An Efficient Face Image Retrieval through DCT Features

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ABSTRACT
This paper proposes a new simple method of DCT feature extraction that utilize to accelerate the speed and decrease storage needed in image retrieving process by the aim of direct content access and extraction from JPEG compressed domain. Our method extracts the average of some DCT block coefficients. This method needs only a vector of six coefficients per block over the whole image blocks In our retrieval system, for simplicity, an image of both query and database are normalized and resized from the original database based on the cantered position of the eyes, the normalized image equally divided into non overlapping 8X8 block pixel Therefore, each of which are associated with a feature vector derived directly from discrete cosine transform DCT. Users can select any query as the main theme of the query image. The retrieval images is the relevance between a query image and any database image, the relevance similarity is ranked according to the closest similar measures computed by the Euclidean distance. The experimental results show that our approach is easy to identify main objects and reduce the influence of background in the image, and thus improve the performance of image retrieval.

KEY WORDS
Content-based image retrieval, JPEG, Discrete cosine transforms, Feature extraction.

1. Introduction

Content based image retrieval (CBIR) is a hot topic research in the last decade. A number of image feature based on color, texture, and shape attributes in various domains have been reported in the literature [1, 2].
Recent research is started to develop image analysis and content feature extraction directly from compressed domain [5].
CBIR system can be classified as two phases: indexing and searching. In the indexing phase, each image of the database is represented by a set of attribute features color, texture and shape. In searching phase, when the user selects a query image, a query vector feature is computed. Using similarity distance measure well know Euclidian distance, the query vector compared to the feature vectors in the feature database and retrieve to the user the images that most close or similar to the query image.

To provide a fast feature extraction for compressed domain, therefore, a new wave of research efforts is direct access to feature extraction in compressed domain [3, 4]. All existing research on compressed domain is limited to DCT domain. The logic behind is that DCT is a good approximation of principal component extraction, which helps to process and highlight the signal frequency features.
In this paper we propose a simple method for face image retrieval based on DCT coefficient, we extract the average of some DCT coefficient features per block over the entire of the whole image. Then these features for each image blocks are concatenated to construct a feature vector.
The rest of the paper is organized as follows: in section ii a brief content based image retrieval. In section iii gives brief descriptions of DCT based block transform. In section iv how to extract features vectors from DCT. In section v presents how to measure the similarity distance and in section vi experimental results. Section vii gives the conclusion

2. Content Based Image Retrieval

Content-based image retrieval systems have been dealt with the issue of automatic indexing and retrieval of images. The general image retrieval system is shown in Figure 1. It consists of three main modules such as input module, query module, and retrieval module [6].

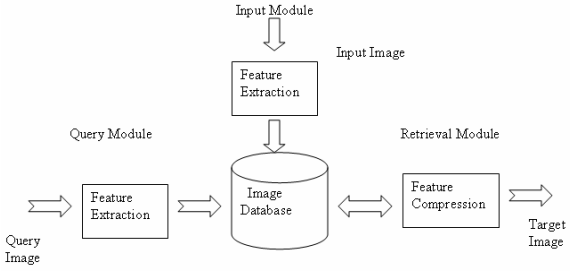


Fig.1. Block diagram of image retrieval system

In the input module, the feature vector is extracted from input image. It is then stored along with its input image in the image database. On the other hand, when a query

image enters the query module, it extracts the feature vector of the query image. In the retrieval module, the extracted feature vector is compared to the feature vectors stored in the image database. As a result of query, the similar images are retrieved according to their closest matching scores. Finally, the target image will be obtained from the retrieved images.

3. DCT-based Transform

JPEG is a Joint Photograph Expert Groups, its uses combination of spatial and frequency domain coding, the image is divided into 8X8 blocks, and then using the DCT each transformed into the frequency domain. In our system The normalize image is converted into gray color space, its equally divided into non-overlapped 8X8 blocks.

The 2-dimensional DCT of an image $f(i, j)$ for $i, j = 1,\ldots\ldots\ldots\ldots, N$ can be defined as

$$f(u,v) = \frac{1}{\sqrt{2N}} c(i)c(j) \sum_{x=1}^{N} \sum_{y=1}^{N} f(x,y) \cos\left[\frac{(2x+1)i\pi}{2N}\right] \cos\left[\frac{(2y+1)j\pi}{2N}\right]$$

$$c(u) = \begin{cases} \frac{1}{\sqrt{2}} & if u = 0 \\ 1 & if u > 0 \end{cases}$$

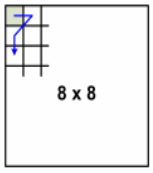
Where $f(x, y)$ the element of the image f, N is *is the size of the block that the DCT implemented.*

4. Feature Vector Extraction

For efficient image feature extraction, our method uses the average of some entire DCT coefficients in compressed domain as the feature vectors. The images either query or database is normalized by cropping based on the coordinate centred position of the two eyes and then the image obtained is resized. The output image divided into sub-image blocks (non-overlapping 8X8 blocks): $b(i, j), i = 1,\ldots\ldots, p$ and $j = 1,\ldots..q$, and then the DCT is performed independently on the sub-image blocks, the DCT coefficients are coded in a zigzag order as shown in figurer 2. For each sub-block containing one DC coefficient and other 63 AC coefficients, we extract the average of some entire DCT feature set, which are the most upper left coefficients, the DC and the first five AC's being ordered by zigzag order over all DCT coefficients blocks. Considering the following characteristics : (1) the DC coefficient of each sub-block represents average energy of the image, where ; (2) all the remaining coefficients within a sub-block contain frequency information which produces a different pattern of image variation; and (3) the coefficients of some regions within a sub-block also represent some directional texture information; for example, the coefficients of most upper region and those of the most left region in DCT transform domain represent some vertical and horizontal edge information respectively.

In our retrieval system, an image of both query and database are normalized and resized from the original database based on the cantered position of the eyes as shown in figure 2.a, the normalized image equally divided into non overlapping 8X8 block pixel Therefore, each of which are associated with a feature vector derived directly from discrete cosine transform DCT. Users can select any query as the main theme of the query image. The retrieval is the relevance between a query image and any database image as shown in figure 2(c), the relevance similarity is ranked according to closest similar measures computed by the Euclidean distance.

(a)



(b)

Fig.2 (a). Original and normalized image (b) zigzag order

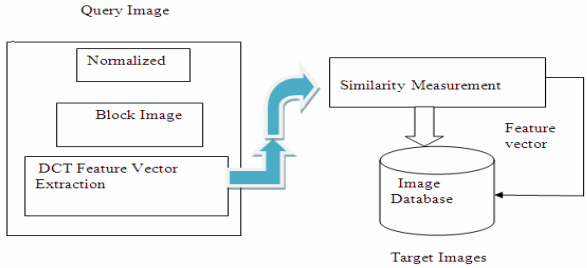


Fig.2 (c). Block diagram of proposed retrieval system

5. Similarity Measure

Large image database systems mostly require efficient comparison as well as feature extraction in order to provide reasonable response to an image query. The similarity measure by a given query image involves searching the database for similar block DCT vectors as the input query. Euclidean Distance is suitable and effective method which is widely used in image retrieval area. The retrieval results are a list of images ranked by their similarities distance with the query image. The similarity distance measure between the vectors of query image and the database image can be defined below as

$$D(I_q, I_d) = \frac{\sqrt{\sum_{i=1}^{N} (I_{qi} - I_{di})^2}}{N}$$

Where D is the distance between the feature vector I_q and I_d and N represent the number of DCT blocks. , the computed distance is ranked according to closest similar; in addition , if the distance is less than a certain threshold set ,the corresponding original image is close or match the query image.

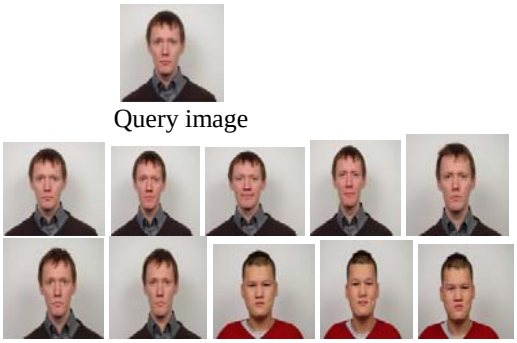
6. Experimental Results

The proposed method has been implemented on Matlab 2007a, on the database of 120 face images , 12 different images per person with different facial situations such facial expression and position were collected..

To evaluate the retrieval efficiency of the proposed method, by exploiting the performance measures the recall and the precision which are widely used. The recall is the ratio of the number relevant images retrieved to the total number of the relevant images in the database. Whilst, the Precision is the ratio of the number of the relevant images retrieved to the total number of the irrelevant and relevant images retrieved as defined below:

$$\text{Re}\,call = \frac{R_r}{T} \quad , \text{Pr}\,escision = \frac{R_r}{T_r}$$

Where R_r the number of similar retrieval images is, T is the total number of similar images in the database images, and T_r is the number of all retrieval images. Our proposed experiment method shows promising results based on the above equations, the retrieval results based on the proposed method as shown in figure 3(.a,b) shows 70% Recall and 58% Precision based on the above equations.



Query image

Retrieved images

(a)

Query image

(b) Retrieved images

Fig.3 (a), (b). Retrieval results

6. Conclusions

In this paper, we propose simple content based face image retrieval methods using the average entire of some DCT coefficient over the all image blocks, the DC and the first five AC's being ordered by zigzag order over all DCT coefficients blocks. The DCT transformation was used to extract the feature vectors directly from the compressed domain of both query image and the database images. Euclidean distance was used to measure the similarity distance in order to retrieve the closest similar to the query image.

The proposed method speedup the calculation complexity and the storage space problem .and the experimental results shows promising results. For further future work, we will improve the rate of the retrieval through the efficient selection of feature face content.

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