PLANT LEAF DISEASE DETECTION

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Abstract: Agricultural productivity is something on which the economy highly depends. This is one of the reasons that disease detection in plants plays an important role in the agriculture field, as having disease in plants is quite natural. If proper care is not taken in this area then it causes serious effects on plants and due to which respective product quality, quantity or productivity is affected. Detection of plant disease through some automatic technique is beneficial as it reduces a large work of monitoring in big farms of crops, and at a very early stage itself it detects the symptoms of diseases i.e. when they appear on plant leaves. Here we present an algorithm for image segmentation technique which is used for automatic detection and classification of plant leaf diseases. It also covers surveys on different disease classification techniques that can be used for plant leaf disease detection. Image segmentation, which is an important aspect for disease detection in plant leaf disease, is done by using genetic algorithms.
Keywords: MATLAB, Classification, Feature extraction, Image processing, Predictive algorithm

I. INTRODUCTION

The existing methodology for disease detection is a just optic observation by specialists through that identification and detection of plant diseases is completed. For Doing thus, an oversized team of specialists still as continuous watching of specialists are needed, that prices terribly high once farms are massive. At an equivalent time, in some countries, farmers don't have correct facilities or maybe the concept that they'll contact specialists. Because of that consulting specialists even price high still as time is overwhelming too. In such conditions, the advised technique proves to be helpful in watching massive fields of crops. And automatic detection of the diseases by simply seeing the symptoms on the plant leaves makes it easier still as cheaper.

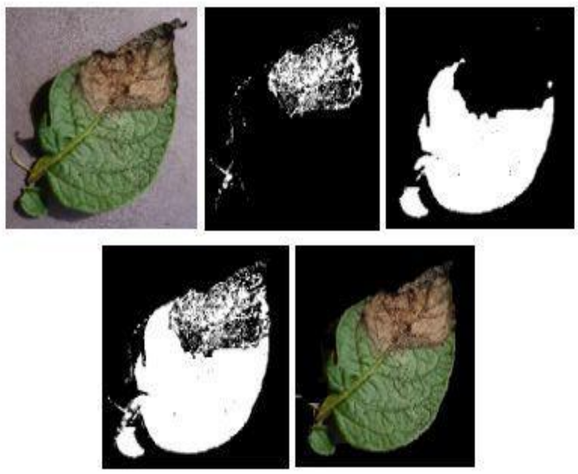
II. PROPOSED SYSTEM

- The proposed solution method for detecting leaf disease using images is as follows:
- This project initially pre-processes the dataset in order to filter useless data and get a smaller data set.
- In the pre-processing step, we can take out the background which is a noise and separate the region of interest which is the leaf.
- Next, different image processing techniques are applied such as:
  - Bit-plane Slicing
  - Erosion
  - Median Filter
  - Dilation
  - Outlining
- Using the above technique's, we make the image ready for feature extraction
- In the next step we are extracting three features namely, colour based feature,texture based feature and affected area based feature.
- Then we are applying lenet5 model to predict the disease

III. IMPLEMENTATION

i. Image Preprocessing.
The image acquired is preprocessed. The preprocessing starts by converting the RGB image to HSV color space.The HSV color space consists of Hue layer H, saturation layer S and value V

ii. Segmentation
There are several algorithms used for segmentation but one of the best methods used for detection of disease is k- means clustering. k-means clustering is a method of vector quantization, originally from signal processing, that is popular for cluster analysis in data mining. k-means clustering aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean, serving as a prototype of the cluster. This results in a partitioning of the data space into Voronoi cells.k-means clustering tends to find clusters of comparable spatial extent, while the expectation-maximization mechanism allows clusters to have different shapes.



The algorithm has a loose relationship to the k-nearest neighbor classifier, a popular machine learning technique for classification that is often confused with k-means because of the k in the name. One can apply the 1-nearest neighbor classifier on the cluster centers obtained by k-means to classify new data into the existing clusters.

Cluster analysis or clustering is the task of grouping a set of

objects in such a way that objects in the same group (called a cluster) are more similar (in some sense or another) to each other than to those in other groups (clusters).
In cluster analysis, the k-means algorithm can be used to partition the input data set into k partitions.
Label every pixel in the image using results from K means. Then a blank cell array is created to store the results of clustering. Followed by creating an RGB label using pixel_labels. Selection of appropriate clusters is another important aspect. The cluster which displays the maximum disease affected part is to be selected. In the next step of feature extraction, the features of the selected cluster are extracted.

iii. Feature Extraction
The features of the selected cluster are extracted. The selected image is converted to grayscale since the image is in RGB format. At the next step the Gray Level Co Occurrence Matrices (GLCM). The required statistics are derived from Gray level co occurrence Matrices (GLCM). The following 10 features that are extracted and evaluated:

- Color based features : mean and standard deviations of R,G and B channels
- Texture based features : contrast, correlation, inverse difference moments, entropy
- Taking a Ratio of defective parts to the whole leaf. The ninefeatures are stored in an array.

iv. Classification Using lenet5
The Lenet5 consists of 2 sets of convolutional and average pooling layers, followed by a flattening convolutional layer, then two fully-connected layers and finally a softmax classifier.

First Layer
The LeNet-5 architecture consists of two sets of convolutional and average pooling layers, followed by a flattening convolutional layer, then two fully-connected layers and finally a softmax classifier.

Second Layer
Then the LeNet-5 applies an average pooling layer or subsampling layer with a filter size 2×2 and a stride of two. The resulting image dimensions will be reduced to 14x14x6.

Third Layer
Next, there is a second convolutional layer with 16 feature maps having size 5×5 and a stride of 1. In this layer, only 10 out of 16 feature maps are connected to 6 feature maps of the previous layer.
The main reason is to break the symmetry in the network and keep the number of connections within reasonable bounds. The number of training parameters in these layers are 1516 instead of 2400 and similarly, the number of connections are 151600 instead of 240000.

Fourth Layer
The fourth layer (S4) is again an average pooling layer with filter size 2×2 and a stride of 2. This layer is the same as the second layer (S2) except it has 16 feature maps so the output will be reduced to 5x5x16.

Fifth Layer
The fifth layer (C5) is a fully connected convolutional layer with 120 feature maps each of size 1×1. Each of the 120 units in C5 is connected to all the 400 nodes (5x5x16) in the fourth layer S4.

Sixth Layer
The sixth layer is a fully connected layer (F6) with 84 units.

Output Layer
Finally, there is a fully connected softmax output layer with 10 possible values corresponding to the digits from 0 to 9.

IV. EXPERIMENT RESULTS

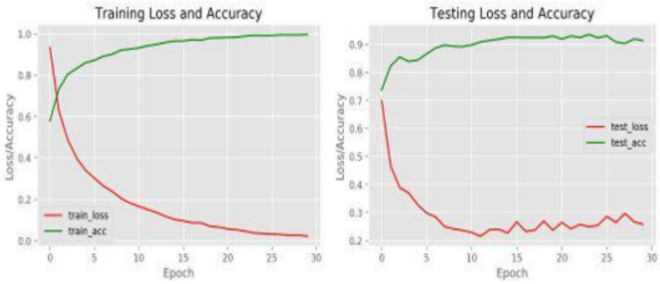
To evaluate the performance of the proposed model, a set of quantitative metrics consisting of accuracy and loss have been used. The results are reported in Table1. A highest validation accuracy of 93.6% was obtained over 30 epochs of training, while a high 99.32% of training accuracy was reported. An average validation accuracy of 93% has been obtained. This is an effective measure of the classification made by the deep learning model. The plots of training and test accuracy and loss against the epochs in Fig. 2 provide a means of visualization and indication of the speed of model convergence.It can be seen that the model has stabilized around 20 epochs and the metrics do not show a significant improvement in the last 10 epochs.

No. of Epochs	**Accuracy**	**Loss**
10	0.9092	0.2626
20	0.9357	0.1851
30	0.9360	0.1955
40	0.9250	0.3085

Results and Analysis

The results show that the model performs well on the dataset and can be used as a means for classification of the three potato leaf diseases with minimum resource requirements. The implementation process requires minimum hardware requirements unlike large neural networks which generally have high computational resource requirements or the use of a Graphics Processing Unit. This is due to less number of training parameters owed to the presence of fewer layers with less filter sizes and smaller train size images. Unlike other state of the art models, the model implementation can be carried out on CPU with minimum time owing to the simplicity. Also, the LeNet model is simple to understand

and easy to implement. The model thus provides a simple and effective way of solving the problem of plant disease detection.



V. CONCLUSION AND FUTURE WORK

This project gives the executed results on different disease classification techniques that can be used for plant leaf disease detection and an algorithm for image segmentation technique used for Automatic detection as well as classification of plant leaf diseases has been described later. Therefore, related diseases for the plant were taken for identification. With very less computational efforts the optimum results were obtained, which also shows the efficiency of the proposed algorithm in recognition and classification of the leaf diseases. Another advantage of using this method is that the plant diseases can be identified at an early stage or the initial stage. The futuristic scopes of this project are the following features:

- Using CNN to get better accuracy and precision.
- Creating a mobile app.
- Deploying this system in a real life scenario.

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