CONTENT BASED MEDICAL IMAGE RETRIEVAL USING SHAPE DESCRIPTORS: REVIEW PAPER

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Abstract

This review paper consists of the work already done on medical images. The work includes the previous works being done in this field related to the medical images being retrieved by using the various shape descriptors. In this paper a brief overview of digital imaging is given. This paper presents the basics of image retrieval process that includes the two techniques for image retrieval and about the fourier descriptor to extract the features of image which is one of the important research contents in content based image retrieval process. Different shape signatures have been exploited to derive fourier descriptors, however fourier descriptors derived from different signatures can have significant different effect on the retrieval process.

Keywords CBIR, Shape Signatures, Medical Image Database, Fourier Descriptors.

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1. Introduction

Recent advances in computing and communication technology are taking the actual information processing tools to their limits. The last years have seen an overwhelming accumulation of digital data such as images, video, and audio. Owing to the rapid development of digital and information technologies, people now live in a multimedia world. More and more multimedia information is generated and available in digital form from varieties of sources around the world. Along with the information, people appear that want to make use it. Before one can use any such information, however, it will have to be located first. At the same time, the increasing availability of potentially interesting material makes this search harder. Currently, solutions exist that allow searching for textual information. Many text-based search engines are available on the World Wide Web, and they are among the most visited sites, indicating they foresee a real demand. Identifying information is, however, not possible for visual content, as no generally recognized description of this material exists. Multimedia databases on the market today allow very limited searching for pictures using characteristics like color, texture and information about the shape of objects in the picture. Visual information plays an important role in our society; visual information may be represented in various forms, such as still pictures, video, graphics, 3D models, animation etc. The Visual Information Retrieval (VIR) systems are concerned with efficient storage and record retrieval. In general, a VIR system is useful only if it can retrieve acceptable matches in real time. In addition to human- assigned keywords, VIR systems can use the visual content of the images as indexes, e.g. color, texture, and shape features. It has been well-known that features should verify a number of properties:-

i. Invariance
ii. Stability
iii. Simplicity
iv. Real time computation

One of the basic visual information needs to be processed is image, the need to find a desired image from a collection is shared by ordinary users as well as many professional groups,

including journalists, design engineers and art historians. While it is attractive to provide higher level query using indexing methods such as keyword indexing and textual annotation to make use of facilitation of query language, such as SQL, from current database techniques, there are several drawbacks with these indexing methods:

(i) They do not conform to a standard description language,

(ii) They are inconsistent,

(iii) They are subjective, i.e. they might not capture the image content

(iv) They are time consuming.

In order to overcome these drawbacks, recent researches on image retrieval focus on content based image retrieval (CBIR), which utilizes low level image features such as color, texture and shape. Several commercial and academic prototypes of CBIR systems have been developed recently to allow searching through image databases by image content. These include QBIC, Photobook, Virage and Visual SEEKS.

2. Image Processing

An image may be defined as a 2-D function f(x, y), where x and y are plane coordinates and the amplitude of f at any pair of coordinates(x, y) is called the intensity of image at that point. When x, y and the intensity values of f are all finite, discrete quantities, the image is then known as the digital image. The field of Image processing refers to the processing digital images by means of digital computer. Digital image is composed of finite number of elements, each of which has a particular location and value. These elements are called picture elements (pels) or pixel. Pixel is the term used most widely to denote the elements of a digital image. Image processing is basically the field of Artificial intelligence (AI) whose objective is to emulate human intelligence. The field of AI is very vast and is growing very fast in terms of development. The area of image analyzing is in between image processing and computer vision. Image processing encompasses processes whose inputs and outputs are images and in addition encompasses processes that extract attributes from images, up to and including the recognition of individual objects. The process of acquiring an image of the area containing text, preprocessing that image, extracting the characteristics,

describing those characteristics in form suitable for computer processing, and recognizing those characters all are under the scope of Image Processing.

3. Image retrieval

Image Retrieval means retrieving an image from the huge database by firstly extracting the features and then comparing the features of database image with the query image.

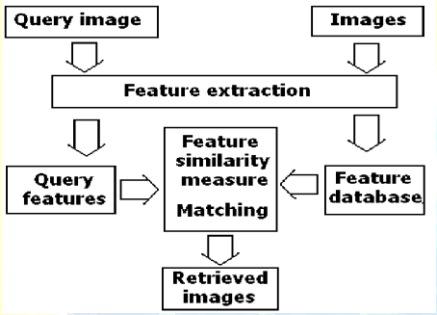

Figure1. Image retrieval process

There are two different approaches of image retrieval

3.1 Text based image retrieval

The text-based technique first annotates with text, and then uses text-based database management system to perform image retrieval. The use of text-based image retrieval was very popular in the early days of computer vision, but its usage has been less dominant in recent years.

3.1 .1 **Uncontrolled Vocabulary**

The most common method for image retrieval is to annotate image with associated text. The human indexer can describe image according to content, the caption of the image, or the background information such as time, place, or photographer. To access the desired image data,

the seeker can construct queries using homogenous description, such as keyword, to match the annotation. Since this method does not limit the indexer and the seeker to use specific textual information to describe images, the term," uncontrolled vocabulary" , is used to distinguish this method from other systematic methods.

3.1.2 **Controlled Vocabulary**

In an attempt to introduce a measure of control to the vast number of descriptive word, which might be used when, indexing images, and considerable attention has been paid to the development of thesaurus-based indexing system.

3.2 Content based image retrieval

CBIR or Content Based Image Retrieval is the retrieval of images based on visual features such as color, texture and shape. Reasons for its development are that in many large image databases, traditional methods of image indexing have proven to be insufficient, laborious, and extremely time consuming. These old methods of image indexing, ranging from storing an image in the database and associating it with a keyword or number, to associating it with a categorized description, have become obsolete. This is not CBIR. In CBIR, each image that is stored in the database has its features extracted and compared to the features of the query image. It involves two steps:

• Feature Extraction: The first step in the process is extracting image features to a distinguishable extent.

•Matching: The second step involves matching these features to yield a result that is visually similar.

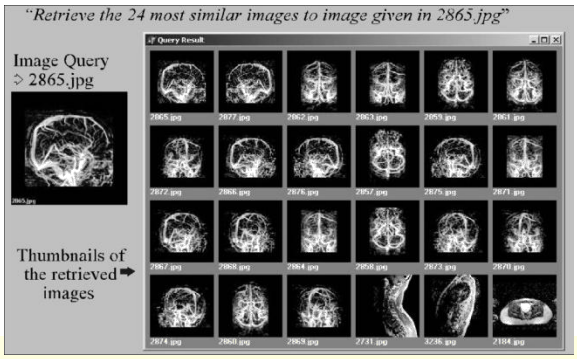

Figure2. Example of CBIR

4. Features

Color Features

One of the most important features that make the recognition of images possible by humans is color. Color is a property that depends on the reflection of light to the eye and the processing of that information in the brain. The color is used every day to tell the difference between objects, places, and the time of day. Usually colors are defined in three dimensional color spaces. These could be RGB (Red, Green, and Blue), HSB (Hue, Saturation, and Brightness). The last two are dependent on the human perception of hue, saturation, and brightness. Color searches will usually involve comparing color histograms, though this is not the only technique in practice. Color represents the distribution of colors within the entire image. This distribution includes the amounts of each color, but not the locations of colors.

Texture Features

Texture is that innate property of all surfaces that describes visual patterns, each having properties of homogeneity. It contains important information about the structural arrangement of the surface, such as; clouds, leaves, bricks, fabric, etc. It also describes the relationship of the surface to the surrounding environment. In short, it is a feature that describes the distinctive physical composition of a surface. Texture properties include: (Coarseness, Contrast, Directionality, Line-

likeness, Regularity, and Roughness). Texture is one of the most important defining features of an image. It is characterized by the spatial distribution of gray levels in a neighborhood. In order to capture the spatial dependence of gray-level values, which contribute to the perception of texture, a two-dimensional dependence texture analysis matrix is taken into consideration. This two-dimensional matrix is obtained by decoding the image file; jpeg, bmp, etc.

Shape Features

Shape may be defined as the characteristic surface configuration of an object; an outline or contour. It permits an object to be distinguished from its surroundings by its outline. Shape representations can be generally divided into two categories: -

1. Boundary-based, and
2. Region-based.

Boundary-based or Contour -based shape representation only uses the outer boundary of the shape. This is done by describing the considered region using its external characteristics; i.e., the pixels along the object boundary. Region-based shape representation uses the entire shape region by describing the considered region using its internal characteristics; i.e., the pixels contained in that region.

5. Shape Signatures

Shape signatures are a method for compactly encoding the shape of molecules, and also their electrostatic properties. A 3D shape signature is a compact representation for some essence of a shape. Shape signatures are commonly utilized as a fast indexing mechanism for shape retrieval. Effective shape signatures capture some global geometric properties which are scale, translation, and rotation invariant. In general, a shape signature is any 1-d function representing 2-D areas or boundaries. Some of the most important shape signatures are:

5.1 Centroid distance

This function is expressed by the distance of boundary coordinates from the centre of the shape.

$$C(t)=([x(t)-xc]^2 +[y(t)-y_c]^2)^{1/2}$$

5.2 Complex Coordinates

It is a function representing a complex number generated from boundary coordinates

$$Z(t)= x(t)+ iy(t)$$

5.3 Cumulative angular function

Shape can also be represented in form of boundary angles. The cumulative angular function

$$\varphi(t) = [\theta(t) - \theta(0)]\mathrm{mod}(2\pi)$$

6. Fourier Descriptor

FD can be used as a representation of 2D closed shapes independent of its location, scaling, rotation and starting point. Common FD method mainly consists of computation of boundary pixels, use of shape signatures. Fourier transform is used for shape signature to compute fourier coefficients. These fourier coefficients are invariant to translation, scaling and rotation and change of start point are used as fourier descriptors. The computation of FD is used to compute the shape features. Fourier transformation on shape signatures is widely used for shape analysis; there are also some recent attempts to exploit it for shape retrieval [5]. FD represents the shape of the object in frequency domain. The lower frequency descriptors contain information about the general features of the shape, and the higher frequency descriptors contain information about finer details of the shape[1].

7. Literature review

This topic consists of the previous works being done. These are being discussed as under:

A comparative study paper compared shape retrieval using FDs derived from four shape signatures. Its results showed that shape retrieval using FDs derived from centroid distance signature was significantly better than that using FDs derived from the other three signatures. The property that centroid distance captures both local and global features of shape makes it desirable as shape representation.

Another paper for included existing shape representation and description techniques that were been reviewed. Generally, the two classes for shape representation and description used in this were: contour-based and region-based. Under each class, the methods were divided into structural and global methods. The different methods were further distinguished between methods working in space domain and methods working in transform domain.

New Fourier descriptor shape signature was discussed in this next paper. The proposed signature was evaluated against several commonly used shape signatures. The experimental results demonstrated that the proposed signature and the centroid distance (CD) signature yield comparable results; however, the proposed signature (FPD) performed better in the case of high recall.

An efficient and robust shape-based image retrieval system was being proposed. In this the Prompt edge detection method to detect edge points, which is compared with the Sobel edge detection method was used. Also introduced was the shape representation method, the mountain-climbing sequence (MCS) which is invariant to translation, rotation, and scale problems. The results of the proposed method show a superior matching ratio even in the presence of a modest level of deformation.

Another study investigated content-based image retrieval using various shape descriptors. The descriptors included 11 moment invariants, area ratios (3- concentric ring based and 8-sector based) and simple shape descriptors (eccentricity, compactness, convexity, rectangularity, and solidity). The similarity measures used were Euclidean distance and Cosine correlation coefficient.

A novel method for shape- based image retrieval defect in shape retrieval was being presented in the other paper. It showed that it is possible to combine the Compactness and Fourier descriptors

of region with Krawtchouk moments of the image. This way, the obtained descriptors include the regions.

8. Conclusion

The medical images are present in huge quantity in the medical image database. So the better results can be drawn by extracting the shape features and applying the shape signatures with the help of fourier transformation, which invariant of rotation, position, and size.

Medical knowledge, examined from an information perspective, arises in highly diverse forms. For example, consider two important classes of medical knowledge: anatomy and physiology. Anatomic information rests on visual appearances. Physiologic information arises from biologic processes, and it may not be visual. It could include data about metabolism, diet, age, environment, exercise, numeric parameters from physiologic tests such as blood pressure, etc. Hence the medical images are retrieved for better diagnostics and then for better and good quality treatment.

9. References

[1]Dengsheng Zhang and Guojun Lu "A Comparative Study on Shape Retrieval Using Fourier Descriptors with Different Shape Signatures".

[2]Dengsheng Zhang, Guojun Lu "Review of shape representation and description techniques".

[3]El-ghazal, O.Basir and S.Belkasim "A NEW SHAPE SIGNATURE FOR FOURIER DESCRIPTORS".

[4]Hwei-Jen Lin, Yang-Ta Kao, Shwu-Huey Yen, and Chia-Jen Wang "A Study of shape-Based Image Retrieval" .

[5]Chung-Lin Huang and Dai –Hwa Huang. "A content-based image retrieval system"

[6]M. Sarfraz and A. Ridha "Content-based Image Retrieval using Multiple Shape Descriptors".

[7]Yanyan Wu, Yiquan Wu "Shape-based Image Retrieval Using Combining Global and Local Shape Features".