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Image Retrieval: A Literature Review

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Abstract—**In the recent years, with the acquaintance of internet, there has been large amount of data resides on the web. Therefore it becomes necessity for fast retrieval search engines that retrieve documents and images.This paper tries to provide a comprehensive review and characterize the various problems of image retrial techniques. We present a survey of the most popular image retrieval techniques with their pros and cons. Content Based Image Retrieval is the latest technique for image retrieval.In order to make image retrieval more effective researcher are moving towards Association based image retrieval, that is new direction of CBIR. Finally, based on existing technologies and the demand from real-world applications, a few promising future research directions are suggested.**

Index Terms—**Image Retrieval, Content Based Image Retrieval, Association Based Image Retriveal.**

I. INTRODUCTION

An image retrieval system is a computer system for browsing, searching and retrieving images from a large database of digital images [1]. This area of research is very active research since the 1970s. The purpose of an image database is to store and retrieve an image or image sequences that are relevant to a query [2]. There are a variety of domains such as information retrieval, computer graphics, database management and user behavior which have evolved separately but are interrelated and provide a valuable contribution to this researchsubject.

II. IMAGE RETRIEVAL APPROACHES

An image is a representation of a real object or scene. With the development of the internet, and the availability of image capturing devices such as digital cameras, huge amounts of images are being created every day in different areas including remote sensing, fashion, crime prevention, publishing, medicine, architecture, etc. During this era the world is moving very fast because of internet, so we need to developefficient and effective methodologies to manage large image databases for retrieval. For this purpose there are many general purpose image retrieval systems, some of them are given below [3]:

i) Text-based Image Retrieval
ii) Content-based Image Retrieval
iii)Hybrid Approach

A. *Text Based Image Retrieval (TBIR)*

TBIR is currently used in almost all general purpose web image retrieval systems. As shown in Fig. 1 this approach uses the text associated with an image to determine what the image contains. Google, Yahoo Image Search engines are examples of systems using this type of approach. However

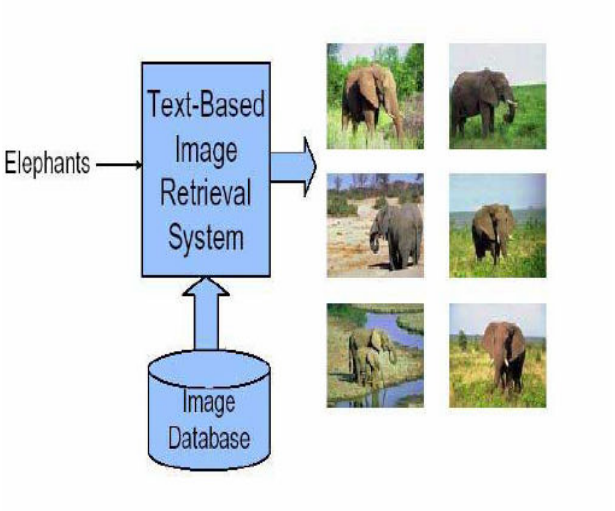

Fig. 1: Text Based Image Retrieval

these search engines are fast and robust but sometimes they fail to retrieverelevant images. The main advantages anddisadvantagesof text based image retrieval are given below [4]:

Advantages:
--Easy to implement
– Fast retrieval
– Web image search (surrounding text)

Disadvantages:
– Manual annotation is impossible for a large database
– Manual annotation is not accurate
– Polysemy problem (more than one object can be refer by the same word)
– Surrounding text may not describe the image

B. *Content Based Image Retrieval (CBIR)*

In late 1990's, Content-based image retrieval was introduced by T. Kato. It has been used as an alternative to text based image retrieval. IBM was the first, who take an initiative by proposing query-by image content (QBIC) [5].

CBIR involves the following four parts in system realization: data collection, build up feature database, search in the database, arrange the order and results of the retrieval.

Advantages
– The features employed by the image retrieval systems include color, texture, shape and spatial are retrieve automatically.
– Similarities of images are based on the distances between features .

In Fig. 2 shows the content based image retrieval method.

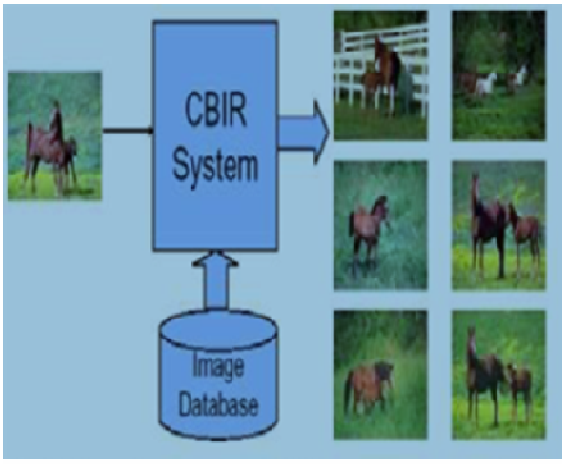

Fig. 2: Content Based Image Retrieval

1)Types of CBIR based Image Retrieval

a) Region-based :The Netra and Blobworld are two earlier region based image retrieval systems [6]. During retrieval, a user is provided with segmented regions of the query image, and is required to assign several properties, such as the regions to be matched, the features of the regions, and even the weights of different features [7].

b) Object-based: Object-based image retrieval systems retrieve images from a database based on the appearance of physical objects in those images. These objects can be elephants, stop signs, helicopters, buildings, faces, or any other object that the user wishes to find. One common way to search for objects in images is to first segment the image in the database and then compare each segmented region against a region in some query image presented by the user [8]. Such image retrieval systems are generally successful for objects that can be easily separated from the background and that have distinctive colors or textures.

c)Example-based :Users give a sample image, or portion of an image, that the system uses as a base for the search.The system then finds images that are similar to the base image.

d) Feedback-based :System shows user a sample of pictures and asks for rating from the user. Using these ratings, system re-queries and repeats until the right image is found [9].

CBIR involves the following four parts in system realization: data collection, build up feature database, search in the database, arrange the order and deal with the results of the retrieval [10].

Data collection Using the Internet spider program that can collect webs automatically to interview Internet and do the collection of the images on the web site, then it will go over all the other webs through the URL, repeating this process and collecting all the images it has reviewed into the server.

Build up feature This systemis based on indexing. Firstly we analysis the collected images and then extract the feature information.Currently , the features that use widely involve low level features such as color, texture and so on, the middle level features such as shape etc.

Search the Database the search engine will search the suited feature from the database and calculate the similar distance, then find several related webs and images with the minimum similar distance.

Process and index the results Index the image obtained from searching due to the similarity of features, then return the retrieval images to the user and let the user select. If the user is not satisfied with the searching result, he can re-retrieval the image again, and searches database again.

2) Feature Extraction

In Table:1 the different methods based on features are used to extract the images. The main features based methods are described as following.

a)*Color:* Color is the feature of content based image retrieval systems for retrieve the image.

First a color space is used to represent color images. The RGB space where the gray level intensity is represented as the sum of red, green and blue gray level intensities [11]. Variety of color spaces include, RGB, LUV, HSV (HSL), YCrCb and the huemin-max-difference (HMMD) [12].Common color features or descriptors in CBIR systems include, color-covariance matrix, color histogram,

color moments and color coherence vector . The Color Structure Descriptor (CSD) represents an image by both the local structure of the color and the color distribution of the image or image region.

*b) Texture:*The notion of texture generally refers to the presence of a spatial pattern the has some properties of homogeneity [13]. Directional features are extracted to capture image texture information. The six visual texture properties were coarseness, contrast, directionality, line likeness, regularity and roughness.

Two classes of texture representation method can be distinguished:

1) Structural methods including morphological operator and adjacency graph, describe texture by identifying structural primitives and their placement rules. They deal with the arrangement of image primitives, presence of parallel or regularly spaced objects.

2)Statistical methods which include the popular co-occurrence matrix, Fourier power spectra, Shift invariant principal component analysis (SPCA), Tamura feature, Multi-resolution filtering technique such as Gabor and wavelet transform, characterize the texture by statistical distribution of the image intensity.

3) In spectral approach, texture description is done by Fourier transform of an image and then group the transformed data in a way that it gives some set of measurements.

c) Shape: Shape is also one of the important feature of an image. Generally we can divided the shape into two categories, region-based and boundary-based. In the late years we just uses only the outer boundary of the shape while the current uses the entire shape region [11], [14].

The most successful representatives for these two categories are Fourier descriptor and moment invariants.

Table 1: Overview of commonly used feature in IR

Features	Methods to extract image
Color	histograms, color co-occurrence histograms.
Texture	directionality, periodicity, randomness, fourier-domain characteristics, random fields.
Shape	segmentation & contour extraction followed by: contour matching, moments, template, matching
Others	wavelet coefficient, eigen images, edge-maps of user made sketch, image context vectors

1) Fourier descriptor: The fourier descriptor is to use the Fourier transformed boundary as the shape feature. Some early work can be found. To take into account the digitization noise in the image domain, Rui et al. proposed a modified Fourier descriptor which is both invariant to geometric transformations and strong to noise.

2) Moment invariants: The main motive of moment invariants is to use region-based moments which are invariant to transformations, as the shape feature. The Hu identified seven such moments based on his work. Many improved versions emerged in this method. Based on the discrete version of Green's theorem, Yang and Albregtsen proposed a fast method of computing moments in binary images. Some facts that motivated the most useful invariants were found by extensive experience and trial-and-error, Kapur et al. developed algorithms to systematically search and generate for a given geometry's invariants.

C. Hybrid Approach

The recent trend for image search is to fuse the basic techniques of Web images,i.e. Textual context (usually represent by the keywords) and Visual features for retrieval. In the hybrid approach we join the existing textual and visual features to provide a better result.

The simplest approach for this method is based on counting the frequency-of-occurrence of words for automatic indexing.

The second approach takes a different stand and treats images and texts as equivalent data. It attempts to discover the correlation between visual features and textual words on an unsupervised basis, by estimating the joint distribution of features and words and posing annotation as statistical inference in a graphical model.

As a result, pure combination of text based and content based image retrieval approaches is not sufficient for dealing with the problem of image retrieval on the Web.

We can also combine the features of content based image retrieval to improve the image retrieval technique. These hybrid features also enhance the retrieval technique i.e. color and texture, texture and shape based hybrid approach etc.

III. Performance Evaluation of Proposed CBIR System

Evaluation of retrieval performance is a crucial problem in Content-Based Image Retrieval(CBIR). Many different methods for measuring the performance of a system have been created and used by researchers. With this, the following formulae are used for finding Precision and Recall values[13], [15].

Precision measures the proportion of the total images retrieved which are relevant to the query.

$$\text{Precision} = \frac{\text{No. of relevant images retrieved}}{\text{Total no. of images retrived}}$$

The recall measure is defined as the fraction of the all relevant images.

$$\text{Recall} = \frac{\text{Total number of relevant images}}{\text{Number of relevant images retrieved}}$$

High precision means that less irrelevant images are returned or more relevant images are retrieved, while high recall indicates that few relevant images are missed.

IV. Future Directions and Image Retrieval System

1)Similar to Human Judgments

To understand user required images, further to plug and play the query and stored images in such a way that reflects human identical judgments and information-seeking behavior.

2)Semantic Gap

As there are no such techniques available which properly deal with semantic gap and hence new image annotation techniques need to be developed.The researchers are moving to reduce the semantic gap in broad domains.

3)Efficiency

Efficiently accessing stored images by content.

4) New User Interface

Providing usable human interfaces to CBIR systems.
Developing new user interfaces for searching and browsing based on image content and further annotating images by some new tools.

5)Image Mining

To develop efficient image mining technique such as text mining techniques might be combined with visual-based descriptions.

6) Storage

Providing compact storage for large image database.

V. Conclusion

As conclusion, this paper provides a study of image retrieval work. A wide variety of researches have been made on image retrieval. Each work has its own technique, contribution and limitations. As a review paper, it might not include each and every aspect of individual works, however this paper attempts to deal with a detailed review of the most common traditional and modern image retrieval systems from early text based systems to content based retrieval. This paper

review those works mainly based on the methods/approaches they used to come up to an efficient retrieval system together with the limitations/challenges. And we tried to give a constructive idea for future work in this field.

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