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A STUDY OF CONTENT BASED IMAGE RETRIEVAL SYSTEM: OVERVIEW AND APPLICATIONS

Computer Science

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ABSTRACT

The database is a collection of useful information which is stored for future retrieval. This information can be represented in one of the forms like text, number, table, graph, chart, image, audio and video. But in our research we are concerned with the information which is in form of images. Now-a-days with the immense use of internet, a large amount of images are stored in the database on the web. It leads to the need of an efficient retrieval system that retrieves images from these large databases very fast. In this paper we have gone through a comprehensive review and describe the widely used techniques with their pros and cons. This paper represents different image retrieval approaches, applications and image features.

KEYWORDS

image retrieval, TBIR, CBIR, color, texture, shape

1. INTRODUCTION

Presently many recent advances have taken place in the technology, which make it possible to store, manipulate and retrieve large number of images. It has given a raised to the use of content based image retrieval system. CBIR is a technology that helps to efficiently organize images in the database and retrieve them from the database. CBIR uses visual content of an image such as color, texture, shape, spatial layout.

1.1 Image retrieval approaches

Image retrieval technology is broadly classified into two major categories [1]:

1. Text - Based Image retrieval
2. Content - Based Image retrieval

1.1.1 Text Based Image Retrieval

In early 1970s Text Based Image Retrieval system was used to retrieve images from the image database. In Text Based Image Retrieval method images are represented by adding text like keywords, captions or image descriptions in the database. These keywords, captions or image descriptions are stored in the form of attributes as a part of the database. This method is known as textual annotation of images. In user query, user requests for retrieval of image. The image retrieval system asks the user for one or more keywords to organize the search criteria. Then Image Retrieval system performs a matching process based on the similarity of the search criteria to the text annotations given to the images in the database. Images cannot be expressed completely with keywords. If keywords are used to identify images, it will not give the proper output because different users perceive different meanings to the same image. Because the textual annotations are based on language and variations in annotation they impose challenges to Image Retrieval System.

2. Content Based Image Retrieval

Content based image retrieval system was initiated in 1990's to deal with the problems aroused in text based image retrieval. Content Based Image Retrieval System is also known as Query By Image Content (QBIC). CBIR uses visual content of images such as color, texture, shape etc to search and retrieve digital images. In CBIR systems, input is supplied in the form of image and on the basis of matching image attributes the most similar images are retrieved from the database.

The process of CBIR involves following steps [2]:

1) Image acquisition: This is the first stage of any CBIR system. In this stage according to the user's choice desired images are collected.

2) Image preprocessing: Image preprocessing is a set of operations to improve the image in order to increase the chances for the success of other processes. The image is processed to extract the features that describe its components. In the processing stage images are filtered, and normalized. Then image segmentation and object identification is performed.

3) Feature Extraction: Features such as color, texture, shape etc. describe the image content. These features cab further be classified as low-level and high-level features. In this stage visual information is extracted from the image and saved as feature vectors in a feature database.

4) Similarity Matching: The feature vectors stored in the feature database are compared with images stored in image database for measuring similarity. In this stage visually similar image features are measured through similar measure methods. There are different similarity methods like Euclidean distance, Minkowski-Form distance, Histogram Intersection etc.

5) Resultant Retrieved images: In this stage previously stored image information is searched to find matched images from the database. The output of this stage is similar images that have the same or very closest features as of the query image.

6) User interface and feedback: This stage is responsible for displaying outcomes, their ranking, searching through automatic or manual preferences scheme etc.

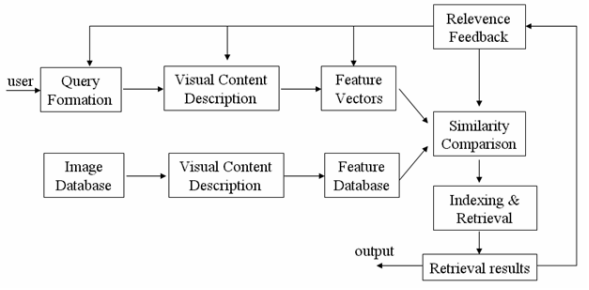

Figure 1.1: Architecture of CBIR system

2.1 Applications of CBIR

Because of the wide use of Internet, the sharing of thousand of millions of images with diverse content has become possible. This diverse content belongs to various fields. These applications of CBIR serve in the various fields such as [3],

- Crime prevention
- The military
- Intellectual property
- Architectural and Engineering Design
- Fashion industry
- Advertising
- Remote sensing system and geographic information system
- Education
- Entertainment
- Art and gallery
- Medical diagnosis
- Web searching

3. Feature Extraction

Feature or content extraction is the basis of Content Based Image Retrieval. These features are the characteristics of image content. Rather than using keywords for representing (identifying) images Content Based Image Retrieval uses visual features such as color, texture, shape, spatial relationship etc. to represent and index image.

3.1 Color feature

Color is a dominant visual content descriptor through which an image can be easily identified. Hence color is the most extensively used visual feature in content based image retrieval system. To extract the color features from the image content, it is necessary to determine appropriate color space and efficient color descriptor. Many kinds of color spaces like RGB, HSV, CIE L*a*b, CIE L*u*v, YIQ, YCbCr, CMY, HIS, YUV etc.. Various types of color descriptors are color histogram, color coherence vector, color correlogram and color moments. Before selecting an efficient color descriptor, color space must be determined first.

3.2 Texture feature

Texture refers to homogeneous visual patterns within the image. Texture includes significant information about the structural arrangement of the surface, like; clouds, leaves, bricks, fabric, etc. It also describes the relationship of the surface to the surrounding environment. In short, it is a feature that describes the distinctive physical composition of a surface. It is an important feature to define the high-level concepts for image retrieval. Various texture properties are Coarseness, Contrast, Directionality, Line-likeness, Regularity and Roughness.

The majority of statistical representations of texture are Co-occurrence Matrix, Tamura's Texture Feature, Markov Random Field Texture Models, Gabor Transform and Wavelet Transform.

3.3 Shape feature

Shape refers to the shape of an image as well as the shape of a particular region of the image. To determine the shape, segmentation and edge detection is applied to an image. But sometimes it requires human involvement for precise shape detection because some methods like segmentation cannot be completely automated. Generally shape features are described after images have been segmented into regions or objects. Since it is difficult to achieve robust and precise image segmentation, shape features are rarely used. Shape features are only used when objects or regions are readily available.

The shape features can be represented as:

- Boundary based: Boundary based shape features are Rectilinear shapes, Polygonal approximation, Finite element models, Fourier Descriptors and Curvature Models.
- Region-based: Region based shape features are Super quadrics, Implicit Polynomials and Blum's skeletons.

4. Related Work

Color is the most widely used visual feature in image retrieval. Rui et al [4] indicate that background complications can be easily handled with color feature and depict that color is independent of image size and orientation. A number of representative studies related to color perception and color spaces are presented in literatures [5] [6].

According to Kiranyaz et al. [7] the color feature of an image can be a powerful feature for the purpose of CBIR, if extracted in a perceptually oriented way and kept semantically intact. Chen and Hao [8] depicted that color space transform is important for color feature extraction and data redundancy reduction. The identification of suitable color space is essential and useful in many color image processing application, such as image display, processing, retrieval, recognition, and compression.
In the early 1990s, when the wavelet transform was initiated and its theoretical framework was established, wavelet transform became more popular and many researchers [9] [10] [11] instigated the use of it in texture representation.

Sanjay T. Gandhe, K. T. Talele and Avinash G. Keskar, [12] place onwards an image mining technique using wavelet transform. The authors presented an image mining approach using wavelet transform. This approach uses common pattern identification and data mining models. They have built a prototype model for identification with DWT + PCA system. It is critical to handle large amount of images and directs to memory management issue. As a result the database should be able to handle images efficiently.

The Fourier descriptor was used the Fourier transformed boundary as the shape feature. To take into account the digitization noise in the image domain, Y. Rui, A. C. She, and T. S. Huang [13] proposed a modified Fourier descriptor which was both robust to noise and invariant to geometric transformations. The moment invariants were used region which was invariant to transformations, as the shape feature.

5. CONCLUSION

In this paper we have introduced different approaches of image retrieval, process of content based image retrieval and applications of content based image retrieval. The content based image retrieval techniques are still in the research phase. This paper introduces some techniques used by other researchers in which color and texture are the widely used features for image retrieval.

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