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Image Retrieval Techniques: A Survey

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Abstract

In image processing, Image Retrieval (IR) is one of the most exciting and fastest growing research areas in the field of multimedia technology. We present here a highlight of recent research for Image Retrieval. Some trends and probable future research directions are presented. Different techniques are there but this paper provides an review of the present technique that is relevance feedback schemes (RF) and analysis of Retrieval Systems based on Relevance feedback Techniques in content-based image retrieval (CBIR).We expose the major problems that we have recognized: the lack of a good measurement of visual similarity, the little importance accorded to user interaction and feedback. There are some really smart techniques proposed by researchers for efficient and robust content-based image retrieval. In this research, the aim is to highlight the efforts of researchers who conducted some brilliant work and to provide a proof of concept for intelligent content-based image retrieval techniques.

Keywords: Image retrieval, intelligent image indexing, image data store, search by visual contents, Relevance Feedback, Interactive Genetic Algorithm, content-based image retrieval and semantic-based image retrieval.

I. INTRODUCTION

Content-based image retrieval, a technique which uses visual contents to search images from large scale image databases according to user's interests, has been an active and fast advancing research area since the 1990s. During the past decade, remarkable progress has been made in both theoretical research and system development. However, there remain many challenging research problems that continue to attract researchers from multiple disciplines. Before introducing the fundamental theory of content-based retrieval [1], we will take a brief look at its development. Early work on image retrieval can be traced back to the late 1970s. In

1979, a conference on Database Techniques for Pictorial Applications was held in Florence. Since then, the application potential of image database management techniques has attracted the attention of researchers. Early techniques were not generally based on visual features but on the textual annotation of images. In other words, images were first annotated with text and then searched using a text-based approach from traditional database management systems. Comprehensive surveys of early *text-based image retrieval* methods can be found in [1, 5, 11, 21, 22]. Text-based image retrieval uses traditional database techniques to manage images. Through text descriptions, images can be organized by topical or semantic hierarchies [15, 20] to facilitate easy navigation and browsing based on standard Boolean queries. However, since automatically generating descriptive texts for a wide spectrum of images is not feasible, most text-based image retrieval systems require manual annotation of images. Obviously, annotating images manually is a cumbersome and expensive task for large image databases, and is often subjective, context-sensitive and incomplete. As a result, it is difficult for the traditional text-based methods to support a variety of task-dependent queries. In the early 1990s, as a result of advances in the Internet and new digital image sensor technologies, the volume of digital images produced by scientific, educational, medical, industrial, and other applications available to users increased dramatically. The difficulties faced by text-based retrieval became more and more severe. The efficient management of the rapidly expanding visual information became an urgent problem. This need formed the driving force behind the emergence of content-based image retrieval techniques [2,3,6,7,8,9,10,12,14,19,23,24]. In 1992, the National Science Foundation of the United States organized a workshop on visual information management systems to identify new directions in image database management systems. It was widely recognized that a more efficient and intuitive way to represent and index visual information would be based on properties that are inherent in the images themselves. Researchers from the communities of computer vision, database management, human-computer interface, and information retrieval were attracted to this field. Since then, research on content-based image retrieval has developed rapidly. Since 1997, the number of research publications on the techniques of visual information extraction, organization, indexing, user query and interaction, and database management has increased enormously. Similarly, a large number of academic and commercial retrieval systems have been developed by universities, government organizations, companies, and hospitals. Comprehensive surveys of these techniques and systems can be found in [24]. Content-based image retrieval, uses the visual contents of an image such as *color*, *shape*, *texture*, and *spatial layout* to represent and index the image.

In typical content-based image retrieval systems (Figure 1.1), the visual contents of the images in the database are extracted and described by multi-dimensional feature vectors. The feature vectors of the images in the database form a feature database. To retrieve images, users provide the retrieval system with example images or sketched figures. The system then changes these examples into its internal representation of feature vectors. The similarities /distances between the feature vectors of the query example or sketch and those of the images in the database are then calculated and

retrieval is performed with the aid of an indexing scheme. The indexing scheme provides an efficient way to search for the image database. Recent retrieval systems have incorporated users' relevance feedback to modify the retrieval process in order to generate perceptually and semantically more meaningful retrieval results.

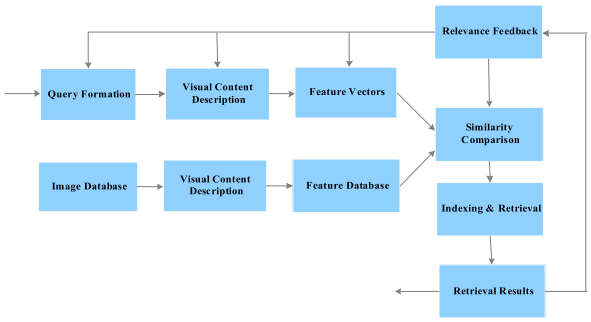

Figure 1.1: Diagram for content-based image retrieval system

II. IMAGE RETRIEVAL TECHNIQUES

Many image retrieval techniques have been developed by researchers and scientists, some of the most important and widely used image retrieval techniques are shown in Figure1.2. Latest research work on image retrieval techniques highlighted in Table-1 &Table-2 is discussed and evaluated below.

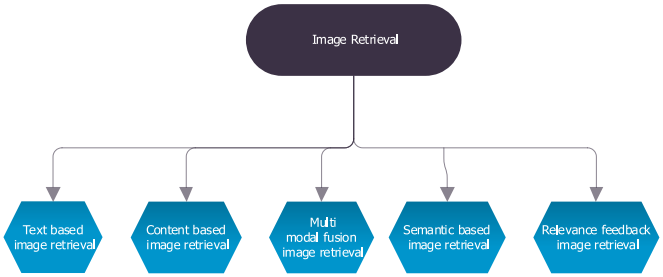

Figure 1.2: Various Image retrieval techniques

A. Text Based Image Retrieval

Text-based image retrieval is also called description-based image retrieval. Text-based image retrieval is used to retrieve the XML documents containing the images based on the textual information for a specific multimedia query. To overcome the limitations of CBIR, TBIR represents the visual content of images by manually assigned keywords/tags. It allows a user to present his/her information need as a textual query, and find the relevant images based on the match between the textual query and the manual annotations of images [1, 5, 11, 21, 22].

B. Content Based Image Retrieval

In content based image retrieval, images are searched and retrieved on the basis of similarity of their visual contents to a query image using features of the image. A feature extraction module is used to extract low-level image features from the images in the collection. Commonly extracted image features include color, texture and shape [2,3,6,7,8,9,10,12,14,19,23,24].

C. Multimodal Fusion Image Retrieval

Multimodal fusion image retrieval involves data fusion and machine learning algorithms. Data fusion, also known as combination of evidence, is a technique of merging multiple sources of evidence. By using multiple modalities, we can learn the skimming effect, chorus effect and dark horse effect [4].

D. Semantic Based Image Retrieval

Image retrieval based on the semantic meaning of the images is currently being explored by many researchers. This is one of the efforts to close the semantic gap problem. In this context, there are two main approaches: Annotating images or image segments with keywords through automatic image annotation or adopting the semantic web initiatives [15, 20].

E. Relevance Feedback Image Retrieval

The difference between the user's information need and the image representation is called the semantic gap in CBIR systems. The limited retrieval accuracy of image nuclear retrieval systems is essentially due to the intrinsic semantic gap. In order to reduce the gap, relevance feedback is very helpful into CBIR system. The basic idea behind relevance feedback is to integrate human perception subjectivity into the query and involve user to evaluate the retrieval results. Then depending upon user's integration the similarity measures are automatically refined. There are lots of CBIR algorithms has been proposed and most of them work on the finding effectively specific image or group of relevant image to that query image using similarity computation phase. But it is necessary to have user's interaction to get better results [13, 16, 17, 18].

F. Relevance Feedback Schemes

Table-1: Relevance Feedback Techniques

Category	**Relevance Feedback Methods**	**Advantages**	**Limitations**
Statistical Based RF Methods	Delta Mean algorithm	Determines which features can efficiently differentiate between the relevant and irrelevant image examples	As small size cannot calculate exact variance of data set, so it is receptive to data set size.
	Standard	Bunch of relevant images	It assumed irrelevant sample

	Deviation and Variance	exhibit the specific features and are inversely proportional to the relevant image set variance	to be unimodal which is not actually possible.
	QPM (query point movement)	Estimates the perfect query point from which the ideal relevant images can be retrieved.	QPM unable to make better use of irrelevant samples when images are not unimodal.
Kernel Based RF Methods	Bayesian Frame work	Textual based image retrieval method is used extensively in this scheme. User interaction is always computed in terms of probabilities of a random variable.	When extraction of texture, shape and color features is done individually for retrieval of image performance evaluation using Bayesian models decreases considerably.
	SVM (Support Vector Machine)	SVM derived better results for pattern identification without dealing with the filed Information.	SVM sensitive to small sample data sizes.
	BDA (biased discriminant analysis)	Calculates the linear transformation for the scattered negative and positive images.	Gaussian distribution methods for relevant data set are the main flaw for the efficient results.
Entropy Based Methods	KL (Kullback-Leibler) Distance	Makes few difference measures on the basis of entropy due to which derivation of KL Distance calculated between two distributions is done.	On the distributions of data there is lacks of the constraints.

Table-2: Analysis of Retrieval Systems based on Relevance feedback Techniques

S.NO	**AUTHOR**	**YEAR**	**PROPOSED METHOD**	**RESULTS**
1	Benitez, Beigi, & Chang	1998	Meta seek	Average Precision= 0.70
2	Vasconcelos & Lippman	2000	Bayesian Learning Algorithm	Precision/ Recall curve were plotted.
3	Jorma Laaksonen	2001	Self-Organizing Maps	The average ‘ t ’ value = 0.174
4	Sean D. MacArthur, Carla E.Brodley, and Avinash C. Kak	2002	Using decision trees Relevance feedback	Average retrieval precision curve were plotted

5	Su, Zhang, Li,and Ma	2003	Bayesian classifier	Accuracy increase in top 10, 20 & 100 results =2.6 %, 13.4 % and 7.8%
6	Slobodan Cabarkapa	2005	Relevance feedback based adaptive retrieval approach	Average Retrieval rate =89.5%
7	Quanzhong Liu	2008	Real-code genetic RF	Precision=75% and Recall=69%
8	C. D. Ferreira	2009	Genetic programming based relevance feedback	Precision/ Recall curve were plotted.
9	Peter Auer and Zakria Hussain	2010	Implicit relevance feedback	Average precision =15.0
10	Lining Zhang and Lipo Wang	2010	Generalized Biased Discriminant Analysis	Average precision in top 20, 140 results=83.35 % & 30.73 % Average Recall in top 20, 140 results= 14.18 % & 35.27 %
11	Chih-Chin Lai and Ying-Chuan Chen	2011	Interactive genetic algorithm	Precision=80.6% Recall=15.8%
12	Manish Chowdhury, Sudeb Das and Malay Kumar Kundu	2012	Ripplet Transform & fuzzy relevance feedback	Average Precision=0.55
13	P. M. Pawar & A .N. Holambe	2013	Navigation Pattern Mining	Precision= 80%
14	Wankhede, V.A., Mohod and P.S.	2015	ABIR (Association-based image retrieval) algorithm	Precision/ Recall curve were plotted.

III. CONCLUSION

With the increasing demands of multimedia applications over the Internet, the importance of image retrieval has also increased. In this research study, image retrieval techniques that have used the relevance feedback schemes to improve the performance as well as accuracy of the image retrieval process are discussed. All these techniques have their own advantages as well as certain limitations. In other words, there is not a single technique that fits best in all sorts of user's requirements; therefore, the doors are still open to keep inventing new methodologies according to the requirements of image retrieval applications.

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