



Image Indexing and Retrieval Based on Wavelet Correlogram and Color Feature

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Abstract: *With the rapid growth of digital libraries and multimedia databases, the need for an efficient searching method has also increased. Content Based Image Retrieval is one of the most powerful research areas nowadays for searching in image database. To achieve speed and to improve accuracy in retrieval of similar images, one approach is to use correlogram feature for indexing and retrieval. This Paper provides a comprehensive survey of the methods of image indexing and retrieval using correlograms described in literature. In particular, image indexing and features used for indexing and retrieval and measures adopted to compute the similarity between features of two images are critically analysed.*

Keywords: *CBIR, Correlogram, Feature Vector*

I. Introduction

The Content-based image retrieval (CBIR) has become very important research area now days due to rapid growth in image and multimedia database and its applications. Searching an image database of millions of images is a difficult and time consuming task. To reduce searching time one can use indexes like the indexes to search in the book. Different features are used for indexing and retrieval of images. Color, texture and shape are the most powerful features. Feature vectors of various types of images are calculated and stored as indexes of the images. Feature vector of the query image is calculated and compared with those index values for nearest image matching.

II. Previous Work

Global histogram processing is a popular approach. A histogram is a plot of the number of pixels belonging to each specific set of colors. If the difference between global histogram of query image and same of database image falls below certain threshold, the images are considered to be similar. Major drawback of global histogram processing is it does not give any information about spatial distribution of colors. Local histogram processing gives information about spatial distribution of colours. Images are partitioned into fixed number of rectangular cells containing fixed number pixels. Local histogram of each cell of query image is computed and compared with local histogram of same cell of database image. Histogram does not give spatial correlation among color changes. But colour correlogram expresses different colours and how spatial correlation of color changes with distance [1]. It is a structure which has been used to capture color information, which is a table indexed by color pairs, where the k -th entry for (i,j) specifies the probability of finding a pixel of color j at a distance k from another pixel of color i . But same color different texture images color correlogram fails [1]. So Wavelet Correlogram is another approach which uses wavelet coefficients to create feature vector.

One of the most important properties of wavelet transform is space-frequency decomposition of the input signal [3]. This property enables us to apply pixel domain tools, such as color correlogram, to the wavelet coefficients of an image. A wavelet correlogram expresses how the spatial correlation of pairs of wavelet coefficients changes with distance. Therefore, the multiscale-multiresolution property of the wavelet transform and Translation and Rotation invariance of color correlogram are combined. Consequently, the image indexes obtained by the wavelet correlogram method may have better discriminative performance. Among different wavelet decomposition algorithms, the 2D Gabor wavelet has special properties, which make it an appropriate wavelet transform to be used in the wavelet correlogram algorithm.

A. Wavelet Correlogram

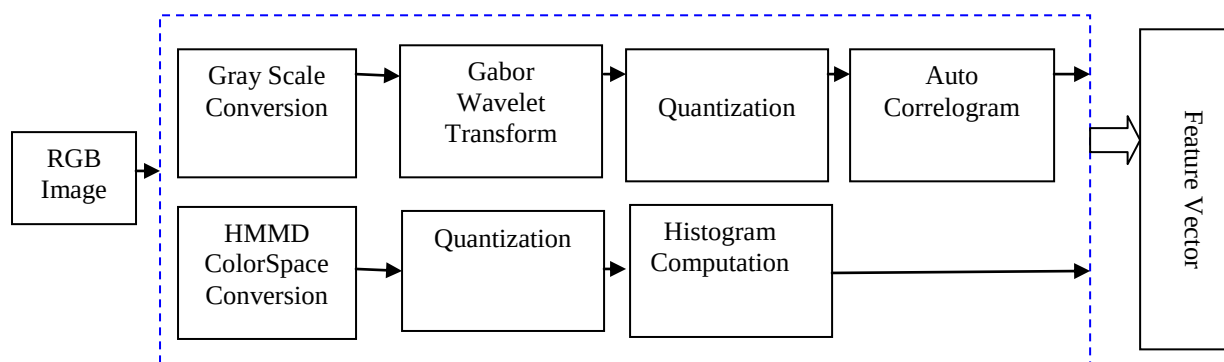
Wavelet correlogram indexing algorithm consists of three steps. First, the discrete wavelet transform of the input image is computed using Daubechies' wavelets for their regularity, separability and compact support properties. In practice, a limited number of scales are sufficient for wavelet decomposition. According to [2] applying wavelet transform in three scales gives a good compromise between efficiency and effectiveness of the algorithm. Then, the wavelet coefficients are quantized into a small number of levels.

III. Proposed Approach

In proposed approach wavelet features and colour features both are used for constructing feature vector. To extract and store wavelet features wavelet correlogram technique is used[2]. A wavelet correlogram expresses how the spatial correlation of pairs of wavelet coefficients changes with distance. Therefore, the multiscale-multiresolution property of the wavelet transform and translation invariance of color correlogram are combined. Consequently, the image indexes obtained by the wavelet correlogram method may have better discriminative performance.

Color is an important feature amongst expressive feature of an image. In proposed technique along with wavelet correlogram to retrieve relevant image color feature is also used. To include color feature simple structure that is a color structure histogram is used. Color histogram is one of the most frequently used color descriptors that characterizes the color distribution in an image. The *color structure histogram* aims at identifying localized color distributions using a small structuring window. To ensure interoperability, the color structure histogram is constructed in the *hue-min-max-difference* (HMMD) color space.

Figure 1 Proposed Approach to extract features



a. Preprocessing

The input RGB image is first converted into grayscale to reduce the computations because it consists of only single plane while RGB consists of three planes Red, Green and Blue. Gray scale image is used for extracting wavelet features. To create color structure histogram, convert image into HMMD (Hue, Min, Max, Difference) Colour space.

b. Gabor Wavelet Transform

There are different wavelet decomposition algorithms, among them the 2D Gabor wavelet has special properties, which make it an appropriate wavelet transform to be used in the wavelet correlogram algorithm. The brief review of the 2D Gabor wavelet transform for implementation is available in [7].

c. Quantization

The next block whose task is to quantization of the coefficients are discretized using the quantization thresholds obtained experimentally for good performance. Small coefficients are considered as noise (and discarded)[7] and the negative coefficients are truncated to suppress the undesirable effects of sinusoid oscillations of the Gabor wavelets.

d. Auto-Correlogram

Autocorrelogram of the quantized coefficients is computed along the direction normal to Gabor wavelet orientation:

$$\alpha_{m,n}(i, i) = \frac{\left| \left\{ (x, y) \mid W_{m,n}(x_0, y_0) = c_i; W_{m,n}(x_{k_m}, y_{k_n}) = c_i \right\} \right|}{\left| \left\{ (x, y) \mid W_{m,n}(x, y) = c_i \right\} \right|}$$

Where, $W_{m,n}$ is the matrix of the quantized Gabor wavelet coefficients.

e. Histogram Computaion

The histogram is defined as the frequencies of the pixels in grayscale image. The quantization is a process in which the histogram is divided into levels. This histogram values are computed using HMMD color space, and is defined using color space quantization operating points: 128 bins. Each color subspace is uniformly quantized along the Hue and Sum axes where the number of quantization levels for both hue and sum parameter are [1 4 8 8 8] and [16 4 4 4 4].

V. Experimentations and Results

We implement all the approaches using Matlab 7.8.0, using a PC running Windows 7 Basic.

a. Image Databases

To demonstrate the performance of the new algorithm on a CBIR, Subset of 120 images from Corel Image dataset of 1000 images are used. Test set is having 20 images of 6 categories.

b. Retrieval Efficiency

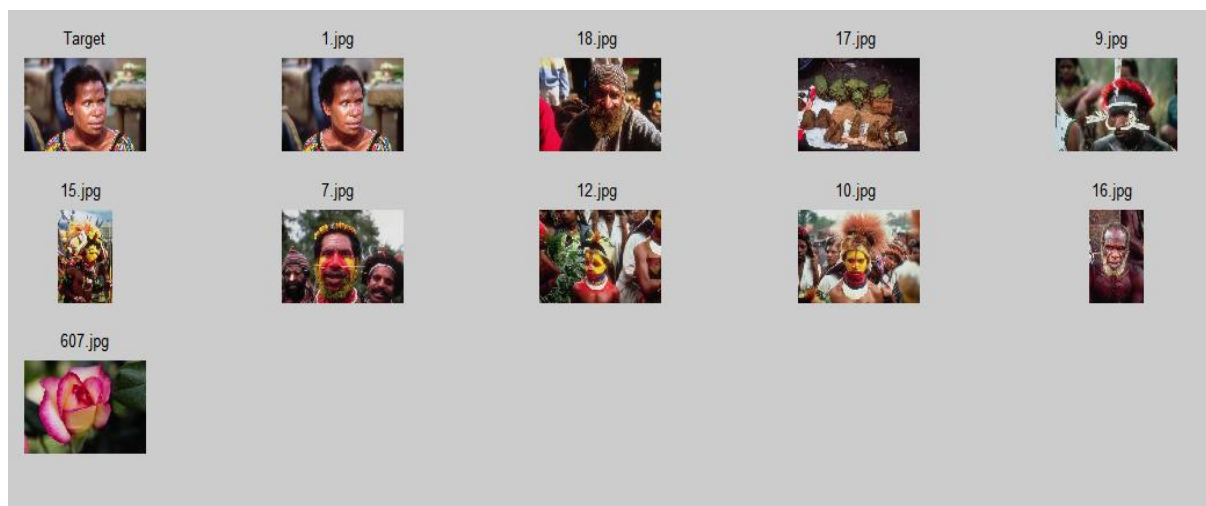
The retrieval efficiency, namely recall and precision were calculated using 1000 natural color images (100 in each category) from Corel image database.

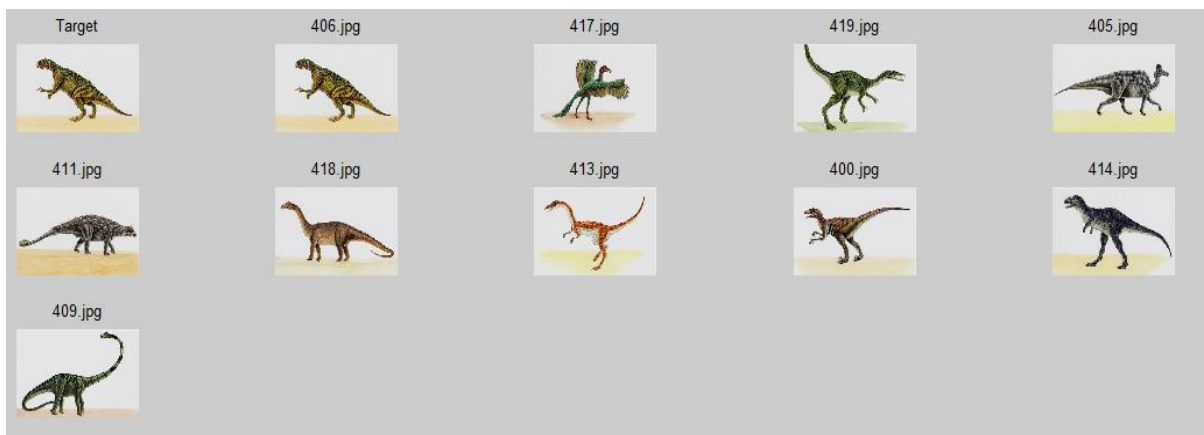
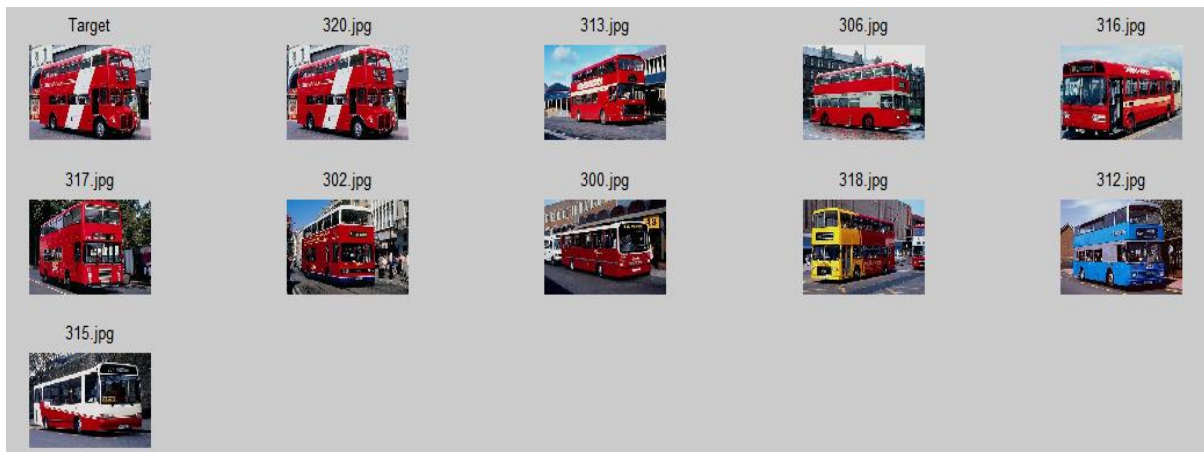
$$\text{Precision} = \frac{\text{No of relevant images retrieved}}{\text{Total No of images retrieved}}$$

$$\text{Recall} = \frac{\text{No of relevant images retrieved}}{\text{Total No of relevant images in the Database}}$$

Categories	Gabor Wavelet Correlogram		GWC with color features	
	Precision(%)N=10	Recall(%)	Precision(%)N=10	Recall(%)
Africans	52.9	33.2	80.0	40.0
Beaches	42.0	26.2	46.6	23.3
Buildings	47.8	26.5	50.0	25.0
Buses	88.3	65.1	93.3	46.6
Dinasaures	96.2	65.0	96.6	48.3
Flowers	75.5	50.4	100	50

c. Results





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