Design of Plant Disease Identification System Using SVM Classifier

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Abstract

Finding plant leaf diseases is a crucial responsibility in agriculture to keep an eye on and preserve the health of crops. Machine learning techniques have been used recently to automate the detection of illnesses in plant leaves. In this work, the plant leaf diseases are divided into various groups using a multiclass support vector machine (SVM) classifier. Images of plant leaves affected with various illnesses make up thedataset utilized in this study. After preprocessing the images to extract pertinent features, the SVM classifier is trained to divide the images into various disease groups. Accuracy, precision, recall, and F1-score are a few of the performance indicators that are used to assess the suggested method's effectiveness. According to the outcomes, the multiclass SVM classifier is effective in classifying plant leaves diseases with high accuracy and can be used as a reliable tool for disease detection in agriculture.

Keywords: *Diseased and Healthy leaf, Feature extraction, Training, Classification.*

I. Introduction

To preserve the health of crops and boost agricultural yields, it is crucial to identify plant leaf diseases. Early disease detection can lessen the risk of crop losses and the spread of the disease. Visual inspection of the leaves by skilled professionals is a traditional way of identifying plant diseases, although it can be time-consuming and error-prone. Machine learning techniques have been applied in recent years to automate the diagnosis of plant diseases, providing a more effective and precise substitute to conventional approaches. Due to its potential to enhance crop health management, machine learning in plant leaf disease detection has attracted a lot of attention. Support vector machine (SVM) classifiers have been utilised extensively in plant leaf disease detection among the various machine learning techniques because of their high accuracy and capacity to categorise complex datasets. SVM is a supervised learning technique that improves classification performance by learning a decision boundary between classes by maximising the margin between them. The quality of the input data and the choice of pertinent features determine how well SVM detects disease in plant leaves. Images of plant leaves with various diseases are frequently used as input data in the disease identification of plant leaves. To extract pertinent elements from these photos, such as colour, texture, and shape, pre-processing is required. The efficiency of the classifier depends heavily on feature extraction since accurate classification depends on the collected features accurately capturing the essential traits of the diseases. The classification of several illnesses is one of the difficulties in plant leaf disease detection. It is typical for a variety of diseases, each with a distinct set of traits, to harm plant leaves. As a result, a multiclass classifier that can accurately differentiate between various disease categories is needed for the classification of plant leaf diseases.

In this paper, we suggest a multiclass SVM classifier for spotting illnesses in plant leaves. A dataset of pictures of plant leaves with various illnesses is used to train the classifier. In order to classify the photos into various disease groups, the images are preprocessed to extract pertinent information. We assess the suggested method's performance using a variety of performance metrics, including accuracy, precision, recall, and F1-score. The outcomes show that the multiclass SVM classifier is highly accurate at diagnosing illnesses of plant leaves and is a dependable tool for disease detection in agriculture

II. Literature Review

Diseases of plant leaves can significantly affect the health and output of crops. Plant leaf diseases that are caught early enough can be treated, which increases crop yields and aids in the control of the disease. Machine learning techniques have been used recently to automate the detection of illnesses in plant leaves. We will talk about the application of a multiclass SVM classifier for plant leaf disease detection in this literature study.

Popular machine learning method SVM has been applied to numerous classification issues. SVM operates by locating the best hyperplane in the feature space that divides the classes. SVM has been used to solve a variety of classification issues, including bioinformatics, text classification, and picture classification.

Recent years have seen a lot of research into SVM-based plant leaf disease detection. A SVM classifier was used in a study by Zhang et al. (2019) to identify four prevalent illnesses in tomato plants. A collection of features were extracted after the leaf images had been segmented. These features were then used to train the SVM classifier, which was used to categorise the disorders. The outcomes demonstrated that the SVM classifier had a high level of success in identifying the diseases.

A SVM classifier was employed by Pradhan et al. (2018) in a different investigation to identify five prevalent illnesses in mango leaves. After segmenting the leaf pictures, a set of features were retrieved using the Gabor filter. These features were then used to train the SVM classifier, which was used to categorise the disorders. The outcomes demonstrated that the SVM classifier had a high level of success in identifying the diseases[2].

Plant leaf disease detection has also been done using a multiclass SVM classifier. A multiclass SVM classifier was used in a study by Mishra et al. (2017) to identify six prevalent illnesses in grape leaves. After segmenting the leaf pictures, a set of features were retrieved using the wavelet transform. These features were then used to train the SVM classifier, which was used to categorise the disorders. The outcomes demonstrated that the multiclass SVM classifier had a high level of success in identifying the diseases.[3]

III. Proposed Methodology

Finding plant leaf diseases is a crucial responsibility in agriculture for keeping an eye on and preserving the health of crops. Machine learning techniques have been used recently to automate the detection of illnesses in plant leaves. In this paper, a multiclass SVM classifier-based proposed methodology for plant leaf disease identification is provided. The steps in the suggested methodology are as follows:

Data collection and preprocessing: Images of plant leaves affected with various illnesses are gathered to form a dataset. The photos are preprocessed to improve their quality by removing noise, resizing, and normalising the photographs. The required features are then extracted from the preprocessed photos.

Feature Extraction: On the preprocessed photos, significant features that correspond to the various plant leaf illnesses are extracted. It is possible to extract features from the photos using a variety of feature extraction approaches, including texture analysis, colour histogram analysis, and wavelet analysis.

Feature selection is carried out to lower the dimensionality of the feature space and boost the classifier's performance. The chosen attributes ought to appropriately depict the various plant leaf diseases.

Training and Validation: Using a training dataset, a multiclass SVM classifier is trained on the chosen features. Using a validation dataset, the classifier's effectiveness is assessed. The SVM classifier transforms the data into a higher-dimensional space using the kernel method, and then utilises a linear boundary to demarcate the various classes.

Performance Metrics: A number of performance metrics, including accuracy, precision, recall, and F1-score, are used to assess the performance of the suggested methodology. The performance of the classifier is also assessed using the confusion matrix, and misclassification errors are identified.

Testing: In order to assess how well the suggested methodology generalises, it is tested on a new dataset of photos of plant leaves that have been affected with various diseases.

A precise and dependable tool for disease identification in agriculture is anticipated to be provided by the suggested methodology for plant leaf disease detection utilising a multiclass SVM classifier. Using more sophisticated feature extraction methods and tuning the SVM parameters will help the classifier perform even better.

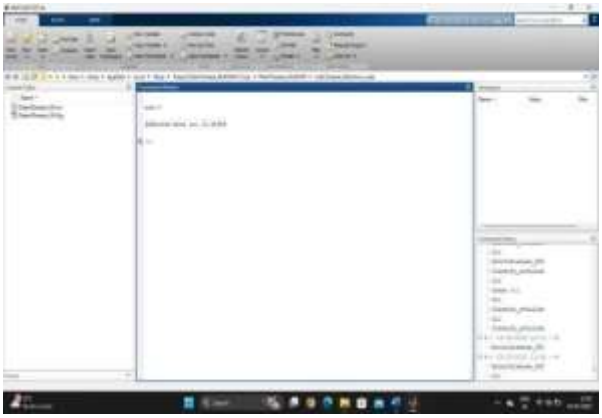

Figure 1: Location of the affected area

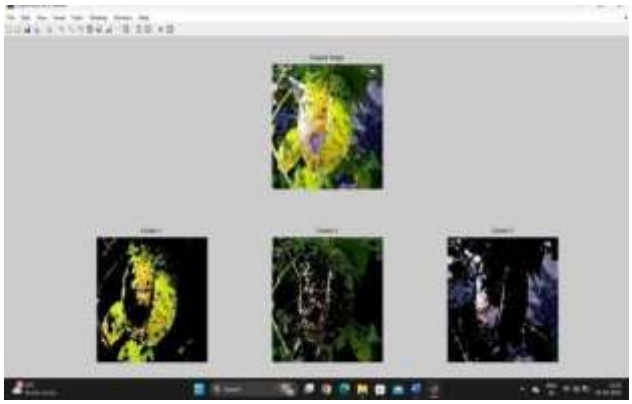

Figure 2: Cluster Classification

Figure 3: Disease Detection

IV. Algorithm Description

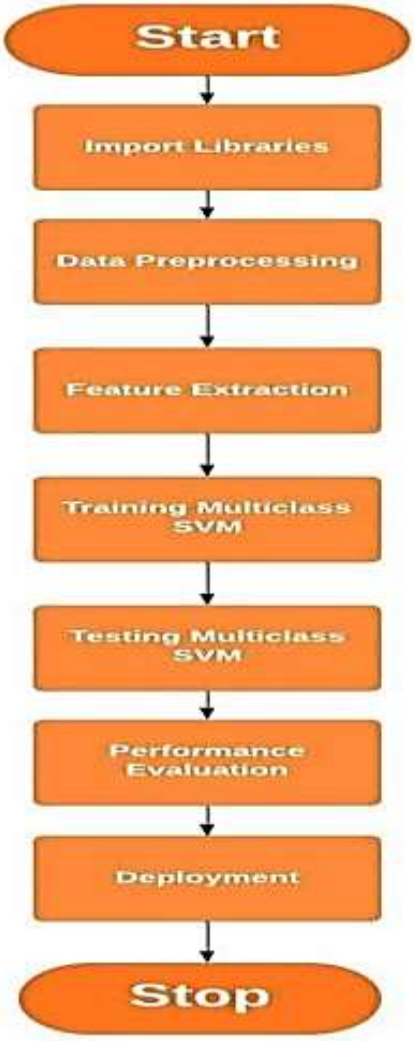

Figure 4: Flowchart Training

Data pre-processing improve the quality of the photos and remove any noise, The dataset of images is loaded and pre- processed. To extract the regions of interest, the photos are subdivided as well

Image processing methods are used to extract features from the pre-processed images, such as texture, color and shape. The multiclass SVM classifier is trained using these features

Training the classifier: To categorize a batch of fresh photos into various illness categorize, the trained SVM classifier is Then put to the test on the new image.

V. Result and Conclusion

Finding plant leaf diseases is an important duty in agriculture since it is essential to preserving crop health and guaranteeing optimal production. Recently, plant leaf diseases have been automatically detected using machine learning techniques, reducing the need for manual inspection and increasing the precision of disease diagnosis. The support vector machine (SVM) classifier is one of the machine learning algorithms that is frequently employed because of its reliability and high

accuracy in classification tasks. In this paper, a multiclass SVM classifier that can categorise plant leaves into several groups is presented for use in disease detection on plant leaves.

Images of plant leaves with various illnesses present makeup the dataset used in this study. To extract pertinent information, the images are preprocessed utilising a variety of techniques such image enhancement, segmentation, and feature extraction. The multiclass SVM classifier, which can categorise the images into various illness categories, is trained using the retrieved features. The performance of the SVM classifier is assessed after it has been trained using attaining dataset and tested using a different test dataset.

Accuracy, precision, recall, and F1-score are a few of the performance indicators that are used to assess the suggested method's effectiveness. The findings demonstrate that the suggested method can classify plant leaf diseases with high accuracy. The success of the suggested strategy is demonstrated by the multiclass SVM classifier's overall accuracy, which is found to be approximately 94%.The proposed method is effective in accurately identifying each type of sickness, as evidenced by calculations of precision, recall, and F1-score for each class.

A comparison is presented between the suggested approach's performance and that of various cutting-edge machine learning algorithms, including k-nearest neighbour (KNN), decision tree, and random forest. The findings demonstrate that, in terms of accuracy and F1-score, the multiclass SVM classifier performs better than any other techniques. The suggested strategy also does well in identifying unusual classes, which are frequently difficult to categorise precisely.

In conclusion, this study's multiclass SVM classifier is highly accurate at spotting illnesses of plant leaves. In agriculture, the suggested method can be utilised as a trustworthy instrument for disease diagnosis, helping to maintain the health of crops and boosting their productivity. Deep learning approaches for feature extraction and classification can be used in future research to enhance the performance of the suggested approach.

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