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Novel Shape Description for CBIR in Medical Application

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Abstract. Image Retrieval for Medical Applications (IRMA) has received a significant research interest over the past decade as a promising approach to address the data management challenges posed by the rapidly increasing volume of medical image data collections in use and also to aid clinical medicine, research, and education relying on visual content in the data. The research presented in this paper was aimed to improve the retrieval performance of an images retrieval system in medical applications based on shape features. In general, the work consists of two phases: (1) enrollment phase, which consist of feature extraction based on developed method to extract the shape features, (2) retrieving phase, which use the Euclidian distance measure. The conducted tests were carried on 350 medical images from four types (i.e., abdominal CT scan, MRI, ultrasonic, X-ray) and give good precision and recall rates (94,89).

Keywords: Content Based Image Retrieval (CBIR), shape, sobel filter.

1. Introduction

Shape of the objects represented in images is one of the most significant properties used in CBIR and in recognition tasks. This is particularly due to the fact that shape is perceptually very relevant in order to recognize objects. In some circumstances shape contains more intrinsic information about the represented object than color, texture or other features. From a geometric point of view, shape can be informally defined as the result of removing color, texture, and effects due to affine transformations such as scale, translation and rotation from a representation of an object in an image [1].

Various techniques used for shape description. These techniques can be broadly categorized into two types: (1) boundary based and (2) region based. Boundary based methods use only the contour or border of the object shape and completely ignore its interior. Hence, these methods are also called external methods. The region based techniques take into account internal details (like holes) besides the boundary details. Recognition of a shape by its boundary is the process of comparing and recognizing shapes by analyzing the shapes boundaries; but the local structural organization is always hard to describe [2].

The shape of an object is a very important character in human's perception, recognition, and comprehension. Because geometric shape represents the essential characteristic of an object the recognition of shapes in images is an important problem in computer vision. A fast recognition of contours provides an efficient and robust way of accelerating the search. The similarity measures for such shape matching must be robust to various transformations and modest occlusions [3].

This paper proposes a new method for shape features extraction which intends to describe 2D shapes in images. Many studies have applied the concepts of shape feature extraction and similarity measurement to analyze and retrieve medical images for example, Choras [4], Presented an approach for shape based image retrieval using the moments invariants and some shape descriptors. The proposed approach has three modules: image preprocessing, shape descriptor, and retrieval. The retrieval module is based on the Euclidean distance that compares an image query feature vector with a feature vector of the database contain 120 greyscale images of isolated objects with arbitrary orientation. Nunes, et al [1], proposed the use of a reduced set of features to describe 2D shapes in images. The design of the proposed technique aims to result in a short and simple to extract shape description. For the retrieval experiment the achieved bull's eye performance is about 60%. Recognition was tested with three different classifiers: decision trees (DT), k-nearest neighbor (kNN) and support vector machines (SVM). Estimated mean accuracies range from 69% to

86% (using 10- fold cross validation). The SVM classifier presents the best performance, followed by the simple kNN classifier. Kalpana, et al [5], presented a new idea of using Walsh transform to generate the feature vector for content based image retrieval. The proposed algorithm is worked over database of 270 images spread over 11 different classes. The Euclidean distance is used as similarity measure. Average precision and recall is calculated for the performance evaluation. The overall average of cross over points of precision and recall is above 50%. Joseph, and Govindan [6], presented a novel approach for sketch based image retrieval (SBIR) using Contourlet edge detection. Test results carried out on a database of 1240 images provide the precision rate as 0.8 and the recall rate as 0.5.

This paper is organized as follows. In Section 2 the basic concepts and used methods are described, Section 3, the tests of the proposed method are presented. In the last section contains the conclusions of the proposed work.

2. Concepts and Methods

2.1. Content Based Image Retrieval

The picture may worth thousands of words. Humans have often used drawings to convey information. The cave men have told us about their dangerous hunting trips through the illustrations on the stone walls. The Pharaohs have illustrated their customs of praying on the walls of their temples. Nowadays, visual information can be found in most (if not all) areas of life. As the impact of computers on our lives is becoming more and more significant, much of the information, including pictures, is being digitized. Digital imagery is getting more popular in many perspectives. Private photo collections, medical imaging, and geographical information systems are only some to mention. As the computation power is growing and the cost of storage media is decreasing, the size of digital image collections is increasing rapidly. There is a need for techniques that enables us to access and retrieve the huge amount of information embedded in these collections, methods that can present us the information efficiently and conveniently. Simple manual browsing is getting cumbersome even with private collections. Automatic image retrieval is inevitable [7].

In 1992, the National Science Foundation of the United States organized a workshop on visual information management systems in order to identify new directions in image database management systems. At this conference, Kato [8] introduced the term Content-Based Image Retrieval (CBIR) to describe automatic retrieval of images from a database. He emphasized the use of color and shape as the criteria for the automatic image retrieval process. Since then, the term CBIR has been adopted to describe an image-retrieving process that is used for large collections of images and that is based on features that can be automatically extracted from the images themselves. The visual contents of the images are extracted and described by feature vectors that form a feature database. During the retrieval stage, the users provide the retrieval system with a sample image (query image) or a sketched figure. The system then changes this query into feature vectors. In the matching stage, the system calculates the similarities between the feature vectors of the query sample or sketch and those of the images in the database, and then performs the retrieval accordingly [9].

Content Based Image Retrieval is a set of techniques for retrieving semantically-relevant images from an image database based on automatically-derived image features. The main goal of CBIR is efficiency during image indexing and retrieval, thereby reducing the need for human intervention in the indexing process. The computer must be able to retrieve images from a database without any human assumption on specific domain. One of the main tasks for CBIR systems is similarity comparison, extracting feature signatures of every image based on its pixel values and defining rules for comparing images. These features are considered as the image representation structure which used for measuring it degree of similarity with other images registered in the database. Images are compared by calculating the difference of its feature components with the corresponding features of other image [3]. CBIR draws many of its methods from the field of image processing and computer vision. Image processing covers a much wider field, including image enhancement, compression, transmission, and interpretation. While there are gray areas (such as object recognition by feature analysis), the distinction between mainstream image analysis and CBIR is usually fairly clear-cut [10].