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Medical image retrieval using modified DCT

K.Rajakumar*, Dr.S.Muttan

[a] *Department of Electronics and Communication Engineering,College of Engineering,Guindy.Anna University.chennai-25.India*

Abstract

An innovative medical image retrieval is proposed to extract low-level image texture features. These low level texture features were extracted directly using Modified Discrete Cosine Transform (MDCT). MDCT coefficients represent dominant directions and gray level variations of the image. Our proposed method uses a hierarchical similarity measure for efficient medical image retrieval and also reduces the search space in a large image database. In an experiment using a database of 200 images, our method shows a higher performance in the retrieval. The retrieval image is the relevance between a query image and database image, the relevance similarity is ranked according to the closest similar measures computed by the Euclidean distance. The experimental results show that, using our MDCT approach, it is easy to identify main objects and reduce the influence of background in the image, and thus improve the performance of medical image retrieval.

Key words: Medical Image retrieval, MDCT, Euclidean Distance

1. Introduction

Nowadays computer imaging and database techniques play an important role in medical field, which leads to the huge amount of digital images with a wide variety of image modalities, such as Computed Tomography(CT), Magnetic Resonance (MR), X-ray and ultrasound images[1]. Developing efficient medical image indexing system is an important work. Recently Picture Archiving and Communication System (PACS) is widely used in hospitals, but PACS provides only simple text-based retrieval capabilities using patient names or patient ID numbers [2]. Content-Based Image Retrieval (CBIR) systems can greatly help to retrieve useful information within enormous amount of medical images.

Typical CBIR systems use a two-step way. First, low-level features such as texture and shape are extracted from each image in image database and stored in a feature database. Second, the feature vector of a query image is computed and compared to the entire feature database. Obviously, extracting features from the entire image are time-consuming work. However, not all part of a medical image is important. Physicians are often interested in more focus of an organ than whole image. The interest or salient region is called Region Of Interest (ROI) which is the most informative and important part of a medical image. ROI is composed of salient or interest points which can represent the local properties of image [3]. If these salient points can be extracted for medical image retrieval, then the time taken for computation may be reduced. In this paper, we proposed a medical image retrieval approach based on Modified DCT (MDCT).

The Discrete Cosine Transform (DCT) has been proved successful at decorrelating and correlating the energy of image data. A feature vector is formed with the variance of the first eight AC coefficients. This technique assumes that these eight AC coefficients have the most discriminating features. The run-time complexity of this technique is small, since the length of the feature vector is small. For texture images, an interesting method that reorders coefficients to produce image sub-bands in a multiresolution decomposition-like form and computes the absolute mean value and standard deviation of each sub band to construct a feature vector has been proposed in [4].

*.Corresponding author. Tel.:+ 91-041-732-42584; fax: +91-417-324-2096.
E-mail address: rajakumarkrishnan@yahoo.co.in.

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The rest of this paper is organized as follows. Section 2 explains the principle of Content Based Image Retrieval (CBIR). Section 3 describes the proposed method. Section 4 presents the experimental results, in comparing with other retrieval methods. Discussion is in Section 5.

2. Content Based Image Retrieval

Content Based Image Retrieval (CBIR) has been an active research area. The principle aim is to retrieve medical images based texture information. Retrieval is often performed in a query by example where a query image is provided by the user. Content Based Medical Image Retrieval (CBMIR) systems have been dealt with the issue of automatic indexing and retrieval of images. The Architecture of Content Based Image Retrieval system is shown in Figure 1. It consists of three main modules such as input module, query module, and retrieval module.

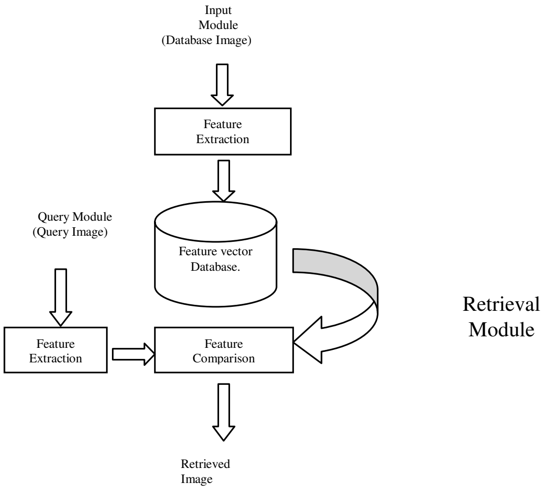

Fig. 1. (a) Architecture of Content Based Image Retrieval

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. Proposed system

In our proposed medical image retrieval system, an image of both query and database is normalized and resized from the original image. The normalized image equally divided into non overlapping 8X8 block pixel .Therefore, each of which is associated with a feature vector derived directly from modified discrete cosine transform DCT (MDCT). 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. The relevance similarity is ranked according to closest similar measures computed by the euclidean distance

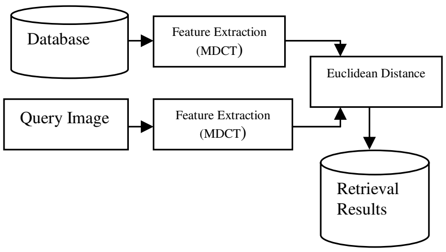

Fig. 2. Proposed Block Diagram

Large image database systems mostly require efficient comparison as well as feature extraction in order to provide reasonable response to a query image [5]. The similarity measure by a given query image involves searching the database for similar block MDCT 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 [6]. The similarity distance measure between the vectors of query image and the database image can be defined below. Where D is the distance between the feature vector and N represent the number of MDCT blocks. The computed distance is ranked according to the 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.

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

4. Experimental Results

The proposed method has been implemented on Matlab 2007a, on the database of 200 medical images. To evaluate the retrieval efficiency of the proposed method, by exploiting the performance measures the recall and the precision which are widely used [7]. 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 images retrieved as defined below.

We use the standard measures, precision and recall, in different forms, to evaluate the results.

$$\text{Recall} = \frac{\text{Number of images retrieved and relevant}}{\text{Total number of relevant images in database}} \tag{2}$$

$$\text{Precision} = \frac{\text{Number of images retrieved and relevant}}{\text{Total number of retrieved images}} \tag{3}$$

Based on these measures, we define the following. The Average Recall Rate (AVRR) is given by

$$AVRR = \frac{1}{Q}\left\{\sum_{j=1}^{Q} \frac{\sum_{i=1}^{32} Rank_i}{N_r}\right\} \tag{4}$$

Where the rank of any of the retrieved image is defined to be its position in the list of retrieved images provided that image is one of the relevant images in the database [8]. The rank is defined to be zero otherwise. N_r is the number of relevant images in the database, and Q is the number of queries performed. In our case, the number of images retrieved was 20, and N_r was less than 20. Hence, when all relevant images are in the retrieved set, ideally,

$$AVRR = (N_r + 1)/2 \tag{5}$$

Our proposed method shows promising results based on the above equations. The retrieval results based on the proposed method as shown in figure 4,5,6 and 7.

CBMIR retrieval percentage is good compare with other retrieval methods, which is shown in Table.1

5. Discussion

We have presented approaches for indexing texture features directly in the MDCT domain by exploiting MDCT coefficients [9]. Here the retrieval results are good since most of the top retrieved images are relevant. Although MDCT is inaccurate results while processing some texture images for example, few AC coefficients have more important texture information than other AC coefficients [10].The proposed method speedup the calculation complexity, solve the storage space problem and the output shows promising results. For further future work, we will improve the rate of the retrieval through the efficient selection of DCT coefficients.

Table 1: Comparison results of proposed algorithm with other techniques

Types of method	Image types	Retrieval %
Proposed method	Ultrasound images	90%
	X-Ray images	93%
	MRI images	97%
	Mammogram images	80%
Shape based method	Ultrasound images	80%
	X-Ray images	82%
	MRI images	75%
	Mammogram images	70%
Correlation Technique method	Ultrasound images	70%
	X-Ray images	65%
	MRI images	60%
	Mammogram images	50%

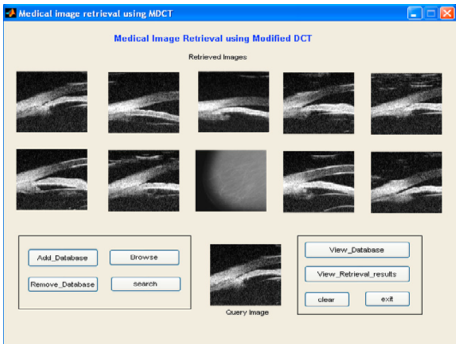

Fig. 4. Simulation result of our proposed algorithm for ultrasound images.

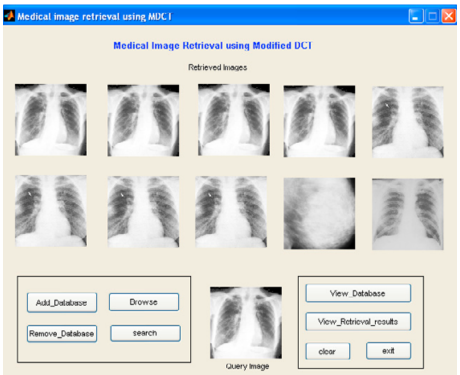

Fig. 5. Simulation result of our proposed algorithm for X-ray images.

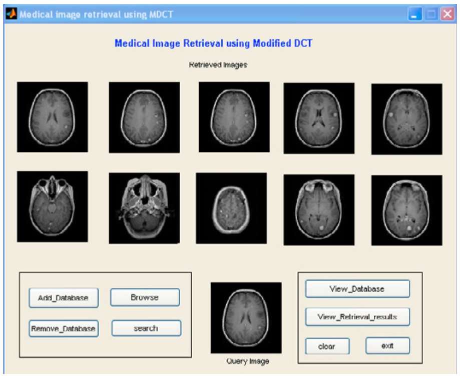

Fig.6.Simulation result of our proposed algorithm for MRI images.

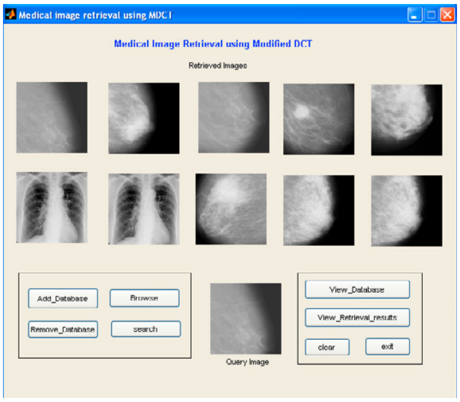

Fig.7.Simulation result of our proposed algorithm for Mammogram images.

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