IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)
e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 9, Issue 2, Ver. VII (Mar - Apr. 2014), PP 25-30
www.iosrjournals.org

A comparative implementation of Content Based Image Retrieval techniques in Wavelet and Cosine domains

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***Abstract**: Content Based Image Retrieval generally uses the key feature of the image such as color, shape, texture to represent and index the image. Recent research in Content Based Image Retrieval is geared towards the development of mythologies for analysing, interpreting, cataloguing and indexing image database. It is also being made to evaluate the performance of image. In this paper first we are going to create database of the features of images by using Content Based Image Retrieval and then we are going to evaluate the database. Discrete Cosine Transform and Discrete Wavelet Transform algorithm are applied to the evaluated features of the input image. This gives the minimum difference, now this applied to database features and output comes in the form of re-rank image. The outputs of both the algorithm is now comparing to conclude the best algorithm for Content Based Image Retrieval.*

***Keywords:** Content Based Image Retrieval, Shape, Color Coherence vector, Discrete Cosine Transform, Discrete Wavelet Transform.*

I. Introduction

Content Based Image Retrieval is the process of retrieving image from a database of library of digital image according to the features of the images. In other words, we can say that it is the retrieving of images that have similar features content of color, texture or shape [1], [2].

The image retrieval system is a system gives a permission to browse, search and retrieve the images. Content Based Image Retrieval is the process of retrieving the required image from a database based on the contents of the image. Color, Texture and Shape are some of the main techniques used for retrieving a particular image from the database. Content Based Image Retrieval support all type of image and search based on the compare feature with an image input. The main components of Content Based Image Retrieval are the features which includes the Geometric Shape of an image, Color and texture of the images. There are two types of features in image, first is local features and other one is global features. Local features are used for the object recognition. Another component is associated text in which we can retrieve features using text associates from image. CBIR (Content Based Image Retrieval) technique has its prime importance in some of the area like Biomedicine, Military, Education, Web image classification and searching. Some of the example of present CBIR are VIPER which is Visual Information Processing for Enhanced Retrieval, QBIC which is Query by image Content and visual Seek which is web tool used for searching images and video over the internet [2], [3].

Images can be compared by forming CCM (Color Co- occurrence Matrix) for the input images as well as the images in the database. For using this method Hue Value is obtained for each and every pixel of the image and CCM is formed using the relevant formulas This CCM of input images is compared with the images in database and resulting images are sorted based on the similarity of features. This method can used to increase the accuracy and helps to obtain the result quickly. In Content Based Image Retrieval, Local features play a significantly very important role in determining the similarity of images along with the shape information with the object. In [4] local color and texture features are computed on a window of regular geometrical shapes surrounding the corner points. General purpose corner detection [5] is also used for this purpose. In [6] fuzzy features are used to capture the shape Information. Shape signatures are computed from blurred images and global invariant moments are computed as a shape feature. Recent retrieval systems have incorporated user's relevance feedback to modify the retrieval process in order to generate perceptually and semantically more meaningful retrieval result.

In this paper we are going to Content Based Image Retrieval method to create the database of the features of images. This database used to compare the outputs of the DCT and DWT algorithms. DCT and DWT algorithm is used to obtain the similar features images from the database in sorted order.

II. Related Work

Author Rui Y in his paper has proposed a survey of technical achievements in area of image retrieval. This paper of Rui Y shows the demand for the CBIR in a real time

application. They also proposed the past achievements in indexing and extracting the visual features of image. [7]

Another author A.W.M. Smeulder has provided the steps to carry out content based image retrieval process. The features which are used to retrieval of image is also explained by them in the paper. The disadvantages like necessity of database, role of similarity and problem of evaluation are also discussed [8]. Author Ahonen T presented a paper, where Content Based Image Retrieval systems are used for facial recognition and texture. In his paper he used an operator called local binary pattern is used for image retrieval, where the LBP value is found for each pixel in input image and compared with the LBP value of database images and images are retrieved [9].

Aigrain et al has discussed the main principals of automatic image similarity matching for database retrieval features. They have reviewed a selection of current technique for both video data management and still image retrieval, including key extension, video skimming, video parsing and shot detection. The paper concludes that the field is expanding rapidly, but that many other research challenges remains, including the difficulty of expressing semantic information in terms of primitive image features and the need for significantly improved information.

III. Content Based Image Retrieval

In previous days because of large image collections the manual annotation approach was very difficult. To overcome these difficulties Content Based Image Retrieval (CBIR) was introduced. Content Based Image Retrieval is the application of computer vision to the image retrieval problem. In this approach images are index using their own visual contents. These visual contents may be color features, shape features and texture features. This approach is also known as a general framework of image retrieval. There are three main aspects of image retrieval.

- Visual feature extraction
- Multidimensional indexing
- Retrieval system design

The color aspect can be obtain by using techniques like histograms and averaging. The texture aspect of image can be achieved by using vector quantization or transform quantization. The third aspect can be achieved by using
morphogical operators or gradient operators. Some of the major area of application are Art Collection, Medical diagnosis, Crime prevention, Military, Intellectual property, Architecture and engineering design and Geographical information and Remote Sensing system [10].

A. Retrieval Based on Color

There are different methods for retrieving images on the basis of color are used. Every image stored in the database in the database is analyzed and a color histogram is computed, which shows the properties of pixels for each image in the database. During the search time, the user can specify the desired proportion of each color (60% green and 40 % blue, for example) or submits a reference image from which a color histogram is calculated. Second option is more effective then the first one. The matching process then retrievers those images whose color histograms matched most closely to the input image [10].

B. *Retrieval Based on Shape*

The ability to retrieve the image by using shape feature of image is the most obvious requirement at the primitive level. Unlike texture, shape is a well-define concept and there are considerable proofs that shows natural objects are primarily recognized by their shape features. There are numbers of feature characteristics of object shape (but independent of size or orientation) are computed for each object identified within each stored image in database. Queries are then answered by computing some sets of features for the input image and retrieving those stored images whose features nearly matched with the input. Two main types of shape feature are commonly used global feature such as moment invariants, aspect ratio and circularity and local features such as sets of consecutive boundary segments. Other methods proposed for shape matching have includes Shocks, elastic deformation of templates and comparison of directional histograms of object shape that can be compared using graph matching techniques. Queries of shape retrieval systems are formulated either by identifying on example image to act as input image or a user- draw sketch. Image retrieval for three-dimensional objects using shape feature is more challenging task particularly where only a single two-dimensional view of object is available.

IV. Discete Wavelet Transform

In numerical analysis and functional analysis, a discrete wavelet transform (DWT) is any wavelet transform for which the wavelet is discretely sampled. As with other wavelet transforms, a key advantage it has is temporal resolution, it captures both frequency and location information.

The DWT of a signal x is calculated by passing it through a series of filters. First the samples are passed through a low pass filter with impulse response g resulting in a convolution of the two:

$$y[n] = (x * g)[n] = \sum_{k=-\infty}^{\infty} x[k]g[n-k].$$

The signal is also decomposed simultaneously using a high-pass filter h. The outputs giving the detail coefficients (from the high-pass filter) and approximation coefficients (from the low-pass). It is important that the two filters are related to each other and they are known as a quadrature mirror filter. However, since half the frequencies of the signal have now been removed, half the samples can be discarded according to Nyquist's rule. The filter outputs are then subsample by 2 (Mallat's and the common notation is the opposite, g- high pass and h- low pass):

$$y_{\text{low}}[n] = \sum_{k=-\infty}^{\infty} x[k]h[2n-k]$$

$$y_{\text{high}}[n] = \sum_{k=-\infty}^{\infty} x[k]g[2n-k]$$

This decomposition has halved the time resolution since only half of each filter output characterises the signal. extension becomes continuous. A two-dimensional (2D) image may have (512)2 pixels. The gray level of the pixel at position (*i, j*) is given by an integer *x*(*i; j*) (between 0 and 255, thus 8 bits per pixel). That long vector **x** can be altered by **x, h**, rest a row at a time (*j*, x) and then by columns (using the one-dimensional (1D) transforms of the rows). This is computationally and algebraically simplest: the 2D Toeplitz and circulate matrices are formed from 1D blocks.

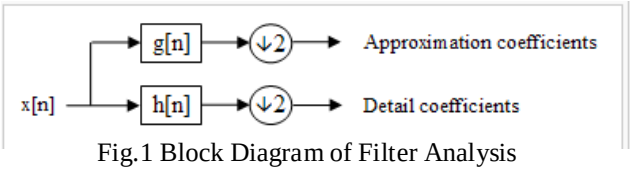


Fig.1 Block Diagram of Filter Analysis

Proposed Work

In this paper we are going to compare the DCT and DWT algorithms for the best output result using Content Based Image Retrieval. First we are going to find colour and shape features of the image and store that information in the database for evaluation. This process is done for creating database of image features for the evaluation phase. Figure shows the overall representation of the first phase.

FEATURE

However, each output has half the frequency band of the input so the frequency resolution has been doubled.

V. Discrete Cosine Transform

A discrete cosine transform (DCT) expresses a finite sequence of data points in terms of a sum of cosine functions oscillating at different frequencies. DCTs are important to numerous applications in science and engineering, from lossy compression of audio (e.g. MP3) and images (e.g. JPEG) (where small high-frequency components can be discarded), to spectral methods for the numerical solution of partial differential equations. The use of cosine rather than sine functions is critical in these applications: for compression, it turns out that cosine functions are much more efficient (as described below, fewer functions are needed to approximate a typical signal), whereas for differential equations the cosines express a particular choice of boundary conditions.

Images are not in nite, and they are not periodic. The image has boundaries, and the left boundary seldom has anything to do with the right boundary. A periodic extension can be expected to have a discontinuity. That means a slow decay of Fourier coe_cients and a Gibbs oscillation at the jump|the one place where Fourier has serious trouble! In the image domain this oscillation is seen as ringing." The natural way to avoid this discontinuity is to *reect* the image across the boundary. With cosine transforms, a double-length periodic

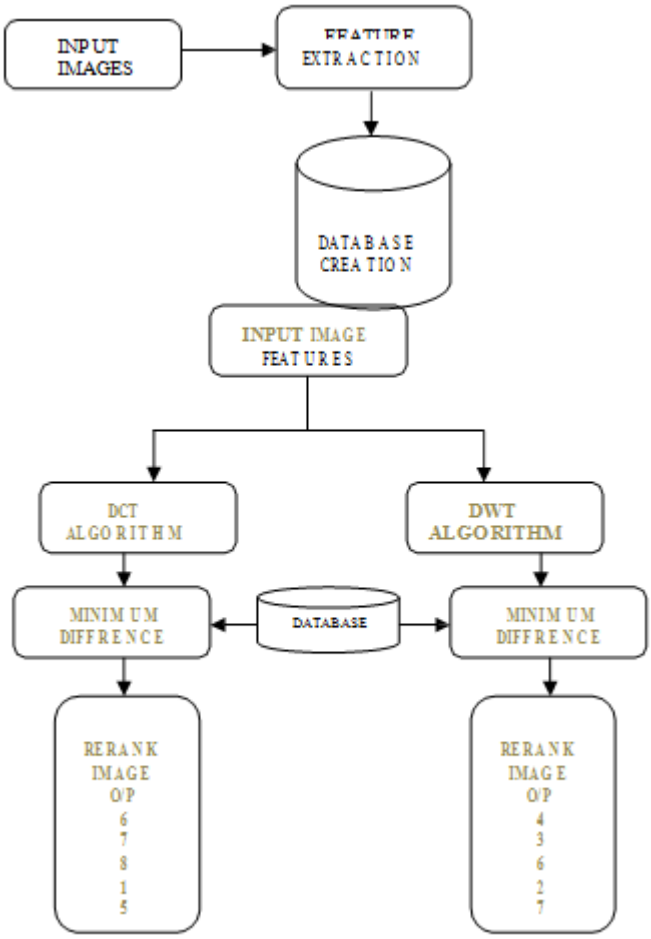


Figure2 - Diagrammatic representation of work flow

In evaluation phase features of image is calculated for image retrieval. DCT and DWT algorithm are applied to input image features. This gives the minimum difference of feature which
is compared with the database. The output of the comparison gives the rerank best matches for the input images. This result then used to choose best option for the Content Based Image Retrieval.

VII. Experimental RESULT Query Image

Retrieved Image 7

Retrieved Image 8

Retrieved Image 9

Retrieved Image 10

Retrieved Image 11

Retrieved Image 12

Retrieved Image 13

Retrieved Image 14

Retrieved Image 15

Retrieved Image 16

Retrieved Image 17

Retrieved Image 18

Retrieved Image 19

Retrieved Image 20

Retrieved Image 21

Retrieved Image 22

Results from DCT,

Retrieved Image 1

Retrieved Image 2

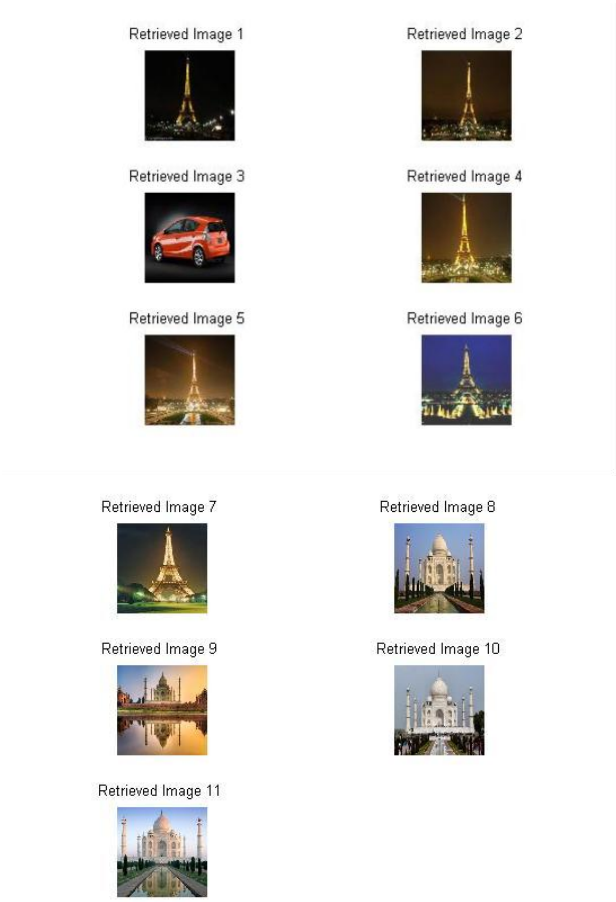
Retrieved Image 3

Retrieved Image 4

Retrieved Image 5

Retrieved Image 6

DWT Results



As we can see, the recall of DCT is 22 out of 30 images in the database, which comes to nearly 73 %, but the precision of DCT comes to about 4 out of 22 (means 4 relevant images are fetched out of 22), thereby giving a precision of merely 18%. While DWT gives a recall rate of 11 out of 30 which is 36%, but the relevancy is about 6 out of 11, which is 54%, showing a 36% improvement over DCT. In CBIR based applications relevancy is of greater importance, so we can check that DWT is better than DCT

VIII. Conclusion

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