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Multi-Feature Content Based Image Retrieval System

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Abstract: *The Content-Based Image Retrieval (CBIR) techniques comprise methodologies to retrieve images over the image data set being studied according to the type of the image. The main purpose of CBIR consists in classifying images avoiding the use of manual labels related to understanding of the image by the human being vision. Numerous techniques have been developed for content-based image retrieval in the last decade. In this paper, we discuss some of the key contributions in the current decade related to image retrieval.*

Keywords: *Content Based Image Retrieval (CBIR), Color, Texture, Shape, edge histogram descriptor (EHD), Precision, Recall.*

I. Introduction

With the growth of technology and internet, images had become really famous nowadays and the search for similar images in large-scale image databases has been an active research area in the last couple of years. Intuitively, the most direct method to compare two images is to compare the pixels in one image to the corresponding pixels in the other image. Clearly, this method is not feasible, because images may have different size that applications cannot determine which pixels from one image correspond to which pixels in the other image. Another reason is the computational complexity. When a system wants to match two images by comparing pixel by pixel, it will take a long time. This is just for two images. Nowadays, we talk about thousands of images stored in databases that are used for image retrieving. Comparing images using their pixels is time consuming. More powerful method is to use image features instead of using the original pixel values because of the significant simplification of image representation, and the easy way to compare images using their features.

A very promising approach to do this task is content based image retrieval (CBIR). The main idea behind CBIR systems is to allow users to find images that are visually similar to the query image. Similar may have different meanings. Some users may be interested in some image regions. Others are interested in some shapes and the color of them. Therefore, different needs mean different methods for similarity. To allow different methods for similarity, different image descriptors are needed. Image descriptors may account for different properties of images. In such systems, images are typically represented by approximations of their contents. Typical approximations consist of statistics, and Fourier or wavelet transformations of the raw image data. This so-called feature extraction which aims to extracting information that is semantically meaningful but needs a small amount of storage. These features are used for computing the similarity between images. Then, some measurement methods are used to calculate the similarity between images. For fast retrieval, an indexing structure based on the query model is developed.

II. Evolution

A number of general-purpose image search engines have been developed. In the commercial domain, QBIC [1] is one of the earliest systems. Recently, additional systems have been developed such as VIR [2], AMORE [3], and Bell Laboratory WALRUS [4]. In the academic domain, MIT Photobook [5] is one of the earliest systems. Berkeley Blobworld [6], Columbia Visualseek and Webseek [7], Natra [8], and Stanford WBIIS [9] are some of the recent well known systems.

[A] QBIC

Query by Image Content (QBIC) [1] system was the first commercial system for CBIR developed by IBM Almaden Research Center, San Jose in 1995. This system uses color, texture, shape, and sketches for image representation. The QBIC system allows queries on large image and video databases based on example images, user-constructed sketches and drawings, color and texture patterns, camera and object motion. The color features are the average of the image color histograms in different color space (RGB, YIQ, Lab, and Munsell). The texture features are the modified version of coarseness, contrast, and the directionality features proposed by Tamura. The shape features used to extract the image features are the area, circularity, eccentricity, and some invariant moments.

[B] NETRA

NETRA [2] system has been developed by Department of Electrical and Computer Engineering at University of California, Santa Barbara in 1997. It uses three feature vectors to represent the image. The first vector is computed from color histogram to represent the image color feature. The second vector is the normalized mean and standard deviation, derived from the Gabor Wavelet Transform of the image, to represent the image texture feature. The third vector is the curvature function of the contour to represent the shape feature. Similarity matching is done by the Euclidean distance. CBIR System Based on the Clustering and Genetic Algorithm.

[C] KIWI

KIWI [3], Key-point Indexing Web Interface, has been developed in France by INSA Lyon in 2001. This system extracts the key points in the query image rather than the entire image using some wavelet-based salient point detector. Color histograms, are computed from each color component (R, G, and B), and the shape descriptors, computed from Gabor Filter, are used as image features. Euclidean distance is used for similarity matching.

[D] Image Miner

Image Miner [4] has been developed by Technology-Zentrum Informatics at University of Bremen in Germany in 1997. It uses color, texture, and shape to describe the image. Color histogram is used to describe image color features. Grey level co-occurrence matrix is used for texture feature. Image contour size, centroids, and boundary coordinates are used for shape features. For similarity, special module is developed within the system.

[E] Photobook

Photobook [5] was developed by Vision and Modeling Group at MIT Media Lab in 1997. It implements three different methods for image representation according to image content type (face, 2D shape, and texture). Photobook consists of three sub-books. There are the Appearance Photobook, Shape Photobook and Texture Photobook, which can extract the face, shape and texture, respectively. To query an image, users can select one of image features that the system supports or a combination of different features besides a text-based description.

III. Key Features

Feature extraction is very crucial step in image retrieval system to describe the image with minimum number of descriptors. It is a means of extracting compact but semantically useful information from images which can describe the image with its content. A "*feature*" means anything that is localized, meaningful and detectable. If we talk about image features, we mean objects in that image such as corners, lines, shapes, textures, and motions. Features extracted from an image describe and define the content of that image. These Features are used as a signature for the image.

[1] Color Feature:

One of the most important features visually recognized by humans in images is color. Color is the sensation caused by the light as it interacts with our eyes and brain. Humans tend to distinguish images based mostly on color features. Because of this, color features are the most widely used in CBIR systems and it is the most studied in literature. Color is a powerful descriptor that simplifies object identification, and it is one of the most frequently used visual features for content-based image retrieval.

[2] Texture Feature:

In the field of computer vision and image processing, there is no clear-cut definition of texture. This is because available texture definitions are based on texture analysis methods and the features extracted from the image. However, texture can be thought of as repeated patterns of pixels over a spatial domain, of which the addition of noise to the patterns and their repetition frequencies results in textures that can appear to be random and unstructured. Texture properties are the visual patterns in an image that have properties of homogeneity that do not result from the presence of only a single color or intensity. The different texture properties as perceived by the human eye are, for example, regularity, directionality, smoothness, and coarseness.

[3]Edge Feature:

Edge finding defined as to the method of inspection and locating sharp indefinite in an image. This indefinite or discontinuities are discriminate as boundaries of objects in a scene that is rapid changes in pixel

intensity. Typically Classical edge detection schemes occupy the image with an operator (2-D filter), which is constructed to be influence to large gradient in the image while inveterate values of zero in uniform regions. There are lot of edge detection operators existing, each design to be sensitive to certain types of edges.

[4] Shape Feature:

Shape is known to play an important role in human recognition and perception and object shape features provide a powerful clue to object identity. Humans can recognize objects solely from their shapes. The significance of shape as a feature for content-based image retrieval can be seen from the fact that every major content-based image retrieval system incorporates some shape features in one form or another. Shape of an object is the characteristic surface configuration as represented by the outline or contour.

"Content-based" means that the search will analyze the actual contents of the image rather than the metadata such as keywords, tags, and/or descriptions associated with the image. The term 'content' in this context might refer to colors, shapes, textures, or any other information that can be derived from the image itself [10]. The main unit of CBIR is an image retrieval technique that used to retrieve from the database the most similar images to the query image [11]. A typical content-based retrieval system is divided into *off-line feature extraction* and *online image retrieval*. In off-line stage, the system automatically extracts visual attributes at either a low-level (such as color, texture, and shape) or at a high-level (such as a color histogram), or both for each image in the database based on its pixel values and stores them in a different database within the system called a feature database [12].

The system represents this example with a feature vector and the distances (i.e., similarities) between the feature vectors of the query example and those of the image in the feature database are then computed and ranked. Retrieval is conducted by applying an indexing scheme to provide an efficient way of searching the image database. Finally, the system ranks the search results and then returns the results that are most similar to the query examples [13]. If the user is not satisfied with the search results, he can provide relevance feedback to the retrieval system, which contains a mechanism to learn the user's information needs.

A typical model for CBIR System is

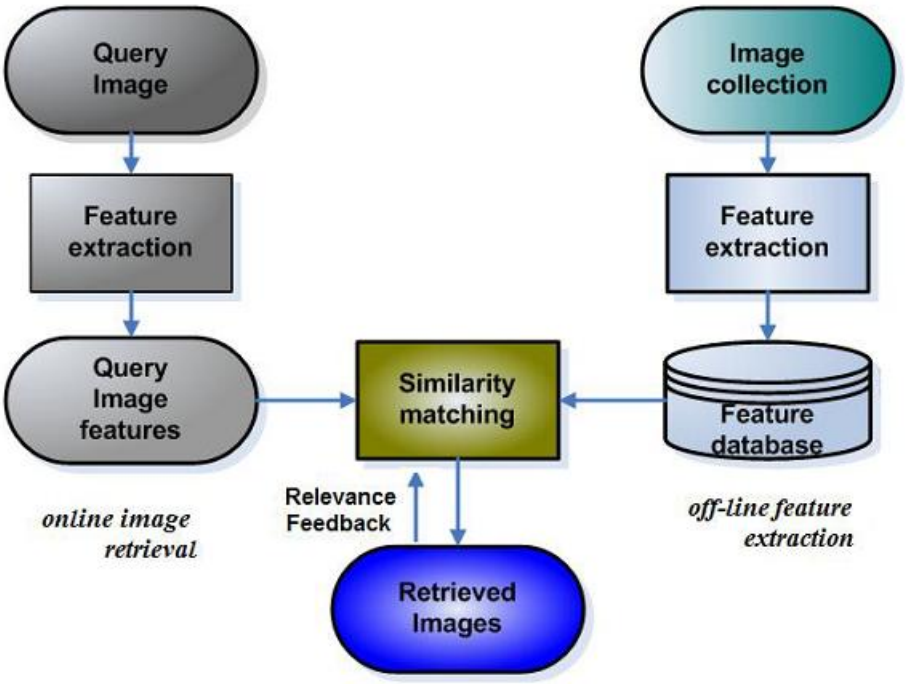

Fig 1. Typical Model of CBIR System.

IV. Performance Evaluation

In CBIR, the most commonly used performance measures are ***Precision*** and ***Recall***.

Precision, P, is defined as the ratio of the number of retrieved relevant images to the total number of retrieved images. This means that precision measures the accuracy of the retrieval. Let the number of all retrieved images be n and let r be the number of relevant images according to the query then the Precision value is:

$\boldsymbol{P}$= (***Number of Relevant Images Retreived Total***) / (***Number of Images Retreived***) (1)

Recall, *R*, is defined as the ratio of the number of retrieved relevant images to the total number of relevant images in the database [66]. This means that recall measures the robustness of the retrieval. Let r be the number of relevant images among all retrieved images according to the query and let M be the number of all relevant images to the query in the whole database then the Recall value is:

$\boldsymbol{R}$ = (***Number of Relevant Images Retreived Total***) / (Total ***Number of*** Relevant ***Images*** in DB) (2)

V. Applications

1 Medical Applications

The use of CBIR can result in powerful services that can benefit biomedical information systems. Three large domains can instantly take advantage of CBIR techniques: teaching, research, and diagnostics [14]. Clinicians usually use similar cases for case-based reasoning CBIR System Based on the Clustering and Genetic Algorithm in their clinical decision-making process. In the medical field, some ailments require the medical practitioner to search and review similar X-rays or scanned images of a patient before proffering a solution.

2 Digital Libraries

There are several digital libraries that support services based on image content. One example is the digital museum of butterflies [15], aimed at building a digital collection of Taiwanese butterflies. This digital library includes a module responsible for content-based image retrieval based on color, texture, and patterns.

3 Crime Prevention

One of the main jobs of police is to identify and arrest criminals in the country. However, to achieve that, the department of security investigation must identify the identity of criminals as fast as possible and with a high accuracy rate. Day after day, the crime rate is increasing so that the police must deal with a large number of criminal's images that stored in a database. Once a new image is arrived, it must be compared with all of these images to classify it correctly. It is clear that, doing this job manually takes a long time so, the need for criminal recognition system is strongly highlighted here.

4 Web Searching

The most important application, however, is the Web, as a big fraction of it is devoted to images, and searching for a specific image is indeed a daunting task. Numerous commercial and experimental CBIR systems are now available, and many web search engines are now equipped with CBIR facilities, as for example Alta Vista, Yahoo and Google. Today it is estimated that there are 30 billion images in Imageshack, Facebook holds 35 billion photos and Corp's PhotoBucket has 10 billion photos [16].

5 Other Applications

In the commerce department, before trademark is finally approved for use, there is a need to find out if such or similar ones ever existed. In architectural and engineering design, image database exists for design projects, finished projects, and machine parts. In publishing and advertising, journalists create image databases for various events and activities such as sports, buildings, personalities, national and international events, and product advertisements.

VI. Conclusion

Network and development of multimedia technologies are attractive more popular, users are not satisfied with the established information retrieval techniques. So now days the CBIR are becoming a source of exact and fast retrieval. There are various applications of CBIR. Using single feature for retrieving images from database leads to less precision and recall rate. To improve retrieval efficiency system should include various features i.e. color, texture, shape and edge. For the better performance various algorithms can be is introduced with different distance measurement techniques.

References

[1]. M. Flickner, H. Sawhney, W. Niblack, J. Ashley, Q. Huang, B. Dom, M. Gorkani, J. Hafner, D. Lee, D. Petkovic, and P. Yanker, "Query by image and video content: The QBIC system," *IEEE Computer*, vol. 28, no 9, pp.23-32, Sep. 1995.

[2]. A. Gupta, and R. Jain, "Visual Information Retrieval," *Comm. Assoc. Comp. Mach*., vol. 40, no. 5, pp. 70–79, May. 1997.

[3]. S. Mukherjea, K. Hirata, and Y. Hara, "AMORE: A World Wide Web Image Retrieval Engine," *Proceedings of World Wide Web*, vol. 2, no. 3, pp. 115-132, June. 1999.

[4]. A. Natsev, R. Rastogi, and K. Shim, "WALRUS: A Similarity Retrieval Algorithm for Image Databases," *IEEE Transaction On Knowledge and Data Engineering*, vol.16, pp. 301-318, Mar. 2004.

[5]. A. Pentland, R. Picard, and S. Sclaroff , "Photobook: Content based manipulation of image databases," *International Journal of Computer Vision*, vol.18, no 3, pp.233–254, June 1997.

[6]. C. Carson, M. Thomas, S. Belongie, J.M. Hellerstein, and J. Malik, "Blobworld: A System for Region-Based Image Indexing and Retrieval," *Proceedings of Visual Information Systems*, pp. 509-516, June 1999.

[7]. J. Smith and S. Chang, "Visualseek: A Fully Automated Content-Based Image Query System," *Proceedings of the 4th ACM international conference on Multimedia Table of Contents*, Boston, Massachusetts, United States, pp. 87-98, Nov. 1996.

[8]. W. Ma and B. Manjunath, "Natra: A Toolbox for Navigating Large Image Databases," *Proceedings IEEE Int'l Conf. Image Processing*, Santa Barbara, 1997, pp. 568- 571.

[9]. J. Wang, G. Wiederhold, O. Firschein, and X. Sha, "Content-Based Image Indexing and Searching Using Daubechies' Wavelets," *Int. J. Digital Libraries*, vol. 1, no.4,pp.311-328,1998.

[10]. I. El-Naqa, Y. Yang, N. Galatsanos, R. Nishikawa and M. Wernick, "A Similarity Learning Approach to Content-Based Image Retrieval: Application to Digital Mammography," *IEEE Transactions on Medical Imaging*, 2009.

[11]. N. Singh, S. Dubey, P. Dixit, and J. Gupta. "Semantic Image Retrieval by Combining Color, Texture and Shape Features," *International Conference on Computing Sciences*, 2012.

[12]. S. Gerard and C. Buckely, "Term-Weighting Approaches in Automatic Text Retrieval," *Information Processing and Management*, vol. 24, no.5, pp. 513-523, Jan. 1988.

[13]. F. Long, H. Zhang, H. Dagan, and D. Feng, "Fundamentals of Content Based Image Retrieval," *Multimedia Signal Processing Book*, Chapter 1, Springer-Verlag, Berlin Heidelberg New York, 2003.

[14]. K. Seo, " Content-Based Image Retrieval by Combining Genetic Algorithm and Support Vector Machine," *Proceedings of the 17th international conference on Artificial neural networks*,2007.

[15]. Y. Huang, C. Huang, H. Sun and Y. Liao, "Fault Diagnosis Using Hybrid Artificial Intelligent Methods," *Industrial Electronics and Applications (ICIEA), the 5th IEEE Conference*, 2010.

[16]. M. Kherfi, D. Ziou, and A. Bernardi, "Image Retrieval From the World Wide Web: Issues, Techniques, and Systems," *ACM Computing Surveys*, vol. 36, no. 1, pp. 35–67, March 2004.