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A SURVEY ON VARIOUS CONTENT-BASED IMAGE RETRIEVAL TECHNIQUES

SACHIN S. MAHULKAR[1]AND DR. AJAY P. THAKARE[2]
[1]Dept. of Electronics & Telecommunication Engineering,
Sipna College of Engg and Technology, Amravati.India
[2]Professor and Head, Dept. of Electronics & Telecommunication Engineering
Sipna College of Engg and Technology, Amravati.India

Abstract

In the day-to-day world, the Image retrieval from the web by web users plays a key role. This paper work is a review of various references of different image retrieval techniques. This paper starts with discussing the working scenario of text-based image retrieval then the content-based image retrieval, also sketch-based image retrieval. Content-based retrieval of images has become a hot research area. The reason for this is the fact that we need effective and efficient techniques to access large volumes of digital images data according to requirements of users. This paper briefly discusses various features extraction techniques of content-based image retrieval such as texture, color, and the shape and the various algorithms involved in texture image retrieval.

Keywords: Image retrieval, Review, Content-based image retrieval, Texture image retrieval, the Semantic Gap, Feature extraction.

1. INTRODUCTION

We are living in the digital age of information, a digital Renaissance. Image retrieval (IR) has become an important research area in digital world where digital image collections are rapidly being created and made available to large number of users through the World Wide Web. The digital libraries and multimedia databases will consist of heterogeneous types of information including text, audio, image, and video. However, having access to all of the information in the world is pointless without a means to search for it. Image retrieval has been very operational research area as long as from 1970. Content-based image retrieval lies at the crossroads of multiple disciplines such as databases, artificial intelligence, image processing, statistics, computer vision, high-performance computing, and human-computer intelligent interaction. All research bodies study image retrieval from different perspective.

An earlier CBIR system depends on global image features, such as texture statistics and color histogram. Global features cannot record object properties, so local features are recommend for object class recognition. For this reason, higher-level image features are preferred to lower-level ones. Similar image elements, like lines, pixels, and patches can be categorized together to form higher-level units, which are more likely to correspond to objects or object parts. Different types of features can be combined to improve the distinguishable feature. For example, using color and texture to identify sample image animal is more reliable than using color or texture alone. The context information is also helpful for identifying objects. While improving the potential of our system by designing higher-level image features and combining individual ones, to be developed to apply more and more features because a limited number of features cannot satisfy the requirement of recognizing many different objects in general photographic images.

I. IMAGE RETRIEVAL TECHNIQUES

An image retrieval system is one of the compelling research areas which can be used for retrieving, searching and browsing images from a big database of digital images. Most historic and regular methods of image retrieval system apply some method of adding metadata such as keywords, captioning, or descriptions to the images so that retrieval can be performed over the glossary words. In this work, the image retrieval classified mainly as Content-Based Image Retrieval (CBIR), Text-Based Image Retrieval (TBIR), Sketch-Based Image Retrieval (SBIR), Query-based Image Retrieval (QBIR) and Semantic Based Image Retrieval

II. CONTENT BASED IMAGE RETRIEVAL (CBIR)

Content-based means that the search analyzes the contents of the image rather than the metadata such as keywords, tags, 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. 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. Thus a system that can filter images based on their content would provide better indexing and return more accurate results The images are retrieved only through the Texture, Color, Shape in content-based image retrieval. Smeulders et al [4] in which the collection of kinds of literature states the earliest use of the term content-based image retrieval in the literature seems to have been described the experiments into automatic retrieval of images from a database by color and shape feature. The term has since been widely used to describe the process of retrieving desired images from a large collection on the basis of features (such as color, texture, and shape) that can be automatically extracted from the images themselves and the features used for retrieval can be either primitive or semantic, but the extraction process must be predominantly automatic.

Smeulders et al [4] and the Ying Liu [5] and Nikhil et al [6] pointed out the fundamental difference between content-based and text-based retrieval systems are that the human interaction is an indispensable part of the latter system. Humans tend to use high-level features (concepts), such as keywords, text descriptors, to interpret images and measure their similarity.

The semantic gap is the gap between the object in the world and the information in a (computational) description derived from our recording of that scene. The semantic gap is the lack of coincidence between the information that one can extract from the visual data and the interpretation that the same data have for a user in a given situation.

A CBIR system should provide full support in bridging the semantic gap between numerical image features and the Richness of human semantics.

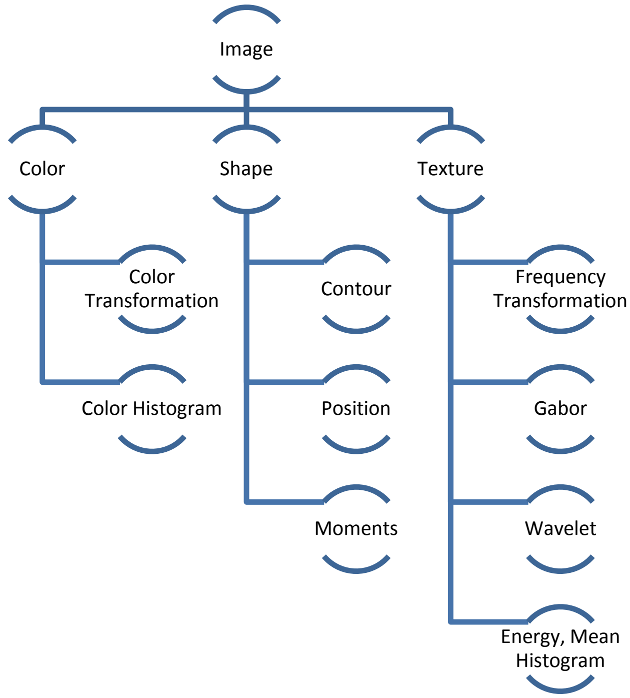

Fig: Features used in CBIR

In Content-Based Image Retrieval schemes we search for images by query by example:

- Select an example image.
- Extract features from the image (color, texture, shapes).
- Locate other images with similar colors, textures, and shapes.
- Match image.

III. FEATURE EXTRACTION IN CBIR

1. Retrieval by Color

Smeulders et al [7] and Arthi et al [8] stated the main components of CBIR are the features which include the Geometric shape, colors and the texture of the image. Schettini et al Features can be of two types of local features and global features. Object recognition can be done easily using the local features.

Chang et al [9] proposed that the image retrieval using the color distribution, mean and the standard deviation and was tested with three different databases. The other component is the relevant feedback where it helps to be more precise in searching the relevant images by taking up the feedbacks of the user.

Kekre et al [10] pointed out that Color feature is one of the most widely used features in image retrieval. Colors are defined on a selected color space. Variety of color spaces are available, they often serve for different applications. Color spaces shown to be closer to human perception and used widely in RBIR which include KMCG, KVE, RGB, KEVR, the hue-min-max-difference and KFCG.

Sun et al [11] proposed a color distribution entropy method, which gives correlation of the color spatial distribution in an image. The color distribution entropy describes how pixel patches of identical color are distributed in an image which is the main difference between color distribution entropy, geo stat, and the spatial chromatic histogram.

Xue et al [12] show unrelated color images and color histogram moment of extraction, and then two methods of extracting color feature vector weighted to achieve similar distance, based on the realization of the characteristics of the color image Retrieval system, similar to the last distance based on the size of the return search results.

Lin et al [13] proposed the three features of color that are coincidence distribution matrix, the difference between pixels of the color histogram and scan pattern for k-mean.

Common color features or descriptors in CBIR systems include, color- covariance matrix, color histogram, color moments, and color coherence vector and has included dominant color, color structure, scalable color as color features, the authors are interested in objects taken from the different point of view and illumination. As the result, a set of viewpoint invariant color features has been computed. The color invariants are constructed on the basis of hue, hue-hue pair and three color features computed from reflection model [14]. Most of those color features though efficient in describing colors, are not directly related to high-level semantics. For convenient mapping of region color to high-level semantic color names, some systems use the average color of all pixels in a region as its color feature. Although most segmentation tends to provide homogeneous color regions, due to the inaccuracy of segmentation, average color could be visually different from that of the original region. A dominant color in HSV space is defined as the perceptual color of a region. To obtain dominant color, the authors first calculate the HSV space color histogram ($10 * 4 * 4$ bins) of a region and select the bin with the maximum size. Then the average HSV value of all the pixels in the selected bin is defined as the dominant color. The selection of color features depends on the segmentation results. For instance, if the segmentation provides objects which do not have homogeneous color, obviously average color is not a good choice. It is stated that for more specific applications such as human face database, domain knowledge can be explored to assign a weight to each pixel in computing the region colors. It should be noted that in most of the CBIR works, the color images are not pre-processed. Since color images are often corrupted with noise due to capturing devices or sensors, it will improve retrieval accuracy significantly if the effective filter is applied to remove the color noise. The pre-processing can be essential especially when the retrieval results are used for human interpretation.

2. Retrieval by Shape

Ying Liu et al [15] pointed out the retrieval images from the large image collections. A fast image retrieval based on object shapes extracted from objects within images. Multiple shapes at the lower level can be mapped into a single shape at a higher level. Given a query shape, by searching only the relevant paths in the hierarchy, large portions of the database can thus be pruned away. An angle mapping used to transform a shape from one level to another higher level. Angle mapping replaces some edges of shape by a smaller number of edges based on the angles between the edges thus reducing the complexity of the original shapes.

Renato et al [16], as using a single color histogram for the whole image, or local color histograms for a fixed number of image cells, the one we propose (named Color Shape) uses a variable number of histograms, depending only on the actual number of colors present in the image and using a large set of heterogeneous images and pre-defined query/answer sets show that the Color Shape approach offers good retrieval quality with relatively low space overhead, outperforming previous approaches.

Jagadish [17] proposed to construct an index structure on the data such that given a template shape, matching shapes can be retrieved in time that is less than linear in the size of the database, that is, by means of an indexed lookup.

3. **Retrieval by Texture**

Texture models can be divided into following classes:

i. Statistical methods: Texture is defined in terms of the spatial distribution of gray values (e.g.. co-occurrence matrices, autocorrelation features). In the early 1970s, Haralick et al.

proposed the co-occurrence matrix representation of texture features. This approach explored the gray level spatial dependence of texture. It first constructed co-occurrence matrix based on the orientation and distance between image pixels and then extracted significant analysis from the matrix as the texture representation.

ii. Filtering methods - spatial and Fourier domain filtering, Gabor filtering and wavelet filtering.

iii. Geometric methods.

iv. Model-based methods (e.g.. random field models and fractals),

M. Kokare et al [18] pointed out a new set of two-dimensional (2-D) rotated complex wavelet filters are developed with complex wavelet filter parameter, which gives texture information strongly oriented in six different directions with 45 apart from complex wavelet transform. The 2-D RCWFs are non-separable and oriented, which improves characterization of oriented textures. Major texture image retrieval methods are still incapable of providing retrieval result with less computational complexity and high retrieval accuracy. To reconized this problem, they suggested a approach for texture image retrieval by using jointly a set of dual-tree rotated complex wavelet filter (DT-RCWF) and dual-tree-complex wavelet transform (DT-CWT), which gives texture features in 12 different directions.

Ying Liu et al [5] and Kekre et al [10] suggested out the texture is the important part of human visual perception and can be promptly used for identifying different image sections. Texture features indicate the shape distribution, better suits the macrostructure and microstructure of the images as compared with color and shape features. Texture representation mechanism can be classified into three categories, namely statistical, structural, and multi-resolution filtering methods. The identification of specific textures in an image is achieved primarily by modeling texture as a two- dimensional gray level variation. This two-dimensional array is called as Gray Level Co-occurrence Matrix (GLCM). GLCM explain the frequency of one gray tone appearing in a specified spatial linear relationship with another gray tone, within the area under investigation.

Zhang et al [19] suggested an image retrieval method on the basis of Gabor filter. Texture features are obtained with calculating the mean and variation of the Gabor filtered image.

Rotation normalization is realized by a circular shift of the feature elements so that all images have the same specific direction. The image indexing and retrieval are conducted on textured images and natural images.

Yossi et al [20] proposed a retrieval method based on the Earth Movers Distance with an appropriate ground distance is shown to handle both complete and partial multi-textured queries. As an illustration, different images of the same type of animal are easily retrieved together. At the same time, animals with subtly different coats, like cheetahs and leopards, are properly distinguished.

IV. TEXT-BASED IMAGE RETRIEVAL (TBIR)

The text-based image retrieval applies the method of adding the metadata, such as captioning, keywords, or descriptions to the images. The retrieval employed over the annotation words and it makes the annotation more complicated and time consuming and also requires extensive manpower lto manually annotate the images. The linguistic content is not considered in TBIR. Dinakaran.D et al [2] suggested an effective and efficient composite image retrieval system by searching text with both text and image-based query. The textual and visual content captions are generated from the text query and image query. The captions are changed into a vector parameter. Similarly, textual and visual captions are determined and transformed into vector representation for the images stored in the database. The vector which is produced by the user query is then equated with the vectors stored in the database. The content-based and text techniques return two autonomous lists of images with different weights and two lists must be combined in a purposeful way to give the user a mixed image list.

Clough et al [1] suggested the cross-language information retrieval method through which the images are captioned and the where the given textual query is preprocessed such as the normalization, removal of stop words and word stemming is used and a document ranking scheme used where captions containing all query terms are ranked and Tobbias [3] suggested the FIRE system which use both the CBIR and Textual based retrieval method combined. An interactive image retrieval mechanism using user title feedback for a text-based approach to collect titles from all the fields which lead to more complication and reflect more possibilities to produce unmatched titles. Instead of assembling the titles from the image database, assemble only from retrieved image sets for the given user query. The caption fields, filename, and the alternate tag other than the user input query terms, have more chances for getting match terms to narrow the search.

V. SKETCH BASED IMAGE RETRIEVAL

Sketch-based image retrieval uses the input as sketches and based on the sketches the relevant images are retrieved and also stated that the sketch-based image retrieval (SBIR) is still a young research area, there are many applications capable of using this retrieval paradigm, such as web searching and pattern detection. They also mentioned a drawing a simple sketch query turns very simple since touchscreen-based technology is being expanded. A generalised approach for SBIR based on detecting simple shapes which are named keyshapes, works as a local strategy, but instead of detecting keypoints, it detects keyshapes over which local descriptors are computed. It is based on keyshapes allow to represent the structure of the objects in an image which could be used to increase the effectiveness of the retrieval task. Indeed, our results show an better development in the retrieval effectiveness with respect to the state of the art. Furthermore, combining the keyshape approach with a bag of feature approach allows achieving significant improvement with respect to the effectiveness of the retrieval task.

VI. SEMANTIC BASED IMAGE RETRIEVAL

Horst et al [21], proposed a method to reduce the semantic gap in the image retrieval techniques and pointed out that semantic feature layers are more than the static descriptors and classified human world features.

Athanasiadis et al [22], pointed out a framework for concurrent image segmentation and object labeling leading to automatic image annotation. Focusing on the semantic analysis of images, it contributes to knowledge-assisted multimedia analysis and bridging the gap between semantics and low-level visual features. The proposed framework operates at semantic level using possible semantic labels, formally represented as fuzzy sets, to make decisions on handling image regions instead of visual features used traditionally. In order to stress its independence of a specific image segmentation approach, we have modified two well-known region growing algorithms, i.e., watershed and recursive shortest spanning tree, and compared them to their traditional counterparts.

Wu et al [23] proposed a framework employs an ontology and MPEG-7 descriptors to deal with problems arising between syntactic representation and semantic retrieval of images. Instead of building a single ontology for a specific domain, the framework allows for the construction of incrementally multiple ontologies, and shares ontology information not only between the image seekers but also between different domains. Naïve Bayesian inference is used to estimate the similarity between query ontology and domain ontology for matching relevant images

CONCLUSION

These papers categorize the various concepts in image retrieval techniques and a collection of 23 papers was studied and various image retrieval techniques and their types and methods are categorized such as the text-based, content-based and the Semantic-based image retrieval.

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