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Fertilizers Recommendation System For Disease Prediction Using Improved SVM

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ABSTRACT

Agriculture is several of the key industries that affect a nation's industrial prosperity. Most people in countries like India rely on agriculture to make a living. Numerous innovations are being incorporated into farming to make it simpler for growers to cultivate and increase their production, such as Neural and machine learning methodologies. The relevant functionalities are performed in this article's software: cultivar recommendations, fertilizer suggestions, and phytopathogens forecasting, correspondingly. One of the main causes of decreases in the amount and quality of food products is vegetation diseases, particularly on the stems. If a plant has a crop disease in the context of agriculture, this stunts the progress of the farming level. Identifying plant diseases is a crucial part of preserving crops. Following pre-processing with thresholding, segmentation is conducted using the Guided Active Contour approach, and ultimately, a Support Vector Machine is used to identify the crop diseases. To propose fertiliser, the illness similarity metric is employed.

INTRODUCTION

The early identification of pathogens or infectious agents is made possible by detecting and classifying plant pathogens using computer vision. Phyto pathologists may examine images acquired using image processing techniques to diagnose plant pathogens. Using images and computer vision techniques benefit growers across all aspects of agriculture. In most cases, the aberrant physiological functioning of plants is what causes diseases in plants. Consequently, the difference between the plant's regular and aberrant biological capabilities leads to the generation of clinical manifestations. The viruses often infect plant leaves and are found on the stem. Various methods of image processing may forecast these various leaf signs and illnesses. These many approaches use several core techniques, including recognition, extraction of features, and categorization, among others. Most often, segmentation is used to distinguish between normal and infected layers of leaves to forecas t and diagnose plant disease.

Photos of various kinds are taken using a camcorder or related tools, and even those pictures are then utilized to spot the damaged region in the leaf. Then, several graphics methods are used to analyze the photos to extract various valuable attributes required for further analysis. It is very important to identify leaf image diseases to forecast both the number and quality. A light polygon leaf model-based initial identification step is first accomplished, then employed to direct the development of aggressive contouring. The leaves are subsequently categorized using overleaf data, which combine shape-based descriptor provided by the triangular model with local curve information. Present a strategy used in this research to overcome the challenges posed by such complicated pictures for simple and exotic leaves. As illustrated in Figure 1, the process begins with a segmented image relying on a charting technique, which is then utilized to direct the development of leaf borders and execute a categorization algorithm to locate illnesses and suggest fertilizers for damaged plants.

LITERATURE REVIEW

Among the emerging countries with the greatest growth rates is India, wherein rural residents and farming account for 58% of total income [1, 12]. India is falling ahead despite its output being enormous since there has yet to be an innovative path that has been proposed that can cope with the precise detection of plant diseases [3, 10]. Pathogens are the main cause of crop illnesses, and current research does not include fertilizer optimization to raise the quality of crops. The Convolutional Neural Networks (CNN) Method is used in this study to create an image analysis strategy utilizing a Raspberry Pi kit. While existing schemes employ different operation functions to learn and categorize the outputs, the CNN system learns the filtering. The main benefit of this application is the invention of a new feature activation function using appropriate optimization. The objective of this study is to more accurately forecast plant diseases earlier on and stop additional crop loss. The location of the disease's afflicted region is also discovered to apply fertilizers more effectively.

The authors of [1, 6] suggested a neural network-based method to identify the illness. This study examines the use of evolutionary algorithms to optimize loss functions so that only robust variables may persist via natural selection. In [2, 8], the authors suggested using Generative Adversarial Networks for quasi-training that classifies pictures and is solely utilized to learn the classifier. To locate the size of a plant, identify the portions of the plant that are damaged by the illness, and categorize a picture of a leaf, the researchers of [3,11] suggested a method that uses the Distance matrix clustering approach. In [4, 7], the authors suggested a pattern recognition-based illness characterization and diagnosis method in cotton leaves using feature extraction and an adaptable autonomic prediction framework. The authors of [5, 9] suggested a method to group faults that used a classification method. The picture was divided into a variety of clusters, and it was discovered that one or more of those groupings included solely diseased regions. In this study, the K-means clustering algorithm used squared Distance measure.

3. PROPOSED SYSTEM

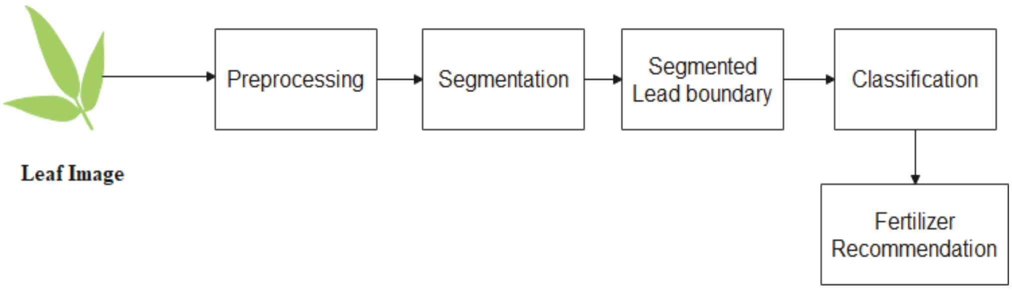

Figure 1. Flow of the proposed system

Steps in Image Classification:

The stages of the suggested picture categorization method are as follows:

Image procurement: Obtaining a vision of a leaflet to carry out a class-based assessment.

Preprocessing: The image pre-processing stage aims to enhance picture metrics by suppressing unwanted aberrations and emphasizing image abilities that are likely applicable for comparable treatment.
The preprocessing takes a picture as input and produces an output that is flattened, inverted, and monochrome.

Segmentation:
Enforces active shape approach with guidance using unrestricted dynamic shapes to the challenging nature photos. Coping with unpleasant shapes would attempt to squeeze through any grab made in the fruit's perimeter.
The polygons developed model in the first phase is utilized in the suggested solution both as an early plant shape and as a form before to direct the optimizer's progress toward the leaf border.

Disease Prognosis:
The leaf picture is classified as normal or impacted using the Support Vector Machine (SVM) technique. Due to the color, shape, and texture of a leaf, vectors are generated. The preprocessed foliage was then classified using a hyper-plane, combined with a classification decoder to identify illnesses in leaf recognition more accurately.

Disease Prediction:

Depending on the intensity degree, suggest the appropriate fertilizer for the afflicted leaves.
Biofertilizers both exist. The administrator may save the fertilizers based on illness classification and severity gradations. Depending on the severity of the ailment, advised fertilizer dosages.

Improved Support Vector Machine (ISVM)

SVM is a classification method that examines the information and finds patterns to categorize it. The basic objective is to create a hyperplane that categorizes each learning vector into a certain category.

- Finding a function Fx that yields the hyper-plane is the aim of SVM.
- Two kinds of data sets are divided by a hyperplane.
- The ideal hyperplane is known as the linear classifier.
- There are two methods for separating the data sets: linearly and nonlinearly.
- If there is no inaccuracy in the separation and the separation between the two nearest vector points is at their greatest, the vector is said to have been ideally separated.

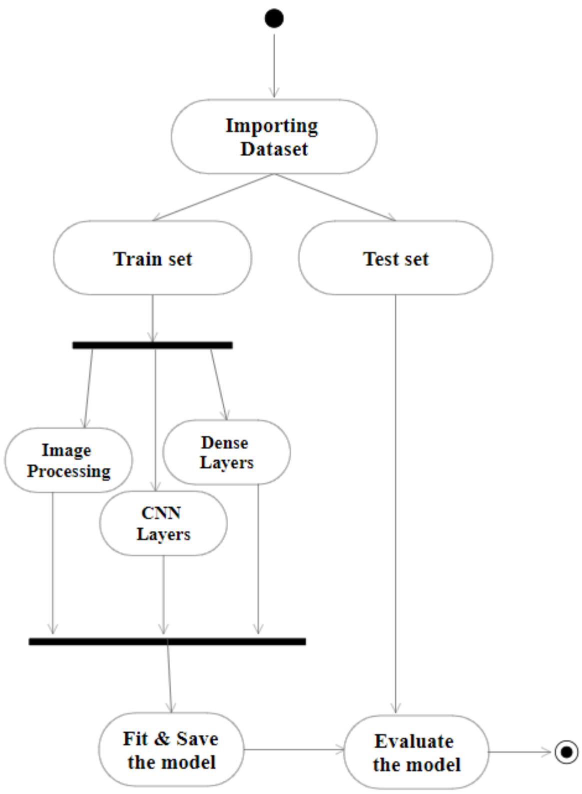

Figure 2. Process Flow chart

3. RESULTS AND DISCUSSION

The goal is to evaluate the SVM approach versus the current Convolutional Neural Networks (CNN) approach. True positive, false positive, true negative, and false negative are some examples of the metrics utilised. The.NET framework is used to actualize the suggested strategy. The Python source code for the preexisting CNN method can be found online at [https://github.com/cs-chan/Deep-Plant]. Figure 3 shows the results of a camera test including 15 photos.

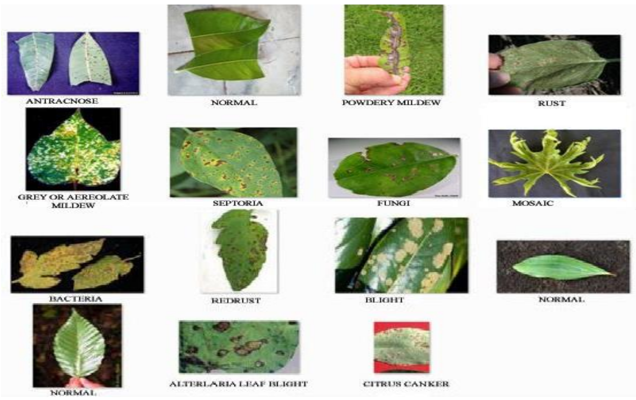

Figure 3. Plant disease dataset

The evaluation of the findings is a crucial component of every research project. The plant leaves sickness data used in this study was obtained from the "Kaggle - Plant Village Leaf Dataset." But only fruit crop leaf illnesses are discussed in this article. According to the 80:20 rule, the first data set is split into two pairs: the training data and the test images. The information then goes through various steps, such as visual pre-processing, image segmentation, extraction of features, and categorization, as was previously stated. Because far more precise clusters may be produced at k=4, the K-means Clustering method is utilized during the image segmentation step. So, from the corrupted crop picture, the Area of Interest is effectively retrieved. Svm classification development utilises three different classifiers: the Support-Vector Machine Classifiers, the K-Nearest Neighbor Classifier, and the Random Forest Classifier. The greatest overall results will be achieved using the Support Vector Machine Classifier. Here's a look at how these three classification approaches stack up against one another: The dimension of the matrix used to describe the probabilities is equal to the number of classes, N. In the table, we can see four different combinations of expected and actual values. The nature of the prediction (positive or negative) and its outcome (true or untrue) set the parameters for these potential outcomes.

True Positives (TP), True Negatives (TN), False Positives (FP), and False Negatives are four possible combinations (FN). The effectiveness of categorization techniques is evaluated using the confusion matrix. Confusion Matrix influences several performance metrics, including Precision Score, Recall Score, and F1 Score. As was covered in the categorization section, there are 4 groups here since there are 4 separate leaf diseases that affect the fruit crop. As a result, the prediction model will be 4 X 4.

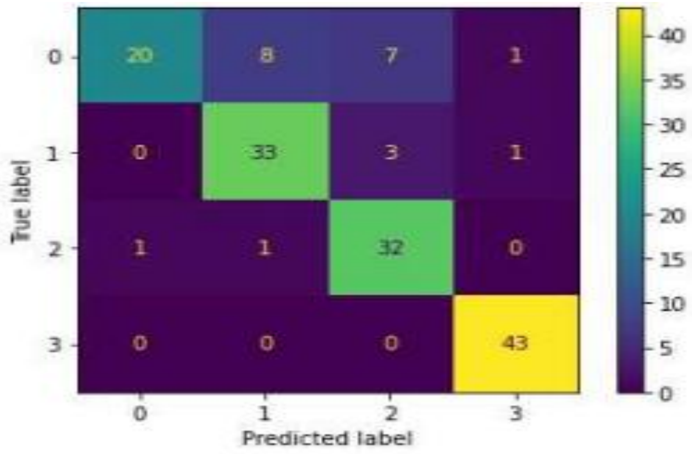

Figure 4. Confusion Matrix

F1 Score = (2*Precision Score*Recall Score) / (Precision Score + Recall Score)

Recall Score = TP / (TP + FN)

Precision Score = TP / (TP + FP)

Various Performance metrics values are illustrated in table 1. Figure 5 shows the comparison graph for various values got through the experimental analysis.

Parameters	ISVM	KNN	RF
Precision	0.76	0.66	0.78
F1 Score	0.84	0.76	0.80
Recall	0.94	0.85	0.85

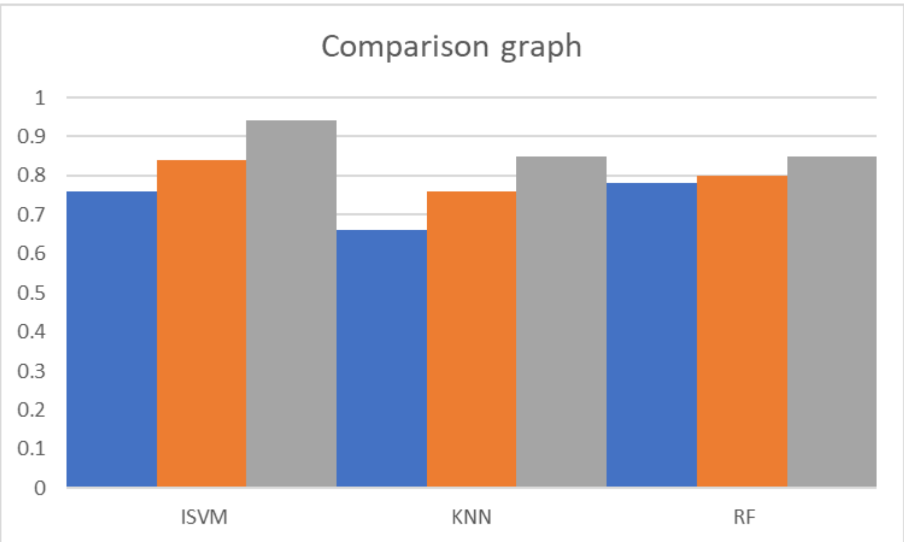

Figure 5. Comparison Graph

Conclusion

In order to categorize tree leaves, detect diseases, and provide fertiliser, the suggested method makes use of support vector machines. An existing method for predicting leaf diseases using a convolutional neural network (CNN) is compared to the suggested method. When compared to currently available CNN, the proposed SVM approach provides superior results. CNN has an F-Measure of 0.7 and SVM of 0.8 for the same set of photos, whereas CNN's accuracy in identifying leaf illness is 0.6 and SVM's is 0.8. Here, researchers are testing the proposed method on preexisting public datasets. Additionally, a number of segmentation methods can be used to further enhance precision. It is possible to modify the suggested algorithm to detect diseases affecting other plant parts, such as leaves and fruits.

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