A Survey On: Content Based Image Retrieval Systems

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ABSTRACT
As the network and development of multimedia technologies are becoming more popular, users are not satisfied with the traditional information retrieval techniques. so nowadays the content based image retrieval are becoming a source of exact and fast retrieval. In this paper the techniques of content based image retrieval are discussed, analysed and compared. It also introduced the feature like neuro fuzzy technique, color histogram, texture and edge density for accurate and effective Content Based Image Retrieval System.

General Terms
Content Based Image Retrieval Technology, neuro-fuzzy system.

Keywords
Content Based Image Retrieval, Neuro Fuzzy, Color Histogram, Texture, Edge Density

1. INTRODUCTION
Content Based Image Retrieval (CBIR) is any technology that in principle helps to organize digital image archives by their visual content. By this definition, anything ranging from an image similarity function to a robust image annotation engine falls under the purview of CBIR The most common form of CBIR is an image search based on visual [1] .The increasing amount of digitally produced images requires new methods to archive and access this data. Conventional databases allow for textual searches on Meta data only. Content Based Image Retrieval (CBIR) is a technique which uses visual contents, normally called as features, to search images from large scale image databases according to users' requests in the form of a query image. Apart from the usual features like color and texture, a new feature extraction algorithm called edge histogram is introduced. Edges convey essential information to a picture and therefore can be applied to image retrieval. The edge histogram descriptor captures the spatial distribution of edges. This model expects the input as Query by Example (QBE) and any combination of features can be selected for retrieval. The focus is to build a universal CBIR system using low level features. These are mean, median, and standard deviation of Red, Green, and Blue channels of color histograms. Then the texture features such as contrast, energy, correlation, and homogeneity are retrieved. Finally the edge features that include five categories vertical, horizontal, 45 degree diagonal, 135 degree diagonal, and isotropic are added [2]. Human being gets images, sound and any other information by seeing, hearing and perception and analysis. Human judge similarity of images and sounds according to their semantic contents, for instance the searching for a star's picture is based on his facial characters or other contents. So the retrieval methods based on text or keywords for the digital multimedia apparently can't meet the demand that human being get multimedia information exactly. With more and more multimedia information appear on the Internet and other digital multimedia as well as human beings' thirst for exact and fast retrieval,based on contents multimedia information retrieval becoming the focus of the academe research as well as images retrieval of contents is one of the important study aspect of multimedia information retrieval.[32]. Existing color-based general-purpose image retrieval systems roughly fall into three categories depending on the signature extraction approach used: histogram, color layout, and region-based search. And, histogram-based search methods are investigated in two different color spaces. A color space is defined as a model for representing color in terms of intensity values. Typically, a color space defines a one- to four- dimensional space. A color component, or a color channel, is one of the dimensions. Color spaces are related to each other by mathematical formulas.The two three-dimensional color spaces, RGB and HSV, are investigated.[6] CBIR involves the following four parts in system realization: data collection, build up feature database, search in the database, arrange the order and deal with the results of the retrieval.

1) Data collection Using the Internet spider program that can collect webs automatically to interview Internet and do the collection of the images on the web site, then it will go over all the other webs through the URL, repeating this process and collecting all the images it has reviewed into the server.

2) Build up feature database using index system program do analysis for the collected images and extract the feature information. Currently, the features that use widely involve low-level features such as color, texture and so on, the middle level features such as shape etc.

3) Search the Database The system extract the feature of image that waits for search when user input the image sample that need search, then the search engine will search the suited feature from the database and calculate the similar distance, then find several related webs and images with the minimum similar distance.

4) Process and index the results after researching Index the image obtained from searching due to the similarity of features, then return the retrieval images to the user and let the user select. If the user is not satisfied with the searching result, he can re-retrieval the image again, and searches database again. The retrieval of content based image involves the following systems

A. Color-based retrieval
Color feature is the most intuitive and obvious feature of the image, and generally adopt histograms to describe it. Color histograms method has the advantages of speediness, low

demand of memory space and not sensitive with the images' changes of the size and rotation, it wins extensive attention consequently.

B. The retrieval based on texture feature

When it refers to the description of the image's texture, we usually adopt texture's statistic feature and structure feature as well as the features that based on spacial domain are changed into frequency domain.

C. The retrieval based on shape feature

There is three problems need to be solved during the image retrieval that based on shape feature. Firstly, shape usually related to the specifically object in the image, so shape's semantic feature is stronger than texture. [15]

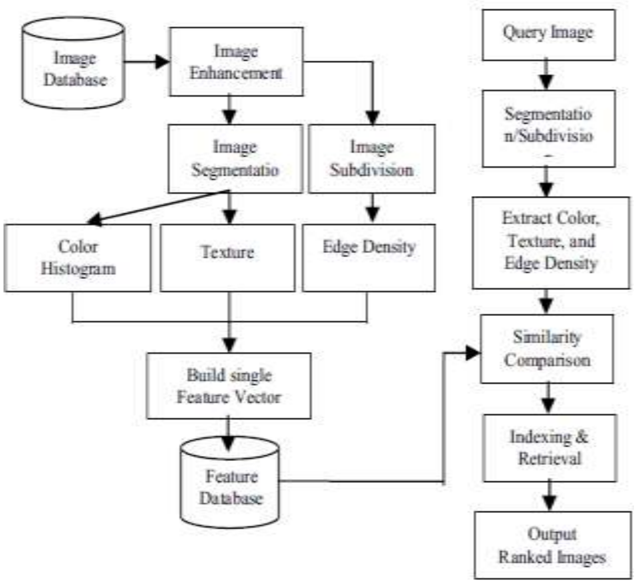

Figure 1. Flow Chart of Content Based Image Retrieval [15]

D. The retrieval based on Neuro Fuzzy

The technique of the proposed neurofuzzy content based image retrieval system in two stages. Stage 1: the query to retrieve the images from database is prepared in terms of natural language such as mostly content, many content and few content of some specific color. Fuzzy logic is used to define the query. [18].

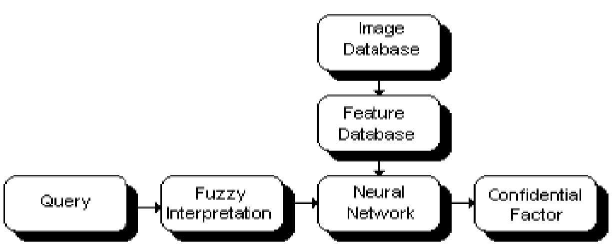

Figure 2. Block diagram of Neuro Fuzzy system [18]

2. EVOLUTION

Early work on image retrieval can be traced back to the late 1970s. In 1979, a conference on Database Techniques for Pictorial Applications was held in Florence. Since then, the application potential of image database management techniques has attracted the attention of researchers. In the early 1990s, as a result of advances in the Internet and new digital image sensor technologies, the volume of digital images produced by scientific, educational, medical, industrial, and other applications available to users increased dramatically. The difficulties faced by text-based retrieval became more and more severe. The efficient management of the rapidly expanding visual information became an urgent problem. In 1996, Greg Pass Ramin Zabih [1] described for comparing images called histogram refinement, which imposes additional constraints on histogram based matching. Histogram refinement splits the pixels in a given bucket into several classes, based upon some local property. Within a given bucket, only pixels in the same class are compared. Here describe a split histogram called a color coherence vector (CCV), which partitions each histogram bucket based on spatial coherence. After that Chad Carson, Serge Belongie, Hay it Greenspan, and Jitendra Malik [3] Retrieve images from large and varied collections using image content as a key is a challenging and important problem. In 1997 they present a new image representation which provides a transformation from the raw pixel data to a small set of localized coherent regions in color and texture space. This so-called "blobworld" representation is based on segmentation using the Expectation Maximization algorithm on combined color and texture features. The texture features we use for the segmentation arise from a new approach to texture description and scale selection. Then Yong Rui,Thomas S. Huang and Sharad Mehrotra [2] in 1998 research many visual feature representations have been explored and many system built. While these research efforts establish the basis of CBIR, the usefulness of the proposed approaches is limited. Specifically, these efforts have relatively ignored two distinct characteristics of CBIR systems: (1) the gap between high level concepts and low level features; (2) subjectivity of human perception of visual content. This research proposes a relevance feedback based interactive retrieval approach, which effectively takes into account the above two characteristics in CBIR. During 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 approach 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 [4] 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 color histograms of two images. The Fuzzy Hamming Distance is suitable for this application because it can take into account not only the number of different colors but also the magnitude of this difference. Constantin Vertan , Nozha Boujemaa [5] propose to revisit the use of color image content as an image descriptor through the introduction of fuzziness, which naturally arises due to the imprecision of the pixel color values and human perception. In 2000 they proposed the use of both fuzzy color histograms and their corresponding fuzzy distances for the retrieval of color images within various databases. Again in 2000 Stefano Berretti, Alberto Del Bimbo, and Pietro Pala, [7] proposes retrieval by shape similarity using local descriptors and effective indexing. Shapes are partitioned into tokens in correspondence with their protrusions, and each token is modelled according to a set of perceptually salient attributes. Shape indexing is obtained by arranging shape tokens into a suitably modified M-tree index structure. Two distinct distance functions model respectively, token and shape perceptual similarity Arnold W.M. Smeulders, Marcel Worring, Simone Santini, Amarnath Gupta, and Ramesh Jain, [6] starts discussing In 2000 the working conditions of content-based retrieval: patterns of use, types of pictures, the role of semantics, and the sensory gap. Subsequent sections discuss computational steps for image retrieval systems. Step one of the review is image processing for retrieval sorted by color, texture, and local geometry. Features for retrieval are discussed next, sorted by: accumulative and global features, salient points, object and shape features, signs, and structural combinations thereof. 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 driving force of the field, the heritage from computer vision, the influence on computer vision, the role of similarity and of interaction, the need for databases, the problem of evaluation, and the role of the semantic gap. Constantin Vertan, Nozha Boujemaa[8] in 2001 focuses on the possible embedding of the uncertainty regarding the colors of an image into histogram type descriptors. The uncertainty naturally arises from both the quantization of the color components and the human perception of colors. Fuzzy histograms measure the typicality of each color within the image. And also define various fuzzy color histograms following a taxonomy that classifies fuzzy techniques as crude fuzzy, fuzzy paradigm based, fuzzy aggregational and fuzzy inferential. For these fuzzy sets, must develop appropriate similarity measures and distances. For a region-based image retrieval system, performance depends critically on the accuracy of object segmentation. Yixin Chen James Z Wang [9] 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 color, texture, and shape properties. Ju Han and Kai-Kuang Ma,[10] in 2002 presents a new color histogram representation, called fuzzy color histogram (FCH), by considering the color similarity of each pixel's color associated to all the histogram bins through fuzzy-set membership function. A novel and fast approach for computing the membership values based on fuzzy c-means algorithm is introduced. The proposed FCH is further exploited in the application of image indexing and retrieval. Experimental results clearly show that FCH yields better retrieval results than CCH. Minakshi Banerjee, Malay K. Kundu [12] in 2003 discussed the common problem in content based image retrieval (CBIR) is selection of features. Image characterization with lesser number of features involving lower computational cost is always desirable. Edge is a strong feature for characterizing 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 techniques it does not require pre segmentation for the computation of features. This algorithm is also computationally attractive as it computes different features with limited number of selected pixels. DeokHwan Kim , ChinWan Chung [14] in 2003 propose 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 method are invariant under linear transformations, the method 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 [16] in 2004 propose a novel framework for automatic metadata generation based on fuzzy k-NN classification that generates fuzzy semantic metadata describing spatial relations between objects in an image. For each pair of objects of interest, the corresponding 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, similarity measure, and relevance feedback. Raghu Krishnapuram, Swarup Medasani, Sung Hwan Jung, Young-Sik Choi, and Rajesh Balasubramaniam [17] 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 [18] proposed a neuro-fuzzy technique for content based image retrieval in 2005. The technique is based on fuzzy interpretation of natural language, neural network learning and searching algorithms. Firstly, fuzzy logic is developed to interpret natural expressions such as mostly, many and few. Secondly, 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 [20] in 2005 presents a localized CBIR system , that uses labeled images in conjunction with a multiple instance learning algorithm to first identify the desired object and re-weight the features, and then to rank images in the database using a similarity measure that is based upon individual regions within the image.

3. RECENT WORK

Support vector machines(SVM) are extensively used to learn from relevance feedback due to their capability of effectively tackling the above difficulties. However, 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 neighbor distances. This approach allows recalling a higher percentage of images with respect to SVM-based techniques [22] there after quotient space granularity computing theory into image retrieval field, clarify the granularity thinking in image retrieval, and a novel image retrieval method is imported. Firstly, aiming at the Different behaviors under different granularities, obtain color features under different granularities, achieve different quotient spaces; secondly, 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.[23]

Then a combination of three feature extraction methods namely color, texture, and edge histogram descriptor is reviewed. There is a provision to add new features in future for better retrieval efficiency. Any combination of these methods, 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 analyzed in this work are by using computer vision and image processing algorithms. For color the histogram of images are computed, for texture co occurrence matrix based entropy, energy, etc, are calculated and for edge density it is Edge Histogram Descriptor (EHD) that is found.[24] After that local patterns constrained image histograms (LPCIH) for efficient image retrieval is presented. Extracting information through combining local texture patterns with global image histogram, LPCIH is an effective image feature representation method with a flexible image segmentation process. This kind of feature representation is robust and invariant for several image transforms, such as rotation, scaling and damaging.[27]. In another system the image is represented by a Fuzzy Attributed Relational Graph (FARG) that describes each object in the image, its attributes and spatial relation. The texture and color attributes are computed in a way that model the Human Vision System (HSV) [28].

4. OPEN AREAS

There are various areas to work with for the improvement of the content based image retrieval system. It is already been discussed that the existing techniques may be used to improve the quality of image retrieval and the understanding of user intentions. An approach that combines two different approaches to image retrieval, together with active use of context information and interaction has been proposed. An important aspect of the research work outlined here is to design and evaluate a system that, in addition to combine the use of TBIR with CBIR [37]. Use of the hybrid feature including color, texture and shape as feature vector of the regions to match images can give better results. Results on a database of 1000 general-purposed images demonstrate the efficiency and effectiveness of the image representation for region based image retrieval. [33]. The technique called self taught multiple-instance learning (STMIL) that deals with learning from a limited number of ambiguously labeled examples is also a effective area to work with for efficient results. STMIL uses a sparse representation for examples belonging to different classes in terms of a shared dictionary derived from the unlabeled data. This representation can be optimized under the multiple instances setting to both construct high level features and unite the data distribution [34]. The problem of bridging the semantic gap between high level query which is normally in terms of an example image and low level features of an image such as colour, texture, shape and object forced to apply techniques to reduce the semantic gap. Existing techniques for image retrieval based on fuzzy logic and natural language query is a novel approach based on natural language fuzzy logic queries, fuzzy mapping of image database and fuzzy similarity distance for retrieving the images based on their contents. Fuzzy logic for the interpretation of the texture queries for content-based image retrieval is latest and effective technique [36].

5. CONCLUSIONS

The purpose of this survey is to provide an overview of the functionality of content based image retrieval systems. Most systems use color and texture features, few systems use shape feature, and still less use layout features. Fuzzy logic has been used extensively in various areas to improve the performance of the system and to achieve better results in different applications. The fuzzy inference integrates various features perfectly in content based image retrieval system and reflects the user's subjective requirements, the experiments achieve good performance and demonstrate the efficiency and robustness of system.

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