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CONTENT BASED IMAGE RETRIEVAL A REVIEW

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Abstract: - Content Based Image Retrieval (CBIR) is an application of computer vision to the problem of image retrieval. The term "Content" might refer to the features such as color, texture, shape etc. Almost all of the CBIR systems utilize query by example wherein the user provides the query image to the system. The system then extracts the features of the query image, searches the database of images for similar images and exhibits the related images to the user in order of the similarity. Potential uses of CBIR include Architectural and engineering design, art collections, crime prevention, geographical information and remote sensing systems, intellectual property, medical diagnosis, military, photograph archives, retail catalogues, nudity-detection filters, face finding, textiles industry etc. Various techniques have been developed in the field of image retrieval like Relevance Feedback, Support Vector Machine, Gray Level Co-Occurrence Matrix, Gabor filter technique etc.

Keywords: Content based Image Retrieval (CBIR), Image Retrieval, Color, Texture, shape.

1. Introduction

The advancement in technology and development of highly economical devices for capturing, storing and transmitting images, have led to the creation of huge image libraries. This has been more complex with the increased use of World Wide Web. Technology is improving with time and the usage of digital images is increasing in various fields like engineering, science, geography, history, architecture, advertising, design, publishing, fashion and medicine. So the retrieval mechanism and processing of the desired image from a large database of images has become important. For many years researchers have been working on image retrieval processes. There are two methods which are used for image retrieval. These are: Text based image retrieval and Content based image retrieval. Text-based Image Retrieval employs text as the primary means to represent and retrieve images from large databases. Images are stored along with keywords entered by a user that reflects in a relatively broad manner the content of the image. Text-based image retrieval systems are easy to implement and are relatively fast in computation. But there exist some drawbacks such as manual annotation was not always available in case of large volume of images and was not much accurate. Moreover it was also very subjective. Another drawback was that there are no fixed set of words that would describe the image content according to what the user was searching. Thus the problems with traditional methods of image retrieval like text based image retrieval have led to the rise of interest in techniques for retrieving images on the

basis of automatically-derived features such as color, texture and shape – a technology now generally referred to as Content-Based Image Retrieval (CBIR).

The rest of the paper is organized as follows: Section 2 describes the fundamental aspects of CBIR. The related work is presented in Section 3. The techniques that have been proposed so far are discussed in Section 4. The conclusion has been given in Section 5.

2. Fundamental aspects of CBIR

The term CBIR originated in 1992, when it was first used by T. Kato to describe experiments into automatic retrieval of images from a large database, based on the shapes and colors present. Since then, this term has been used to describe the process of retrieving desired images. The more realistic approach was taken by Swain and Ballard [17] in 1991 by working with simple low level features such as the color histograms. Thus a need was felt for developing efficient CBIR system due to increasing number of applications. Another important factor which led to its ever growing demand was to find a desired image from a large collection which was shared by many professional groups, including art historians, design engineers and journalists. Content-Based Image Retrieval (CBIR) system is therefore a technique for retrieving images on the basis of automatically derived features such as color, texture and shape. The basic block diagram of CBIR system is as shown in Figure 1.

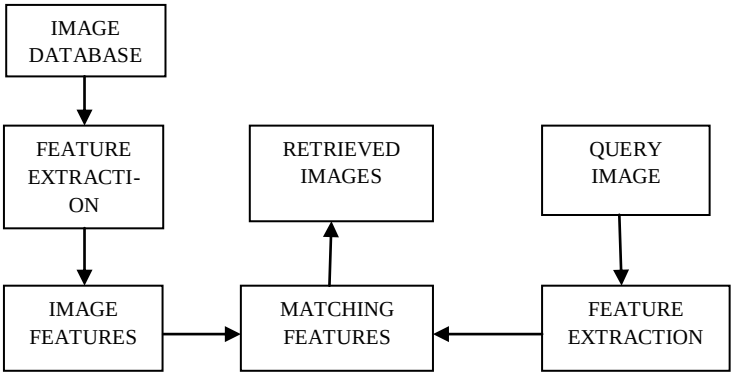


Figure 1: Block diagram of CBIR system.

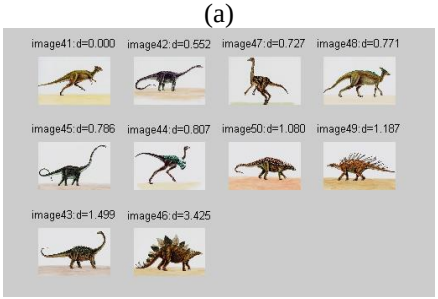
An efficient CBIR system requires a database of images. Image Database is required for searching relevant images as per the user demand or query. In feature extraction block, a feature vector from each image in the database is extracted and then set of all feature vectors is organized as a database index and stored in the Image Features block. At query time, a feature vector is extracted from the query image and is given for matching to the system. Finally the matching of the feature vectors of query image and the images in the database is done.

CBIR system can be implemented to achieve higher efficiency. Content-based image retrieval utilizes representations of features that are automatically extracted from the images themselves. Image queries can be classified into three levels of abstraction: logical features such as identity of objects shown, abstract attributes such as the significance of the scenes depicted and primitive features such as color, texture or shape. In this paper the primitive features have been discussed in further sections.

Content-based image retrieval system uses the visual contents of an image such as texture, color, shape, and spatial layout to represent the image. In typical CBIR systems, the visual content of the images in the database are extracted and are described by multi-dimensional feature vectors. The feature vectors of images in the database form a feature database. To retrieve the images, users provide the retrieval system with example images. The system then changes these examples into its internal representation of feature vectors and compare the query image with the stored images. Therefore a typical CBIR system performs two major tasks. The first one is feature extraction where set of features called feature vectors are derived from the query image and the images in the database. The second one is similarity measurement where distance between a query image and the image in the database is calculated. Almost all of the current CBIR systems use query-by-example, a technique in which an image (or part of an image) is selected by the user as the query. The system extracts the feature of the query image, searches the database for images with similar features, and exhibits relevant images to the user in order of similarity to the query given by the user. An example has been shown in fig. 2 describing

the results of CBIR system. An example of query image has been shown in Figure 2.(a) and the retrieved images have been shown in Figure 2.(b).

(a)



(b)

Figure 2: Different image retrieval results for the same query image: (a) query image (b) retrieved images.

3. RELATED WORK

Swati Aggarwal et al. [1] in "Content Based Image Retrieval using Color Edge Detection and Discrete Wavelet Transform" proposed a novel approach for Content Based Image Retrieval which combined the color and shape features. The proposed algorithm used color edge detection technique and wavelet- based feature extraction technique. The proposed approach extracted the edges from Y matrix of YCbCr (The Y in YCbCr denotes the luminance component and Cb and Cr represent the chrominance components) using Canny edge detection technique and the RGB histogram was computed as global statistical descriptor that represented the distribution of colors in an image. Manhattan distance was used as a similarity measure to detect the final image rank.

Yuhan Wang et al. [2] in "A Comparison of Content Based Image Retrieval Systems" analyzed and compared the performance of two kinds of retrieval systems: Multimedia Video Indexing and Retrieval System (MUVIS) and Query-By-Semantic-Example (QBSE). They conducted experiments on these two real typical content-based image retrieval systems: MUVIS (visual content based), and QBSE (semantic content based), and compared their performance by using precision-recall measure.

Zhiyong Zeng et al. [3] in "A Novel Image Representation And Learning Method Using SVM For Region-Based Image Retrieval" conducted semantic similar region retrieval by using a small number of features and machine learning method for the efficient image database indexing. To achieve this goal, authors characterized the color content of an image by exploiting region Legendre color distribution moments (RLCDM) directive from color space for which there was no need to construct color histogram and also the color space was not quantized into histogram bins. Meanwhile, they also incorporated texture descriptor and shape descriptor into RLCDM to work together to reduce the occurrence of false positive and to more precisely capture image semantic concepts. In addition, they also considered SVM with a generalized kernel for relevance feedback tool to meet the requirements of region-based image retrieval using variable length representations.

Snehal Mahajan et al. [4] in "Image Retrieval Using Contribution-based Clustering Algorithm with Different Feature Extraction Techniques" proposed different feature extraction techniques with contribution based clustering algorithm to retrieve the similar images from database. The techniques they used were RGB color histogram, RGB color histogram with Canny edge detection and local binary pattern (LBP). The LBP operator was used to calculate texture features. Experimental results were tested on the test dataset of about 771 images from the Washington University database. Euclidean distance method was used for the similarity measurement of query image and database image.

Roshi Choudhary et al. [5] in "An Integrated Approach to Content Based Image Retrieval" proposed a content based image retrieval integrated technique which extracted both the color and texture feature. To extract the color feature, color moment (CM) was used on color images and to extract the texture feature, local binary pattern (LBP) was performed on the grayscale image. Then both the color and texture features of image were combined to form a single feature vector. In the end similarity matching was performed by Euclidian distance which compared feature vector of database images with query images.

A.Bhagyalakshmi et al. [6] in "A Survey on Content Based Image Retrieval Using Various Operators" focused on different features descriptors for image retrieval and analyzed various retrieval operators like Local Binary patterns (LBP), Local Ternary patterns (LTP), Local Derivative Patterns (LDP) and Local Tetra patterns (LTP) using high level features to improve the performance and accuracy in CBIR system. The authors also presented a review on main CBIR components including low level descriptors for feature extraction such as color, texture, shape and various image retrieval methods using local binary operators.

4. EXISTING TECHNIQUES

The different techniques that have been proposed for color, texture and shape are discussed below:

A) Color based CBIR techniques

Color is regarded as one of the most expressive visual feature and it is widely used feature in content based image retrieval. Color is relatively robust to background complications and independent of image size and orientation. The conventional methods of color retrieval include color histograms [4], color correlogram, dominant color descriptor (DCD), color coherence vector (CCV) [14], Weighted average [15] etc. The color indexing work of Swain and Ballard [17] was based on color histograms. Color moments have also been successfully used in content based image retrieval systems [5].

B) Texture based CBIR techniques

Like color, texture is also an important low-level feature that describes the surface properties of an object and their relation to the surrounding environment. Texture is highly used for image search and retrieval applications. In conventional texture features used for CBIR, there are statistic texture features using gray-level co-occurrence matrix (GLCM) [10], Markov random field (MRF) model, simultaneous auto-regressive (SAR) model, Local Binary Pattern (LBP) [4], edge histogram descriptor (EHD), Gabor filter etc. Other techniques like BDIP (block difference of inverse probabilities) and BVLC (block variation of local correlation coefficients) features [7] have also been proposed which effectively measure local brightness variations and local texture smoothness, respectively. The common known texture descriptors are Wavelet Transform [9], Gabor-filters [8], co-occurrence matrices [10] and Tamura features [12], Gabor wavelets [13].

C) Shape based CBIR techniques

Shape is one of the basic features used to describe image content. Shape description or representation is an important issue both in object recognition and classification. Shape features are described and represented by two classes namely Region based methods and boundary based [6] also called as Contour based methods. A shape can be described by different aspects. These shape parameters are Mass, Center of gravity (Centroid), Mean, Variance, Dispersion, Axis of least inertia, Digital bending energy, Eccentricity, Circularity ratio, Elliptic variance, Rectangularity, Convexity, Solidity, Euler number, Profiles, Hole area ratio etc. Many techniques, including chain code, polygonal approximations [11], curvature, Fourier descriptors and moment descriptors [11], gradient method [16] for shape feature have been proposed and used in various applications.

5. CONCLUSION

The increased use of images in many applications has stirred the development of highly efficient and effective image retrieval systems. This led to the development of content based image retrieval system i.e. CBIR. CBIR would retrieve images on the basis of visual content of the image like color, texture, shape etc. rather than textual annotation. The desirable features of CBIR system include reducing the retrieval time and increasing the efficiency of the system. Thus a system needs to be developed that can automatically extract relevant objects from a huge dataset.

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A Brief Author Biography

Supreet Sidhu- Supreet Sidhu was born on 4th June, 1990 and completed her graduation in Electronics & Communication Engineering in 2013 from Giani Zail Singh Punjab Technical University Campus, Bathinda (Punjab). Presently she is doing her M. Tech. (Electronics & Communication Engineering) in the same campus. Her research interests focus on image processing. She is presently working in the field of image retrieval.

Dr. Jyoti Saxena – Jyoti Saxena did B.Sc Engineering (Electronics and Communication Engineering) with Honours in 1983, M. Tech (Electronics and Communication Engineering) with distinction in 1988 from Regional Engineering College, Kurukshetra (Now National Institute of Technology, Kurukshetra) and PhD from University School of Information Technology, GGS Indraprastha University, Delhi. Presently, she is working as Professor and Head in the department of Electronics and Communication Engineering at Giani Zail Singh Punjab Technical University Campus, Bathinda (Punjab). Prior to this, she worked at Regional Engineering College, Hamirpur (Now NIT, Hamirpur) and Regional Engineering College, Kurukshetra (Now NIT, Kurukshetra). Her teaching and research interests include soft computing, Signal Processing and Communication systems. She is a life member of Indian Society for Technical Education and Institution of Engineers. She has guided many M.Tech. Projects and Thesis and has more than 40 publications in national/international journals and conferences.