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A Survey on CBIR Features Extraction Techniques

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***Abstract*— The need to find a desired image from large database is shared by many professionals. Because of many problems in text-based image retrieval, the new technology was introduced which is known as Content-Based Image Retrieval. Content-Based Image Retrieval is an active research topic since the last decade. Image retrieval based on low level features like color, texture and shape is wide area of research scope. In this paper, all the methods of color, texture and shape features extraction is described. Researchers can combine any of these methods and can get the highest precision and recall by testing different combinations.**

***Keywords*— CBIR, Content Based Image Retrieval, feature extraction, low lever features.**

I. INTRODUCTION

Image processing has an enormous range of applications and almost every area of science and technology such as medicine, space program, agriculture, industry and law enforcement make use of these methods and one of the key issues with any kind of image processing is image retrieval which is the need to extract useful information from the raw data such as recognizing the presence of particular color or textures before any kind of reasoning about the image's contents is possible [1]. Image retrieval is technique concerned with searching and browsing digital images from database collection. Information Retrieval is very active research since the 1970s [1]. Due to more and more images have been generated in digital form around the world, image retrieval attracts interest among researchers in the fields of image processing, multimedia, digital libraries, remote sensing, astronomy, database applications and other related area [4]. Fast retrieval of images has not always been easy, especially when you are working with thousands of images. An effective image retrieval system needs to operate on the collection of images to retrieve the relevant images based on the query image which conforms as closely as possible to human perception [4].

In text-based image retrieval, images are indexed using keywords, which means keywords are used as retrieval keys during search and retrieval. Text-based retrieval is non-standardized because different users employ different keywords for annotation. Text descriptions are sometimes subjective and incomplete because they cannot depict complicated image features very well [2].

The Content Based Image Retrieval uses image content to search and retrieve digital images from huge database of images. Content-based image retrieval systems were introduced to solve the problems of text-based image retrieval. Content based image retrieval is a set of techniques for retrieving semantically-relevant images from an image database based on automatically-derived image features [2].

Researchers are using Euclidian Distance to compare to images and they are using WANG database, which is sample database, used for testing purpose in Content Based Image Retrieval. WANG consists of 10 categories, if each category has 100 images then WANG database is of 1,000 images and if each category has 1,000 images then WANG database is of 10,000 images. Recently researchers are working on three parameters of CBIR: Precision, Recall and Retrieval Time. Precision is ratio of relevant retrieved images and total retrieved images. Recall is ratio of relevant retrieved images and total relevant images in database. Retrieval time is time taken to retrieve all images.

II. LITERATURE REVIEW

Researchers have proposed different methods to improve the system of image retrieval. Very first they have introduced keyword based image retrieval then they have introduced content based image retrieval. Both of these methods are explained here:

A. *Keyword Based Image Retrieval*

In keyword based image retrieval, images are indexed using keywords, which means keywords are used as retrieval keys during search and retrieval.

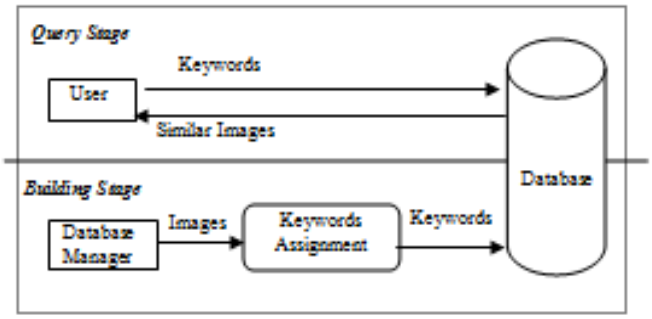

Fig1.General Framework of Keyword Based Image Retrieval [4]

General Framework of keyword based image retrieval is shown in Fig.1. Before images are being stored in the database, they are examined manually and assigned keywords that are most appropriate to describe their contents [4]. Then these keywords are stored in database. During query stage, user will input keyword or keywords which constitute the search criteria. A keyword matching process is then performed to retrieve images associated with the keywords that match the search criteria [4].

B. *Content Based Image Retrieval*

In content based image retrieval, images are indexed using its features like color feature, texture feature and shape feature.

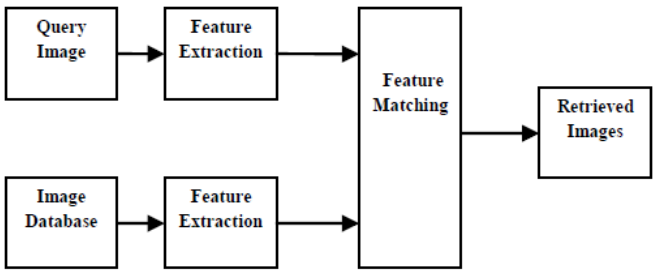

Fig2.General Framework of Content Based Image Retrieval [6]

General Framework of content based image retrieval is shown in Fig.2. Before images are being stored in the database, they are examined and features are extracted from the images. Parameters of these features are stored in database. During query stage, user will input image which constitute the search criteria. Features matching process is then performed to retrieve images associated with the features that match the search criteria.

III. FEATURE EXTRACTION

There are three types' lower level features that can be extracted from the image. That features are color feature, texture feature and shape feature. There are many methods to extract these features. All the methods to extract color feature, texture feature and shape feature are explained here.

A. Color Feature Extraction

Color is a perception that depends on the response of the human visual system to light and the interaction of light with objects [8]. In Content based image retrieval, color is one of the most widely used visual features. The key issues in color feature extraction include the color space, color quantization, and the choice of similarity function [8]. Many methods has been introduced by researchers to extract color feature from the image. Here all the method to extract color feature are explained.

- Color Histogram: The color histogram depicts color feature which cannot capture color distributions or textures within the image. In this method color histogram feature is divided into global and local color extraction. Using Global Color Histogram, an image will be encoded with its color histogram, and the distance between two images will be determined by the distance between their color histograms [6]. Local color histogram gives spatial information. Local color histogram also gives the information related to the color distribution of regions. The first step is to divide the image into segment and then to obtain a color histogram for each block then image will be represented by these histograms. When comparing two images, we calculate the distance, using their histograms, between a region in one image and a region in same location in the other image [6].
- Geometric Moments**:** In image processing, an image moment is ascertain particular weighted average (moment) of the image pixels' intensities, or a function of such moments, usually chosen to have some attractive property or interpretation [6]. Image moments are generally used to describe objects after segmentation. This feature use only one value for the feature vector, which mean that when the image size becomes relatively large, computation of the feature vector takes a large amount of time and the pros of using this feature combine with other features such co-occurrence, which can provide a better result to user [6].
- Color Moments: Color moments are the statistical moments of the probability distributions of colors and have been successfully used in many retrieval systems, especially when the image contains just the object, it means color moment will work best when image has only object. Three parameters are calculated in this method: Mean, Variance and Skewness. Color moments have been proved to be efficient and effective in representing color distributions of images and it suffer from the problem that they fail to encode any of the spatial information surrounding the color within the image [8].
- Color Correlogram: color correlogram is use for encoding the color information of an image. This method incorporates spatial data in the encoded color

information so it avoids a number of the problems of those representations. The color correlogram has the advantages that it includes the spatial correlation of colors, can be used to describe the global distribution of local spatial correlation of colors and is simple to compute [8].

- Color Coherence Vector: It is a split histogram which partitions pixels according to their spatial coherence. Each pixel within the image is partitioned into two types, i.e., coherent or incoherent depend on whether it is part of a larger region of uniform color. Separate histograms can then be produced for both coherent and incoherent pixels thereby including some spatial information in the feature vector and due to its additional spatial information; it has been shown that it provides better retrieval results than the color histogram [8].
- Average RGB: The main purpose of this method is to filter out images with larger distance at early stage. Another reason of choosing this method is that it uses a small number of data to represent the feature vector and it also uses less computation as compared to others methods. However, if this feature is not combined with other features, the accuracies of query result could be significantly impact [6].

B. Texture Feature Extraction

Texture refers to the visual patterns that have properties of homogeneity that do not result from the presence of only a single color or intensity [8]. It is a natural property of virtually all surfaces and it contains important information about the structural arrangement of surfaces. Many methods has been introduced by researchers to extract texture feature from the image. Here all the method to extract texture feature are explained.

- Discrete Wavelet Transform: This method is used to decompose a signal. In this method, we decompose the signal using filter banks. The outputs of filter banks are down sampled, quantized and encoded by the encoders. The decoders are used to decode the coded representations. Take an N×M image then filter each row and then down sample to obtain two N×M/2 images then filter each column and sub sample the filter output to obtain four sub images, the one obtained by low-pass filtering the rows and columns is referred to as the LL image, the one obtained by low – pass filtering the rows and high pass filtering the columns is referred to as the LH image, the one obtained by high-pass filtering the rows and low- pass filtering the columns is called the HL image and the sub image obtained by high-pass filtering the rows and columns is referred to as the HH image and each of the sub-images obtained in this fashion can then be filtered and sub sampled to obtain four more sub images. This process can be continued until the desired subband structure is obtained [10, 12].\
- Gaussian pyramid: It is used to decompose images into information at multiple scales, to extract features and to remove noise from the image. It consists of low-pass filtered, down-sampled version of the previous level of the pyramid, where the base level is defined as the original image [10].
- Fourier transform: In this method, a signal is decomposed into a number of sinusoids of different frequency. The Fast Fourier Transform (FFT) refers to a class of algorithms for efficiently computing the Discrete Fourier Transform (DFT) hence FFT is not an approximation of the DFT, it is the DFT with a reduced number of computations. DFT is most useful in digital signal processing, Convolution and digital filtering [10].
- **Ranklet Transform:** Fourier Transform has been the mainstay of signal transform and it converts a signal from the time domain into the frequency domain to measure the frequency of the signal. In CBIR, FT was used to extract texture features from high-frequency components of the images. But FT could not provide local image features and failed to capture the objects locations in an image. After its revolution, Wavelet Transform was used in CBIR methods due to its efficiency and effectiveness in image analysis and compression. Ranklet Transform belongs to a family of nonparametric, orientation-selective, and multi resolution features and it has been used for pattern recognition and in particular to face detection [14]. Ranklet Transform also has been used in medical fields. Some tests show that Ranklet Transform is better than some methods such as pixel-based and wavelet-based image representations [14]. Ranklet Transform has three main properties. First, it is nonparametric that it is based on nonparametric statistics that deal with a relative order of pixels instead of their intensity values; second, it is orientation selective that it is modeled on Haar wavelets which means that for an image, vertical, horizontal, and diagonal ranklet coefficients are computed and it is multi-resolution that the Ranklet Transform can be calculated at different resolutions using Haar wavelet supports [14].
- Steerable Pyramid: It generates a multi-scale, multi-directional representation of the image. The image is decomposed into low-pass sub-band and high-pass sub-band and decomposition is iterated in the low-pass sub-band and the Steerable Pyramid decomposition is similar to the two-dimensional discrete wavelet transform but with directional sub-bands [10].

C. Shape Feature Extraction

The reason for choosing shape feature for describing an object is because of its inherent properties thus shape of the object has proved to be a promising feature based on which several image classification and retrieval operations can be performed. Unlike

the color and texture features of the object, the shape feature is more effective in semantically characterizing the content of the image [15]. In literature the shape descriptor has been classified into two major kinds, contour based and region based shape descriptors. Contour shape techniques uses only shape boundary information and two types of approaches for contour shape modelling: continuous approach and discrete approach. Continuous approaches do not divide shape into sub-parts; usually a feature vector derived from the integral boundary is used to describe the shape [15]. The region based shape representation technique takes the whole region under consideration, not only boundary information. The region based technique is further classified into two types namely structural and global and some of the global region based techniques are Area, Euler Number, Eccentricity, Geometric Moments, Zernike Moments, Pseudo-Zernike Moments, Legendre Moments, Generic Fourier Descriptor, Grid Method and Shape Matrix while the different structure based techniques are Convex Hull, Media Axis and Core [15]. Many methods has been introduced by researchers to extract shape feature from the image. Here all the method to extract shape feature are explained.

- Fourier Descriptors: They are obtained by applying Fourier transform on shape boundary, the Fourier transformed coefficients are called the Fourier descriptors (FD) of the shape. For good shape description, an appropriate shape signature is essentially required to obtaining FD. The nice properties of FDs are its robustness and easy to derive. With Fourier descriptors, coarse shape features or global shape features are captured by lower order coefficients and the finer shape features are captured by higher order coefficients and Noise is not a problem with Fourier descriptors. With fast Fourier transform (FFT), the computation is efficient [16].
- CSS Descriptors: They are essentially the descriptors of key local shape features. Not only the locations of, but also the degree of concavities of shape boundaries are detected by dealing shape in scale space. These features are very important to human perception in judging the similarity between shapes. The dimension of CSS descriptors is very low. It only captures the local shape features, the global features which are also important to shape representation are missed out from the representation. There may be no CSS descriptors for smooth convex shapes such as polygon composed of straight lines [16].
- Zernike moments: This method allows independent moment invariants to be constructed to an arbitrarily high order. Zernike moments descriptor does not need to know boundary information, making it suitable for more complex shape representation [16]. Zernike moments descriptors can be constructed to arbitrary order like Fourier descriptors, this overcomes the drawback of geometric moments in which higher order moments are difficult to construct[16].

IV. CONCLUSION

After analyzing all the techniques of CBIR, we concluded that only color or texture or shape feature cannot describe image so we are suggesting that researcher should find best method of color feature extraction then best method of texture feature extraction and then best method of shape feature extraction. After finding all best method, combine all method so you can get very good precision as well as best recall.

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