SVM BASED LEAF CLASSIFICATION USING HISTOGRAM AND GEOMETRIC FEATURES

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ABSTRACT:

Identification of leaf and plants is an area of research which has gained a lot of attention in these years and is also an important tool in the field of agriculture, crop rotation, cultivation, forestry and much more. The process generally begins with the acquisition of images i.e., enhancement of leaf images, segmentation of leaf, its feature extraction and the classification. Today, Classification of plants using its various categories has been a broad application. In this paper we presentdifferent techniques which can be used for plant leaves classification. The classification method includes some segmentation algorithms and pattern classification techniques. This technique helps in plant-leaf classification. This process and analysis is effective and the performance of the leaf classification system is analyzed using Support Vector Machines (SVM). SVM is trained and tested for various categories of leaf images using different Kernel Functions and Histogram Features. The results show satisfactory performance and the highest accuracy of 93.04% is achieved using Gaussian Kernels.

Keywords: acquisition; segmentation algorithms; SVM; kernel functions;

1. INTRODUCTION:

Plants are omnipresent and it is the backbone of all life on Earth and a significant resource for human well-being. The first and foremost step during design phase is leaf recognition which can be further continued to get the final identification of plant.Plant Identification plays a crucial role in various fields like medicine, agriculture, forestry and pharmacological science etc., Due to various serious issues like global warming and lack of awareness of plant knowledge, the leaf categories are becoming rare and many of them are about to extinct. Development of a high speed efficient classifying technique has become an important area of active research. With the current technologies, plants are very well used in the sector of medicine and agriculture. The major challenge in this study is to identify the most valuable and favorable algorithm and techniques for plant identification through leaf recognition.

2. LITERATURE REVIEW:

Many methodologies have been developed in automated fashion for plant leaf identification. Image processing techniques performs image segmentation task which identifies the texture, color and pattern of the leaf.Classification of plantswas based on the characterization of texture properties. Many authors have utilized a combined classifier learning vector quantization along with the radial basis function. There also exists a method that incorporates shape and vein features. In Stephen Gang Wu et. al. (2007) the authors describe Artificial Neural Network (ANN) for classification. In Liu Huanget al. (2011), recognition feature techniques such as Scale Invariant Feature Transform(SIFT) and Bag of Features(BoF) are considered, which also generates lower dimensional feature vectors. In Abdul Kadir et. al.(2012) features were extracted using Principal Component Analysis (PCA) and converted into orthogonal features and the results were given as input to the classifier which used Probabilistic Neural Network(PNN). The Shape features were eccentricity, roundness, dispersion, solidity, convexity, and features called Generic Fourier Descriptors (GFDs). Vishakha Metre et. al. (2013) uses Stochastic Gradient Descent (SGD) algorithm for segmentation and k- Nearest Neighbor(k-NN) for classifying the plants. In Mohamed Elhadi Rahmani et. al. (2015), comparing the performance of various classification algorithms also considering the supervised learning algorithms for classification especially decision tree and Naïve Bayes was discussed.

3. OUTLINE OF THE WORK:

The database which contains leaf images are first acquired. There are three major phases which arePreprocessing, Feature Extraction and Classification. The first phase of preprocessing follows a CRE method which is Contrast Improvement, Removal of Noise (Noise Removal) and Edge Enhancement. The preprocessing is extended to segment the input images. Segmentation is carried out using Fuzzy C-Means (FCM) andGeometric features, segmented features are given as input for feature extraction using Histogram. The last phase of Classifying is done using SVM (Support Vector Machine) techniques which identifies the leaf image.

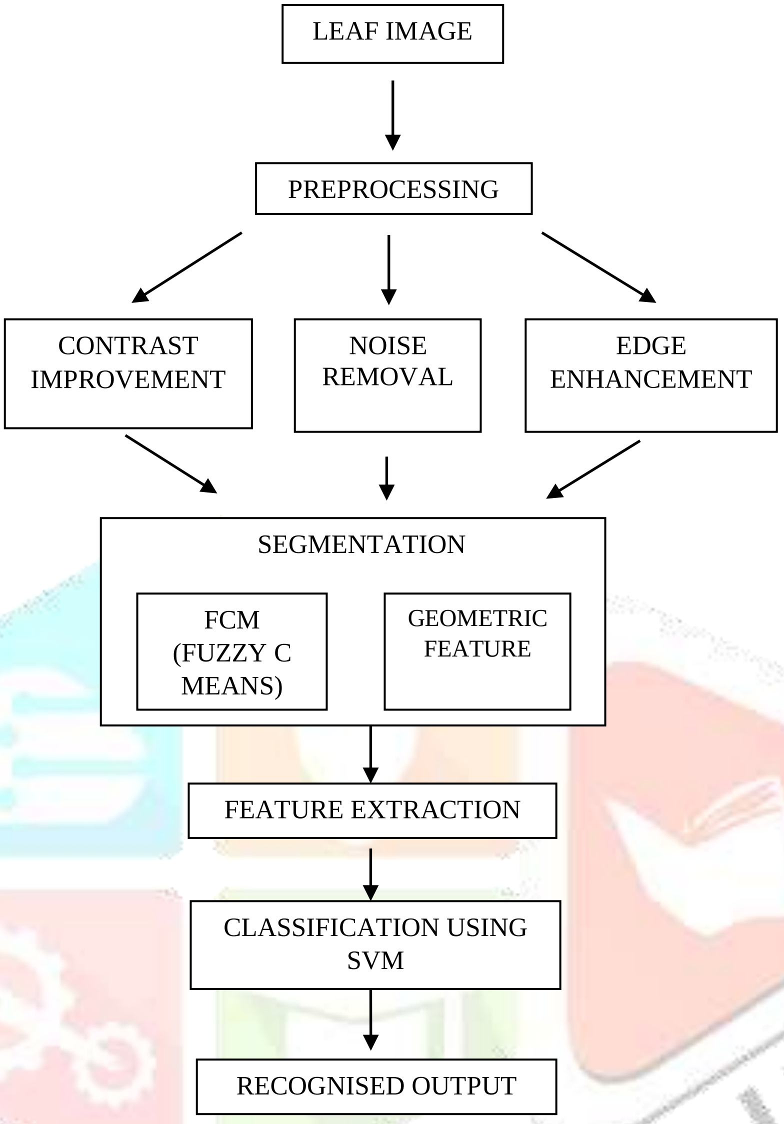

Fig 1. Block diagram of leaf classification

4. PROPOSED METHODOLOGY:

Almost the leaf classification suggests the preprocessing method gives a better performance for the segmentation. The segmentation process goes to using three methods which is given on the block diagram. Those methods are Fuzzy C-Means (FCM), Geometric feature. This implies the feature extraction inputs. Also some of the features extracted from the input.

5. PREPROCESSING:

5.1 CONTRAST ENHANCEMENT (C):

The first main process of preprocessing is contrast enhancement which is achieved by weighing the input leaf image and the interim equalized image recursively until the allowed intensity range is maximally covered. This technique is known as Histogram Equalization.

5.2 REMOVAL OF NOISE (R):

Using a Gaussian filter for noise suppression, the noise is smoothed out, at the same time the signal is also distorted. The use of a Gaussian filter as pre-processing for edge detection will also give rise to edge position displacement, edges vanishing, and phantom edges.

5.3 EDGE ENHANCEMENT (E):

Fuzzy C means clustering is a technique which produces high quality images. There are existences of many edge detection methods.Among these this approach using Fuzzy logic elevates the performance in the output for Gray scale images.The features considered for edge detection are Mean, Variance and Correlation. Using these features, edge enhancement is performed.

$$Mean = \mu_i = \sum_{i,j=0}^{N-1} i(P_{i,j}) \quad (5.1.1)$$

$$Variance = \sigma_i^2 = \sum_{i,j=0}^{N-1}(i - \mu_i)(P_{i,j}) \quad (5.2.1)$$

$$Correlation = \sum_{i,j=0}^{N-1} P\left[\frac{(i-\mu_i)(j-\mu_j)}{\sqrt{(\sigma_i^2)(\sigma_j^2)}}\right] \quad (5.3.1)$$

6. SEGMENTATION :

Fuzzy c-means has been a vital tool for image processing especially in clustering objects in an image. Mathematicians included the spatial term into the FCM algorithm to improve the accuracy of clustering under noise. A fuzzy logic model can be described on fuzzy sets that are defined on three components of the HSL color space and HSV. The membership functions aim to describe colors follow the human intuition of color identification.

The Fuzzy C Means Algorithm focuses on partitioning a finite group of n elements X = $\{x_1,\ldots,x_n\}$ into a collection of c fuzzy clusters subject to certain given criteria. Given a finite set of data, the algorithm returns a list of c cluster centers $C = \{c_1,\ldots,c_c\}$ and a partition matrix $W = w_{i,j} \in [0,1], i = 1, \ldots, n, j = 1, \ldots, c,$ where each element, w_{ij} , tells the degree to which element x_i , belongs to cluster c_j.

The FCM aims to minimize an objective function

$$arg_c min \sum_{i=1}^{n} \sum_{j=1}^{c} w_{ij}^{m}\, x_i|| - c_j||^2 \quad (6.1)$$

Where

$$\omega_{ij} = \frac{1}{\sum_{k=1}^{c}\left(\frac{\|x_i - c_j\|}{\|x_i - c_k\|}\right)^{\frac{2}{m-1}}} \quad (6.2)$$

7. FEATURE EXTRACTION:

The task of the feature extraction is to obtain the most relevant information from the original data and represent that information in a higher dimensionality space.The goal of feature selection is to reduce the dimensionality of vectors associated to patterns by selecting a subset of attributes smaller than the original. The histogram often refers to the pixel intensity values. Histogram is normally a graph which shows the number of pixels in an image at each different intensity value found in that image.

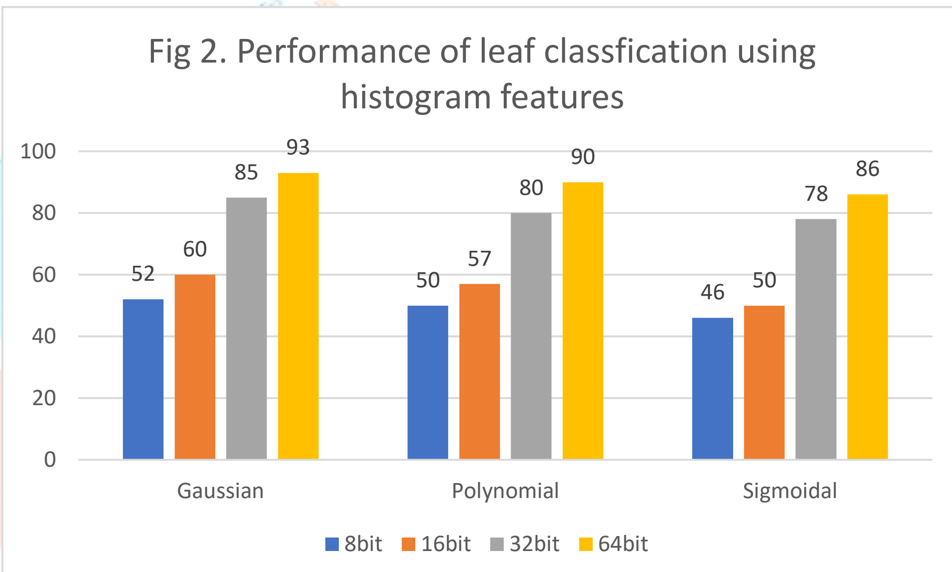

Fig 2. Performance of leaf classification using histogram features

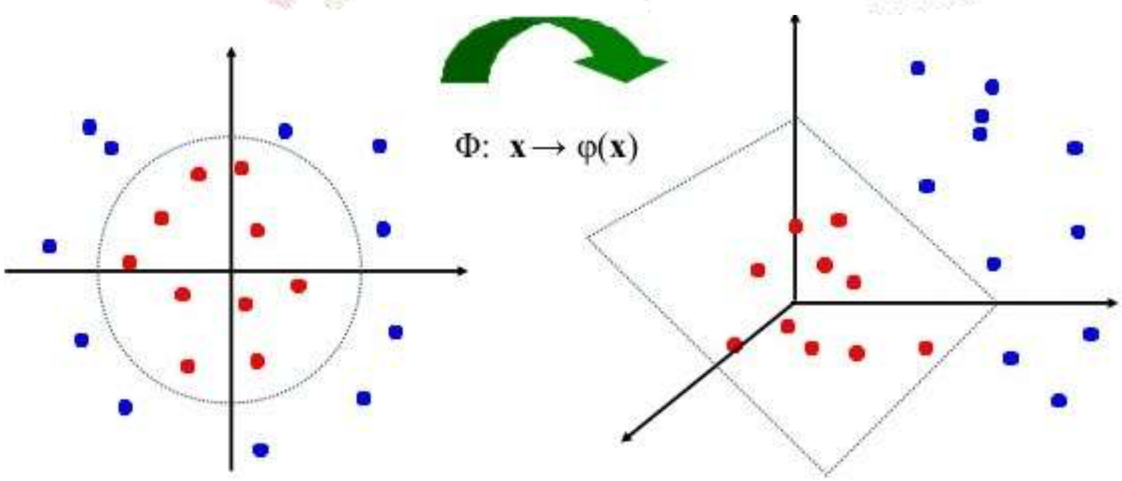

Fig 3: An example for SVM kernel function$\Phi(x)$maps two dimensional input spaceto higher three dimensional feature space. (a) Nonlinear problem. (b) Linear problem

8. CLASSIFICATION:

For identifying the plant leaf,Support Vector Machine (SVM) is one among the most prominent multiclass classification techniques for high-dimensional feature vectors. The Kernel Functions considered are Gaussian, Sigmoidal and Polynomial. For linearly separable data, SVM finds a separating hyperplane which separates the data with the largest margin. For linearly inseparable data, it maps the data in the input space into a high dimension spacex $\in R^{I}7 \rightarrow \Phi(x) \in R^{H}$ with kernel function $\Phi(x)$, to find the separating hyperplane. If the training data are linearly separable, then SVM finds the optimal hyper plane that separates the data without error.

9. EXPERIMENTAL RESULTS:

The experiments are conducted using the CLI database. The Sigmoidal and Polynomial kernels produced results which performed comparatively low and less accurate output. While the Gaussian Kernel performed relatively better and high accurate results were generated.

The polynomial kernel is similar to sigmoidal, but the boundary is of some defined but arbitrary order.From the analysis, Gaussian kernel function in SVM provides better performance for leaf classification. The table below shows the accuracy of the kernel functions.

Kernel function	Gaussian	Polynomial	Sigmoidal
Accuracy(In %)	93.04	90.14	86.23

10. CONCLUSION:

In this paper an efficient method for classifying leaf images has been described. 8, 16, 32 dimensional histogram features where extracted from segmented leaf images. The performance of the system was studied using support vector machine. SVM was trained and tested for different kernel functions and the system showed an accuracy of 93.04%.

REFERENCES:

[1] Abdul Kadir, Lukito Edi Nugroho, Adhi Susanto and Paulus Insap Santosa, "Performance Improvement of Leaf Identification System Using Principal Component Analysis," International Journal of Advanced Science and Technology, Vol. 44, pp. 113 - 124, July, 2012.

[2] Vishakha Metre, Jayshree Ghorpade, "An Overview of the Research on Texture Based Plant Leaf Classification," International Journal of Computer Science and Network, Vol 2, Issue. 3, pp. 2277 - 5420, 2013.

[3] Mohamed Elhadi Rahmani, Abdelmalek Amine, Mohamed Reda Hamou, "Plant Leaves Classification," The First International Conference on Big Data, Small Data, Linked Data and Open Data, 2015, pp.75 - 80.

[4] Suman S. G, B. K. Deshpande, "Plant leaf Classification using Artificial Neural Network Classifier," International Journal of Innovative Research in Computer and Communication Engineering, Vol. 5, Issue. 5, pp.10189 - 10196, May 2017.

[5] Ms. Divya T,Asha C Korwar ,Prof. Virupakshappa, "A Survey On Recognition Of Plant Leaves Using Various Classifiers And Various Morphological Features," International Journal of Advance Foundation and Research in Computer, Vol. 2, Issue. 5, pp. 89-95, May - 2015.

[6] Sapna Sharma, Dr. Chitvan Gupta, "Recognition of Plant Species based on leaf images using Multilayer Feed Forward Neural Network," International Journal of Innovative Research in Advanced Engineering, Vol. 2, Issue. 6, pp. 104 - 110, June 2015.

[7] Manisha M. Amlekar, Ashok T. Gaikwad, "Plant classification based on leaf Shape features using Neural Network," International Conference on Innovation in Science, Engineering, Humanities and Management, pp. 214 - 218, September 2017.

[8] Aamod Chemburkar, Anand Sartape, Ajinkya Gawade, Prasad Somawanshi, "Automated Tool for Plant Leaf Classification Using Morphological Features," International Journal Of Engineering And Computer Science, Volume. 3, Issue. 11, pp. 9098 - 9102, November, 2014.

[9] A.H. Kulkarni1, Dr. H.M.Rai, Dr. K.A.Jahagirdar, P.S.Upparamani, "A Leaf Recognition Technique for Plant Classification Using RBPNN and Zernike Moments," International Journal of Advanced Research in Computer and Communication Engineering, Vol. 2, Issue.1, pp. 984 – 988, January 2013.

[10] Stephen Gang Wu, Forrest Sheng Bao, Eric You Xu, Yu-Xuan Wang, Yi-Fan Chang and Qiao-Liang Xiang, "A Leaf Recognition Algorithm for Plant Classification Using Probabilistic Neural Network," pp. 1 – 6, 29 July 2007.

[11] A. Kadir,L.E. Nugroho, A. Susanto and P.I. Santosa, “A Comparative Experiment Of Several Shape Methods In Recognizing Plants,” International Journal of Computer Science & Information Technology, Vol. 3, Issue. 3, pp. 256 - 263, June 2011.

[12] Kue-Bum Lee and Kwang-Seok Hong, “An Implementation of Leaf Recognition System using Leaf Vein and Shape,” International Journal of Bio-Science and Bio-Technology Vol. 5, Issus. 2, pp.57 – 66, April, 2013.

[13] Abdul Kadir, Lukito Edi Nugroho, Adhi Susanto, Paulus Insap Santosa, “Leaf Classification Using Shape, Color, and Texture Features,” International Journal of Computer Trends and Technology, pp. 225 - 230, Aug 2011.

[14] Abdolvahab Ehsanirad And Sharath Kumar Y. H., “Leaf recognition for plant classification using GLCM and PCA methods,” Oriental Journal of Computer Science & Technology, Vol. 3, Issus 1, pp. 31-36, 2010.

[15] Jyotismita Chaki, Ranjan Parekh, “Plant Leaf Recognition using Shape based Features and Neural Network classifiers,” International Journal of Advanced Computer Science and Applications, Vol. 2, Issue. 10, pp. 41 -47, 2011.

[16] Anuja Vaidya , Divyesh Pujari, Harsh Desai, Krunal Borse and Sagar Patel, “Leaf Recognition – A Technical Review,” International Journal For Research In Emerging Science And Technology, Vol. 2, Issue. 1, pp. 46 – 51, January-2015.

[17] Shayan Hati, Sajeevan G, “Plant Recognition from Leaf Image through Artificial Neural Network,” International Journal of Computer Applications, Vol. 62, Issue.17, pp. 15 – 18, January 2013.

[18] Subhankar Ghosh, Harish Kumar, Pradeep Kumar, Devaraj, Jyothi S.Nayak, “Study on Classification of Plants Images Using Combined Classifier,” International Journals of Advance Research in Computer Science and Management Studies, Vol. 3, Issue. 4, pp. 516 – 526, April 2015.

[19] Mr. Girish Athanikar, Ms. Priti Badar, “Potato Leaf Diseases Detection and Classification System,” International Journal of Computer Science and Mobile Computing, Vol. 5 Issue. 2, pp. 76-88, February-2016.

[20] L. Ramesh, V. Nirmala, “Betel Leaf Disease Classification Using Clustering Method,” Journal of Chemical and Pharmaceutical Sciences, Issue. 1, pp. 193 - 196 , February 2017.