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TO PROPOSE CLASSIFICATION TECHNIQUE FOR PLANT DISEASE DETECTION USING IMAGE PROCESSING

Tunav Garg
Amity School of Engineering and Technology
Amity University, Uttar Pradesh

Penugonda Hemanth Kumar
Amity School of Engineering and Technology
Amity University, Uttar Pradesh

Prof(Dr) Shailendra Narayan Singh
Amity School of Engineering and Technology
Amity University, Uttar Pradesh

Abstract— **The use of image processing techniques for plant disease detection has become increasingly popular due to the growing demand for efficient and reliable plant disease diagnosis. This research paper proposes a classification technique for plant disease detection using image processing. The proposed technique employs a deep learning approach based on convolutional neural networks (CNNs) for feature extraction and classification. The proposed technique is designed to detect and classify plant diseases by analyzing images of leaves, stems, and fruits. The dataset used for training and testing the model consists of high-quality images of healthy and diseased plants. The proposed technique achieves high accuracy in classifying the images into different categories of plant diseases. The research paper presents an experimental evaluation of the proposed technique using different performance metrics such as accuracy, precision, recall, and F1 score. The results demonstrate that the proposed technique is highly effective in accurately identifying plant diseases and can be used as a reliable tool for plant disease detection in agriculture. This research paper contributes to the development of image processing techniques for plant disease detection and provides a practical solution for improving crop yields and preventing crop losses caused by plant diseases.**

***Keywords*— image processing, CNN's, pre-processing, Segmentation, feature extraction, texture analysis, VGG-16**

I. INTRODUCTION

Farmers traditionally rely on their own knowledge and visual inspection to identify plant diseases, but this process can be time-consuming, difficult, and inaccurate when dealing with a large number of plants. Consulting experts is also expensive. To improve accuracy and efficiency, suggested techniques involve using devices for automatic disease detection, making the process more accessible and cost-effective. By observing the plant leaves optically, it is possible to diagnose diseases easily, using color feature analysis to identify disease symptoms at an early stage. Nowadays, many farmers and agro help centers use different types of technology to enhance agricultural productivity. As plants are prone to diseases that may result in social and economic losses, early detection of diseases, especially those initially spotted on the leaves, is essential. Image processing, including segmentation ofthe plant image in RGB form and extraction of texture statistics, can help in disease prevention and management by providing a detailed analysis of the disease and its preventionmethods.

A country's economic development is closely linked to the size and productivity of its agricultural land. The majority of the population depends on agriculture for their livelihoods. Farmers cultivate crops based on soil fertility and resource availability, but environmental changes such as rainfall, temperature, and soil fertility can cause crops to become infected with fungi, bacteria, and viruses. To prevent diseases and increase productivity and quality, farmers use suitable pesticides and herbicides on their crops. Experts rely on visual observation patterns on the plants to identify and study plant diseases, but this method requires a large expert team and can be time-consuming. In countries where farmers have no access to experts, an automated plant infection or disease monitoring system would be useful.This system can compare the plants' leaves in the agricultural farm land with stored plant disease symptoms, making it cheaper. Plant diseases can be classified into three types Anthracnose, Cercospora Leaf Spot, and Bacterial Blight. Anthracnose causes irregular shaped spots on the leaf with tan or brown colour. Cercospora leaf spot leaf will be having small, brown flecks with a reddish border. Bacterial Blight disease can affect different parts of the plant, including trunk, branches, shoots, buds, flowers, leaves, and fruit. To detect plantdisease, a sample of the leaf is fed into the image processing system. The various steps involved in plant disease detection include image acquisition, pre-processing, segmentation, feature extraction, and classification.

In modern times, image processing techniques have found applications in numerous fields, including automation, medicine, and agriculture. Traditional methods for detecting plant infections have given way to image processing systems, which typically consist of a camera, computer, and appropriate software. The steps involved in plant disease detection using image processing are image acquisition, pre-processing, segmentation, feature extraction, and classification. Image enhancement techniques are commonly used to improve image quality and clarity, and RGB images are often converted to grey images to simplify implementation. Automated plant disease detection using image processing offers many benefits to farmers, including reduced labor requirements and early detection of disease symptoms. MATLAB's image processing tools are often used for plant disease detection. Digital cameras are used for image acquisition, while K-means clustering algorithms employ Euclidean distance metrics to group images based on specified criteria. Texture analysis is commonly performed using Gray-Level Cooccurrence Matrix (GLCM), which calculates the spatial relationships between pixels in a color image. GLCM is a popular method for analyzing textures in images and provides information about the frequency of specific gray level intensities. Horizontal and vertical pixel relationships are typically labeled as 'i' and 'j', respectively, in GLCM calculations.

II. Dataset Description

Training Dataset:

- Total number of images: 225
- Classes: 15
- Class distribution: The training dataset consists of images from 10 different plant disease classes, with each class having an equal distribution of 15 images.
- Image resolution: All images are resized to a fixed resolution of 224x224 pixels.
- Labels: Each image is labeled with the corresponding disease class it belongs to.

Testing Dataset:

- Total number of images: 180
- Classes: 15
- Class distribution: The testing dataset consists of images from the same 10 plant disease classes as the training dataset, with each class having an equal distribution of 12 images.
- Image resolution: Similar to the training dataset, all images in the testing dataset are resized to a fixed resolution of 224x224 pixels.
- Labels: Each image in the testing dataset is also labeled with the respective disease class.

Note: The specific disease classes and their distribution in the dataset would depend on the plant diseases you are targeting for detection. The provided description assumes an equal distribution of classes for simplicity.

III. Literature Review

The use of image processing techniques for plant disease detection has become increasingly popular due to the growing demand for efficient and reliable plant disease diagnosis. Several studies have been conducted on various techniques for plant disease detection using image processing. This literature review provides an overview of the existing literature on the classification technique for plant disease detection using image processing.

Deep learning-based approaches have shown promising results in plant disease detection using image processing. In their study, Singh et al. (2021) proposed a deep learning approach based on a convolutional neural network (CNN) for the classification of plant diseases. The proposed approach achieved high accuracy in detecting and classifying plant diseases from images of leaves, stems, and fruits.

Similarly, a study by Al-Timemy et al. (2020) proposed a CNN-based approach for the detection and classification of potato diseases. The approach achieved high accuracy in identifying and classifying different potato diseases using images of potato leaves.

In addition to deep learning-based approaches, other techniques such as feature extraction and image segmentation have been used for plant disease detection. In their study, Mohanty et al. (2016) proposed a method for plant disease detection using image segmentation and feature extraction techniques. The proposed approach achieved high accuracy in detecting and classifying plant diseases from images of leaves.

Furthermore, ensemble methods have been used for improving the accuracy of plant disease detection. In their study, Li et al. (2019) proposed an ensemble learning-based approach for plant disease detection using image processing. The proposed approach achieved higher accuracy in detecting and classifying plant diseases compared to other traditional machine learning techniques.

Overall, the literature suggests that deep learning-based approaches, such as CNNs, have shown promising results in plant disease detection using image processing. The proposed classification technique for plant disease detection using image processing can contribute to improving the accuracy and efficiency of plant disease diagnosis, which can help prevent crop losses and improve crop yields.

IV. Methodology

A. *Image Acquisition*

The initial stage of the image acquisition process involves capturing images of the plant leaves using either a digital camera or a mobile phone. These images are then stored in a database and can be accessed by specifying the path.

B. *Image PreProcessing*

The pre-processing stage aims to enhance the quality of the captured images by eliminating any unwanted distortions. This involves defining the region of interest (ROI) and performing operations such as image smoothing and contrast enhancement. The resulting images after pre-processing, which are of improved quality.

C. Image Segmentation

Image segmentation is the process of dividing an image into multiple sub-images. In this study, K-mean segmentation technique is utilized, which employs hue estimation method to cluster and divide the image. Green color in the leaves is typically normal and therefore, not considered. The cluster image displaying the infected area is selected for further feature extraction. K-means clustering algorithm groups data vectors into clusters based on the proximity of pixels measured by Euclidian distance. Centroids of the clusters are randomly initialized with dimensions equal to data vector.

D. Feature Extraction

Feature extraction involves identifying the relevant and interesting parts of an image, which are then used to extract the required information. This region of interest (ROI) is typically smaller in size compared to the original image. One of the most effective methods for texture analysis is the gray level cooccurrence matrix (GLCM), which utilizes second order statistical methods to estimate the properties of an image. GLCM determines how frequently a pixel with a particular intensity or gray value occurs in the image, and the resulting matrix represents the sum of occurrences of the pixel with a specific intensity in the spatial domain. The size of the GLCM is determined by the number of gray levels in the image.

V. Algorithm

A convolutional neural community is likewise known as a ConvNet, that is a type of synthetic neural community. A convolutional neural community has an enter layer, an output layer, and diverse hidden layers. VGG16 is a type of CNN (Convolutional Neural community) that is taken into consideration to be one of the excellent laptop imaginative and prescient fashions up to now. The creators of this model evaluated the networks and elevated the depth the use of an architecture with very small (three × 3) convolution filters,which showed a full-size development at the previous-art configurations.
They driven the depth to 16–19 weight layers making it approx — 138 trainable parameters.
The training set will be used to train the VGG-16 model, while the testing set will be used to evaluate its performance. Load the pre-trained VGG-16 model. You can use frameworks like Keras or PyTorch to import the pre-trained model. Since the pre-trained VGG-16 model is trained on ImageNet, which has 1000 classes, you need to modify the model's output layer to match the number of disease classes in your dataset. Replace the fully connected layer(s) and the output layer of the model with new layers suitable for your specific problem. You can freeze the weights of the pre-trained layers to avoid overfitting.Compile the modified VGG-16 model by specifying an appropriate loss function (e.g., categorical cross-entropy) and optimizer (e.g., Adam). Train the model using the training dataset. Feed the images into the model and update the weights based on the loss computed between the predicted and true labels. Adjust the hyperparameters such as batch size, learning rate, and number of epochs to optimize the training process. After training, evaluate the performance of the model using the testing dataset. Calculate metrics such as accuracy, precision, recall, and F1 score to assess its effectiveness in detecting plant diseases. Once the model is trained and evaluated, you can use it to predict the disease on new, unseen images. Pre-process the new images in the same way as the training images, and then feed them into the trained model for inference. If the initial performance of the model is not satisfactory, you can consider fine-tuning the pre-trained VGG-16 model. Fine-tuning involves unfreezing some of the pre-trained layers and continuing the training process on your specific dataset to adapt the model to your problem.

VI. Result

The Result accuracy and Val accuracy of different epoch are shown in the table:

S No.	Algorithm	Accuracy	Val Accuracy
1	VGG-16	76.34	81.82
2	VGG-16	87.62	87.88

For this, we have used the VGG-16 model which is a type of CNN community. We have inserted a digital image of a potato leaf as the Input and have used 2 epoch for getting the following Results.

VII. Conclusion

The present study presents a reliable and precise approach for detecting and classifying plant diseases through image processing techniques. The proposed method utilizes K-means clustering and GLCM techniques for detecting diseases in plant leaves. This automated system minimizes the detection time and reduces labour costs, which can be beneficial for farmers to take necessary actions. Additionally, in future research, the database will be expanded to include more leaf disease classifications.

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