Chapter 25
Using Global Shape Descriptors for Content Medical-Based Image Retrieval

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ABSTRACT
In this chapter, the authors propose a new method belonging to content medical-based image retrieval approaches and that uses a set of region-based shape descriptors. The search engine discussed in this work allows the classification of newly acquired medical images into some well known categories and also to get the images that are more similar to a query image. The final goal is to help the medical staff to annotate these images. To achieve this task, the authors propose a set of three descriptors that are based on: (1) Hu, (2) Zernike moments, and (3) Fourier transform-based signature, which are considered as region descriptors. The advantage of using this kind of global descriptor is that they are very fast, real time, and they do not need any segmentation step. The authors propose also a comparative study between these three approaches. The search engines are tested by using a database composed of 75 images that have different sizes, and that are classified into five classes. The results provided by the proposed retrieval approaches are given with high precision. The comparison between the three approaches is achieved using classification matrices and the recall/precision curves. The three proposed retrieval approaches produce accurate results in real time. This proves the advantage of using global shape features as a preliminary classification step in an automated aided diagnosis system.

1. INTRODUCTION
Content Based Image Retrieval (CBIR) has been one of the most important research areas in the field of computer vision over the last 20 years. The huge amount of available multimedia data and the growing accessibility of visual information’s are driving the need for thematic and easy access methods for allowing retrieve multimedia content; in the place of using text based multimedia retrieval (Müller, Michoux, Bandon & Geissbuhler, 2004).
Medical images are widely used to make and support the clinical decisions in hospitals and health centers. In medical practices, medical images are very useful and are used to provide enough information about diseases state, in order to recommend an effective treatment. A large volume of medical images are produced and stored in hospitals. However, these images are not exploited again after they have been used to make a first diagnosis. The annotation of image collections for retrieval is an active research area (Yao, Zhang, Antani, Long, & Thoma, 2008). Indeed, there are many problems such as the subjectivity of the annotation which is depending on human labelling and also the problem of choosing relevant keywords even when working with restricted vocabulary which need to be addressed.

If they are well annotated, medical images databases available in every health centers can be considered as a knowledge base concerning diseases and diagnosis. This information could be used for any medical diagnosis process. However, a large majority of information systems used in hospitals like PACS systems (Picture Archiving and Communication Systems) provide a response to the queries using only simple textual and clinical attributes (Hood & Scott, 2006). In the other hand, DICOM (Digital Imaging and Communications in Medicine), is a standard for image communication allowing patient information storage within the actual image(s). Although this storage system still having some problems of standardization.

The methods issued from Content Based Image Retrieval can solve this annotation problem, and can be used to assist the medical diagnosis. These kinds of applications belong to the new emerging challenges of medical image retrieval problems named Content Medical Based Image Retrieval (CMBIR). In this context, medical image databases can provide the possibility to search by image contents, and this by using the advantages of visual features. The CBIR techniques, which are used for image search and recognition, can give a solution that enriches and extends the functionalities and the efficiency of existing systems. We can notice that some important research in this field has evolved Content Based Image Retrieval (CBIR) into different scenarios such as arts, films industry, 3D retrieval, medical image retrieval, among others (Veltkamp, Burkhardt, & Kriegel, 2001; Sebe, Lew, Zhou, Huang, & Bakker, 2003; Tangelder & Veltkamp, 2008).

Color and texture features can be used either on a global image level, or on local parts of the image. An easiest and simple way to exploit regional features is to use blocks of fixed size and location by partitioning the image. Some other approaches uses a pre-treatment based on image segmentation and shapes features (Lee, Antani, Chang, Gledhill, & Long, 2009; Long, Antani, & Thoma, 2003). After segmentation, the images can be described by some invariant descriptors that are related to the extracted shape features. The problem of segmentation based approaches is that fully automated segmentation methods still being a difficult and unsolved problem. The most important feature in a medical image is the gray level variations within some specific regions in the image. Color feature are not very important in this context. That is why; shape and texture features are more considered for medical image processing.

In this chapter, we propose to use a set of global and region shape descriptors in order to achieve a search engine applied to medical images. The advantage of using these kinds of descriptors is to avoid some difficult pre-processing steps like segmentation and edge detection, whose results are not always describing relevant shapes. Another advantage is that these approaches are very fast and real time in the most cases.

The search engine described in this chapter uses a set of signatures based on Hu moments, Fourier descriptors and Zernike moments. This search engine allows retrieving the images representing high similarity with a query image. It can also be used as a classifier permitting to assign the new medical images acquired into well-known categories.