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TEXTURE EXTRACTION FOR IMAGE RETRIEVAL USING PYRAMIDAL WAVELET TRANSFORM

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ABSTRACT
Content based image retrieval which provides suitable way to retrieve images from large database. Content based image retrieval (CBIR) is used in many applications. This technique is used to retrieve similar images to user defined specification. The goal of this technique depends on content properties such as shape, color and texture. This paper suggests an algorithm for texture extraction using pyramidal wavelet coefficient of an image and its feature vectors. This algorithm gives features extraction by using energy, standard deviation and a combination of both features. For similarity measurement between query image and database images distance metric is used. The experimental results shown that the above technique is better than traditional CBIR
Keyword:- Content Based Image Retrieval, Wavelet , Feature Vector, Image Database, Texture

1. INTRODUCTION

In current era fast worldwide takes place through internet where we require large number of data to be placed over and retrieved. In digital imaging image in the form of data which needs to be retrieved. In digital library for searching required image such as flowers, animals, plant etc. In face recognition it gives matched face form large database. In medical imaging diagnosis is carried out and also multimedia databases are rapidly increases hence efficient search algorithm need to be developed. Retrieval of image data has traditionally been based on human insertion of some text describing the scene, which can then be used for searching by using keywords based searching methods. However in many situations this traditional method is incomplete. So, content based image retrieval (CBIR) technique is proposed by many authors. CBIR first coined in 1992 by T.Kato,

Image retrieval is the technique in which query image compared with large database and gives similar results of query image. Image retrieval also captures important characteristics of query image and database images. Image retrieval based on content uses different types of features such as texture, color and shape. This paper we concentrate on texture feature. Texture is that innate property of all surfaces that describes visual patterns, each having properties of homogeneity. It contains important information about the structural arrangement of the surface, such as; clouds, leaves, bricks, fabric, etc. It also describes the relationship of the surface to the surrounding environment . Overall it is a feature that describes the distinctive physical composition of a surface.

Texture provide important characteristics for surface and object identification .These texture feature derived from either Gabor Wavelet or pyramidal Wavelet transform but Gabor wavelet transform suffer from three main drawbacks are it requires large space for storage, not efficient algorithm and require lot of computation time. To overcome this drawback new transform is used called as pyramidal Wavelet transform. In CBIR comparison of query image and database image takes place by different feature like standard deviation, energy and combination of feature vectors. All possible combinations represented using Manhattan distance and Euclidean distance.

The paper is organized as follows: In section 2 Wavelet Transform is discussed in brief. Image retrieval is proposed in section 3.Experimental results are providing in section 4, which follows by the conclusion.

2. WAVELET

Wavelet means wave + let i.e .scaling of single at different time period. Wavelet is small wave with varying frequency and limited duration. Wavelet is powerful tool for analysis and synthesis of signals. Localization and sharp

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transition of signal in spatial and frequency domain can by carry out successfully very efficient with wavelet. An attractive feature of wavelet transform is sub band coding and multi-resolution analysis. Wavelet transform is comparatively new and fast developing method for analysis of images .Wavelet transform split input signal into two component one contain low frequency (LP) part of input signal and other is high frequency (HP) part of input signal. Decomposition of wavelet the continuous wavelet transform of 1-D single f(x) is defined as,

$$(W_{af})\,(b) = \int f(x)\,\Psi_{a,b}(x)\,dx \tag{1}$$

Where, $\Psi_{a,b}(x)$ is computed from mother wavelet by dilation and translation

$$\Psi_{a,b}(x) = \frac{1}{\sqrt{|a|}}\,\Psi\,((x-a)/b) \tag{2}$$

The equation (1) can be discredited by restraining a & b to discrete lattice ($a = 2^{b}, b \in I$)

Resolution of the signal is the measure of amount of detail information signal changed by filtering operation and scale is changed by up sampling and down sampling. up sampling means adding a new sample and down sample means to reducing sample rate.

Subsampling is a combination of up sampling and down sampling. Subsampling procedure start with passing this signal through half band digital low pass filter after passing signal through a half band low pass filter. Half of sample can be eliminated. Resolution is halved after filtering operation. Sub sampling operation after filtering does not affect resolution half component can be discarded which are greater than cutoff frequency the signal is then sub sample by 2.

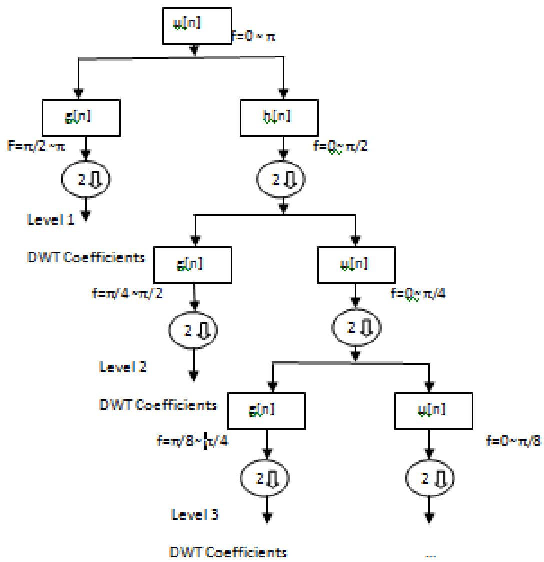

Figure 1. Subband Coding Algorithm

This procedure can be mathematically be expressed as,

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$$Y[n] = \sum_{k=-\infty}^{\infty} h[k].x[2h-k] \quad (3)$$

Discrete wavelet transform employs two sets of function called scaling functions and wavelet functions which are associated with low pass and high pass filter respectively decomposition of signal is obtained by successive high pass and low pass filtering of time domain signal. After filtering half of samples can be eliminated, decomposition mathematically expressed as follows:-

$$Y_{high}[k] = \sum x[n].\ g[2k-n] \quad (4)$$

$$Y_{low}[k] = \sum x[n].\ \mathrm{h}[2k-n] \quad (5)$$

$Y_{high}[k]$ and $Y_{low}[k]$ are output of high pass and low pass filter respectively .However this operation doubles frequency resolution The original signal x[n] is first passed through half band high pass filter g[n] and low pass filter h[n]. A powerful but conceptual simple structure for representing images at more than one resolution is image pyramid. That pyramidal wavelet invented by Burt and Addson in 1983. In pyramidal wavelet transform signal is passed through a low pass and high pass filter and filter output decimated by two.

Figure 2 shows a three level pyramidal wavelet decomposition of an image S1 of size axb pixels. In first level decomposition one low pass sub images S2 and three orientation selective high pass sub images ($W_2^h W_2^v W_2^d$) are created. In second level low pass image further decomposed in one low pass and three high pass sub images ($W_2^h W_2^v W_2^d$).

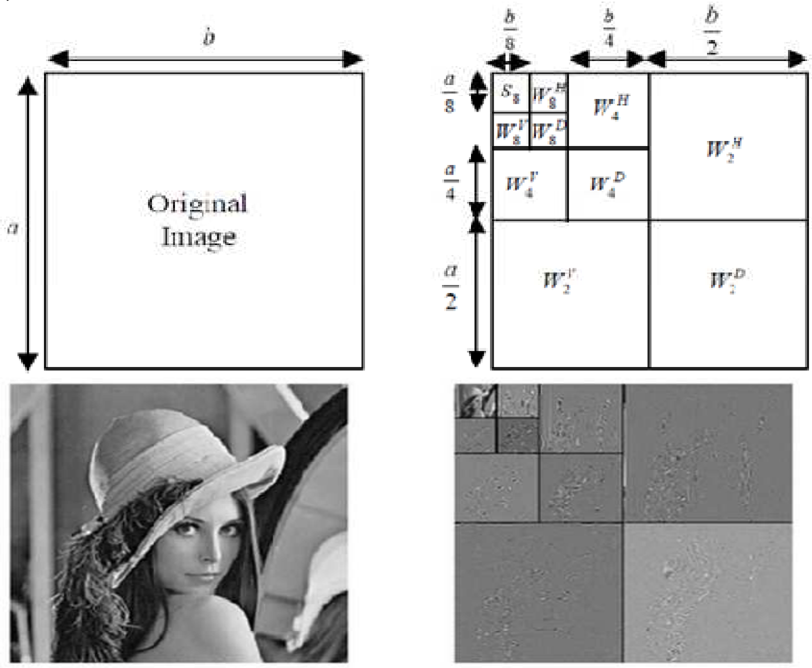

Figure 2. Pyramidal decomposition

This process is repeated on low pass sub images to form higher level of decomposition. Three stage decomposition will create three low pass sub images and nine high pass directional sub images. Low pass sub image are low resolution version of original image at different scale the vertical, horizontal, diagonal sub images provide information about change in corresponding direction respectively.

3. IMAGE RETRIEVAL

Figure3 shows image retrieval technique in which input image (query image) is given to extract features by using texture analysis and construct the feature vector.

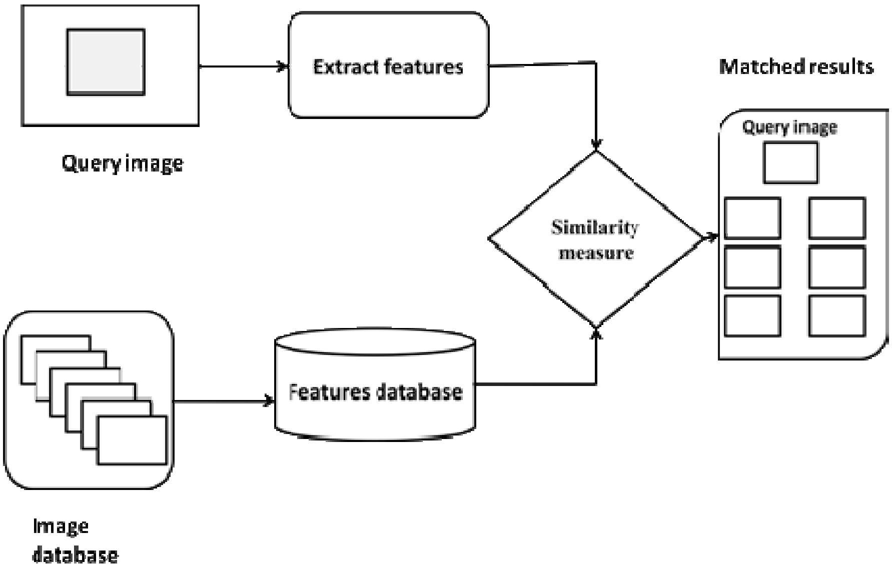

Figure 3 Basic Image Retrieval System

Image database consist of different types of images such as faces, flowers, etc .Construct feature vector for these images and stored in features database. Comparison between feature vector of input image and database images done at similarity measure by using Manhattan distance(L1) and Euclidean distance(L2) is given by,

$$D_{qi}^{M} = \sum_{j=1}^{n} | \overline{t_{qj}} - \overline{t_{ij}} | \quad (6)$$

$$D_{qi}^{M} = \sqrt{\sum_{j=1}^{n} (\bar{t}_{qj} - \bar{t}_{ij})^2} \quad (7)$$

Where $\bar{t}_{qj}$ and $\bar{t}_{qj}$ are the feature of the query and database image respectively. We know that distance of image from itself is zero. The distances are stored in increasing order and depending upon distance closest set of images will be retrieved.

4. ALGORITHM

Step 1: Give the query image (input image) size of 512x512.

Step 2 : Each image from database and query image are divided into 128x128 non overlapping sub images by using pyramidal wavelet transform. These subimages are decomposed into three levels.

Step 3 : Calculate feature vector by using energy, standard deviation and combination of both.

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Step 4 : Measure the similarity between features of query image and database images by using L1 or L2.
Step 5 : Matched images will be retrieved.

5. EXPERIMENTAL RESULTS

Texture database used in experimentation consist of 40 images which can downloaded randomly from internet. Size of each image 512x512 is divided into sixteen 128x128 non overlapping sub images, thus create a database of 640 patterns. The 128x128 image patterns are decomposed into three levels. In pyramidal wavelet transform for three level decomposition we get (4x3=12) bands of wavelet transform. The Haar and Daubechies are use for computing coefficients of pyramidal wavelet transform with feature parameters such as energy, standard deviation and combination of both. These feature parameters at each decomposition level are use to construct a feature vector. The length of feature vectors is equal to (12x number of feature parameter use in combination).Figure 4 shows a top 9 matches images are taken from retrieval. The performance measure in terms of number of texture patterns is similar with query image. Table 1 provides a detail comparison of performance with different features with different wavelet coefficient such as Haar, db4 and db8.

In Table 1 it shows that combination of energy and standard deviation as well as energy features will improve the retrieval performance. But length of feature vector for combination of both features is large, so it requires more computation time as compare to energy feature vector. Table1 clear that Manhattan distance function L1 gives better result than Euclidean distance function L2. Hence energy with Haar pyramidal wavelet coefficient gives best performance in image retrieval.

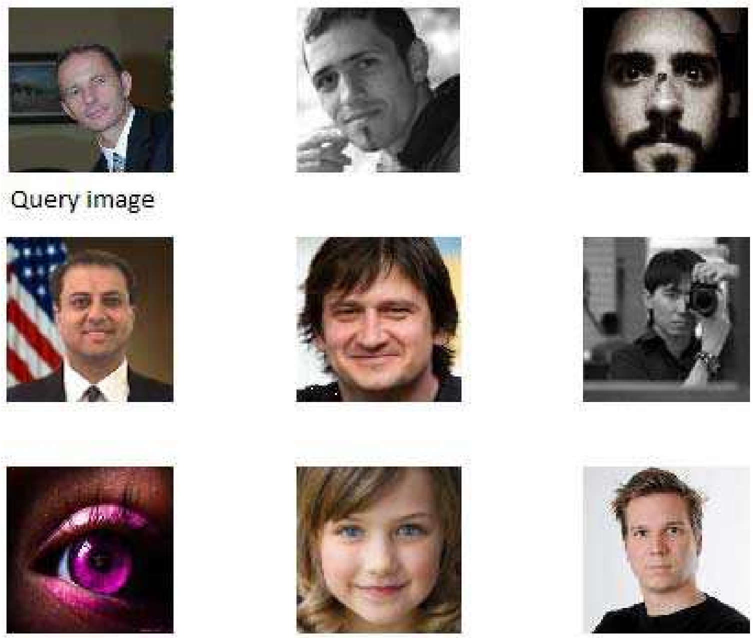

Figure 4 Retrieved Images

Table 1

Features	Haar		DB4		DB8	
	L1	L2	L1	L2	L1	L2
Energy	80.00%	50.00%	70.00%	50.00%	70.00%	40.00%
Std deviation	70.00%	20.00%	50.00%	30.00%	60.00%	40.00%
Energy + std deviation	80.00%	50.00%	80.00%	50.00%	70.00%	40.00%

6. CONCLUSION

Image retrieval using wavelet transform based on texture feature extraction is proposed. Texture feature extraction is done by three level decomposition using pyramidal wavelet transform which gives detailed coefficient. A detailed comparison of query image and database images depends on standard deviation, energy and combination of both by using Manhattan distance(L1)and Euclidean distance(L2).In Euclidean distance(L2) distances in each dimensions are squared before the summation due to this great emphasis on those feature give large dissimilarity. we found more modern approach by using Manhattan distance in which sum of absolute difference feature vectors is taken. Hence Manhattan distance with Haar wavelet transform gives an 80% result which is better than Euclidean distance.

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