Study of Content Based Image Retrieval

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Abstract- Content Based Image Retrieval (CBIR) is a technique that enables a user to extract an image based on a query, from a database containing a large amount of images. A very fundamental issue in designing a content based image retrieval system is to select the image features that best represent the image contents in a database. In this paper, our proposed method mainly concentrated on database classification and efficient image representation. Most of the available image search tools, such as Google Images and Yahoo! Image search, are based on textual annotation i.e. metadata of images.

Keywords - CBIR, Image Searching, Retrieval.

1. INTRODUCTION

A picture is worth thousands of words. In many applications, such as art collections, photographic archives, retail catalogs, medical diagnose, crime prevention, military applications, intellectual property, architectural and engineering design, and geographical information and remote sensing systems [1], it has been seen that information is more effectively conveyed by pictures or images. In many areas of commerce, government, academia, and hospitals, large collections of digital images are being created. Many of these collections are the product of digitizing existing collections of analogue photographs, diagrams, drawings, paintings, and prints. Usually, the only way of searching these collections was by keyword indexing, or simply by browsing.

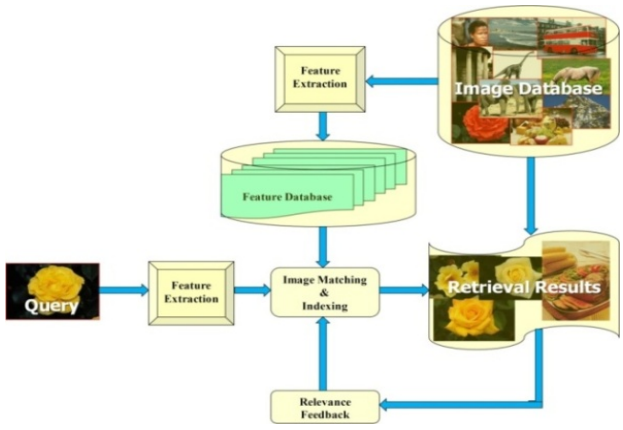
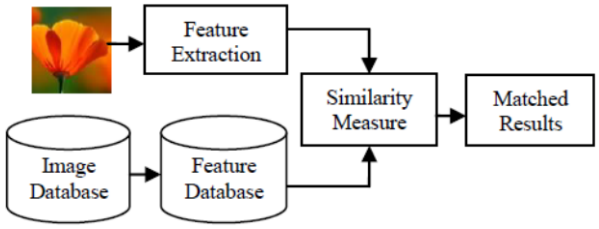


Fig.1 A Conceptual Framework for Content-Based Image Retrieval

Digital image databases however, open the way to content-based searching. In this paper we survey some technical aspects of current content-based image retrieval systems. A number of other overviews on image database systems, image retrieval, or multimedia information systems have been published, see e.g. [18], [6], [7],[3], [17]. This survey however, is about the functionality of contemporary image retrieval systems in terms of the following technical aspects: querying, relevance feedback, result presentation, features, and matching. This article is a short version of a much more comprehensive survey [8], which covers substantially more systems, and also treats the following aspects: indexing data structures, performance, and applications.



"Content-based" means that the search will analyze the actual contents of the image rather than 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 [12][14]. CBIR is desirable because most web based image search engines rely purely on metadata and this produces a lot of garbage in the results. Also having humans manually enter keywords for images in a large database can be inefficient, expensive and may not capture every keyword that describes the image. The evaluation of the effectiveness of keyword image search is subjective and has not been well-defined. In the same regard, CBIR systems have similar challenges in defining success.[2]

The most common method for comparing two images in content-based image retrieval (typically an example image and an image from the database) is using an image distance measure. An image distance measure compares the similarity of two images in various dimensions such as color, texture, shape, and others. For example, a distance of 0 signifies an exact match with the query, with respect to the dimensions that were considered. As one may intuitively gather, a value greater than 0 indicates various degrees of similarities between the images. Search results then can be sorted based on their distance to the queried image.[5] Many measures of image distance (Similarity Models) have been developed.[10]

Color

Computing distance measures based on color similarity is achieved by computing a color histogram for each image that identifies the proportion of pixels within an image holding specific values.[2] Examining images based on the colors they contain is one of the most widely used techniques because it can be completed without regard to image size or orientation.[9] However, research has also attempted to segment color proportion by region and by spatial relationship among several color regions.[11]

Texture

Texture measures look for visual patterns in images and how they are spatially defined. Textures are represented by texels which are then placed into a number of sets, depending on how many textures are detected in the image. These sets not only define the texture, but also where in the image the texture is located.[5]Texture is a difficult concept to represent. The identification of specific textures in an image is achieved primarily by modeling texture as a two-dimensional gray level variation. The relative brightness of pairs of pixels is computed such that degree of contrast, regularity, coarseness and directionality may be estimated.[9][12] The problem is in identifying patterns of co-pixel variation and associating them with particular classes of textures such as silky, or rough.

Other methods of classifying textures include:

- Co-occurrence matrix

The co-occurrence matrix captures numerical features of a texture using spatial relations of similar gray tones.[13] Numerical features computed from the co-occurrence matrix can be used to represent, compare, and classify textures. The following are a subset of standard features derivable from a normalized co-occurrence matrix: Where is the the entry in a gray-tone spatial dependence matrix, and Ng is the number of distinct gray-levels in the quantized image. One negative aspect of the co-occurrence matrix is that the extracted features do not necessarily correspond to visual perception.

- *Laws texture energy*

Another approach to generate texture features is to use local masks to detect various types of textures. Convolution masks of 5x5 are used to compute the energy of texture which is then represented by a nine element vector for each pixel. The masks are generated from the following vectors:[14]

- *Wavelet transform*

In mathematics, a wavelet series is a representation of a square-integrable (real- or complex-valued) function by a certain orthonormal series generated by a wavelet. Nowadays, wavelet transformation is one of the most popular of the time-frequency-transformations. This article provides a formal, mathematical definition of an orthonormal wavelet and of the integral wavelet transform. The fundamental idea of wavelet transforms is that the transformation should allow only changes in time extension, but not shape. This is effected by choosing suitable basis functions that allow for this. Changes in the time extension are expected to conform to the corresponding analysis frequency of the basis function. Based on the uncertainty principle of signal processing,

t represents time and ω angular frequency (ω =

2πf, where f is temporal frequency).

The higher the required resolution in time, the lower the resolution in frequency has to be. The larger the extension of the analysis windows is chosen, the larger is the value of Δt

When Δt is large,

1. Bad time resolution
2. Good frequency resolution
3. Low frequency, large scaling factor

When Δt is small

1. Good time resolution
2. Bad frequency resolution
3. High frequency, small scaling factor

Shape

Shape does not refer to the shape of an image but to the shape of a particular region that is being sought out. Shapes will often be determined first applying segmentation or edge detection to an image. Other methods use shape filters to identify given shapes of an image.[12] Shape descriptors may also need to be invariant to translation, rotation, and scale.[9]

- *Fourier transform*

The Fourier transform decomposes a function of time (a signal) into the frequencies that make it up, in a way similar to how a musical chord can be expressed as the amplitude (or loudness) of its constituent notes. The Fourier transform of a function of time itself is a complex-valued function of frequency, whose absolute

value represents the amount of that frequency present in the original function, and whose complex argument is the phase offset of the basic sinusoid in that frequency. The Fourier transform is called the frequency domain representation of the original signal. The term Fourier transform refers to both the frequency domain representation and the mathematical operation that associates the frequency domain representation to a function of time. The Fourier transform is not limited to functions of time, but in order to have a unified language, the domain of the original function is commonly referred to as the time domain. For many functions of practical interest one can define an operation that reverses this: the inverse Fourier transformation, also called Fourier synthesis, of a frequency domain representation combines the contributions of all the different frequencies to recover the original function of time.

- *Moment invariant*

Moments are well-known for their application in image analysis, since they can be used to derive invariants with respect to specific transformation classes. The term invariant moments is often abused in this context. However, while moment invariants are invariants that are formed from moments, the only moments that are invariants themselves are the central moments.

2. RETRIEVAL

The System saves and presents a sequence of images ranked in decreasing order of similarity or with the minimum distances is returned to the user. To evaluate the efficiency of the proposed system precision and recall rates are to be calculated where,

Precision = IR /IT

IR=No Of Relevance Images Retrieved

IT=Total Number of Images Retrieved on the screen

Recall = IR/IRB

IR=No Of Relevance Images Retrieved

IRB=Total Number of relevant Images in the database

3. THE EXISTING IMAGE RETRIEVAL SYSTEMS

There is several various type of existing content-based image retrieval systems had been done in past few years. A survey to content-based image retrieval system had been done by Remco C. Veltkamp and Mirela Tanase. The survey provides an overview of the functionality of temporary image retrieval systems in terms of technical aspects which are 15 querying, relevance feedback, features, matching measures, indexing data structures, and result presentation. The example of CBIR system that involves in that survey such as ADL (Alexandria Digital Library), CBVQ (Content-Based Visual Query), FIR (Formula Image Retrieval), MARS (Multimedia Analysis and Retrieval System), QBIC (Query By Image Content), WISE (Wavelet Image Search Engine) and others[16].

4. ADVANTAGES AND APPLICATIONS

Advantages:

1. Image retrieving based on content not by Meta data search.

2. Histogram calculation increases accuracy compared to conventional methods.

3. Selection of particular picture with the help of CBIR shows similar image.

Applications of CBIR

There are various possible applications for CBIR technology has been identified. Some of these are mentioned below:

- Investigations: face recognition systems, copyright on the Internet
- Shapes identification: identification of defect and fault in industrial automation.
- Medical diagnosis: Tumours detection, Improve MRI and CT scan Understand ability.
- Journalism, advertising Media, Fashion and graphic design.
- Remote sensing: Various information systems, weather forecast, satellite images.
- Trademark databases, Art galleries, museums and archaeology.
- Architectural and engineering designs.
- Cartography: map making from photographs, synthesis of weather maps.
- Digital Forensics: finger print matching for crime detection.
- Geographical information and remote sensing systems

- Radar engineering: helps in detection and identification of targets.
- Retail catalogs
- Nudity-detection filters
- Textiles Industry

5. CONCLUSIONS

Content Based Image Retrieval System overcomes all the drawbacks of Text based image retrieval system. A query image can be retrieved efficiently from the large database. CBIR System has been used in many applications such as architecture, crime prevention, multimedia, education etc.The experiments achieve good performance and demonstrate the efficiency and robustness of system. This will hopefully advanced the field as new tools and technologies will be developed and performance will increase.

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