Plant Recognition using Hog and Artificial Neural Network

Jasti Vishnu Vardhan[1]
Corresponding Author: Dr. Karamjit Kaur[2]
Co-Author: Mr. Upendra Kumar[2]
1: UG student, Department of ECE, Amity University Haryana
2: karam_sekhon@yahoo.co.in, Assistant Professor, Department of ECE and EEE, Amity University Haryana, 122413
ukumar@ggn.amity.edu, Assistant Professor, Department of ECE and EEE, Amity University Haryana, 122413

Abstract:- This paper presents a plant leaf recognition system being implemented through Artificial Neural Networks. The system proposed is designed using MATLAB Software which takes a leaf image from the user and classifies, recognizes the plant species and shows all the relevant details about the plant.it also incorporates a webpage from various plant databases. The leaf features are extracted by using a HOG (Histograms of Oriented Gradients) vector and the ANN(Artificial Neural Network) is used in training through Backpropagation. We have extracted the HOG features from the flavia datasheet of leaves and trained them in the Neural Network. The results were nearly perfect and the accuracy of the program implemented is very high compared with other models.

Keywords- *HOG, ANN, Backpropagation.*

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I. INTRODUCTION

Our earth is surrounded by plants that are present everywhere, even underwater where humans can't reach. They provide us sustenance, shelter, medicines, and fuel. There are different types of plant species and carry significant information for the development of human society. The knowledge of these plants is lost in today world.. Forests like Amazon contain many different plant species, which can be very helpful in medical science. Medicinal plant species like cancer curing Lapacho, and Brazilian Ginseng. The knowledge on these medical plants which is very familiar to the the native tribes living in the forests have to be protected, so it is very necessary to set up a database for plant protection and consider it an important step for their conservation and preservation and also to handle such volumes of information. [1], [2], [3], [4] We believe that the first step we can take by teaching a computer how to identify and classify plants species. There are several ways to recognize a plant by its flower, root, leaf, fruit, etc. but plant leaves can be collected in several months of a year, whereas the flowers and fruits may remain in a shorter specific period. This is the main reason that most of botanists and plant specialists would better like to use the characteristics of leaf to recognize plant species recognition. Plant leaves recognition method is usually based on the observation of the morphological characteristics like shape, size, and structure of a leaf, but it will be a tricky task for experienced botanists also to identify the plants because of the huge number of species existing in the world. In this case, it is helpful and significant for developing a quick and efficient plant recognition system based on the computer to identify the plant species. [5] In comparison with other plant species, classification techniques, such as cell and molecule biology methods, classification based on leaf image is the first option for leaf plant classification. Leaf recognition method is the simplest and most effective way for the recognition of various plant types sampling leaves and photonic they are low cost and convenient. One can easily upload the leaf image to a computer and a computer can extract the characteristics of leaves automatically in image processing techniques [6]. The plant identification system that is in use by botanists at the Smithsonian Institution National Museum of Natural History, Washington was the result of the research "Searching the Worlds Herbaria: A System for Visual Identification of Plant Species"[7]. This system is an advanced computer vision system that helps in the identification of different plant species. To identify plants with broad flat leaves which are more or less two-dimensional in nature, a system that has been developed as the result of the research "Leaf shape identification based plant biometrics".[8] This system is uses the feature extraction methods that are used in image processing. An approach that is used in plant classification is based on the texture properties, which are used in the research "Plants Images Classification Based on Textural Features using Combined Classifier".[9] Researchers have used the combined classifier learning vector quantization. This project proposes a Matlab program using machine learning algorithms for classification and recognition of various plant species displays all the relevant details about the plant.it also incorporates a webpage from various plant databases.

II. REVIEW

Various models are being implemented before for plant recognition based on its leaf, all of which have their own pros and cons. The different models along with the features extracted and classifiers used are mentioned below

Hong Fu and **Zheru Chi** [10] proposed atwo- stage approach for leaf vein extraction has been used by .At the first stage, a preliminary segmentation based on the intensity histogram of the leaf image is used to get the rough regions of the vein pixels. The second stage involves fine checking used trained Artificial Neural network (ANN) Classifier.

Stephen Gang Wu [5] implemented a leaf recognition algorithm for classification by using PNN(Probablistic Neural Network). He extracted 5 basic geometrical features from the leaf image and derived 12 leaf features from them and orthogonalised into 5 principal variables .These 5 principal variables of a n image are used to train the PNN. They were able to achieve an accuracy greater than 90%

Jiazhi Pan and **Yong He** [11] proposed a method where they used the characters such as sizes, radius, perimeters, solidty, and eccentricity using the image processing toolbox. These characters are used as an input vector for training a radial basis function. These method was simple and highly effective, o that it can be integrated into auto machines in the field .the accuracy of this method yielded 80%

Kulkarni, **A.H., Rai, H.M., Jahagirdar, K.A., Upparamani**, [12] proposed a leaf recognition technique for classification using RBPNN (Radial Basis Probabilistic Neural Networks) and Zernike Moments.In this method they have extracted features like shape, vein, color, texture along with Zernike moments. These features are trained in RBPNN and the accuracy of this method is upto 93.82%

Arunpriya, C., Selvadoss Thanamani, **A** [13] proposed an efficient method for plant classification using Kernelized Support Vector Machine where geometrical features like diameter, perimeter, area, longirudinal length, width and also morphological features are extracted and are given as input vector to K-SVM classifier. This method gave an best accuracy of 96.20 %

Dimitris G. Tsolakidis, Dimitrios I. Kosmopoulos, and **George Papadourakis** [14] proposed a method using Zernike Moments and HOG(Histogram of Oriented Gradients) for classification, where the shape features of leaf are computed using Zernike Moments and texture features with HOG and then SVM(Support Vector Classifier) is used for classification .This method produced a best accuracy of 97.18%

The accuracy of using a machine-learning algorithm to classify a leaf is very high and it isn't time consuming like cell and molecular biology methods. This project proposed and implemented a Matlab program using machine learning algorithms for classification and recognition of various plant species displays all the relevant details about the plant.it also incorporates a webpage from various plant databases.

III. PROPOSEL

The project proposes a model to recognize a plant from its leaf image by extracting the leaf features by using HOG (Histogram of Oriented Gradients) feature descripter and validating the feature vector data from a neural network, that is trained, with the vector table from the database of leaves. The vector table is created by extracting HOG features from the samples in the database. A knn classifier is used instead of using neural network but the accuracy of using a neural network is much higher compared to the knn classifier

First, a plant database is set up by consisting of 50 samples for each plant species and the features of each sample is extracted using HOG algorithm.

The vector table containing the HOG features are trained in the neural network for training, testing and validation after categorizing the vector data for different species separately.

Once the user gives an image for recognition, the leaf image gets resized and converted as per requirements of HOG feature descriptor. The vector table data of that leaf after HOG processing is sent into the neural network .the neural network tests the data with the trained data and displays a message box containing the details of that plant species .In addition to the plant species data, it also gives an option to open a webpage

IV. BLOCK DIAGRAM

It is evident from the previous section that using a neural network has good speed for classification As we need to achieve best accuracy with good speed, we need to use a model which doesn't require any user interference once the leaf image is inputed..to achieve this we follow the leaf recognition model mentioned in fig.3.1 . The various steps involved in typical leaf image based plant identification is shown in the flowchart .The proposed method is entirely implemented on MATLAB 2013a, version 8.1 software. The model doesn't need any user interference once the leaf image is inputed.

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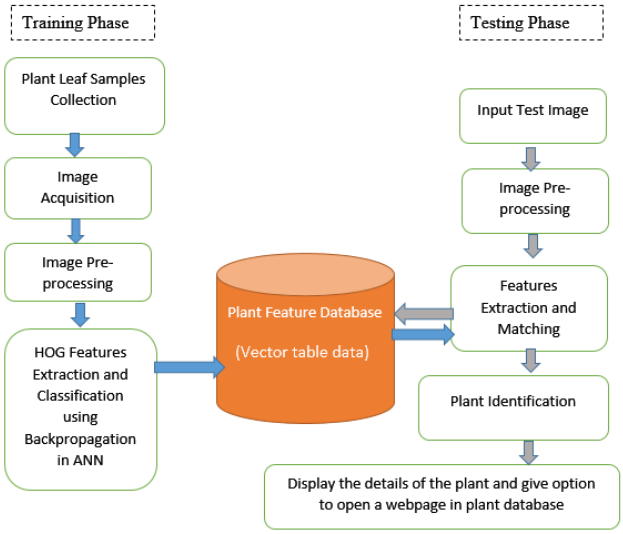

V. IMPLEMENTATION

The entire design is implemented on a MATLAB 2013a. we have used plant leaf samples from the flavia[6] datasheet.A total of 900 leaves are used for extracting HOG features and training them.We have used some flavia leaves datasheet for the implementation. All the leaves are sampled into sets and are stored in a folder that later is used for training.th following figure shows how the leaves are sampled in sets. .8 sets of leaves from the flavia datasheet [6]

Figure 2: Set of leaves from flavia datasheet

The samples usd for training contain 50 samples from each set.the following shows the samples used in each set.All the images are brought into matlab from the file adresses.

Before the leaf image is passed through the HOG vector, it is processed to make it suitable for extraction, initially it is resized and smoothened .The image is resized to [50 50] and smoothened with Gaussian filter with sigma = 0.5.

Figure 3: Applying gaussion filter on grey image

All leaves from the folder are processed one after another. The features of those leaves are extracted using HOG vector descripter. The following images shws visualization of HOG features of a plant leaf.

Figure 5 : visualization of Hog features after Image processing

In the proposed model we use the values for HOG algorithm as proposed by Dalal and Triggs [15]

For masks to compute gradients and derivatives, we used a

- 1D centered derivative mask[-1, 0, +1]

For splitting an image into cells and grouping cells into block .we used a

- Detection windows size 64 x128

For block overlapping

- Cell size is 8x8 and Block size is 16x16(2x2 cells)

For block normalization, initially

1. L1-Norm is used to normalize the values in the block
2. Remove Infinity values
3. L-2 norm is used to normalize the feature vector

L-1 norm

block_feature=block_feature/sqrt(norm(block_feature)^2+.01);

L-2 norm

feature=feature/sqrt(norm(feature)^2+.001);

Artificial Neural Network Design

When the features from the leaf images are extracted, we use the ANN to classification. though there are many methods of classification. we used backpropagation technique to classify the leaves as it has almost near perfect results. The below figure show the Neural Network Design

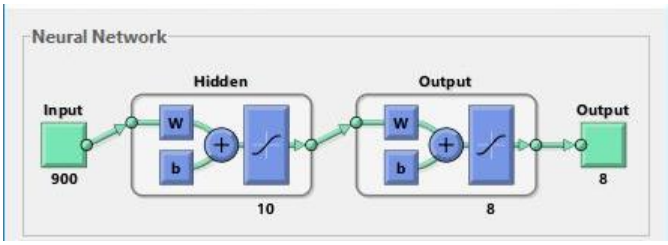

Figure 5 : Neural Network Design

The neural network is traineed with 900 input vectors extracted using HOG and the size of the hidden layer of the Neural Network used is 10. And the final output classifies into 10 outputs(here the no plants)

The training function used her is the Scaled Conjugate Gradient (trainsg) for back propagation. The Setup Division of Data for Training, Validation, Testing in the implemented model is

Training ratio = 70/100;

Validation ratio = 15/100;

Testing ratio = 15/100;

VI. RESULTS AND DISCUSSION

Using HOG features of leaf with combination of a neural network gives higher accuracy. In the implemented model the accuracy obtained for 10 sets of leaves containing around 50 samples each gave an accuracy of 98.5 % .The accuracy will be varied with increasing number of samples the accuracy can ne increased by increasing the size of the image which in turn leads high number of feature extracts using HOG. Though this method requires high computational power compared to other methods for classification of objects in large scale objects, there is a rapid growth of powerful and affordable processors which is the key. Comparing with other methods the combination of HOG and Artificial Neursl Network is very accurate and promising. The below table show comparision of oue method with few others.

Method	**Features extracted**	**Classifier used**	**Best Accuracy**
[6]	5 geometric features 12 morphological features 5 principal variables	PNN (Probabilistic Neural Network)	90%
[10]	Intensity histogram of the leaf image is used to get the rough regions of the vein pixels	ANN (Artificial Neural Network)	97.33%
[11]	Size Radius Perimeter Solidity Eccentricity	Radial Bias Function	80%
[12]	Shape Vein Colour Texture Zernike moments	RBPNN (Radial Basis Probabilistic Neural Networks)	93.82%
[13]	Geometrical features Morphological features	K-SVM (Kernelized Support Vector Machine)	96.20%
[14]	Zernike Moments HOG	SVM (Support Vector MAchine)	97.18%
OUR	HOG	ANN	98.5%

Comparison of our method with others

VII. CONCLUSION

Artificial Neural Networks have come a long way in today's world. Where they are easily accessible form our mobile phones. though the neural network concept has been around from 1970's, the computational power required to run the complex programs is achieved in this decade.H0G feature descriptor has a better accuracy at extracting features compared to any other feature descriptor. Combining HOG method and neural networks the object recognition is very accurate. A large variety of objects trained under HOG and Neural Network can be distinguished very easily by this model and seems very promising. This could help lot of explorers, botanists etc

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