Content based image indexing based on framelet transform and color

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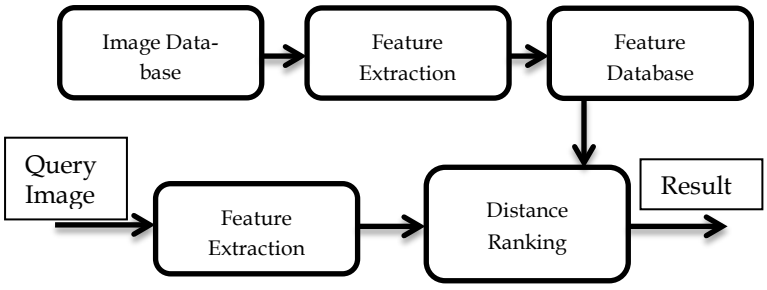
Abstract- This paper presents a novel content based image retrieval (CBIR) system based on Framelet Transform .The proposed method is shift invariant which captured edge information more accurately than conventional transform domain methods as well as able to handle images of arbitrary size. Current system uses texture as a visual content for feature extraction. First Texture features are obtained by computing the energy, standard deviation and mean on each sub band of the Framelet transform decomposed image.
In our method we have applied the color histogram feature that will enhance the current method which uses only the edge information. The results of the proposed methods are compared with conventional methods. We have done the comparison of results of these two methods for image retrieval. Euclidean distance is used as similarity measure in the proposed CBIR system.

Index Terms- Color histogram, cbir, Discrete wavelet transform (DWT), Eucledian distance, Framelet Transform

1 Introduction

Content-based image retrieval is also known as query by image content. Image retrieval has been a very active research area since the 1970s. There exist two approaches to search, to browse, and to retrieve images. The first one is based on textual information attributed to the images manually by a human.This is called text based image indexing [1].A human describes the image according to the image contentof it.This approach is very time consuming and may not be very accurate.To overcome the limitations of text based approach we use CBIR techniques[1,2]. In a CBIR system, images are automatically indexed by summarizing their visual features like the color, texture, and its shape. These features are hence automatically extracted from the images.

Content based image retrieval (CBIR) system performs two tasks (i) Feature extraction, where a set of features called feature vector is prepared to show the content of the image in the database. The second task is similarity calculationwhere a distance between the query image and the image in the database is computed so that the closest images can be retrieved.
Basic CBIR model:



Though a lot of advancement has been done in content based image retrieval system, finding an efficient retrieval method is still a major challenge for researchers.

Most of the methods mainly are based on the efficient extraction of color, shape and texture features.There are three most important feature of an image viz its color shape n texture.

2 Color Features

Color is the basic but a very important feature for image representation and is widely used in image retrieval. This is attributed to the fact that color is invariant with respect to the image scaling, translation, and rotation.

One of the main parts in color feature extraction is the choice of a color space. A color space is a space in multidimension where different dimensions represent different components of color. An example of a color space is RGB [8]. RGB color space gives a useful starting point to represent color features of images.But the RGB color space is not always uniform. The RGB color space can be transformed to derive other color spaces. The idea for color space transformation is to develop a model of color space that is always similar in human color vision. There are many color spaces such as HSV, CIE 1976 (LAB), and CIE 1976 (LUV) are generated by nonlinear transformation of the RGB space. HSVcolor space is also generated using nonlinear transformation of the RGB but it is can be invertible. The HSV color space is almost perceptually uniform. In this paper, we are going to use HSV color space to extract color features.

The HSV color space is extensively used in the field of color vision. The chromatic components viz hue, saturation and value, closely conform to the human color perception. The HSV values of a pixel can be transformed from its RGB values using the following formula:

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$$H = \cos^{-1}\frac{1/2[(R-G)+(R-B)]}{\sqrt{[(R-G)*(R-G)+(R-B)(G-B)]}}$$

$$S = 1 - \frac{3[min(R,G,B)]}{R+G+B}$$

$$V = (\frac{R+G+B}{3})$$

3 Texture Features

Texture means the visual patterns that have properties of uniformity that do not result from the presence of only a single color or intensity [7]. It is a native property of almost all surfaces, like clouds, trees, bricks, hair, and fabric. It contains important information of structural pattern of surfaces and its relationship with surrounding environment. This is very useful in pattern recognition and computer vision.

In this paper we have considered both color and texture features, we have used different color and texture features in our Content-Based Image Retrieval (CBIR) system.

The descriptors that are used are low-level features and can easily be extracted from both pixel and transform domains. For color descriptors, we have used color histogram. And framelet fransform features have been used for texture descriptors. Past results have shown that the color moment and color histogram descriptors show poorer effectiveness since they do not involve spatial relationship between image pixels. Texture is one of the important features and is used along with color feature to provide better results

In this paper we have introduced a new texture feature based on Framelet transform. Another mMultiresolution approach like Gabor filters [5-8] are made of of group of wavelets in which each wavelet captures energy at a specific resolution and orientation. So Gabor filters are able to capture local energy of the entire image .But it has a problem due to computational complexity and non-invariance to rotation .Also the non orthogonal property of the Gabor filters that introduces redundancy in the filtered image.

In this paper we introduced a new texture feature based on Framelet transform. Framelet transform [3-6] is quite similar to wavelets but have few differences. Framelets are two or more high frequency filter banks, which eventually produce more subbands upon decomposition. This can achieve better time frequency localization ability in image processing. There is redundancy between the Framelet subbands, which means change in coefficients of one band can be compensated by other sub bands coefficients. After Framelet decomposition, the coefficient in one subband has correlation with coefficients in the other subband. This means that changes on one coefficient can be compensated by its related coefficient in reconstruction stage which produces less noise in the original image.

4 Mathematical overview

In contrast to wavelets [9], Framelets have only one scaling function(t) and two wavelet functions $\psi 1(t)$ and$\psi 2(t)$. A set of functions {$\psi 1$, 2,……..$\psi N-1$} in a square integrable space $L2$ is called a frame if there exist $A>0$, $B<\infty$ such that for any function $f \in L2$

$A\ f\ 2 \leq f, 2j-k\ 2kjN-1i=1 \leq B\ f\ 2$(1)

Where both A and B are known as the frame bounds. The special case of A = B is known as tight frame. In the tight frame we have, for all $f \in L2$.In order to have fast wavelet frame, multiresolution analysis is usually used to derive tight wavelet frames from scaling functions
Now we can have the following spaces,

$Vj=spank$ {$(2jt-k$} (2)

$Wj=spank$ {$\psi i\ 2jt-k\ i$=1, 2……–1 (3)

With $Vj= Vj-1 \cup W1, -1 \cup W2, j-1 \cup \ldots\ldots. \cup WN-1,-1$ (4)

The scaling function (t) and the wavelets $\psi 1(t)$ and $\psi 2(t)$ are defined using these equations by the low pass filter $\circledcirc 0(n)$ and the two high pass filters $\circledcirc 1(n)$ and $\circledcirc 2(n)$

Let$\varphi\ t = 2 \circledcirc 0\ n\ (2t-n)$ (5)

$\psi\ i\ \ t\ = 2 \circledcirc i\ \ n\ \ \varphi\ \ 2t-n\ \ i$=1, 2…. n (6)

5 Proposed Algorithm

5.1 Training Part

Step1: Load the database.
Step2: Apply framelet transform and convert image RGV to HSV.
Step3: Apply obtain histogram of the image.
Step4: Integration of framelet transform and histogram image.
Step5: Store the result in the DataBase.

5.2 Classifier Part

Step6: Read the Query image (Q_{image}).
Step7: Apply Framelet transform and obtain histogram.
Step8: integrate the result.
Step9: Calculate the Euclidian Distance between the Query image and image database.
Step10: Sort the result from min to max.
Step11: Show the image with min distance.

6 CONCLUSION:

The search for the relevant information in the large database is becoming more challenging. More precise retrieval methods are needed in such cases. The proposed method is expected to give better retrieval results and higher precision. The retrieval using a single feature is not as effective as when both color and texture are included.

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