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Research Article

EVALUATION OF MORPHOLOGICAL RESPONSES IN *PARMOTREMA TINCTORUM* LICHEN USING BACK PROPAGATION NEURAL NETWORKS COLLECTED FROM SERVARAYAN HILLS OF TAMILNADU, INDIA

Kanmani P. [1]*, Rajiv Kannan A. [2]

[1]Department of Computer Science and Engineering, K. S. Rangasamy College of Technology, Tiruchengode, Namakkal, Tamil Nadu, India

[2]Department of Computer Science and Engineering, K. S. R. College of Engineering, Tiruchengode, Namakkal, Tamil Nadu, India

*Corresponding Author Email: pkanmaniit@gmail.com

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ABSTRACT

Lichens are combination of both fungi and algae which is used as one of the key pharmaceutical ingredients in medicinal industry. The traditional way of identification of lichens requires skilled person and also time consuming process for performing the manual based colour test. The present study was planned to develop a reliable technique to identify the lichen species through image processing and machine learning process. Lichen sample was collected and image acquisition was done. Lichen images were preprocessed and to extract the features of lichens by color co-occurrence method. Segmentation of lichen images were performed using K means clustering algorithm. Back propagation neural network was used to automate the identification process. 30 images were taken for training and 40 images were taken for testing. Automation by Neural network revealed that 87% of accuracy in recognising the lichen images. A comparison between the manual and the proposed system identification is evaluated. The results showed that the parameters time, cost had reduced and the efficiency and performance were increased in the proposed system. Further, the automation techniques of the present study will enable to identify the lichen species in easiest approach which helps to predict the important lichen species for pharma industry.

Keyword: Image Processing, Neural Network, K means clustering, color co-occurrence, Lichen.

INTRODUCTION

Lichens are plants that depend on another organism for its survival. It is the combination of two organisms. One of the organisms is a fungi and other is a photobioant like green alga or cyanobacterium. The photobiont photosynthesize the sunlight and produce the plant starch which could be consumed by the fungi. They establish symbiotic relation with each another[1]. Some lichens are more complex and may consist of more than two organisms which are symbiotically related.

The image processing technique can be used for extracting the features of Lichen and authenticating it medicinal qualities. The sample lichen images taken from various locations and plants will be highly useful in identifying the medicinal herbs[2]. Identifying the Lichen samples requires more experience in the field but is subjective to human errors and take more time. The shape, texture, color, compactness and other features of lichens are analysed by applying advanced image processing techniques and capabilities of advanced computing and image storage facilities to obtain useful knowledge.

MATERIALS AND METHODS

Analysis of Morphological Features of *Parmotrema tinctorum*

The morphological features[3,4] extracted from *Parmotrema tinctorum* shows that the thallus is foliose, loosely adnate, 3-30 cm in diameter, and lobate. The lobes are subirregular, elongate, slightly imbricate, plane, separate, 10-20 mm wide. The upper surface of lichen looks gray, smooth, centrally dull, shiny marginally and emaculate. The isidia of upper surface is simple to coralloid branched, and laminal to marginal. The medulla is white with continuous algal layer. The lower surface looks black with brown naked zone peripherally and centrally rhizinate. Apothecia is sparsely insidiate and usually imperforate. The ascospores are broadly ellipsoid.

Collection of Lichen Images from the Database

The first step is the collection of different lichen images from the repository. The collected images are grouped based on species level, morphological characteristics are stored in repository for pre-processing.

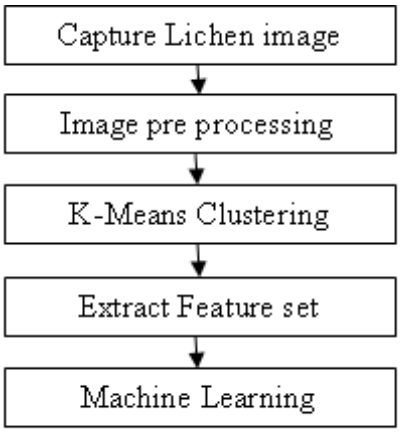

Figure 1: Work Flow in the proposed model

PREPROCESSING

Preprocessing refers to initial processing of input image to correct the distortions, eliminate the noise. Preprocessing is the technique to reduce noise, to remove irrelevant data, transform an image. It also helps to increase the quality of the image.

Median Image Filtering

Median Filter is a nonlinear smoothing which is used to remove impulsive noise and reduce blurring edges of lichen. The pixels are arranged either in the ascending or descending order and then the median for the pixels were evaluated. In the Figure 2 the median pixel lies either in the low value or the higher values[5,6]. The filter takes each pixel in the image and evaluates at its nearby neighbours to decide whether or not it is representatives of its surroundings. It is replacing the pixel value with median of neighbouring pixel value with the median of those values. The image enhancement is shown in the figure 2.

Original Image

Median Image Filtering

Figure 2: Filtering of Image

FEATURE EXTRACTION

It is the process of separating an image into number of segments that has the similar information. The separated segment contains information of various forms. The features[7,8] extracted in each segments are the region, color, boundary values.

Region Based Method

The lichen contains many irregular surface regions forming different shapes. Hence making region based separation[9,10] will help to extract shape features of the image. The image is divided into four regions such that the mirror value is calculated for the lichen. The good and bad coordinates are evaluated and compared with other lichen.

Color Co-occurrence Method

This method is used to extract the spatial information[11,12] of the lichen image ignoring the intensity of the image. Homogeneity, Entropy, Correlation, Contrast are calculated by the co-occurrence method.

Enhanced Curvelet Based Extraction

Lichen contains curves in its edges and inner parts of the plant. Hence to locate the sharp curved features curvelet based segmentation and wavelet based is used. Wavelet transform[13] converts the image to four bands. Each band is of LL, LH, HL, HH details. LL band is taken for analysis sine more details are found in the LL band. LL band is the adaptive band. The features from the curvelet and wavelet transform are extracted.

SEGMENTATION

Conversion of RGB into Lab space

Step 1: The RGB image is converted into Lab color space. Then image is converted into three channels where L is the lightness and a and b are the color spaces of an image.
Step 2: Using the curvelet transformation the image is decomposed into the combination of LL, LH, HI, HH details. Here LL is used for next process.
Step 3: The image is modified to get the differences in the image and is used for edge detection.
Step 4: Centroid function is applied to improve the fragile edges.
Step 5: Extract the improved edges and repeat Step 3 and Step 4 till the enhanced edges are obtained.
Step 6: Apply the k-means clustering algorithm.

K-Means Clustering

The image is grouped based on similarity of colors and the groups forms the cluster. The number of clusters is initially assigned to three so that we get three clusters as shown in the Figure 3. Each pixel in the image is taken and the distance is calculated by using Euclidean distance. The mean and centroid value for the image is taken and the image is clustered according to the values nearing mean and centroid. The process is repeated till the occurrence of no new colors.

Cluster 1 Cluster 2 Cluster 3

Figure 3: Results of Image Filtering

Feature Selection

In order to minimise the irrelevant feature, principle component analysis is used. This minimises the number of irrelevant features also combine the attributes which has the common characteristics by two Boolean operators[15]. The association feature is used in Principle Component Analysis to again fuse the selected features into a single platform.

NEURAL NETWORK

The features selected are trained to the machine by neural networks[16,17]. Network consists of 4 layers. First and last layers are the input and output layers. The layers inside are the hidden layers. Each layer contains neurons that are interconnected. Weights are assigned and the input given to the first layer is adjusted accordingly with the weights and the impurities are decreased iteratively. In back propagation the values are fed forward towards the layers and the discriminations are passed in the backward direction[18,19] iteratively until the accuracy is obtained. The network is trained according to the weights. The features are fed such that the datasets are divided into training and test datasets. In this network 40 images are taken for the training data and 30 images are taken for the test dataset. The BPNN training values are shown in table 4.

Comparison of Manual Identification with Automation

Manual identification involves large number of chemicals and tests in order to identify the type of lichen and is time consuming. During the sample collection in hills researchers scratch and engrave the whole lichen from the trees. This would exploit the existence of the rare species. In this case automation in identifying the lichen through machine learning mechanism will finish these in few seconds without damaging or exploiting the lichens. The result shows the comparison of parameters between manual and automated identification.

RESULTS

The Table 1 and Table 2 shows the features extracted for Tinctorum lichen. The features are grouped into texture, color and lichen. Texture features are analyzed with attributes like Energy, Homogeneity, Entropy, Correlation and Contrast. The attributes such as Mean, Standard deviation, skewness, Intensity, Median are analyzed to extract color features. The lichen features are identified with Diameter, length and width, Area, Perimeter, Smooth factor, Aspect ratio, perimeter of lichen, hull, distance map and narrow factor.

Table 1: Feature Extracted for *Parmotrema tinctorum* Lichen

Image features grouping	Identified features	Attributes
Lichen Texture features	Sub irregular, smooth and shiny, branched, Large lobes,	Energy, Homogeneity, Entropy, Correlation, Contrast
Lichen Color Features	Gray, white at margin, pale green, black with brown at the lower surface.	Mean, Standard deviation, skewness, Intensity, Median
Lichen features	10-20mm wide, smooth, 3-30cm in diameter	Diameter, length and width, Area, Perimeter, Smooth factor, Aspect ratio, perimeter of lichen, hull, distance map x,y, narrow factor

Table 2: Analysis of Texture and color feature for *Parmotrema tinctorum*

Images	Mean	Std Deviation	Median	Intensity	Skewness	Variance
Sample 1	187.50	75.95	201	12,10,13	-0.698	5.0352e+03
Sample 2	171.58	69.02	161	74,71,57	-0.081	4.7648e+03
Sample 3	158.66	78.88	158	84,104,1	-0.108	3585.8107
Sample 4	159.09	74.09	150	107,118,1	0.070	5490.6350
Sample 5	163.96	69.29	159	74,169,61	0.010	4801.7432

Table 3 shows the performance analysis of different denoising techniques. A sample of 5 images is analyzed for calculating wavelet transform, curvelet transform, PSNR and MSE. The wavelet transform value ranges from 21.89 to 23.71 and curvelet transform value between 30.45 and 31.489. The PSNR value is around 18. The obtained MSE value is between 1.723 and 2.58. This low value of MSE shows that the images are of high quality.

Table 3: Performance analysis of different denoising techniques

Image	Wavelet transform	Curvelet transform	PSNR	MSE
Sample 1	23.71	30.45	18.34	**2.58**
Sample 2	22.12	31.489	17.344	**2.24**
Sample 3	22.670	31.34	18.67	**1.98**
Sample 4	21.439	30.89	18.32	**2.43**
Sample 5	21.89	31.24	17.45	**1.723**

Table 4 shows the recognition rate of BPNN. The recognition rates of geometric, color, texture and shape features are obtained as 85.4%, 86.7%, 84.6% and 89.7% respectively.

Table 4: Recognition Rate of BPNN

Features	BPNN
Geometric	85.4%
Color	86.7%
Texture	84.6%
Shape	89.7%

The Figure 4 shows the comparison graph of difference between manual and automation based on evaluation time, cost, efficiency, accuracy and performance.

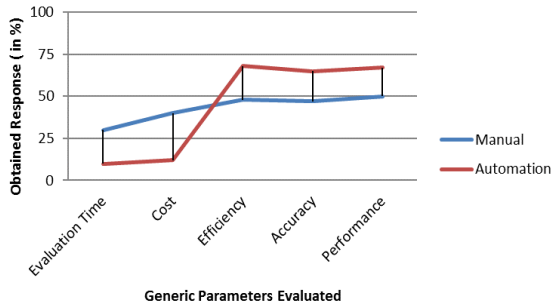

Figure 4: Difference of Parameters Manual vs Automation

CONCLUSION

The automation system for the identification of lichen has been proposed. The results evaluate all the possible features of the genus and give the 87% recognition accuracy. The performance evaluation of the filtering methods is applied to exhibit the quality of the image.

Since lichen possess various bioactive substances as a lead compound in drug discovery which has to be properly identified and authenticated. The present study will be the footstep to researchers, scientists and beginners in the field of Lichenology for identification of different lichen species. Further the work has to be done at different genera of lichen recognition in India for aspects of Bioprospects.

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