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Review Paper on Content Based Image Retrieval

Aditi Giri

M. Tech Scholar, Computer Science & Engineering, Banasthali University, Rajasthan, India

Yogesh Kumar Meena

Assistant Professor, Computer Science & Engineering, MNIT Jaipur, Rajasthan, India

Abstract:

More development of multimedia technology and the rapidly increasing image collections on the Internet have involved important research efforts in providing tools for effective image retrieval, storage and access of image. This paper provides the survey of technical achievements in the research area of image retrieval. A survey is done on the different methods of content based image retrieval for the color, texture and shape. In this paper, the basic components of content-based image retrieval system are introduced. Content Based Image retrieval (CBIR) is the process of retrieving and displaying relevant images from a image database on the basis of its visual content (color, texture and shape). Traditional text based image retrieval (TBIR) doesn't meet the users demand and the need for CBIR development arose due to the enormous increase in image database sizes. This paper reviews the feature extraction methods, which has become one of the key factor in CBIR.

Key words: Image retrieval, Content Based Image retrieval (CBIR)

1. Introduction

Images are presented in computers as a matrix of pixels. They have finite area. By decreasing the pixel dimension the pixel brightness will become close to the real brightness. A representation of a real object or scene is an image. By the development of the internet and image capturing devices such as digital cameras, huge amounts of images are being created every day in many different areas including fashion, remote sensing, medicine, crime prevention, publishing, architecture, etc. During this epoch the world is developing very fast because of internet, so we need to develop effective and efficient methodologies to manage large image databases for image retrieval.

Image processing is a technique where application involves a human being in the visual loop. In other words the images are to be examined and acted upon by people. Information Retrieval is the field of knowledge that deals with the representation, storage, and access to information items. When the retrieved information is a collection of images, this field of knowledge is called Image Retrieval. There are many general purpose image retrieval systems, some of them are given below [4]:

In Text-based Image Retrieval approach to search and retrieve images from the database metadata such as keywords are used. Different users can use different keywords for annotations so that this approach is not considered as valid. This method cannot specify complicated image features perfectly so it can be subjective and incomplete. Additionally, it requires to individually describing every image in the database by human. This is monotonous for very large image databases. To overcome drawbacks of text based image retrieval content based image retrieval approach was adopted.

In Content Based Image Retrieval is also called Visual Image retrieval. Content-based retrieval uses the contents of images to represent and access the images. Content basically refers to low level features like color, texture, shape and spatial information of the image. Because of unique properties of these features are used for content based image retrieval. These features are objective as well as can be easily derived from the image without the need of any external knowledge base.

The rest of the paper is organized as follows. In Section

2 present an literature Survey. Section 3 contains a description of the content based image retrieval methodologies. Performance evaluation of CBIR System is given in Section 4. Conclusion is given in section 5.

2. Literature Survey

Literature Survey covers the background material and prior research work relevant to CBIR.

Hiremath *et al.* [12] have proposed a method for salient point's identification on the basis of color saliency. The color and texture data close to these salient points of concern act as the local descriptors of the image. The combination of the local color, texture and the global shape features gives a strong feature set for image retrieval. The experimental results have demonstrated the effectiveness of the method.

Nandagopalan *et al.* [13] have proposed an creative method for extensive image retrieval on the basis of semantic elements. The method has used a combination of three feature extraction approaches namely color, texture, and edge histogram descriptor.

Pareesh Marwaha *et al.* [14] have presented a basic model for content-based retrieval (CBR) of image data. The CBR technique is extremely effective and efficient than the conventional keyword search. The CBR method provides more correct results in less time.

Trojacanec *et al.* [15] have proposed two-level CBIR architecture. Their proposed upgrading of the two-level architecture was projected to enhance the accuracy of the retrieval results.

Digital images databases however, open the way to content-based searching [16] Multimedia information retrieval as a large research area covering audio, video, text and image analysis has been widely surveyed Local features based methods proved good results [17]. The indexing scheme to be efficient for searching image in the image database, this scheme make content based image retrieval system more successful. Users' relevance feedback has integrated in recent retrieval systems to modify the retrieval process and to generate semantically and perceptually more meaningful retrieval results.

Author	Year	Methods
Singha Hemachandran	2012	Wavelet Based Color Histogram Image Retrieval
Abduljawad A. Amory, Rachid Sammouda, Hassan Mathkour, Rami Mohammad Jomaa	2012	Histogram of each cluster into Gaussian distribution the mean, variance and skewness are computed K-mean clustering algorithm
Rajshree S. Dubey, Rajnish Choubey, Joy Bhattacharjee	2010	Color Histogram, Color Moment, Texture and Edge Histogram Descriptor
Aly S. Abdelrahim, Mostafa A. Abdelrahman, Ali Mahmoud, and Aly A. Farag	2011	Image abstraction techniques, image retrieval method based on binary signature.
Liang Lei, Tongqing Wang, Jun Peng, Bo Yang	2011	Intrinsic Dimension based on HSV Feature, Similarity Measures Based on Shannon Entropy
M. Narayana and Subhash Kulkarni	2013	Edge Histogram Descriptor (EHD) and Color and Color Co-occurrence Matrix (CCM),GLCM
Amandeep Khokher , Rajneesh Talwar	2012	Color, Texture and Shape methods
Meenakshi Madugunki	2011	Global color histogram, Local Color histogram, HSV method, discrete wavelet transform (DWT) for Texture Feature extraction
Gwenole Quellec et.al.	2010	A novel method to adapt a multi dimensional wavelet filter bank
Nhu-Van Nguyen et.al	2010	Clustering and Image Mining Technique
Zhang Xu-bo et.al.	2010	K-means clustering and relevance feedback
Lijun Zhao et.al.	2010	Multi-round relevance feedback (RF) strategy based on both support vector machine (SVM) and feature similarity to reduce the gap
Sharadh Ramaswamy et.al	2009	Clustering-based indexing technique

Table 1: Survey on recent researches on implementation of CBIR

The literature survey is concluded that a wide variety of CBIR algorithms and techniques have been proposed in many different papers. To better capture user's intention selection of image feature is one of the important aspects of Image Retrieval System. It will display the images from image database which are the more relevant to user.

3. Content Based Image Retrieval

Content Based Image Retrieval is the image retrieval system which retrieves images that are based on visual features such as colour, texture and shape [1]. Reasons for content based image retrieval development are that in many large image databases, traditional methods (such as, text based image retrieval) of image indexing have verified to be inadequate, difficult, and extremely time consuming. These old methods of image indexing, ranging from storing an image in the database and associating it with a number or keyword, to associating it with a categorized description, have become archaic. In CBIR, each image which is stored in the database has its features that are extracted and compared to the features of the query image. Content based image retrieval approach has following structure to retrieve image form image database [1].

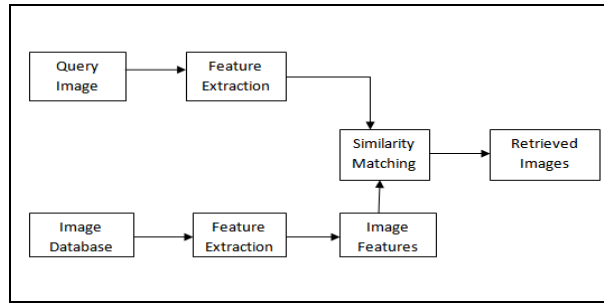


Figure 1: Block Diagram of CBIR

3.1. Collection of Database

A database containing no. of images with any one of the formats .bmp, .jpg, .jpeg, .tiff, .png is required.

3.2. Query

The user provides an image as the query for the system.

3.3. Feature Extraction

There are various kinds of low-level visual features to represent an image, such as color, texture, shape, and spatial relationship. While one type of features can only represent part of the image properties, a lot of work done on the integration of these image features. Details about all the features are given below [2]:

3.3.1. Color

Color is the feature of content based image retrieval systems for retrieve image. Color space is used to represent color images. The RGB space where the gray level intensity is represented as the sum of red, green and blue gray level intensities. Wide variety of color spaces includes, RGB, HSI, LUV, YCrCb, HSV (HSL) and the hue min-max-difference (HMMD). Common color features or descriptors in CBIR systems include, color-covariance matrix, color histogram, color moments and color coherence vector. The Color Structure Descriptor (CSD) [9] represents an image by both the color distribution of the image or image region and the local structure of the color.

3.3.2. Texture

The texture feature is another type of important and useful visual feature for image retrieval. There exist many different approaches to represent and extract textures. To capture image texture information directional features are extracted. The six visual texture properties were coarseness, contrast, directionality, regularity, linelikeness and roughness [7]. Two classes of texture representation method can be distinguished:

- Statistical methods which include the popular co-occurrence matrix, Tamura feature, Multi-resolution filtering technique such as Gabor and wavelet transform, characterize the texture by statistical distribution of the image intensity.
- Spectral approach include Fourier transform of an image that gives texture description and then group the transformed data in a way that it gives some set of measurements.

3.3.3. Shape

Shape is also one of the most important feature of an image. Generally the shape feature is divided into two categories, region-based and boundary-based. The mostly used representation for these two categories are Fourier descriptor [5] and moment invariants.

- Fourier descriptor: The Fourier descriptor is to use the Fourier transformed boundary as the shape feature.
- Moment invariants: The Moment invariants is to use region-based moments, which are invariant to transformations as the shape feature.

Features	Feature Extraction Methods to Extract Image
Color	Color Histogram, Color Moments, Color-Covariance matrix, Color Coherence Vector, Color Correlation, Color Structure Descriptor
Texture	Co-occurrence matrix, Tamura Feature, Gabor Transform, Wavelet Transform and Fourier Transform
Shape	Segmentation, Edge Detection, Fourier Descriptor and Moment Invariants

Table 2. Commonly used feature extraction method in Content Based Image Retrieval

3.4 Similarity Matching

This step involves matching these features to give a result that is visually similar. To find the similarities between query image and the images in the database distance between two images is used. The proposed method used the Euclidean distance between the two feature vectors of the images. The distance can be calculated by the following formula:

$$d(P, Q) = \sqrt{\sum_{i=1}^n (p_i - q_i)^2} \quad [1]$$

Where,

$P = (p_1, p_2, \dots, p_n)$

$Q = (q_1, q_2, \dots, q_n)$

P, Q are two points in n dimensional space.

3.5. Relevant Image Retrieve

The System retrieves and presents a sequence of images. Images are ranked in decreasing order of similarity or minimum distances are returned to the user.

4. Performance Evaluation of CBIR Systems

An important aspect in content-based image retrieval is evaluation of retrieval performance. From generic information retrieval systems many performance measures are adapted. Precision and recall are the most common evaluation measures used in information retrieval, and are defined as follows [6] [7]:

Where,

$$\text{Precision} = \frac{\text{No of relevance image retrieved}}{\text{Total no of images retrieved on the screen}}$$

$$\text{Recall} = \frac{\text{No of relevance Images Retrieved}}{\text{Total no of relevant images in the database}}$$

5. Conclusion

As conclusion, this paper provides literature survey and techniques of content based image retrieval. Many variety researches have been made on content based image retrieval. Each work has its own contribution, technique and limitations. As a review paper, it might not include each and every aspect of content based image retrieval works. This paper gives detailed review of the most common traditional and modern image retrieval systems from early text based image retrieval systems to content based image retrieval. This paper review content based image retrieval works mainly based on the methods/approaches which is used for efficient image retrieval system with the limitations/challenges. In this paper we survey some technical aspects of current content-based image retrieval systems.

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