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Detection and Classification of Plant Diseases Using SVR

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ABSTRACT

Accurate and fast detection of plant diseases can be a great boon to crop yields. Curbing the complete cost to affordable amount is also a serious concern. The present manual technique for the detection of disease is a time-consuming process and many times farmers with humble background cannot afford it. Thus, an automation is needed to make this hectic process fast and well within budget of farmers with low budget. This paper discusses the monitoring of plant diseases using image processing by taking samples of various leaves. In the initial phase, training dataset is created from the collected and enhanced images. Then, a test dataset is prepared arbitrarily and SVR, CNN is utilized for obtaining the classification results. Identification of leaf diseases is the key for preventing the losses in the yield and quantity of the agriculture product. It is very difficult to monitor the plant diseases manually. Leaf diseases can be detected by image processing technique. CNN algorithm is used for leaf diseases classification. Disease detection and classification involve steps like image pre-processing, image segmentation, feature extraction, classification. To detect the plant diseases and to provide the solutions(pesticides) to recover from the diseases.

Keywords : Plant Diseases, SVR, CNN

I. INTRODUCTION

India is agriculture prominent country and most of its population earns living by engaging in this sector. Farmers are required to know almost everything about the crops that how yields can be increased. There is utmost requirement to know effect of various pesticides on crops as there are numerous plant diseases being detected every day. These defects in crops occur due to wrong selection of farming technique or pesticides. The disease caused to crops decreases their quality and quantity. In the present scenario farmers need advice from agriculture experts to tackle any such adverse condition seen in the crops. For detecting these diseases farmers are required to monitor their fields regularly and should possess sufficient knowledge about the symptoms of various diseases detected in the crop.

But in cases where farmers have very less idea about the farming technique and various diseases of the plants, an expert advice becomes crucial part for higher yields. Another problem is that the experts who are being consulted asks high fee. In this scenario, technique that is suggested in this paper is sufficient in detecting defects of the crops.

There are various soft computing techniques that can be deployed for detecting the type of disease in plant leaf. An image segmentation technique is being proposed that automatically detects a particular plant disease and classifies it accordingly.

The classification of certain defect in plant leaves is done using SVR (Support Vector Regression) classification technique. Before applying this classifier, the region affected by disease is found out through segmentation and afterwards the features are extracted. The proposed approach of classifying plant disease utilized thresholding, resizing and Gaussian filtering for pre-processing of images.

For making detection of plant leaf diseases, the entire framework can be divided into four parts. Firstly, image processing part is done and then it is succeeded by segmentation which is carried out through Canny edge detection. This procedure determines the infected areas. Feature extraction is considered as the third step and particularly for texture features statistical Gray-Level Co-Occurrence Matrix (GLCM) features are used. Lastly, for classifying the diseases Support Vector Regression (SVR) is used.

The present development of (IoT) Internet of Things in integration with machine learning has given boost to an automated disease detection project for big agriculture fields. Under this, surveillance of agriculture fields is operated through unmanned and ground vehicles that collects high quality images. After processing is completed, these images are analyzed by Support Vector Regression (SVR) algorithm.

For detecting these diseases farmers are required to monitor their fields regularly and should possess sufficient knowledge about the symptoms of various diseases detected in the crop. But in cases where farmers have very less idea about the farming technique and various diseases of the plants, an expert advice becomes crucial part for higher yields.

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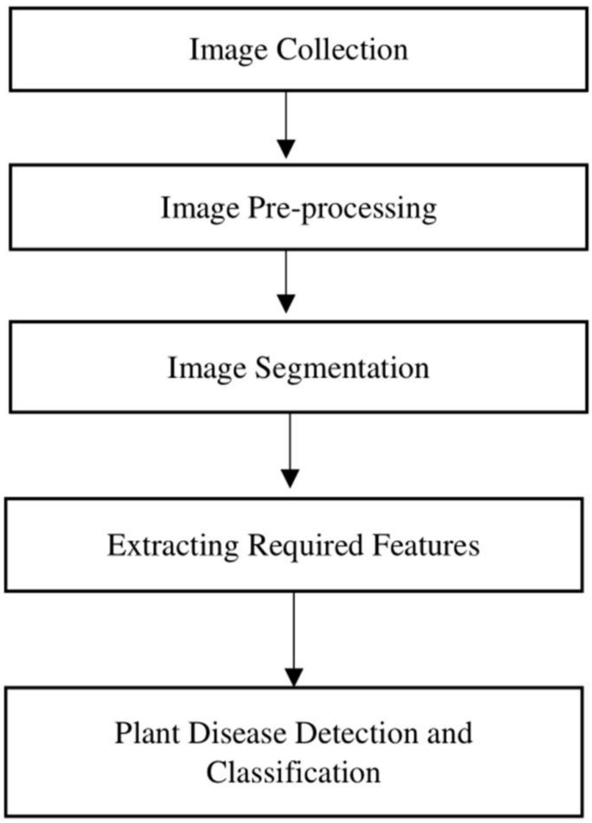

Figure 1: Steps involved in plant disease detection.

II. METHODOLOGY INVOLVED IN PLANT DISEASE DETECTION

Detection of plant disease is a sequential process as first a complete database of images is created. Certain images affected by various kind of diseases are taken and their classifying features are decided. The steps involved with complete detection and classification of diseases are shown in Figure 1.

A. IMAGE PREPROCESSING

The clarity of image gives perfect data for processing. In order to obtain clear image various pre-processing techniques are used; for instance, image clipping is used to crop out the required portion of the image then through various smoothening filters and enhancement techniques quality in terms of contrast of the image is further improved.

The conversion of RGB to gray image is done using below equation,

f(x)=0:2989-R+0:5870-G+0:114:*B

Then, improved contrast is achieved through histogram equalization that spreads the intensity range of the used image.

The steps to be taken are:

- Read image
- Resize image
- Remove noise (Denoise)

- READ IMAGE

In this step, it is used to store the path to our image dataset into a variable then we created a function to load folders containing images into arrays. But first, we need to import the libraries that we are going to use Command.

- RESIZE IMAGE

In this step, some images captured by a camera and fed to the algorithm vary in size, therefore, it should establish a base size for all images fed into the algorithms.

- REMOVE NOISE

Inside the function Processing () to smooth the image and to remove unwanted noise. Gaussian blur is used.

B. IMAGE SEGMENTATION

Image Segmentation is the process by which a digital image is partitioned into various subgroups (of pixels) called Image Objects, which can reduce the complexity of the image, and thus analyzing the image becomes simpler.

There are various image segmentation algorithms to split and group a certain set of pixels together from the image. By doing so, this can actually assign labels to pixels and the pixels with the same label fall under a category where they have some or the other thing common in them.

Using these labels, this can specify boundaries, draw lines, and separate the most required objects in an image from the rest of the not-so-important ones. In the below example, from a main image on the left, we try to get the major components, e.g. chair, table etc. and hence all the chairs are colored uniformly. In the next tab, we have detected instances, which talk about individual objects, and hence the all the chairs have different colors.

C. SUPPORT VECTOR REGRESSION(SVR)

In general, SVR (Support Vector Regression) is quite similar to SVM, but there are some notable differences:

SVR has an additional tunable parameter ε (epsilon). The value of epsilon determines the width of the tube around the estimated function (hyperplane). Points that fall inside this tube are considered as correct predictions and are not penalized by the algorithm.

The support vectors are the points that fall outside the tube rather than just the ones at the margin, as seen in the SVM classification example.

Finally, “slack” measures the distance to points outside the tube, and you can control how much you care about it by tuning a regularization parameter C (more about it in the Python section below).

Support Vector Regression — hyper plane line together with boundary lines defined by +-epsilon. Image by author. A simple way to think about SVR is to imagine a tube with an estimated function (hyper plane) in the middle and boundaries on either side defined by ε. The algorithm's goal is to minimize the error by identifying a function that puts more of the original points inside the tube while at the same time reducing the "slack."

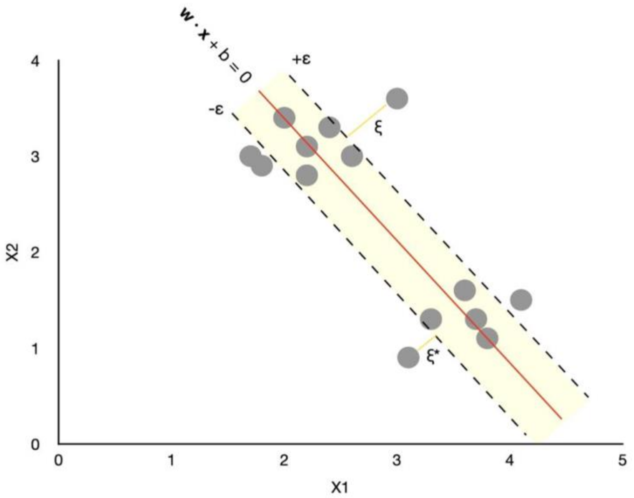

Figure 2: SVR

- SVR ALGORITHM

1. Import the dataset
2. Explore the data to figure out what they look like
3. Pre-process the data
4. Split the data into attributes and labels
5. Divide the data into training and testing sets
6. Train the SVM algorithm
7. Make some predictions
8. Evaluate the results of the algorithm.

D. DETECTION AND CLASSIFICATION OF IMAGE

- CONVOLUTIONAL NEURAL NETWORKS

Convolutional Neural Networks come under the subdomain of Machine Learning which is Deep Learning. Algorithms under Deep Learning process information the same way the human brain does, but obviously on a very small scale, since our brain is too complex (our brain has around 86 billion neurons).

Any CNN consists of the following:

- The input layer which is a grayscale image
- The Output layer which is a binary or multi-class labels
- Hidden layers consisting of convolution layers, ReLU (rectified linear unit) layers, the pooling layers, and a fully connected Neural Network.

It is very important to understand that Artificial Neural Networks, made up of multiple neurons is not capable of extracting features from the image. This is where a combination of convolution and pooling layers comes into the picture. Similarly, the convolution and pooling layers can't perform classification hence we need a fully connected Neural Network.

Preprocessing and Training the model (CNN): The database is Preprocessed such as Image reshaping, resizing and Conversion to an array form. Similar processing is also done on the test image.

A database consisting of about 32000 Different plant species is obtained, out of which any image can be used as a test image for the software. The train Database is used to train the model (CNN) so that it can identify the test image and the disease it has. CNN has different Layers that are Dense, Dropout, Activation, Flatten, Convolution2D, MaxPooling2D. After the model is trained Successfully, the software can identify the disease if the plant species is contained in the database. After successful Training and preprocessing, comparison of the test image and trained model takes place to predict the disease.

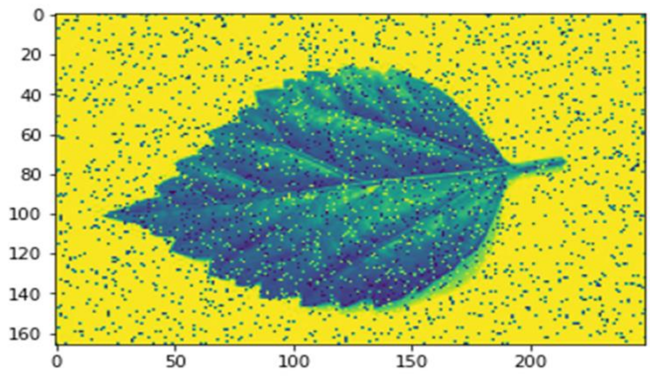

Figure 3: NOISE ADDED IMAGE

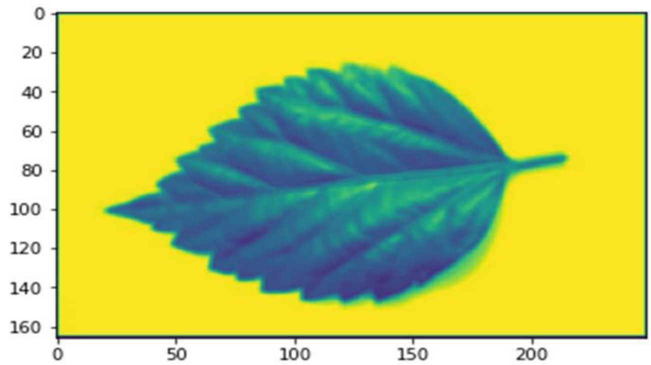

Figure 4: NOISE REMOVED IMAGE

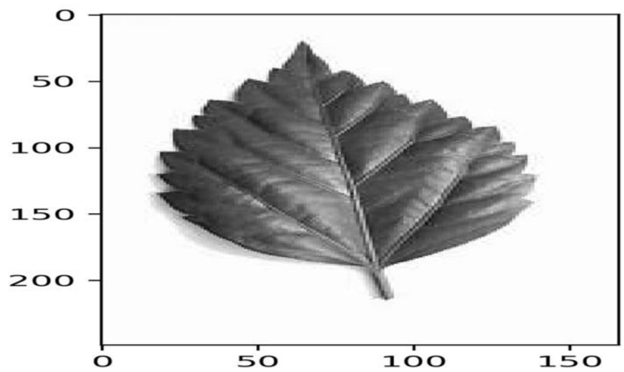

Figure 5: IMAGE PREPROCESSING

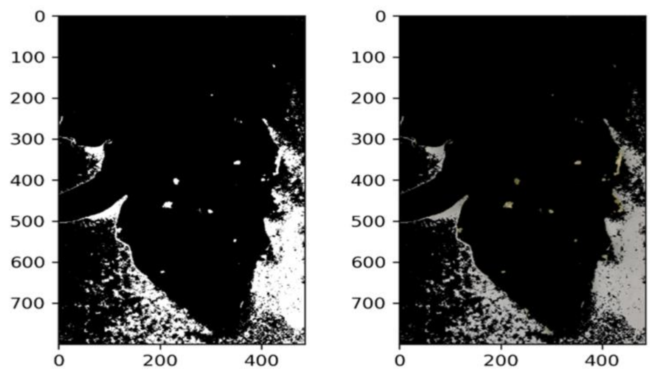

Figure 6: IMAGE SEGMENTATION

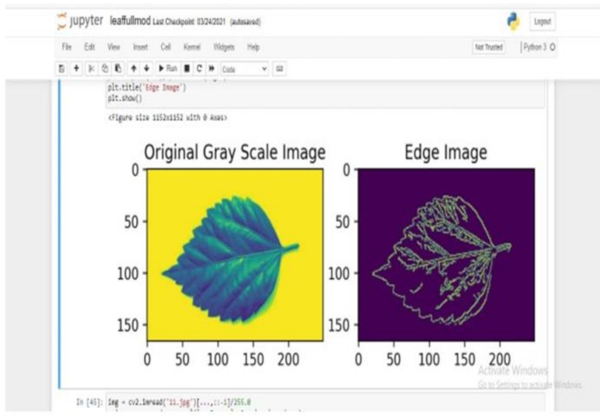

Figure 7: EDGE DETECTION

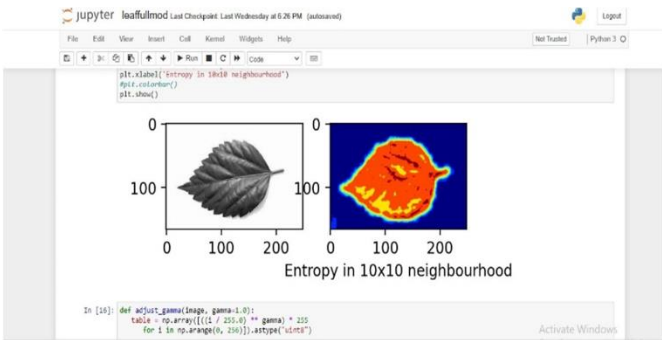

Figure 8: SUPPORT VECTOR REGRESSION

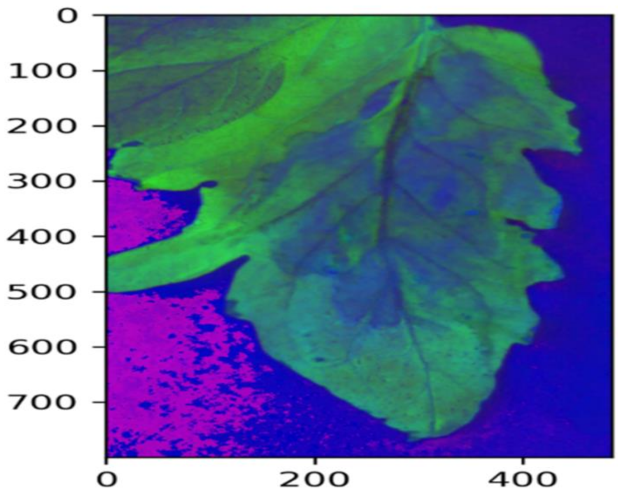

Figure 9: DETECTION AND CLASSIFICATION

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In [22]: categories=["Bacterial_spot","Early_blight","healthy","Late_blight","Leaf_Mold","Septoria_leaf_spot","Spider_mites Two-spotted_sp
In [23]: print(categories)
['Bacterial_spot', 'Early_blight', 'healthy', 'Late_blight', 'Leaf_Mold', 'Septoria_leaf_spot', 'Spider_mites Two-spotted_spide
r_mite', 'Target_spot', 'mosaic_virus']
```

Figure 10: FINAL OUTPUT

Table I: ACCURACY OBTAINED THROUGH APPROPRIATE CLUSTER SELECTION

Disease	Total sample tested	Correctly classified	Accuracy
Healthy	100	100	100%
Bacterial spot	100	100	100%
Septoria leaf spot	100	80	80%
Leaf mold	100	90	90%
Average mold	140	134	96.3%

III. RESULTS AND DISCUSSION

Classification of diseased leaves in their respective classes is done in two major steps. Firstly, a training set is generated by studying prominent features of leaves. For training set deployment 100 items for each class are taken. Then, some samples are taken arbitrarily from the same datasets and testing set is created. Here 100 samples are tested in Table II for each disease and accuracy of 100% is achieved in classifying healthy and diseased leaves. But when further classification of three more diseases is introduced, accuracy of 80% is obtained through appropriate selection of the corresponding clusters. The images to be tested are pre-processed and enhanced. The RGB color space is dependent strongly on device and intensity of light. Thus, conversion to gray scale makes processing of image and analysis easier. One more advantage of using gray scale is that it is closer to the human perception of light. Then, features are extracted from the tested image and SVR classifier compares this data with the training dataset. The execution of these operations is terminated with a message showing the category of the plant disease.

IV. CONCLUSION

The accurate detection and exact classification of diseases in plants is essential for growing the agricultural yields and that too in lower cost. This implementation wrapped the image processing to find the solution of this problem. Using multiple algorithms helpedto understand which algorithm is more suitable for this system. Throughout this researchand field work, it is found that the unavailability of expected data for different agriculturalcrops is the major problem for such analytically implementation. In future, this model canbe implemented as web and mobile applications so that the agriculture department of thecountry and more comfortable for the farmers.

In the future aspect of this work, images can be gathered from high end cameras and sent to the main server where further processing of image is done and after the successful detection of plant diseases every guiding information can be sent back to the user or farmer end.

It is planned to develop an API that would give easieraccess to the collected data for anyone to use. We hope to contribute in the betterment of thecountry by doing and carrying our research forward in the future. This current dataset canbe considered as the base of the future work and any future contribution can be made basedon this structure.

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