques.

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