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PLANT LEAF RECOGNITION USING CNN, RESNET-50 AND SVM

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Abstract

This research paper presents the Plant Leaf Recognition Using Convolution Neural Networks. Leaves are very important or signi cant part of the plant which actually identi es and classify the plants. Classi cation of the plant by their leaf biometric features is commonly performed task of trained botanist and taxonomist. To perform this task, they need to perform various set of operations. Because of this the task of classi cation of plants manually is time consuming. There are many biometric features of leaves of the plants for classi cation. Here the various features of leaves of the plant species are extracted for plant classi cation. A classi er named as a Convolution Neural Network (CNN) is trained to identify the exact leaf class. It is done to achieve high effectiveness with less computational intricacy.

Keywords - Plant leaf recognition, Convolution Neural network (CNN), image acquisition, image pre-processing, Feature extraction, leaf classi cation.

Introduction

Let's imagine a person taking a field trip, and seeing a bush or a plant on the ground, he or she would like to know whether it's a weed or any other plant but have no idea about what kind of plant it could be. With a good digital camera and a recognition program, one could get some useful information. Plants play an important role in our environment. Without plants there will be no existence of the earth's ecology. But in recent days, many types of plants are at the risk of extinction. To protect plants and to catalogue various types of flora diversities, a plant database is an important step towards conservation of earth's biosphere. There are a huge number of plant species worldwide. To handle such volumes of information, development of a quick and efficient classification method has become an area of active research. In addition to the conservation aspect, recognition of plants is also necessary to utilize their medicinal properties and using them as sources of alternative energy sources like bio-fuel. There are several ways to recognize a plant, like flower, root, leaf, fruitetc.

A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning algorithm which can take in an information picture, allocate significance (learnable loads and inclinations) to different angles/ objects in the picture and have tendency to differentiate or separate one from the other. The pre- processing required in a ConvNet is much lower when appeared differently in relation to other calculations or algorithms. While in primitive strategies filters are hand- built, with enough preparing, ConvNets have the ability to gain proficiency with these filters/attributes.

The human visual system has no problem interpreting the subtle variations in translucency and shading in this Figure 1.6 photograph and correctly segmenting the object from its background.

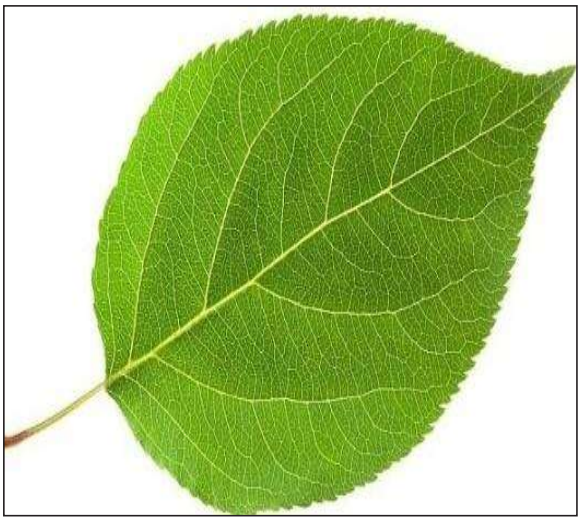

Figure 1. Apple leaf seen as to the naked eye.

Review of Literature

Literature review is a systematic survey concentrated on a research work, attempting to recognize, evaluate, select and synthesize all high-quality research proofs and contentions related to that work. The literature is conducted regarding classification plant leaves.

Shayan Hati and Sajeevan in 2013 described various image processing techniques which are used to extract leaf features such as aspect ratio, width ratio, apex angle, base angle, moment ratio and circularity. Under his research 534 leaves of 20 kinds were taken. Out of which 400 leaves were trained and 134 testing samples were recognized with 92% accuracy.

Anang and Asad [in 2013 introduced an integrated approach of distributed hierarchical graph neuron (DHGN) and K-nearest neighbor (KNN) classifier for plant pattern recognition. DHGN ensures low complexity and minimum processing time. But KNN known as lazy classifier was used for final classification of pattern. Any other classifier would be chosen for better recall accuracy.

Kshitij et al. in 2014 surveyed on various classifiers such as KNN, PNN, Genetic algorithm, SVM, PCA, ANN and fuzzy logic. These different classification techniques can be used for plant leaf disease detection based on its morphological features. He discussed various drawbacks of above classifiers in regard to plant identificationsystem.

Valliammal et al in 2014 describes optimal Genetic algorithm for feature extraction and selection of SVM classifier for classification of leaves. His work gives effective and improved accuracy as compare to KNN classifier. However, KNN performance is completely dependent on training set. Complexity of KNN increases by increasing large data set. So, need of another classifier is suggested.

CNN Architecture

Convolutional Neural Networks (CNN) is one of the deviations of neural network systems utilized vigorously in the field of Computer Vision. It origin at esits name from the sort of hidden layers it comprises of. The hidden or concealed layers of a CNN regularly comprise of convolutional layers, pooling layers, fully connected layers, and normalization layers.Hereit essentially implies that as opposed to utilizing the ordinary activation capacities, convolution and pooling capacities are utilized as activation capacities.

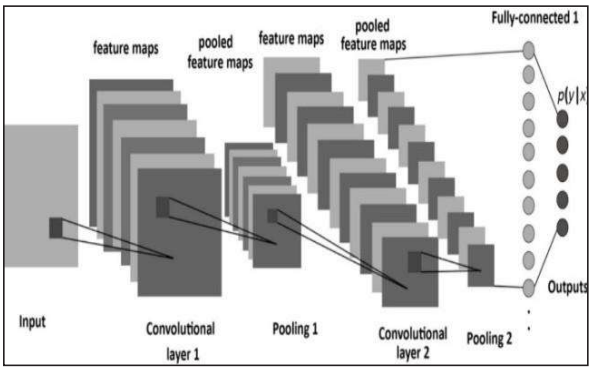

Fig. CNN Architecture

CNN receives the image as a matrix of pixel values. A sequence of convolution, maxpooling and normalization is done in several layers of CNN and is finally regularized.

A.

B. Convolution: it takes in an information signal and applies a channel over it, basically multiplies the information signal with the kernel to get the changed or modified signal. Scientifically, a convolution of two capacities f and g is characterizedas

In case of Image processing, it is simpler to envision a kernel as sliding over a whole picture and along these lines changing the estimation of every pixel all the while.

$$(f * g)(i) = \sum_{j=1}^{m} g(j) \cdot f(i - j + m/2)$$

A. Pooling: Pooling lessens the spatial measurements (Width x Height) of the Input Volume for the following Convolutional Layer. It doesn't influence the profundity measurement of the Volume. The change is either performed by taking the most extreme incentive from the qualities perceptible in the window (called 'max pooling'), or by taking the average of the qualities or values. Max pooling has been supported over others because of its better execution qualities.

B. Normalization: Normalization turns all the negative values to 0 so that a matrix has no negative values. A stack of images becomes a stack of images with no negative values.

C. Regularization: Regularization is an

indispensable feature in pretty much every cutting-edge neural system execution. To perform dropout on a layer, you haphazardly set a slice of the layer's qualities to 0 during forward spread. Dropout powers counterfeit neural system again proficiency with various autonomous portrayals of similar information by on the other hand arbitrarily debilitating neurons in the learning stage.

There are a few pre prepared Convolutional NeuralNetworksthathasgainpopularityandRes Net-50isone of them. Here in this theory work we use pre prepared Convolutional Neural Network ResNet-50 for characterization of plant leaves. ResNet-50 has been prepared or trained in image net dataset. image net dataset has one thousand item classifications and 1.2 million preparing or training pictures. The system is 50 layers profound (deep) and can arrange pictures into 1000 article classifications, for example, keyboard, mouse, pencil, and numerous creatures. Thus, the network has learned rich component portrayals for a wide scope of pictures. The system has a picture in fosize of 224-by-224. ResNet is short name for residual network (as the name of the system shows, the new phrasing that this system presents are residual or lingering learning).

Results and Discussions

Classification involves two stages, training and testing using any classifier. In training stage classifier is prepared utilizing highlight esteem sand its individual target esteems this prepared classifier is then used to classify test images.

In this work total 1125 leaf images of Swedish Leaf Dataset are used and which has been divided into 15 categories out of which 75 images are Acer leaf images, 75 images are Alnas incana leaf image, 75 images are Betula Pebescens, 75 images are Fagus sylvatica, 75 images are Populus, 75 images are Populus tremula, 75 images are Quercus, 75 images are Salix alba, 75 image sare Salixaurita, 75 images are Salixsinerea,75 images are Sorbus aucuparia, 75 images are Sorbusintermedia, 75 images are Tilia, 75 images are Ulmus carpinifolia and 75 images are Ulmus glabra leafimages.

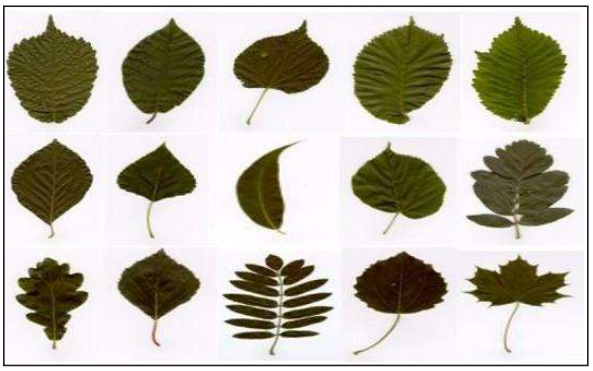

Figure: Sample leaves from Swedish Leaf database

For training phase 20 Acer, 20 Alnas incana, 20 Betula Pebescens, 20 Fagus sylvatica, 20 Populus, 20Populus tremula, 20 Quercus, 20 Salix alba, 20 Salix aurita, 20Salix sinerea, 20 Sorbus aucuparia, 20 Sorbus intermedia, 20 Tilia, 20 Ulmus carpinifolia and 20 Ulmus glabra leaf images are used. For testing phase 12 Acer, 12 Alnas incana, 12 Betula Pebescens, 12 Fagus sylvatica, 12 Populus, 12Populus tremula, 12 Quercus, 12 Salix alba, 12 Salix aurita, 12Salix sinerea, 12 Sorbus aucuparia, 12 Sorbus intermedia, 12 Tilia, 12 Ulmus carpinifolia and 12 Ulmus glabra leaf images are used.

$$Accuracy(\%) = \frac{\text{Total number of images correctly classified} * 100}{\text{Total number of images used for testing}}$$

Here we use 180 images for testing and more than 177 images has been classified correctly so, the recognition rate or accuracy is 98.33%.

Output Designs

Figure: Menu

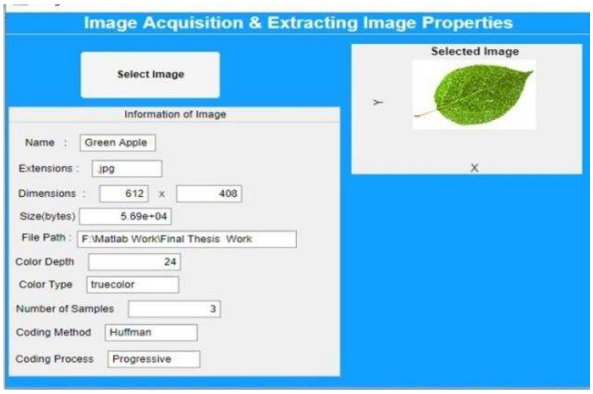

Figure: Image Acquisition & Extracting Image properties

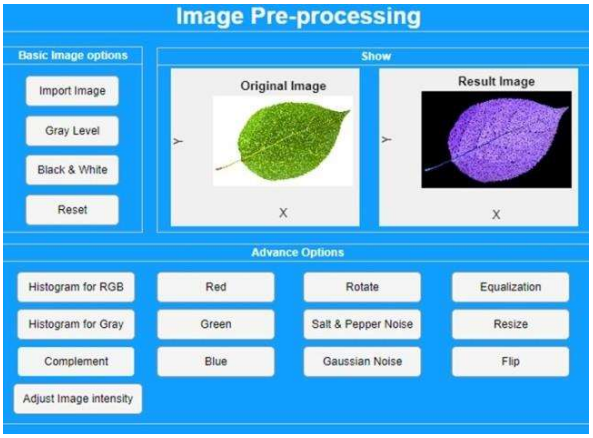

Figure: Image Pre-processing

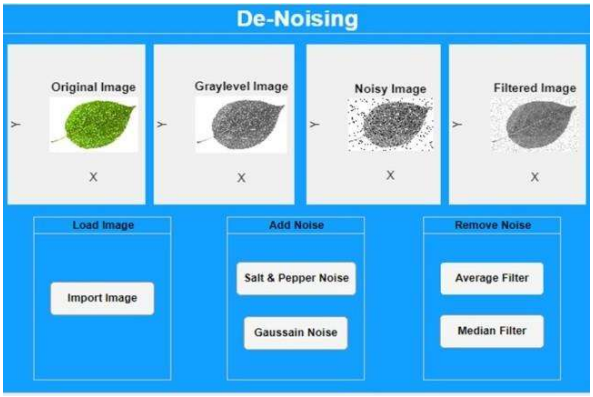

Figure: Noising &De-noising

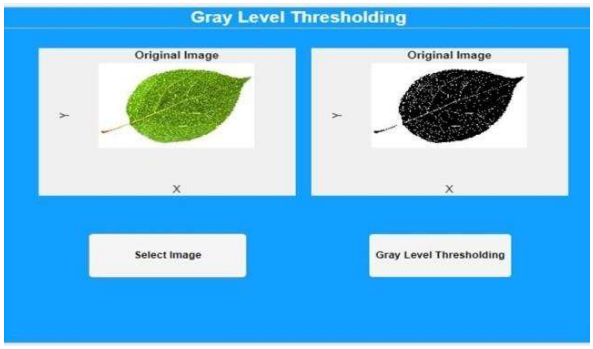

Figure: Gray Level Thresholding

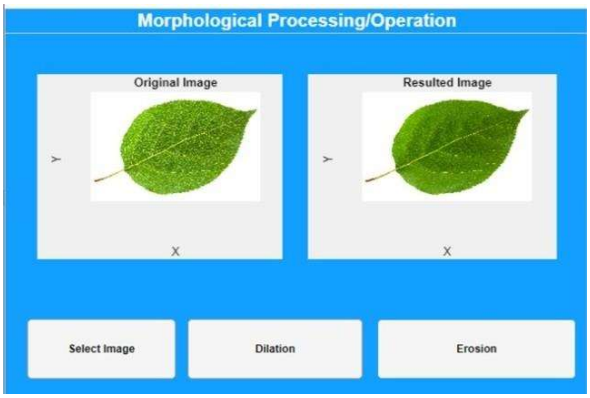

Figure: Morphological Processing

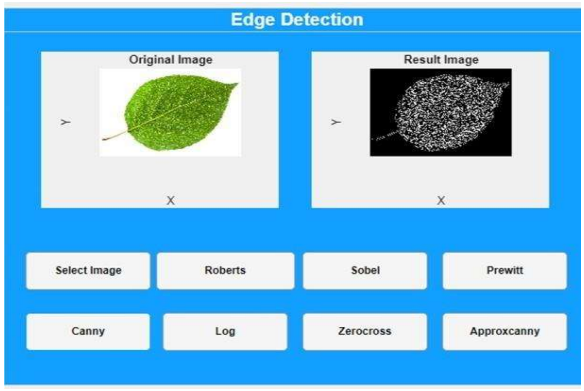

Figure: Edge Detection

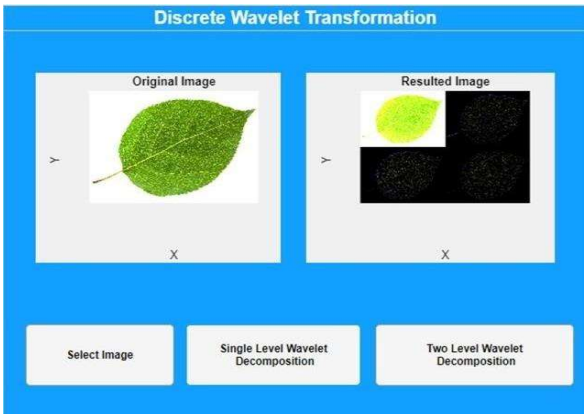

Figure: Discrete wavelet Transformation

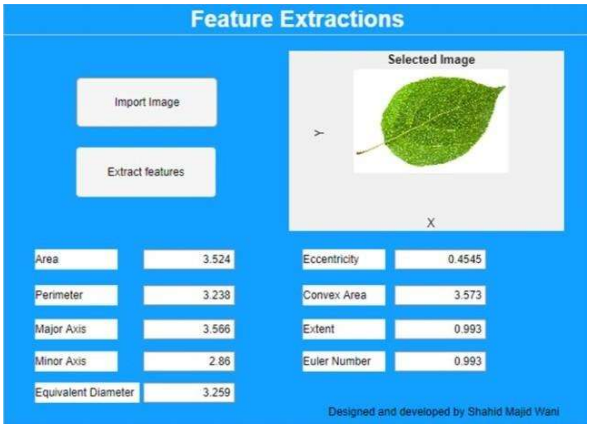

Figure: Feature Extractions

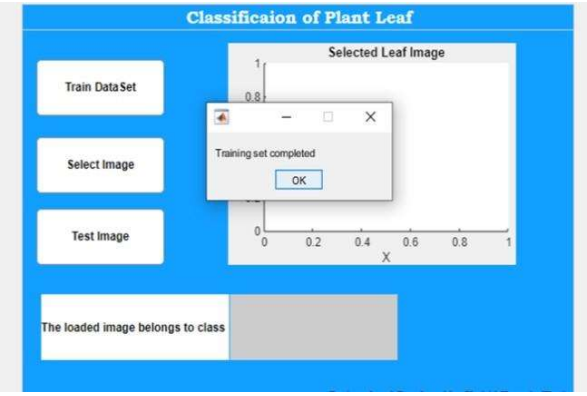

Figure: Classification Training Set Complete

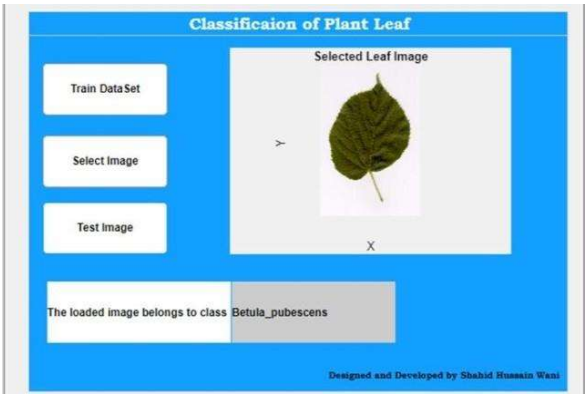

Figure: Classification of Plant Leaves

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Conclusion

The aim of this thesis work was to create a new method called Plant Leaf Recognition using Convolutional Neural Networks which is capable to classify leaf images using CNN model. ResNet-50 a pre trained CNN that has been used in our thesis work to identify the correct species of leaf fromdifferent classes with the recognition rate of more than98.33%. Although performance of the system is good enough but still in future research, we will attempt to recognize leaves attached to branches, in order to develop a visual system that can replicate the method used by humans to identify plant types.

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