# A Review on Image Retrieval Techniques

M.S. Meharban and Dr.S. Priya

***Abstract***--- *Rapid and explosive growth of digital libraries due to the invention of Web cameras, digital cameras, and mobile phones equipped with such devices is making the database management by human annotation an extremely tedious and clumsy task. Image indexing and retrieval is very important research topic that has gained more attention in the current scenario. So in the present situation content based image retrieval is becoming necessary for exact and fast image retrieval. Content Based Image Retrieval (CBIR) is one of the image retrieval techniques which use visual features of an image such as color, shape, and texture features etc. In this paper presents techniques for extracting low level features, various distance measures for measuring the similarity of image and performance measures.*

***Keywords***--- *CBIR, Color, Shape, Texture*

## I. INTRODUCTION

IN the last decade, there has been a rapid growth of the Internet has enormously increased the number of image collections available. The accretion of these image collections (including art works, satellite and medical imagery) has attracted more and more users in various professional fields for example geography, medicine, architecture, advertising, design, fashion and publishing. Image retrieval system provides a set of images from a collection of images in the database that matches the user's needs in similarity evaluations such as image content similarity, edge, and color similarity. Early image retrieval methods found the desired images by matching keywords that are manually assigned to each image [7][8].

A typical CBIR system, involves two phase indexing and searching phase. In a CBIR system, the low-level image feature descriptor is extracted from an image which later can be employed to index the images in a database. In the searching phase, the image features are derived by the retrieval system from an image submitted by a user (as query image). These features are later utilized for similarity matching on the feature vectors stored in the database. The CBIR system offers an easy way for a user to search a digital image from a large database[1].

In a CBIR system low-level feature descriptor is extracted from an image which later can be employed to index the images in the database. Usually in Content Based Image retrieval systems, we extract the visual contents of the images in the database and describe them as multi-dimensional feature vectors.

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The feature vectors of the images in the database form a feature based database. As opposed to the to the keyword based image retrieval system, CBIR requires an image as the input(query image) to the system, in which a set of retrieved images are returned to meet the user preference in terms of the image content, color, edge and texture. The similarity or distances between the feature vectors of the query example or sketch and those of the images in the database are then evaluated and retrieval is performed with the help of an indexing scheme [11].

The Content Based image retrieval is needed to retrieve images that are more appropriate, along with multiple features for better retrieval accuracy. Generally in a search process using any search engine, which is through text retrieval, which won't be so accurate. So, we have to go for Content Based image retrieval. Content Based Image Retrieval is also known as query by image content (QBIC) and content-based visual information retrieval (CBVIR). Two important issues in Content-Based Image Retrieval (CBIR) are similarity measurements and the representation of the visual features. Image Mining deals with the extraction of knowledge, image data relationship or other patterns that are implicitly stored in images.It uses methods from computer vision, image processing, image retrieval, machine learning and artificial intelligence. Primitive features of an image used to identify and retrieve closely matched images from an image database.

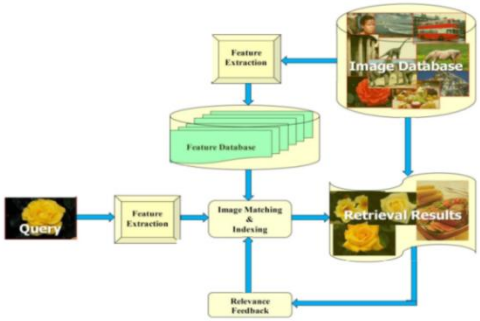


Fig.1: A Typical CBIR System

## II. EXISTING TECHNIQUE FOR FEATURE EXTRACTION

In CBIR systems, a feature is a characteristic that can capture a certain visual property of an image .In feature extraction, features such as color, texture or shape from image are extracted and creates a feature vector for each image.

### *A. Color Feature*

The color distribution of the pixels in an image contains huge amount of information about the image content. The image attribute can be obtained from the image color distribution by employing the color-occurrence matrixcolor space, histogram, moment, and color coherence vector and color structure descriptor. Color space consists of three

dimensional spaces and color is used as a vector in it[15]. Color spaces are required for description of color based retrieval of image. Mostly RGB, HSV, HSI, YCrCb, LAB. Most color images are recorded in the well-known RGB color space.[15].

| Color Feature | Pros | Cons |
|---|---|---|
| Conventional color histogram | Simple, fast computation, invariant to any transformation | No spatial information |
| Color moment | Low complexity | Precision low |
| Fuzzy color histogram | Fast computation. Robust to quantization noise. | More computation |
| Color Correlogram | Encode spatial info | Very slow computation |
| Color Autocorrelogram | Encode spatial info, low complexity | Precision low |
| Color Structure Descriptor | Both color distribution and local structure of the color, Hmmd color space | No spatial information |
| Scalable Color Descriptor | Simple, fast, Hsv color space | No spatial information |
| Color Co-occurrence Feature | Include spatial info, low complexity, high speed, reduce the feature dimensionality | Codebook needed |
| Color Coherence Vector | Include spatial information | Complexity high |

Fig. 2: Color Feature Extraction Methods

### *B. Texture Feature*

Texture refers to the visual patterns that have properties of uniformity that do not result from the presence of only one color or intensity. It is Fourier transformed boundary as the shape feature. The Moment invariants are to use region-based moments, which are invariant to transformations as the shape feature [8].

| Texture Feature | Pros | Cons |
|---|---|---|
| Tamura feature | Effective retrieval | Highly complex |
| Wavelet filter | Detect different frequency and orientation | Precision low |
| Gray level co-occurrence matrix | Including position of pixels having similar gray level values. | High dimensionality |
| Gabor filter | High retrieval | Computation expensive |
| Steerable pyramid | Support any no of orientation | Storage space is high |
| Edge histogram descriptor | Computation easy | Retrieval result poor |
| Gabor moment | Low dimensionality | Computation expensive |
| Bit Pattern feature | Low complexity, high precision, capture edge visual pattern, texture information | Codebook needed |
| LBP,LTP,LTRP | Best feature for texture retrieval | Only suitable for gray scale image |

Fig. 3: Texture Feature

## III. Similarity Distance Measures

The main step of the image retrieval task (as well as in image classification) is in the similarity distance Computation for the nearest neighbor searching, in which the similarity degree between two images is measured. The similarity distance computation plays a major role in the image retrieval system. Image retrieval performance is dependent on the specific distance metric chosen by a user. Image matching among two images (the query image and target image in database) can be performed by evaluating the similarity distance between their feature descriptor. If the system completes similarity distance computation it returns a set of image based on the increasing order of the similarity distance score. Lower score on similarity distance signifies more degree similarity between two images and vice versa. The similarity distance between the two images i.e. the query and target image, can be defined under various distance metric as follows [10].

Let the query feature vector represented by Q and the database feature vector by D. The various distance measures are described below.

- Sum of absolute difference (SAD): SAD is simple method to search for similar image in the database to the query image automatically. Main limitation are Sensitive towards the consequence of background issues of image such us variation in color, size, illumination.

$$D= \sum_{i=1}^{n} |Qi| - |Di| \quad (1)$$

- Euclidian distance (L2): Commonly used for similarity measurement because of its efficiency and effectiveness. Most expensive operation is the computation of square root.

$$D = \sqrt{\sum_{i=1}^{n} (|Q_i} - D_i|)^2 \quad (2)$$

- City block distance(L1) or Manhattan distance: Distance function computationally less expensive because only the absolute difference in each feature consider give large value for the two similar image which create dissimilarity between similar image.

$$D=\sum_{i=1}^{n} |Q_i - D_i| \quad (3)$$

- Canberra distance: Each feature pair difference is normalized by dividing it by sum of a pair of features. Distance matric not robust to outliers

$$D=\sum_{i=1}^{n} |Q_i - D_i|/|Q_i|+|D_i| \quad (4)$$

- Chebychev or L∞ Or Maximum value distance: This matric is used to get the largest value of absolute difference of paired features of feature vector more emphasis on the features

$$D =\max \{|Q1-D1|,|Q2-D2|,\ldots|Qn-Dn|\} (5)$$

## IV. Realated Works

Image retrieval operated in to two domains

1. Pixel domain
2. Compressed domain

Images are generally stored in compressed format so as to reduce storage and bandwidth requirements. In the pixel domain approach for feature extraction first we need to decompress the image. Another method is to perform image retrieval directly in the compressed domain and hence allow faster feature extraction [11], [3].

Because most images appearing on the World Wide Web are compressed in compressed format at source, techniques for handling these compressed images directly in their compressed domain has become increasingly important for a range of applications and digital enterprise sectors [9].Image feature is constructed from in DCT domain in which the JPEG standard compression is involved to generate the image feature.As a matter of fact, the JPEG compression standard is widely used which accounts for more than 95 % of all images on the Web [3]. The CBIR system which extracts an image feature descriptor from the compressed data stream has become an important issue. Since most of the images are recorded in the storage device in compressed format for reducing the storage space requirement .The feature extractor simply generates an image feature for the CBIR task from the compressed data stream without performing decoding**.**

CBIR using multi resolution color and texture feature as its color feature, color auto correlogram in HSV color space are sed. As it texture features, GLCM in wavelet domain. Minkowski-form distance matching criteria, retrieval performance good but they exists semantic gap [10].

A User-Oriented Image Retrieval System Based on Interactive Genetic algorithm Color attributes like color moment. Edge histogram of an image is also considered as the texture features. To reduce the gap between the retrieval results and the users' expectation, computational complexity high Semantic gap is reduced [14].

Another approach to index color images is using feature extracted from the error diffusion block truncation coding. A feature descriptor obtained from a color image is constructed from the EDBTC encoded data (two representative quantizer and its bitmap image) by incorporating the Vector Quantization(VQ).The CHF effectively estimates the color distribution within an image, while the BHF characterizes the image edge and texture[6].

A new way to index a color image by exploiting the low complexity of the Ordered Dither Block Truncation Coding for generating the image features. Image content descriptor is directly constructed from two ODBTC quantizers and the corresponding bitmap image without performing decoding process. The color-occurrence feature derived from the ODBTC quantizer captures the color distribution and image contrast in block based manner, while bit pattern feature characterizes image edge and visual pattern.

A new application of a well-studied image coding technique, namely block truncation coding (BTC).Two image content description image features directly derived from the compressed stream have been developed. They use BCCM and BPH to compute the similarity measures of images for content-based image retrieval applications[11].

## V. CBIR Application and Challenges

### *A. Application*

- Content based tile retrieval system: The computer-aided tile consulting system retrieve tiles from digital tile catalog, so that the retrieved tiles have similar pattern and color to the query tile as possible. During browsing of digital tile catalogue, the system can offer another tile that you may like based on similar color or pattern which would be integrated in to an internet tile shop.
- Medical Diagnosis: Content Based Image Retrieval (CBIR) system retrieve brain images from that database which are similar to the query image. The goal of diagnostic medical image retrieval is to provide diagnostic support by displaying relevant past cases, along with proven pathologies as ground truth.
- Crime Prevention: Collect finger prints, shoe prints, hair pattern and face image stored in the database. Whenever a serious crime is committed they can compare evidence from the scene of the crime for its similarity to records in their database.

### *B. Challenges*

The implementation of CBIR system raises several research challenges, such us

- 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. Relevance feedback is a powerful technique in order to improve the performance. It allows reducing semantic gap between low level feature and high level semantics. Relevance feedback method iteratively refines and updates the retrieved result by learning the user-labeled examples (as relevant or irrelevant image set) to further improve the overall retrieval performance.
- How to retrieve images efficiently
- Size of the image database
- Time complexity for feature extraction

## VI. Performance Measure

The successfulness of the image retrieval system is measured with the precision, recall, and average retrieval rate. These value indicate the percentage of relevant image returned by a CBIR system with a specific number of retrieved image. If the precision and recall is high the retrieval performance is also high. Precision and recall can be calculated by using equation 6 and 7.

$$\text{Precision} = \text{No of relevant image retrieved/Total no of image retrieved} \quad (6)$$

$$\text{Recal} = \text{No of relevant image retrieved/Total no of relevant image in database} \quad (7)$$

The other metrics employed to measure the retrieval performance is the ARR (average retrieval rate) and APR (average precision rate) value which can be formally defined as, where the |DB| denotes the total number of image in the database.

$$\text{ARR}=\frac{1}{|DB|}\sum_{i=1}^{|DB|} Recall \quad (8)$$

$$\text{APR}=\frac{1}{|DB|}\sum_{q=1}^{Nt} Precision \quad (9)$$

## VII. Conclusion

The various methodologies used for extracting the low level features such us color, texture, shape features have been explored in this paper. Various distance measures to find the similarity between images has also been reviewed. This paper cover theory and practical application for CBIR technique. To achieve higher retrieval accuracy, color and texture features are combined together in to the indexing scheme with the other color spaces such as YCbCr, hue-saturation-intensity and lab. Relevance feedback tries to reduce the semantic gap. Image retrieval finds many application such as like medical diagnosis, crime prevention, and fingerprint and iris recognition.

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