International Journal of Engineering Research and Development
***e**-ISSN: 2278-067X, **p**-ISSN: 2278-800X, www.ijerd.com*
Volume 3, Issue 11 (September 2012), PP. 46-50

A Novel Approach for Retrieval System for Plant Leaves Images

Abstract— Image identification of plant leaves based on human vision is difficult task as well as plant identification based on keywords retrieval. It requires the domain knowledge in the botanist field. This work proposes the image texture analysis using Discrete Wavelet Transformation (DWT) and combined with an entropy measurement to identify a query image to one of seven classes that consists of 280 plant leaves images. The experimental results show that the proposed method yields higher correctness retrieval accuracy rate which reaches up to 92% compared to the Gray Level Co-occurrence Matrix (GLCM) that gives 49.28%.

Keywords—content based image retrieval; discrete wavelet transformation; texture retrieval

I. INTRODUCTION

Image retrieval techniques are the important part in the multimedia information retrieval, and its application fields are becoming more widely used, such as web related applications, biomedical applications, earth and space sciences, and etc [1] . There are two research communities, the first one is text based image retrieval, and the other one is content based image retrieval (CBIR) [2].Text based image retrieval offers less complexity method and they are widely used in image retrieval. However, the manual annotation required to assist the text based retrieval process costs long time and not an easy task for non-expert. Due to that, the text based image retrieval is not so preferable especially in plant images. There are many difficulties in designing a retrieval system for plant leaves images such as it requires the domain knowledge which requires the skills of measure of many pre-defined plant characteristics such as flowers, leaves and woody part [3-5]. The other difficulty is the plant leaves images have a wide pattern variation of size, texture, color and shape [3]. Thus, it is a complex task reaching to impossible for non expert to succeed in the searching and retrieving of plant leaves images. Hence there is a large database of digital information available of plants specimen's images. Therefore, it creates the motivation to access and browse this database accurately with an easy way. To overcome all of these difficulties, in addition to assist the student and the researcher in the botanist field in solving the problem of searching for certain species of plant leaves images. Thus, it is requiring an efficient approach of image retrieval system. This research proposes to examine the usage of image texture feature analysis and employ it into the content based images retrieval problem. In addition, this work is to investigate the use of discrete wavelet transformation (DWT), and combined it with entropy measurement to measure significant feature for plant leaves images identification. The proposed method is compared to other effective method for texture analysis such as Gray level Co- occurrence Matrix (GLCM)

II. TEXTURE FEATURE EXTRACTION

Texture feature is an important feature which is used in analysis structure content of images, where quasi repetition of structure parts occurs [6]. It provides a useful feature for image retrieval applications. Texture describes an entire content of images as has been demonstrated in fabric, trees, fruit, and skin. Therefore, many CBIR systems use the texture feature in the feature extraction stage. Texture features can be classified into two categories, firstly spectral feature such as Gabor filter and discrete wavelet transformation, secondly, statistical feature such as Tamura texture by Word feature [and Co-occurrence matrix representation.

Among different texture features, the DWT are widely used for CBIR applications and have been reported presenting better retrieval performance and match the result of studies in human visual perception [9]. GLCM also has been reported to perform well in the image retrieval applications and is presented as another effective approach for image texture analysis.

III. METHODOLOGY

The database used in this work is the plant leaves images dataset that has been obtained from the American National Herbarium Collections This database consists of cropped isolated leaves images, each species include varied number of images, averaged about 30 samples per class. The images of this dataset have wide diversity of image rotation, scale, noise, luminance, and contrast. Fig.1 shows examples of some samples of plant leaves images database that are belong to same group. It can be observed that these samples even though they belong to same group but they have different diversity in image rotation, scale, noise and luminance. Thus, it offers big challenges to design an efficient method in the texture analysis

That is capable to overcome these challenges and providing good retrieval accuracy.

Fig.1 Examples of plant leaves images from the used database and share same group that has scientific name as Acer rubrum

For this work, seven classes have been chosen with variety number of images per class, the total number of images was 280 images. The scientific names to these selected classes are Abutilon theophrasti, Acer negundo, Acer rubrum, Acer saccharinum, Acer saccharum and Ageratina altissima the main implementation of this work consists of two basic steps, the offline and online steps. Hence the images format in the database is RGB format and due to colour changes of the image affected by illumination especially for outdoor image acquisition, so RGB model gives different values in different environment that may reduce the retrieval performance but HSV model gives more stability to that affect since the colour information of HSV space is distributed separately from the illumination part in different channels. Therefore, the offline processing starts with transforming the color space from RGB to HSV for the whole images in the training database. This operation is followed by implementing the Haar DWT to extract texture feature for each of the three components of HSV space.

For each sub band coefficients entropy measurement was used to extract significant information for texture pattern Entropy measurement is giving by equation (1).

$$\text{Entropy} = \sum C(i, j) \log C(i, j) \quad (1)$$

Where $C(i, j)$ is the normalized histogram that is applied to coefficients resulting from wavelet decomposing. As a result, a vector of each image sample on the database was produced. The produced vectors then will be saved in the memory in indexing feature vector which contains the indexes to both the names and the images of training database. In the online processing all the steps in the offline phase implementation were repeated on a query image, and a vector of 48 dimensions was produced. Euclidean distance difference between the vector of image texture feature extracted of the query image and other vectors in training database was calculated. An ascending sorting operation has been implemented to the vector of distances.

There are four sub band coefficient produced from the DWT implementation, and as illustrated in fig.2 these coefficients that are indicated by LL, LH, HL, and HH which are represent the decomposed approximation information, the vertical information the horizontal information, and the diagonal information respectively.

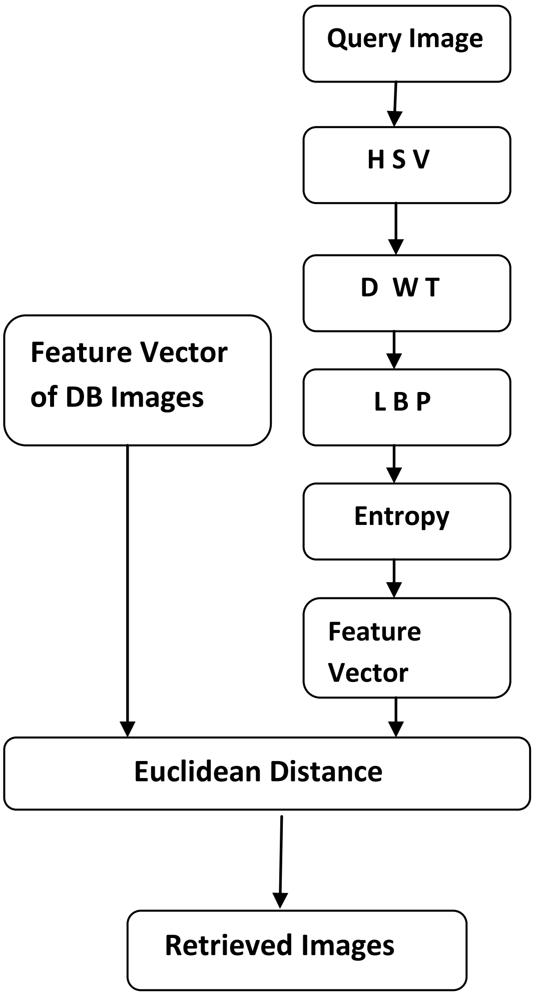
Local binary patterns (LBP):

It is a type of feature used for classification in computer vision. LBP was first described in It has since been found to be a powerful feature for texture classification; it has further been determined that when LBP is combined with the Histogram of orient gradients (HOG) classifier, it improves the detection performance considerably on some datasets. The LBP feature vector, in its simplest form, is created in the following manner:

- Divide the examined window to cells (e.g. 16x16 pixels for each cell).
- For each pixel in a cell, compare the pixel to each of its 8 neighbors (on its left-top, left-middle, left-bottom, right-top, etc.). Follow the pixels along a circle, i.e. clockwise or counter-clockwise.
- Where the center pixel's value is greater than the neighbor, write "1". Otherwise, write "0". This gives an 8-digit binary number (which is usually converted to decimal for convenience).
- Compute the histogram, over the cell, of the frequency of each "number" occurring (i.e., each combination of which pixels are smaller and which are greater than the center).
- Optionally normalize the histogram.
- Concatenate normalized histograms of all cells. This gives the feature vector for the window.

In order to make a decision on which image is most relevant to the query image, the corresponding image to a minimum value of the distances vector was considered as the best matching result. The corresponding name of the class of this image was considered as the class name for the query image. Test dataset has been selected from the training database based on the sample one out scheme [5], where all the samples in the training database has been tested by considering each sample as two times, one time as query by removed it totally from the training database and the second time as training database.

Block Diagram:



IV. RESULT AND DISCUSSION

The analysis of the retrieval result is based on the vector of different distance. Any two samples share that minimum distance are presented as those from same class. The best corresponding relevant is presented as the first rank of retrieved images, the second best relevant is presented as the second rank of retrieved images and so on continuously for there retrieved samples until reach to the end of the retrieved images which are considered. Correctness retrieval rate has been used to evaluate the retrieval performance. Thus, this measure is used to evaluate this work. It can be defined as the number of queries that are classified correctly to the total number of test dataset. In this work, it can be considered top 5 matches as top matches ranks of the relevant retrieved images. Due to the presence that the user prefers to use system that is capable to show small number of probable answer as much as possible. Therefore, using this measure for more than one retrieved images is to evaluate how the system is able to reduce number of probabilities of answers that are possible appearing to the user, and the true one could be appearing in any of these answers.

Correctness retrieval accuracy rate equation:

$$(\mathrm{CRR})_t = \sum_{t=1}^{f} \frac{D_t}{N} \quad - (2)$$

Where:

t = the corresponding rank of relevant retrieved image.
Dt = number of queries that are classified correctly at rank t- th.
N = total number of test dataset.
f = number of selected rank of the retrieval result.

For the implementation of equation (2),

It has been chosen the number of selected rank (f) = 5.
The corresponding rank = (1, 2, 3, 4, 5).
Due to the testing part was based on sample one out scheme Therefore, the total number of test dataset = 280 queries.

Fig.3 shows comparison results in the correctness retrieval rate after the implementation of the proposed method and the GLCM at different ranks. As illustrated in Fig. 3, there are five selected ranks. They present different results based on the selected rank, for example if the user prefers using only first rank to find the correct answer, thus, it can be noticed that the correctness retrieval rate based on first rank for the proposed method is up to 92%, while the GLCM is giving result of 49.28%.

As shown in fig.3 the performance of both methods are changing in different ranks, for example if the user prefer to find the correct answer from one out of two possible choices, where the true answer should be appear to the user in one of these two answer. Thus, it can measure the correctness retrieval rate that is appear to the user based on using two ranks only by measuring the correctness retrieval rate at rank (1) + the correctness retrieval rate at rank (2)), this leads to the increment of the correctness retrieval rate up to 95% for the proposed method, while the performance of GLCM is increased up to 67%.
It can be noticed clearly in fig.2 that the proposed method is giving higher retrieval accuracy rate than the GLCM.

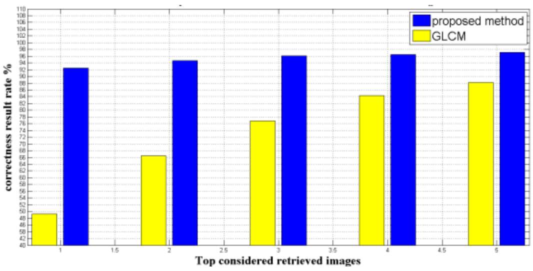


Fig. 3

The correctness retrieval rate vs top considered retrieved Images.

X -→ Retrieved Images
Y → retrieval accuracy rate

V. CONCLUSIONS

The image texture features analysis using the Haar DWT and LBP combined with the entropy measurement demonstrate higher retrieval accuracy rate that can reach to 94% compared to GLCM that presents 54.28%. The proposed algorithm shows better robustness compared to the use of the GLCM by evaluating both methods using image database that are affected by large distortion such as diversity on scaling, orientation, luminance and noise.

REFERENCES

[1] J. Z. Wang, Integrated Region-Based Image Retrieval. Massachusetts: Kluwer Academic Pub, 2001.
[2] Y. Rui, T. S. Huang, and S. F. Chang, "Image Retrieval: Current Techniques, Promising Directions, and Open Issues," Journal of Visual Communication and Image Representation, vol. 10, pp. 39- 62, 1999.
[3] A. Backes and O. Bruno, "Plant Leaf Identification using Multiscale Fractal Dimension," International Conference on Image Analysis and Processing, 2009, pp. 143-150, 2009.
[4] C. Judd and S. Kellogg, "Plant Systematics. A Phylogenetic Approach Sinauer Associates, Inc," Publishers Sunderland Massachusetts USA, 1999.
[5] I. M. Sussex and N. M. Kerk, "The Evolution of Plant Architecture," Current Opinion in Plant Biology, vol. 4, pp. 33-37, 2001.

Mr.C.VENKTAIAH graduate from Chaitanya Bharathi Institute of Technology Hyderabad in Electronics & Communication Engineering. Now pursuing Ph.D. in DIGITAL IMAGE PROCESSING from JNT University Hyderabad

Mr.CH.VENUGOPAL graduate from Medak College of Engineering & Technology in Electronics & Communication Engineering. Now pursuing Masters in DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS) from Jagruthi Institute of Engineering Technology.

Mr.CH.ALEKYA graduate from Sridevi Women's Engineering College in Electronics & Communication Engineering. Now pursuing Masters in DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS) from Jagruthi Institute of Engineering Technology.