Plant Leaf Disease Detection Using Computer Vision Techniques and Machine Learning

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ABSTRACT: Agriculture plays a vital role in the economy of the country. It is the main source of food to sustain on earth. It needs to be preserved. In recent days there were some downfall in the field of agriculture, due to variuos reasons as rainfall, flood, fertilizers, diseases in plants and various other reasons. Hence in order to improve the productivity and economy of the country, it is necessary to predict the diseases in plants at an early stage. Early detection of disease in plants is critical in the field of agriculture. The automatic disease detection at an early-stage is helpful as it decreases the great effort of supervising in large farmhouses of yields. Using digital image processing techniques and machine learning algorithms, the authors presented a method for detecting plant diseases at an early stage. The presented system for plant disease detection is simple and computationally efficient which requires less time for prediction than other deep learning-based approaches. The accuracies of various plant and leaf diseases are calculated and presented in this paper.

Keywords: Machine learning algorithms, CNN.

1.INTRODUCTION:

Developed countries are now putting more money into agriculture. Early detection of plant diseases is critical to avoid losses during the harvest. Different lesions on the leaf can be seen in the early stages of the plant disease. Physically detecting plant diseases is extremely difficult [1] It necessitates a significant amount of effort, knowledge of plant diseases, and an inordinate amount of time. The use of image processing aids in the accurate detection of plant diseases. The strategies for detecting plant diseases using their leaf pictures are presented in this paper. Image processing is a method of performing a few operations on a photograph to obtain a better photograph or extract a few useful records from it. A subset of Artificial Intelligence, machine learning (ML), works automatically or gives instructions to complete a task. Machine learning's main goal is to comprehend training data and fit that data into models that should be useful to people. Machine learning aids in the automatic detection of plant diseases [2]. It has aided good decision-making and forecasting due to the large amount of data generated. The color of the leaves, the amount of damage to the leaves, and the area of the unhealthy plant leaf are used to classify them. The system shown here is useful for monitoring large crop fields. The proposed solution for plant disease detection is less computationally expensive and takes less time to predict than other deep learning approaches because it uses statistical machine Learning and image processing algorithm.

2. LITERATURE REVIEW:

Shima Ramesh et. al. implemented a technique using Random Forest for plant disease detection [6]. They created the dataset and extracted the features using the Histogram of an Oriented Gradient (HOG). The final classification was performed using different classifiers yielding maximum accuracy of about 70%.

Kothawale, et al. presented a system for detecting and classifying grape leaf disease using a support vector machine (SVM) classifier [3]. The leaf area is obtained using histogram thresholding, Grey Level Co-occurrence Matrix (GLCM) is employed for the feature extraction. They classified each image as healthy or affected and achieved an accuracy of 89.90%

Kusumo et. al. proposed a method for the disease detection of corn-plant [9]. In this technique, the features based on color, SIFT, speeded-up robust features (SURF), and object detectors such as HOG are utilized. They performed the performance analysis using various classifiers and achieved maximum accuracy of 87%. H. Sabrol and S. Kumarn presented a decision tree

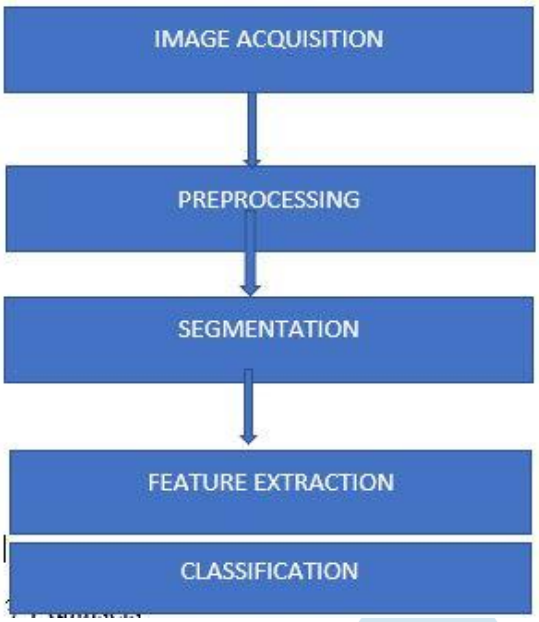
Pavithra, et al. implemented a method for rice leaf disease detection [4]. The shape and color-based features were extracted using Scale Invariant Feature Transform (SIFT). They have performed experimentation using SVM and Artificial Neural Network (ANN) classifiers and achieved accuracies of 95.2% and 92.2% respectively.

Islam et. al. presented a Multiclass Support Vector Machine-based method for detection of Potato Diseases [5]. Their experimentation performed on the public database 'Plant Village' yielded an accuracy of 95%.

3.METHODOLOGY:

Various steps involved in the proposed method for leaf disease detection is implemented as follows,

(i) Image Acquisition/
(ii) Preprocessing
(iii) Segmentation
(iv) Feature Extraction
(v) Classification



3.1 datasets:

The proposed method was carried out with the help of a publicly available dataset , which was curated by Sharada P. Mohanty et al. [2].The dataset contains 87000 RGB images of healthy and unhealthy plant leaves divided into 38 classes.

3.2 preprocessing:

In any computer vision-based system, data preprocessing is essential. The preprocessing steps for each image are depicted. Before extracting features, background noise should be removed to ensure precise results. The given RGB image was first converted to grayscale image, and then the image is smoothed with a Gaussian filter. After that, Otsu's thresholding algorithm is used to binarize the image. The morphological transform operation is then performed on the binarized image to fill in the small holes of the foreground. Following foreground detection, a bitwise AND operation on the binarized image and the original color image yields the RGB image of the segmented leaf. The shape, texture, and color characteristics of the image are extracted.

Contours are used to calculate the area and perimeter of the leaf. The lines that run along the edges of objects that are all the same colour or intensity are known as contours. In an RGB image, the mean and standard deviation of each channel are calculated. The texture features were extracted from the grey level cooccurrence matrix after the colour features were extracted from the image (GLCM).The image's unique pixel relationship is represented by the GLCM. Extracting texture features from GCLM is a traditional method in computer vision. Contrast, Dissimilarity, and other characteristics were extracted from GCLM. Homogeneity, Energy and Correlation.

3.3 Feature extraction:

The features characterize appropriate & refined qualities/evidence related to objects, distinguishing one object from other objects. The features are supportive of identifying objects and labeling the category tag to an object. The feature abstraction stage is most substantial in making the classification/recognition model and searching for the extraction of relevant attributes characterizing each class. The features used in the presented system are explained as follows.

1.Grey Level Co-occurrence Matrix (GLCM):

It is used in a series of "second-order" texture calculations to measure the combinations of picture element brightness values (grey levels) that occur in a picture. The matrices are used to figure out how pixels are related spatially. The GLCM technique is extremely sensitive to any changes in the images, such as rotation, scale, and so on. By observing repeating patterns, spatial distribution, colour arrangement, and intensity, we can visually distinguish the texture of an image.

2.Shape Features:

For the calculation of the shape feature, we have used the contour. Contours are described as a curve joining all the continuous points (along the boundary), having the same color or intensity. The contours are a useful tool for shape analysis and object detection and recognition.

3.Statistical and Color Feature:

The standard statistical feature such as mean, median, and standard deviation are utilized here. The color feature is extracted as the amount of green color in the leaf. The RGB value of true Green color is (0,255,0). But the actual images there is always variation in the image color values due to various lighting conditions. Channel pixel intensity is between 30 and 70. Subtracting the green color portion from one yields the non-green portion of the image

The correlation matrix can be used to predict how features are related to one another. In all machine learning problems, feature selection is critical. The features are selected based on the variables' correlation with the target variable.

3.4 classical model development:

For classification, CNN and SVM classifier was used, which is very efficient in performing classification.

4 RESULT & DISCUSSION:

The proposed algorithm is tested on a database of 300 images of different leaves taken from the publicly available dataset which includes 100 healthy and 200 diseased leaves. The database was divided into two sets during the experiment: the training set, which contained 180 images (70 percent), and the testing set, which contained 120 images (30 percent). The accuracy, sensitivity, recall,

F1-score, and precision of the presented system were calculated to evaluate its performance. The classification testing accuracy is 95 percent when the train-test split is 60 percent -40 percent. Furthermore, 5-fold cross-validation was used to make the model more robust, and 93.7 percent accuracy.

Models	Accuracy	Precision	Sensitivity	F1 score
SVM	82.5%	84.5%	90.6%	87.6%
CNN	96.1%	95%	88%	92%

5 CONCLUSION:

In this paper, the authors proposed a new approach to identify the occurrence of diseases in plants at an early stage. Various steps involve in the proposed method were, image acquisition, Preprocessing, Segmentation, Feature extraction and classification. The best results were obtained with very little computational effort, demonstrating the efficacy of the proposed algorithm in the recognition and classification. Another benefit of using this method is that plant diseases can be detected at an early or early stage. Classification operation is performed with CNN and SVM classifier and their performance is evaluated. It is evident from their result that the performance of CNN classifier was best in terms of accuracy when compared to SVM classifier.

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