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A SURVEY ON CONTENT BASED IMAGE RETRIEVAL (CBIR) SCHEMES

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ABSTRACT

In present innovation the securing, transmission, storing and control are permitted on the huge accumulations of images.With the build in ubiquity of the system and improvement of interactive multimedia innovations, clients are not fulfilled by the conventional data recovery procedures. So these days, the content based image retrieval (CBIR) is turning into a wellspring of accurate and fast retrieval.This paper gives an overview of the currentlyavailable literature on content based image retrieval.Here most mainstream algorithms of feature extraction and pertinence feedback that attempt to bridge extracted low level features and features with high level semantics gap from image are talked about.

Keywords: CBIR, Image Retrieval, Feature Extraction.

INTRODUCTION

The use of images in human communication is not a new concept, our cave-dwelling ancestors painted pictures on the walls of their caves, usage of maps and building plans for delivering information is almost certainly dates back to pre-Roman times. However the twentieth century has seen the growth and importance of images in all turns of life. Images play a vital part in the fields of medicine, journalism, education, advertising, design, and entertainment.

Need for Image Data Management

The process of digitisation does not in itself make image collections easier to manage. Some type of cataloguing and indexing is still required, the only difference being that much of the required information can now potentially be derived automatically from the images themselves.

The need for efficient storage and retrieval of images recognized by managers of large image collections such as picture libraries and design archives for many years. After examining the issues involved in managing visual information, the participants concluded that images were indeed likely to play an increasingly important role in electronically-mediated communication. But, the significant research advances, relating collaboration between a numbers of disciplines, would be required before image providers could take full advantage of the opportunities offered. They recognized a number of critical areas where research was required, comprising, image query matching, indexing and feature extractions user interfacing and data representation.

One of the main problems they highlighted was the difficulty of locating a desired image in a large and varied collection. While it is impeccably feasible to find a desired image from a small collection merely by browsing, more actual techniques are required with collections containing thousands of items.

Content-Based Image Retrieval (CBIR) systems are search engines for image databases, which index images according to their content. A typical task solved by CBIR systems is that a user submits a query image or series of images and the system is required to retrieve images from the database as similar as possible. Another task is a support for browsing through large image databases, where the images are supposed to be grouped or organised in accordance with similar properties. Although the image retrieval has been an active research area for many years (Smeulders et al. (2000) [1] and Datta et al. (2008) [2]). This difficult problem is still far from being solved. There are two main reasons, the first is so called semantic gap, which is the difference between information that can be extracted from the visual data and the interpretation that the same data have for a user in a given situation. The other reason is called sensory gap, which is the difference between a real object and its computational representation derived from sensors, which measurements are significantly influenced by the acquisition conditions.

The semantic gap is usually approached by learning of concepts or ontologies and subsequent attempts to recognise them.

Image Retrieval Problem

In this computer age, virtually all spheres of human life including commerce, engineering, hospitals, government, academics, architecture, surveillance, crime prevention, graphic design, fashion, journalism and historical research use images for efficient services. A huge collection of images is known as image database. An image database is a system where image data are integrated and stored [3]. Image data include the raw images and information extracted from images by automated or computer assisted image analysis.

The police maintain image database of stolen items, crime scenes and criminals. In the medical profession, X-rays and scanned image database are kept for research purposes, monitoring, and diagnosis. In architectural and engineering design, image database exists for machine parts, finished projects and design projects. In publishing and advertising, journalists create image databases for various events and activities such as sports, international events, product advertisements, buildings and personalities. In historical research, image databases are created for archives in areas that include arts, sociology, and medicine. In a small group of images, modest browsing can recognize an image. But the same procedure cannot be applied for large and varied collection of images, where the user encounters the image retrieval problem. An image retrieval problem is the problem encountered when searching and retrieving images that are relevant to a user's request from a database. To solve this problem, text-based and content-based are the two techniques adopted for search and retrieval in an image database.

In text-based retrieval, images are indexed using keywords, classification codes, which are used as retrieval keys during search and retrieval [4]. Text-based retrieval is non-standardized because different users employ different keywords for annotation. Text explanations are sometimes subjective and inadequate as they cannot represent a complicated image features very well. Examples are texture images that cannot be described by text. Textual information about images can be easily searched using existing methods, but have need of individuals to personally define all images in the database. This is unreasonable for huge databases, or for images that are created automatically. It is also possible to slip images that use dissimilar synonyms in their descriptions. Models based on sorting images in semantic classes like "cat" as a subclass of "animal" avoid this problem, but still face the same scaling issues [5].

The Content Based Image Retrieval (CBIR) technique uses image content to search and retrieve digital images. Content-based image retrieval systems were introduced to address the problems associated with 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 [6]. The main goal of CBIR is efficiency during image retrieval and indexing, thus decreasing the dependency of human for intervention in the indexing process. The computer must be able to retrieve images from a database without any human assumption on specific domain.

Content Based Image Retrieval (CBIR)

Content Based Image Retrieval is a task of searching images from a database and retrieval of an image, which are seems to be visually similar to a given example or query image. Content-based image retrieval uses the visual contents of an image such as shape, texture, colour, and spatial layout to represent and index the image. In content-based image retrieval systems, the visual stuffing of the images in the database are extracted and described by multi-dimensional feature vectors. These feature vectors can be computed by different methods available to the users. The CBIR system consists of following components:

- ***Query Image:*** It is the image to be search in the image database whether the same image is present or not or how many are similar kind images are exist or not.
- ***Image Database:*** It consists of n number of images depends on the user choice.
- ***FeatureExtraction:*** It extracts visual information from the image and saves them as features vectors in a features database. The feature extraction finds the image description in the form of feature value (or a set of value called a feature vector) for each pixel. These feature vectors are used to compare the query with the other images and retrieval.
- ***Image Matching:*** The information about each image is stored its feature vectors for computation process and these feature vectors are matched with the feature vectors of query image which helps in measuring the similarity.
- ***Resultant Retrieved Images:***It searches the previously maintained information to find the matched images from database. The output will be the similar images having same or very closest features as that of the query image.

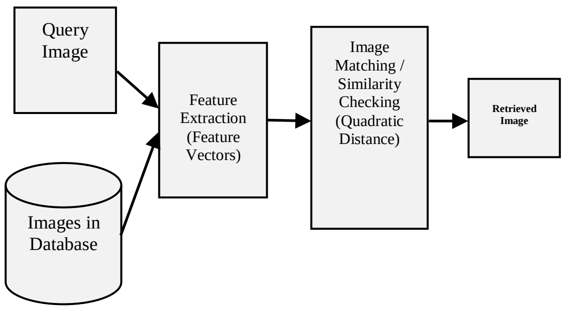

Figure 1: CBIR System and its various components

Principle of CBIR

Content-based retrieval uses the contents of images to represent the images. A typical content-based retrieval system is divided into off-line feature extraction and online image retrieval. A basic framework for content-based image retrieval is illustrated in Figure 2 [6]. In off-line stage, the system automatically extracts visual attributes (colour, shape, texture, and spatial information) of each image in the database based on its pixel values and stores them in a different database within the system called a feature database. The feature data (also known as image signature) for each of the visual attributes of each image is very much smaller in size compared to the image data, thus the feature database covers an abstraction (compact form) of the images in the image database. One advantage of a signature over the original pixel values is the significant compression of image representation. But, a more significant aim for using the signature is to gain an improved correlation between image representation and visual semantics [6].

In on-line image retrieval, the user can submit a query example to the retrieval system in search of desired images. The method represents this example with a feature vector. The distances (i.e., similarities) between the feature vectors of the query example and those of the media in the feature database are then computed and ranked. Retrieval is directed by applying an indexing scheme to provide an efficient way of searching the image database. Then system ranks the search results and then returns the results that are most similar to the query samples. If the user is not satisfied with the search results, he can provide relevance feedback to the retrieval model, which has a mechanism to learn the user's information needs.

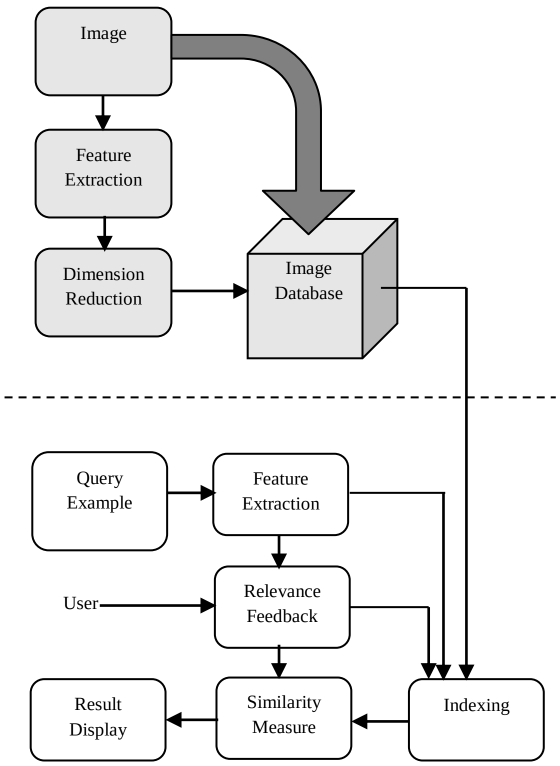

Figure 2: A Conceptual Framework for Content-Based Image Retrieval

Existing CBIR Systems

Early CBIR systems as QBIC (Flickner et al., 1995) [7] and VisualSEEk (Smith and Chang, 1996) [8] were based on image colours represented by a kind of colour histogram, which totally ignored structures of materials and object surfaces present in the scene. Visual appearances of such structured surfaces are commonly referred as textures and their characterisation is essential for understanding of real scene images.

Later systems attempted to include some textural description, e.g. based on wavelets as CULE (Chen et al., 2005) [9], IBM Video Retrieval System (Amir et al., 2005) [10] or Gabor features as MediaMill (Snoek et al., 2008) [11]. MUFIN (Batko et al., 2010) [12], which is focused on efficiency and scalability, includes a simple texture representation by MPEG-7 descriptors.

A CBIR system (Anaktisi) (Chatzichristofis et al., 2010) [13] is aimed at a compact representation, which was extracted by fuzzy techniques applied to colour features and wavelet based texture description. However, texture representations in these systems are more or less supplemental and the algorithms rely on colour features. Although retrieval results look promising, they are often provided by enormous image databases than exact image indexing. It is quite simple to fill the first result page with very similar images from a large database (e.g. sunsets, beaches, etc.), nevertheless, the lack of image understanding is revealed on further result pages.

In narrow image domains, CBIR systems are more successful e.g. trademark retrieval (Leung and Chen, 2002 [14]; Wei et al., 2009 [15]; Phan and Androutsos, 2010 [16]), drug pill retrieval (Lee et al., 2010) [17] or face detection (Lew and Huijsmans, 1996) [18] and similarity, which evolved in a separate field.

One of the reasons of disregarding textural features are that they are still immature for a reliable representation (Deselaers et al., 2008) [19] and at least weak texture segmentation of images is required (Smeulders et al., 2000) [1]. If the segmentation is extracted, shape features and region relations can be employed (Datta et al., 2008) [2], however, the reliable segmentation is a difficult problem on its own. Recent methods avoid the image segmentation by local descriptors as SIFT (Lowe, 2004) [20], which were extended to colour images and used for image indexing (van de Sande et al., 2010 [21]; Burghouts and Geusebroek, 2009a [22]; Bosch et al., 2008 [23]). However these key point based descriptors are more suitable for description of objects without large textured faces than homogeneous texture areas.

LITERATURE REVIEW

Evolution

Early work on image retrieval can be traced back to the late 1970s. In 1979, a meeting on Database Methods for Pictorial Applications was held in Florence. Since then, the applications of image database organization methods has attracted the devotion of researchers. In 1990s, as a result of advances in the Internet and new digital image sensor technologies, the volume of digital images produced by educational, scientific, industrial medical and other applications available to users increased dramatically. The problems faced by text-based retrieval became more and more severe. The effective organization of the rapidly expanding visual information became an urgent problem.

In 1996, Greg Pass Ramin Zabih [24] described for comparing images called histogram refinement, which enforces additional constraints on histogram

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based matching. Histogram refinement ruptures the pixels in a given bucket into various classes, based upon some local property. Inside a given bucket, only pixels in the same class are compared. Here describe a split histogram named as colour coherence vector (CCV), which partitions each histogram bucket based on spatial coherence. After that Chad Carson, Serge Belongie, Hayit Greenspan, and Jitendra Malik [25] Retrieve images from large and varied collections using image content as a key is a challenging and important problem. In 1997 they proposed a new image representation which provides a transformation from the raw pixel data to a small set of localized coherent regions in colour and texture space. This so-called "blobworld" representation is based on segmentation using the Expectation Maximization algorithm on combined colour and texture features. The texture features they use for the segmentation arise from a new approach to texture description and scale selection.

Yong Rui,Thomas S. Huang and Sharad Mehrotra [26] in 1998 research many visual feature representations have been explored and many system built. While these investigation efforts establish the basis of CBIR, the usefulness of the proposed methods is limited. Specifically, these efforts have relatively ignored two distinct characteristics of CBIR systems:

- The gap between high level concepts and low level features.
- Subjectivity of human perception of visual content.

This research proposes a relevance feedback based interactive retrieval method, which effectively takes into account the above two characteristics in CBIR. Throughout the retrieval process, the user's high level query and perception subjectivity are captured by dynamically updated weights based on the user's relevant feedback. This method greatly reduces the user's effort of composing a query and captures the user's information need more precisely.

In 1999 Mircea Ionescu, Anca Ralescu [27] analysed the performance of Content-Based Image Retrieval (CBIR) systems is mainly depending on the image similarity measure it use , the feature space of each image is real valued the Fuzzy Hamming Distance which can be successfully used as image similarity measure. The study reports in 1999, shows the results of applying Fuzzy Hamming Distance as a similarity measure between the colour histograms of two images. The Fuzzy Hamming Distance is appropriate for this application because it can take into account not only the number of different colours but also the magnitude of this difference.

Constantin Vertan , Nozha Boujemaa [28] propose to revisit the use of colour image content as an image descriptor through the introduction of fuzziness, which naturally arises due to the imprecision of the pixel colour values and human perception. In 2000 they proposed the use of both fuzzy colour histograms and their corresponding fuzzy distances for the retrieval of colour images within various databases.

In 2000 Stefano Berretti, Alberto Del Bimbo, and Pietro Pala, [29] propose retrieval by shape similarity using local descriptors and effective indexing. Shapes are divided into tokens in correspondence with their protrusions, and each token is modelled according to a set of perceptually salient attributes. Shape indexing is achieved by arranging shape tokens into a suitably modified M-tree index structure. Two distinct distance functions model correspondingly, token and shape perceptual similarity.

Arnold W.M. Smeulders, Marcel Worring, Simone Santini, Amarnath Gupta, and Ramesh Jain, [30] start discussing in 2000 about the working conditions of content-based retrieval: patterns of use, types of pictures, role of semantics and sensory gap. Subsequent sections discuss computational steps for image retrieval schemes. First step of the review is image processing for retrieval sorted by colour, local geometry, and texture. Features for retrieval are debated next, sorted by: object and shape features, salient points, accumulative and global features, structural combinations, and signs. Similarity of pictures and objects in pictures is reviewed for each of the feature types, in close connection to the types and means of feedback the user of the systems is capable of giving by interaction. In the concluding section, presenting the view on: the heritage from computer vision, the driving force of the field, the role of similarity, the need for databases, the problem of evaluation, and the role of the semantic gap, the influence on computer vision and of interaction.

Constantin Vertan, Nozha Boujemaa [31] in 2001 focusedon the possible embedding of the uncertainty regarding the colours of an image into histogram type descriptors. The ambiguity naturally arises from both the quantization of the colour components and the human sensitivity of colours. Fuzzy histograms measure the typicality of each colour within the image. And also describe various fuzzy colour histograms following a taxonomy that classifies fuzzy techniques as fuzzy paradigm based, crude fuzzy, fuzzy aggregation and fuzzy inferential. For these fuzzy sets, must develop appropriate similarity measures and distances. For a region-based image retrieval model, performance depends critically on the accuracy of object segmentation.

Yixin Chen James Z Wang [32] proposed a soft computing approach, unified feature matching (UFM), which greatly increases the robustness of the retrieval system against segmentation related uncertainties. In the retrieval system, an image is represented by a set of segmented regions each of which is characterized by a fuzzy feature (fuzzy set) reflecting texture, shape and colour properties.

Ju Han and KaiKuang Ma,[33] in 2002 presents a new colour histogram representation, called fuzzy colour histogram (FCH), by considering the colour similarity of each pixel's colour associated to all the histogram bins through fuzzy-set membership function. A unique and fast method for computing the membership values based on fuzzy c-means algorithm is presented. The proposed FCH is further exploited in the application of image indexing and retrieval. Investigational results clearly show that FCH yields better retrieval results than CCH.

Minakshi Banerjee, Malay K. Kundu [34] in 2003 discussed the common problem in content based image retrieval (CBIR) is selection of features. Image description with lesser number of features involving lower computational cost is always desirable. Edge is a strong feature for describing an image so a robust technique is presented for extracting edge map of an image which is followed by computation of global feature (like fuzzy compactness) using gray level as well as shape information of the edge map. Unlike other existing methods it does not require pre segmentation for the computation of features. This procedure is also computationally attractive as it computes different features with limited number of selected pixels.

DeokHwan Kim, ChinWan Chung [35] in 2003propose a new content-based image retrieval method using adaptive classification and cluster merging to find multiple clusters of a complex image query. When the measures of a retrieval technique are invariant under linear transformations, the technique can achieve the same retrieval quality regardless of the shapes of clusters of a query.

Yuhang Wang, Fillia Makedon, James Ford, Li Shen Dina Goldin [36] in 2004 propose a novel framework for automatic metadata generation based on fuzzy kNN classification that generates fuzzy semantic metadata describing spatial relations between objects in an image. For every pair of objects of interest, the equivalent R-Histogram is computed and used as input for a set of fuzzy k-NN classifiers. Typical content-based image retrieval (CBIR) system would need to handle the vagueness in the user queries as well as the inherent uncertainty in image representation, resemblance measure, and relevance feedback.

Raghu Krishnapuram, Swarup Medasani, Sung Hwan Jung, Young-Sik Choi, and Rajesh Balasubramaniam [37] in 2004 discuss how fuzzy set theory can be effectively used for this purpose and describe an image retrieval system called FIRST (Fuzzy Image Retrieval System) which incorporates many of these ideas.

S. Kulkarni, B. Verma1, P. Sharma and H. Selvaraj [38] proposed a neuro-fuzzy technique for content based image retrieval in 2005. The technique is based on fuzzy interpretation of neural network learning, searching algorithms and natural language. Firstly, fuzzy logic is developed to interpret natural expressions such as mostly, many and few. Furthermore, a neural network is designed to learn the meaning of mostly red, many red and few red.

Rouhollah Rahmani, Sally A. Goldman, Hui Zhang, John Krettek, and Jason E. Fritts [39] in 2008 presented a localized CBIR system, that uses labelled images in conjunction with a multiple instance learning algorithm to first identify the desired object and reweight the features, then to rank images in the database using a similarity measure that is based upon individual regions within the image.

Recent Work

Support Vector Machines (SVM) are extensively used to learn from relevance feedback due to their capability of effectively tackling the above difficulties. But, the performances of SVM depend on the tuning of a number of parameters. It is a different approach based on the nearest neighbour paradigm. Each image is ranked according to a relevance score depending on nearest neighbour distances. This approach allows recalling a higher percentage of images with respect to SVM-based techniques [40] there after quotient space granularity computing theory into image retrieval field, illuminate the granularity thinking in image retrieval, and a novel image retrieval technique is imported. Firstly, aiming at the Different behaviours under different granularities, gain colour features under different granularities, achieve different quotient spaces; then, do the attribute combination to the obtained quotient spaces according to the quotient space granularity combination principle; and then realize image retrieval using the combined attribute function[41]. Then a combination of three feature extraction methods namely texture, colour, and edge histogram descriptor is studied. There is a provision to add new features in future for better retrieval efficiency. Any grouping of these approaches, which is more appropriate for the application, can be used for retrieval. This is provided through User Interface (UI) in the form of relevance feedback. The image properties analysed in this work are by using computer vision and image processing algorithms. For colour the histogram of images are calculated, for texture co-occurrence matrix based energy, entropy, etc., are calculated and for edge density it is Edge Histogram Descriptor (EHD) that is found[42].Thereafter local patterns constrained image histograms (LPCIH) for efficient image retrieval are presented. Extracting information through combining local texture patterns with global image histogram, LPCIH is an operative image feature representation method with a flexible image segmentation procedure. This type of feature representation is robust and invariant for several image transforms, scaling, damaging and such as rotation[43]. In another system the image is represented by a Fuzzy Attributed Relational Graph (FARG) that describes each object in the image, its qualities and spatial relation. The colour and texture attributes are computed in a way that model the Human Vision System (HSV) [44].

CONCLUSION

Content based image retrieval is a challenging method of capturing relevant images from a large storage space. Although this area has been explored for decades, no technique has achieved the accuracy of human visual perception in distinguishing images. Whatever the size and content of the image database is, a human being can easily recognize images of same category.

From the very beginning of CBIR research, similarity computation between images used either region based or global based features. Global features extracted from an image are useful in presenting textured images that have no certain specific region of interest with respect to the user. Region based features are more effective to describe images that have distinct regions. Retrieval systems based on region features are computationally expensive because of the need of segmentation process in the beginning of a querying process and the need to consider every image region in similarity computation.

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