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Content Based Image Recovery with Moving Picture Expert Group-7

[1]Dhage Sachin Govindrao, [2]Shelkikar R.P.
[1]M. E. Student, Department of ECE, TPCT, Osmanabad, Maharashtra, India
[2]Assistant Professor, Department of ECE, TPCT, Osmanabad, Maharashtra, India

Abstract: ***Due to rapid increase in volume of image and video collections, traditional methods of Indexing and retrieval using only keywords have become outdated. Therefore alternative methods to describe images using their visual content have been developed. To produce and test algorithms for content-based image and video retrieval, MUVIS (Multimedia Video Indexing and Retrieval System) was developed at TUT. The goal of MUVIS is a fast, real-time and reliable audio/video (AV) browsing and indexing application, which is also capable of extracting some key features (such as color, Texture and shape) of the AV media. Most of the existing image retrieval systems perform reasonably when using color feature. The dissertation presents two contributions: one is region based shape and the second is contour-based retrieval method. The former contribution concerns shape analysis and retrieval. Shape attributes can be roughly divided into two main categories: boundary-based and region-based. Since the human visual system itself focuses on edges and ignores uniform regions, this dissertation concentrates on boundary-based representations. but due to some limitations of the contour based approach like, we cannot use this approach when the object consist of the disjoint regions that's why we have introduced second approach for the shape representation which is nothing but the region based approach which gives better result when the object consist of the disjoint regions. A novel boundary-based method using curvature scale space approach (CSS) and region based method using angular radial transform (ART) is developed in this dissertation. Simulation results show that the proposed technique produced encouraging results when using MPEG-7 shape test database. However, retrieval accuracy using color or texture features does not produce as good results.***

Keywords: MUVIS, CSS, TUT, ART, CBIR, MPEG-7, ZENRIKE MOMENTS, GRID, FOURIER DESCRIPTORS.

I. INTRODUCTION

1.1 The use of images

Historical records show the use of images date back to paintings on walls of cave by early man. In the pre-Roman times images were seen mostly in the form of building plans and maps . The need and use of images grew with the ages, particularly with the advent of photography in the sixteenth century. In the twentieth century, introduction of computer and advances in science and technology gave birth to low cost and efficient digital storage devices and the worldwide web, which in turn became the catalyst for increasing acquisition of digital information in the form of images. In this computer age virtually all spheres of human life including commerce, government, academics, hospitals, crime prevention, surveillance, engineering, architecture, journalism, fashion and graphic design and historical research are in need of, and use of images for efficient services. A large collection of images is referred to as ***image database***. Image database is a system where image data are interestedly stored . Image data include the raw images and information extracted from images by automated or computer assisted image analysis. The police maintain image database of criminals, crime scenes and stolen items. In the medical profession X-rays, and scanned image database are kept for diagnosis, monitoring and research purposes. In architectural and engineering design image database exist for design projects, finished projects and machine parts. In publishing and advertising journalists create image database for various events and activities such as sports, buildings, personalities, national
and international events, and product advertisements. In historical research image database are created for archives in areas that include arts, sociology and medicine.

1.2 Image retrieval problem

In small collection of images simple browsing can identify an image. This is not the case for large and varied collection of images, where the user encounters image retrieval problem. Image retrieval problem is the problem of searching and retrieving images that are relevant to a user's request from a database. typical retrieval problem example is a design engineer who needs to search his organization database for database for design projects similar to that required by his clients or the police seeking to confirm the face of a suspected organization database for database for design projects similar to that required by his clients or the police seeking to confirm the face of a suspected retrieving images that are relevant to a user's request from a database.

1.3 Visual content levels

Images are naturally endowed with attributes or information content that can help in resolving the image retrieval problem. The information content that can be derived from an image is classified into three levels.

I] Low level – They include visual features such as color, texture, shape, spatial information and motion.

II] Middle level – Examples include presence or arrangement of specific types of objects, roles and scenes.

III] High level – Include impressions, emotions and meaning associated with the combination of perceptual features. Examples include objects or scenes with emotional or religious significance.

II. CBIR SYSTEM ARCHITECTURE

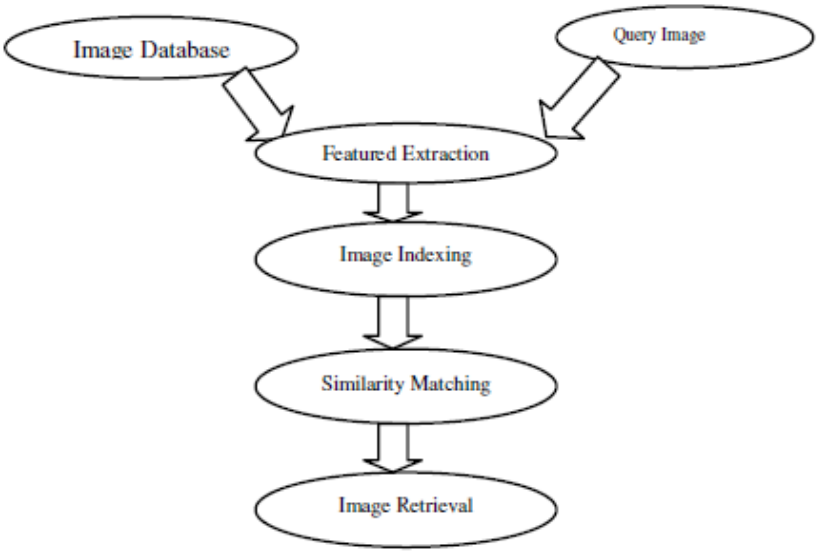

Fig 1 Architecture of CBIR system

A typical CBIR system as shown in Fig.1 automatically extract visual attributes (colour, shape, texture and spatial information) of each image in the database based on its pixel values and stores in a different database within the system called **feature database.** The feature data for each of the visual attributes of each image is very much smaller in size compared to the image data. Thus the feature database contains an abstraction (compact form) of the images. In the image database; each image is represented by a compact representation of its contents (colour, texture, shape and spatial information) in the form of a fixed length real-valued multi-component **feature vectors or signature.** visual attributes of each image is very much smaller in size compared to the image data. Thus the feature database contains an abstraction (compact form) of the images in the image database; each image is represented by a compact representation of its contents (colour, texture, shape and spatial information) in the form of a fixed length real-valued multi-component **feature vectors or signature.** The users usually formulate query image and present to the system. The system automatically extract the visual attributes of the query image in the same mode as it does for each database image, and then identifies images in the database whose feature vectors match those of the query image, and sorts the best similar objects according to their similarity value. During operation the system processes less compact feature vectors rather than the large size image data thus giving CBIR its cheap, fast and efficient advantage over text-based retrieval. CBIR system can be used in one of two ways. First, exact image matching, that is matching two images, one an example image and the other, image in image database. Second is approximate image matching, which is finding most closely match images to a query image?

III. OTHER SHAPE DESCRIPTORS

In Content Based Image Retrieval (CBIR), shape is one of the primary low level image features. Many shape representations have been proposed. However, most of them assume the knowledge of shape boundary information which is not available in general situations. Among them, region-based shape descriptors are not only applicable to generic shapes, but also robust to noise and distortions. In this paper we study and compare three region shape descriptors: Zernike moment descriptors (ZMD), grid descriptors (GD) and geometric moments descriptors (GMD). The strengths and limitations of these methods are analyzed and clarified. A Java frame retrieval framework is implemented to test the retrieval performance. The study and retrieval experiments on standard shape databases show that ZMD is the most suitable for shape retrieval in terms of computation complexity, compact representation, robustness, hierarchical coarse to fine representation and retrieval performance. Contour shape descriptors are among the important shape description methods. Fourier descriptors (FD) and curvature scale space descriptors (CSSD) are widely used as contour shape descriptors for image retrieval in the literature. In MPEG-7, CSSD has been proposed as one of the contour-based shape descriptors. However, no comprehensive comparison has been made between these two shape descriptors.In this paper we study and compare FD and CSSD using standard principles and standard database. The study targets image retrieval application. Our experimental results show that FD outperforms CSSD in terms of robustness, low computation, hierarchical representation, retrieval performance and suitability for efficient indexing.A considerable number of image retrieval systems have been developed for commercial use and demonstrations versions are in existence in the academic world.

IV. IMPORTANT CONCEPT OF CBIR SYSTEM:

4.1 MUVIS

In 1998, first MUVIS system has been implemented for indexing and retrieval in large image databases using search and query techniques based on semantic and visual features. Recently, based on the experience and feedback from this first query system, MUVIS project has been reformed to become a PC-based system, which supports indexing, browsing, and querying various multimedia types such as image, video and audio. Furthermore, the system allows real-time audio and video capturing, and if needed encoding by last generation codec such as MPEG-4 or H.263+.

The proposed MUVIS systm is based upon several objectives and ideas. First of all it is intended to support real time video indexing (with or without audio), and therefore, it has *AVDatabase* application specially designed for creating audio/video databases. Corresponding application for images, *IDatabase*, is developed to handle all image indexing capabilities. Second, the system is further intended to index existing video clips regardless of their formats. *DbsEditor* is the application for appending such existing video clips into an existing database. Features such as color, texture and, shape are extracted off-line by *DbsEditor*. Moreover, *DbsEditor* can also add and remove features to/from any type of database since MUVIS system is now being improved to suppor querying based on multiple features. Finally, there is an application called *MBrowser*, which is the main media retrieval and browser terminal. It has a built-in search and query engine, which is capable of finding media primitives in any database and for any media type that is similar with the queried media source. Retrieval results for the queried source are produced by comparing its feature vector(s) with the feature vectors of the media primitives available in the database. Euclidean distance is used as a similarity measure between two feature vectors and minimum Euclidean distance yields the best similarity. Accordingly, all media primitives are sorted and afterwards the query results are shown in the user interface of *MBrowser*. Our efforts within MUVIS are closely connected to the MPEG-7 standardization, whose aim is to offer a standard description of the content of multimedia description.

4.2 MPEG-7

MPEG-7 is an ISO/IEC standard developed by MPEG (Moving Picture Experts Group, formally named as "Multimedia Content Description Interface" which aims to create a standard for describing content of multimedia data. The rapid increase in audio-visual information has created a demand for representation that goes beyond the simple waveform or sample-based, compression-based (such as MPEG-1 and MPEG-2) or even object-based (such as MPEG-4) representations. MPEG-7 focuses on the interpretation of *meaning* and *content* of information. Therefore, MPEG-7 has a key role in content-based retrieval. In this chapter different steps of multimedia description are described. The goal of the MPEG-7 standard is to allow interoperable searching, indexing, filtering and access of AV content by enabling interoperability among devices and applications that deal with AV content description. MPEG-7 describes specific features of AV content as well as information related to AV content management

4.3 Region based descriptor: ART

The region based shape descriptor belongs to the broad class of shape analysis techniques based on moments. It uses a complex 2D Angular Radial Transformation (ART), defined on a unit disk in polar coordinates. Angular Radial Transform (ART) is a region based shape descriptor for MPEG-7. ART bases functions are orthogonal and defined in polar-coordinates in a separable form along both radial and angular directions . Therefore, it can represent the shape of object in an image with minimum amount of information redundancy. Away from this attractive property, ART has additional attractive characteristics, where it could represent shape information using a small number of features, robust against noise and is rotationally invariant . The ART coefficients are defined by:

$$Fnm = \{Vnm(p,Q),f(p,Q)\} = \int_0^2 \int_0^1 Vnm(p,Q),f(p,Q)pdpdQ$$

4.4 Contour based shape descriptor : CSS

In this section, the MPEG-7 contour shape descriptor is presented we explain the underlying theory, discuss its properties and overview some experimental results. The contour shape descriptor is based on the Curvature Scale Space (CSS) representation of the contour. The CSS representation has been successfully used for search and retrieval in the past, but it has been further extended and optimized during the MPEG development phase.

The Curvature scale space representation:

The concept of CSS representation is intuitively easy. It is based on an observation that when comparing shapes, humans tend to decompose shape contours into concave and convex sections. The overall similarity is assessed based on similarity of the "corresponding" sections: e.g. how prominent they are, their length relative to the contour length and their position and order on the contour. The CSS representation also "decomposes" the contour into convex and concave sections by determining the inflection points (e.g. points where curvature is zero). This is done in a multiresolution fashion, where the contour is analyzed at various scales, obtained by a smoothing process.

V. RESULTS

By using ART descriptor we have shown you some of results of proposed method when it is applied to the MPEG-7 CE-1 database.

Table 1. CE1 Core Experiment Results for the Region Shape Descriptor

Query image	No. of relevant images that are retrieved	No. of relevant images present in the data base.
	14	16
	13	16
	11	16
	14	16
	9	16
	12	16
	12	16
	13	16
	13	16

Few of the examples that we are helped a lot to conclude similarity based retrieval results for region shape descriptor.

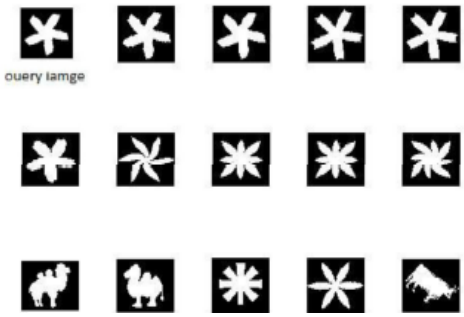

Fig. 2 similarity based retrieval results for region shape descriptor.

By using CSS descriptor we have shown you some of results of proposed method when it is applied to the MPEG-7 CE-1 database.

Table 2. CE1 Core experiment result for the Contour Shape descriptor.

Query image	No. of relevant images that are retrieved	No. of relevant images present in the data base.
	14	16
	15	16
	14	16
	13	16
	12	16
	13	16
	12	16
	11	16
	12	16
	8	16

Few of the examples that we are helped a lot to conclude retrieval result for the contour based approach.

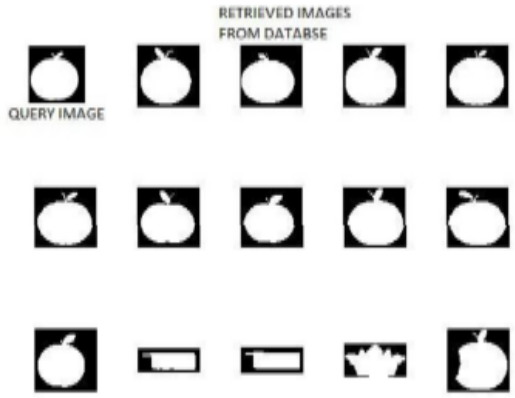

Fig. 3 Retrieval results for contour based approach descriptor.

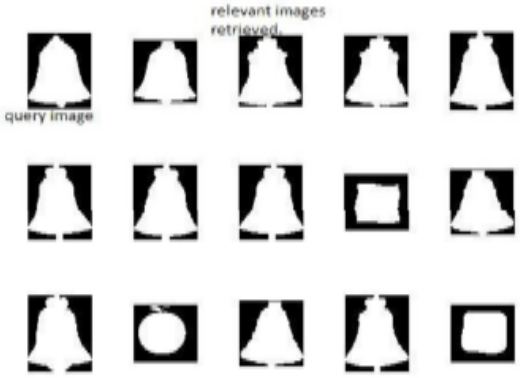

Fig. 4 Retrieval results for contour based approach descriptor.

VI. CONCLUSION

Finally we conclude that we are successful in every of the parameter and saying that, the CBIR using MPEG- 7 is the advance and fully reliable method for retrieval the method.

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