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Rose Leaf Disease Detection using Digital Image Processing &Deep Learning

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Abstract—Rose plant is used to process for a research in this paper.Leaf disease detection is the input for to prevent the losses in the farming and also the product. Diseases decrease the efficiency of plant, which restricts the plant growth and also loss the quality and quantity. In this paperthe approach is to the progress of rose leaf disease detection model that is based on basic image classification, by the use of deep CNN. For detection on rose leafs we used here the image processing and deep learning techniques. Deep learning is the exact and precise model for the plant disease detection. Infected leaves are collected and labeled as per the diseases finding on it. Processing of taken image is performed along with the pixel wise operation to get better the image information. Extracting the features and fit into the neural network. By the detection with CNN in image processing is the success for representing the possibility of this approach in the category leaf disease detection.

***Keywords*—Convolutional neural networks, deep learning, Image processing, Plant disease, Rectified Linear Units**

1. INTRODUCTION

The categorization and identification of rose plant diseases is the technical and economical importance in the plants species [2]. In the plant classification if we research on rose plant, then find that the rose leaf is infected by several pathogens of the plant which cause disease and slowly destroy its health, marketability and also aesthetic value [2]. Research in Rose plants is aimed at to increase the amount produced quality , with a reduction of making make use of of and with improved profit. Management of diseases is a challenging task. Traditionally, leaf diseases were detected through chartgoing over of plant tissue by train experts [3]. As per the visually inspection of the plant diseases is quite be hard to find out the diseases fastly. This was costly and improper paradigms as human intelligence is not perfect. This can be best solved using deep learning, where the image of infected rose leafs is pre-processed and fit into neural network model for detection of ailment. This all basic procedure used in any approaches[4,5,6,7,8,9,10]. In addition to this, artificial neural networks and SVM [12] are also used for the image identification and classification. Deep learning avoids the features of threshold based segementation[13], and its also healthy for classification of leaf diseases. In this research, three categories of rose leafs are studied. Several artificial neural network architectures are designed from scratch and the best model was implemented for training. Digital image processing technique such as RGB to gray scale and otsu's thresholding were used with the aim of exposure and classificationion of leaf diseases[5].Neural networks is a computational advance used in computer science and other research disciplines, which is based on a large collection of neural units. Each neural unit is connected with many others, and links can be enforcing or inhibitory in their effect on the activation state of connected neural units[10].

2. MATERIALS AND METHODS

The hole procedure of developing the model for rose plant
disease recognition exploitation Convolutional Neural Network is represented more intimately. the entire method is split into many necessary stages in subsections below, beginning with gathering images for classification method using neural networks.

DATA SET

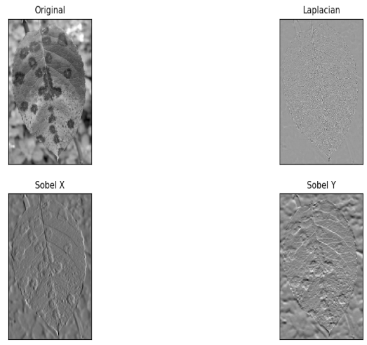
Datasets are required at all stages of object recognitionresearch,startingfromtrainingphasetoevaluating the presentationof detection steps. All the images collected for the dataset were downloaded from the Internet, searched by different disease names on various online sources. Images in the dataset were grouped into different modules which represented rose leaf diseases which could be visually determined from leaves. To differentiate healthy leaves fromdiseasedones, onemoreclassisadded into thedataset. From the dataset an extra class with the background images is beneficial to get the more accurate classification[11]. Thus, deep neural network could be trained to differentiate the leaves from the surrounding. From the dataset which taken from online sources if there was some duplicate images that are removed by developed python script applying the procedure. The main aim of presented study is to train the network to learn the features that differentiate one class from the others. Therefore, when using the output images, the chance for the network to learn the appropriate features has been increased. The augmentation process shows all supported diseases together with the number of orig inal images and number of augmented images for every class used as training and validation dataset for the diseaseclassification model[5,6,7].

A. IMAGE PREPROCESSING

Rose leaf datasets are arbitrarily sized RGB images. At first the image is cropped on leaf diseases area. And then converted to gray levels. To enhance the image we used Laplacian filter. the RGB images into the grey images using colour conversion using equation (1).

f(x)=0.2989*R + 0.5870*G + 0.114.*B* - - - - - - - - - - *(1)

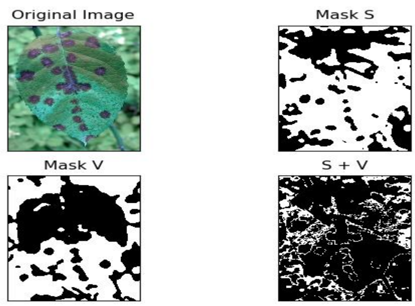
As most of the neural network models assume a square shape input images, it is resized to 256× 256 pixels maintaining uniform aspect ratio. It is ensured that images contain all the required information for feature extraction. In order to make convergence faster while training the network, dataset are normalized. Then find the mean of all images for the normalization. Data normalization is carried out by subtracting the mean from each pixel, and then dividing the result by the standard deviation. Hence, each input parameter i.e. Pixel in this case, are maintained a similar data distribution[10,11].



B. INTERACTIVE FOREGROUND EXTRACTION USING GRABCUT

Everything outside this rectangle will be taken as sure background and inside rectangles is unknown. Similarly any user input specifying foreground and background are considered as hard-labeling which means they won't change in the process. Computer does an initial labeling depending on the data we often find[8]. It labels the foreground and background pixels (or it hard-labels). Now a Gaussian Mixture Model (GMM) is used to model the foreground and background. Depending on the data we gave, GMM learns and create new pixel distribution. That is, the unknown pixels are labeled either probable foreground or background depending on its relation with the other hard-labeled pixels in terms of color statistics (It is just like clustering). Here use k-means cluster on the input images. A graph is built from this pixel distribution. Nodes in the graphs are pixels. Additional two nodes are added, Source node and Sink node. Every foreground pixel is connected to Source node and every background pixel is connected to Sink node.

The weights of edges connecting pixels to source node/end node are defined by the probability of a pixel being foreground/background. Canny edge detection is use on it. The weights between the pixels are defined by the edge information or pixel similarity. If there is a large difference in pixel color, the edge between them will get a low weight.



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C. IMAGE SEGMENTATION

Image segmentation is one of the most important process for disease detection and has a crucial impact on the overall performance of the developed systems[14]. The K-Means clustering technique is a well-known approach that has been applied to solve low-level image segmentation tasks[9]. This clustering algorithm is convergent and its aim is to optimize the partitioning decisions based on a user-defined initial set of clusters[10]. This paper is proposed to k-means segmentation method to segment target areas. The area affected by the disease is the target area. Belowfigures shows the outputs from the segmentation.Since the neural network tends to over-fit in case of limited number of training data samples trained with higher number of epochs [15], we implement the technique of image augmentation for artificially expanding dataset. Zoom, shear, rotation functions are the Image augmentation parameters used. In addition to this,adaptive histogram equalization and contrast stretching, histogram equalization are used as custom functions to generate augmented images. Usage of these parameters results in generation of images having these attributes during training of artificial neural network model.Then a threshold segmentation algorithm is used to segment the graph. It cuts the graph into two separating source node and sink node with minimum cost function. The cost function is the sum of all weights of the edges that are cut. After the cut, all the pixels connected to Source node become foreground and those connected to Sink node become background.The process is continued until the classification converges.

(a) (b) (c)

a. Original Imageb.Extracted Image
c. Segmented Image

D. DESIGN OF ARTIFICIAL NEURAL NETWORK

Initially, 4 convolutional and pooling layers are consisting to network is built from scratch. For an input value of x of the i[th] convolutional layer, it computes:$\boldsymbol{xic}=\boldsymbol{ReLU}(\boldsymbol{Wi}\times\boldsymbol{x})$, **(1)** [16].

Since, x shows the convolution operation and Wi shows the convolution kernels of the layer. The values of Wi = [W 1, W 2,…, W K], and K is the number of convolution kernels of the layer. Each kernel W K is an M × M× N weight matrix with M being the window size and N being the number of input channels[5,12].

The hidden layer contains the hyper-parameters that fine tuned along with it. This resulted outputs in gradual increase in precision. Eventually, Neural Network consisting the 7 hidden layers resulted the best performance and highest accuracy. Rectified linear function (ReLU(x) = max(0, x)), is used as activation function and in pooling, we pass convolutional neural network and window size.

The discrepancy between predicted result and the label of the input and it defined as the sum of cross entropy into the loss functions:

$$\boldsymbol{E}(\boldsymbol{W})=-\boldsymbol{1}/\boldsymbol{n}\ \Sigma\Sigma[\boldsymbol{yik}\mathbf{log}\boldsymbol{P}(\boldsymbol{xi}=\boldsymbol{k})+(\boldsymbol{1}-\boldsymbol{kk}=\boldsymbol{1nxi}=\boldsymbol{1yik})\ \mathbf{log}(\boldsymbol{1}-\boldsymbol{p}(\boldsymbol{xi}=\boldsymbol{k}))],$$

Where, W shows the weight matrices of convolutional and fully connected layers, n represents the number of training samples, i show the index of training samples, and k shows the index of classes. yik = 1 if the ith sample belongs to the kth class; else yik = 0.

$P(xi = k)$ is the probability of input xi belonging to the k^{th} class that the model predicts, which is a function of parameters W. Output layer is also a fully connected layer but in this case, softmax function is used as activation function. Finally, we run regression on ConvNet and Adam is used as an optimization algorithm instead of the classical stochastic gradient descent procedure[11].

3. RESULTS AND DISCUSSIONS

The results presented in this section are related to training with the whole database containing both original and segmented images. It is known that convolutional networks are able to learn features when trained images on larger datasets, results achieved when trained with only original images will not be explored. Taking into account the fact that during this research our image database was developed. In addition, since no one has used deep learning to identify plant diseases in scientific literature, it is impossible to compare it with other examples. In this paper, a new approach of using image processingand deep learningmethod was explored in order to automatically classify and detect diseases from rose leaf images. The complete procedure was described, correspondingly, from collecting the images used for training and validation to image pre-processing and segmentation and finally the procedure of training the deep CNN.

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