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A Survey on Visual Information Retrieval Tools With Wavelets

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Abstract

A Content-base Video retrieval, which provides convenient ways to retrieve Video from large Video database. While many previous Video retrieval techniques do not look at regions in an Video, region based Video retrieval techniques have been gaining attention recently. Traditional method for retrieval has failed to retrieve multimedia data like Video, audio, video etc. CBIR is very active research area which is used retrieves Videos based on Video visual features. The present method uses a new technique based on wavelet transformations to create feature vector of Video, characterizing texture feature of the Video is constructed. For quick retrieval statically detail of Video like mean of approximation, standard deviation and second moment is utilized for shape in Video. Our method derives feature vector for each Video characterizing the texture feature of sub Video from only three iterations of wavelet transforms. The K Means Clustering Algorithm is used to cluster the group of Videos based on feature vector of Videos by considering the minimum Euclidean distance. LIRe (Lucene Image Retrieval) is a light weight open source Java library for content based image retrieval. It provides common and state of the art global image features and offers means for indexing and retrieval. Due to the fact that it is based on a light weight embedded text search engine, it can be integrated easily in applications without relying on a database server

Keywords

Image Retrieval, Image Features, Image Search, Image Indexing, Progressive Image Retrieval Strategy

I. Introduction

Content-Based Image Retrieval (CBIR) is considered as the process of retrieving desired images from huge databases based on extracted features from the image themselves (without resorting to a key word). Features are derived directly from the images and they are extracted and analyzed by means of computer processing[1]. CBIR is a bottleneck of the access of multimedia databases that deal with text, audio, video and image data which could provide us with enormous amount of information . Many commercial and research CBIR systems have been built and developed (e.g.: QBIC, Virage, Pichunter, visual SEEK, Chabot, Excalibur, photobook, Jacob) [2]. Content based image retrieval [3]-[4], allowing to automatically extract targets according to objective visual contents of image itself(e.g. color, texture and shape) has become increasingly attractive, in Multimedia Information Service System (MISS). With appealing time frequency localization and multi-scale properties, wavelet transform proved to be effective in visual feature extraction and representation. It can be used to characterize textures using statistical properties of the gray levels of the points/pixels comprising a surface image. In CBIR, wavelet approaches mainly include wavelet histogram and wavelet moment of image, etc. [12]. Wavelet transform can be used to characterize textures using statistical properties of the gray levels of the pixels comprising a surface image [13]. The wavelet transform is a tool that cuts up data or functions or operators into different frequency components and then studies each component with a resolution matched to its scale. In this paper, we used D4 and Haar wavelet transforms to decompose color images into multilevel scale and wavelet coefficients, with which we perform image feature extraction and similarity match by means of F-norm theory. We also present a progressive retrieval strategy, which contributes to flexible compromise between the retrieval speed and the recall rate. The retrieval performances are compared with the existing wavelet histogram technique. The efficiency in terms Recall rate and retrieval speed is tested with five types of images and the results reflect the importance of wavelets in CBIR.Fnorm theory along with progressive retrieval strategy improves retrieval performance.

Recently, a quick increasing the amount and complexity of digital collections on Web requires the development of new searching engines and novel methods for multimedia information retrieval because the most of Web documents contain any kind of visual data. However, the most businesses don't know how to develop a successful management information system (MIS) that often stems from management's inability to understand both the power and limitations of information technology [Emery, 1987], [Kumar, 2005]. Integration and using the recent Web-based technologies and particularly, development of MIS for multimedia information search, access, retrieval, and processing permits to business generate new revenue from online products querying and sales, reduce costs through online customer support, attract new customers via web marketing and advertising, develop new Web-based markets and distribution channels for existing and new information-based products accessible on the Web [Gupta, 2005]. The most common way to classify images is generation of textual queries, however, the maintenance and the management of queries for image retrieval is a very time-consuming activity. The typical approach of automatic indexing the images as a principal part of retrieval process is based on the analysis of low-level image characteristics such as colour, texture or shape [Starostenko, 2005], [Chavez, 2006]. Unfortunately, this type of systems does not provide the semantics associated with content of an image. Nowadays, a novel approaches for development of VIR systems are those which provide the content based image retrieval (CBIR) to support management and treatment of multimedia documents. In practice, it is easier to execute queries based on low-level features such as shape, image dimensions, pixel values, colour, grey level, and histogram. Therefore, the problem resides in how to express a query, for instance (recover red cars) in terms of shape, colour, histogram, or pixels values. In other words, it is necessary to represent the content of an image query in a convenient way in order to search for the corresponding images from the collection and recover images with the best matching. There are several reports about recent researches in the visual information retrieval area. CBIR systems can be classified into two main groups: Commercial Image Retrieval Systems such as Excalibur Visual RetrievalWare, IMatch, QBIC, Virage [Excalibur, 2004], [Virage, 2004], and Prototype Research Systems: AMORE, Photobook, VisualSeek, Black Box, IRONS, and Keyblock are examples of Prototype Research Systems [MIT, 2003], [Westphal, 2004], [Chavez, 2006]. The more perspective researches are those which use a semantic space to formulate queries. Table 1 summarizes the features of the well-known CBIR systems.

Table 1: Visual Features used in Well-Known Image Retrieval System

System	Colour	Shape	Texture	Relevance Feedback	Semantic Representation
Excalibur	YES	YES	YES	NO	NO
IMatch	YES	YES	NO	YES	NO
QBIC	YES	NO	YES	NO	NO
Virage	YES	YES	YES	-	NO
AMORE	YES	YES	NO	-	NO
Photobook	YES	YES	YES	YES	NO
VisualSEEK	YES	-	YES	YES	NO
Black Box	YES	YES	YES	YES	-
Keyblock	YES	-	-	YES	YES
IRONS	YES	YES	NO	YES	YES

In this research we propose to apply the machine-understandable semantics for search, access, and retrieval of multimedia data using ontology. Grubber's famous description defines ontology as an approach which describes semantics, establishes a common and shared understanding of domain, and facilitates the implementation of user-oriented vocabulary of terms and their relationship with objects in image [Fensel, 2004], [Grubber, 1993]. In such a way, the meaning of an image may be obtained in textual form as set of descriptions for image related to a particular ontology. Proposed CBIR system may be used in business, medicine, education, architecture, entertainment, GIS, journalism, remote sensing, Internet shopping catalogue, tourist information support, etc. [Jensen, 2006], [Hiroshi, 2005].

II. LIRe

LIRe is a Java library for content based image retrieval. LIRe extracts image features from raster images and stores them in a Lucene index for later retrieval. LIRe also provides means for searching the index. LIRe is intended for developers and researchers, who want to integrate content based image retrieval features in their applications. Due to the simplicity of the approach (no database and only a few lines of code are needed to integrate LIRe) it is an easy way to test the capabilities of classical CBIR approaches for single application domains. Also the integration of additional image features is possible easily to further extend the functionality of LIRe. Currently the following image features are included in LIRe: 1. Color histograms in RGB and HSV color space. 2. MPEG-7 descriptors scalable color, color layout and edge histogram, see [1]. 3. The Tamura texture features coarseness, contrast and directionality, see [8] 4. Color and edge directivity descriptor, CEDD, see [2] 5. Fuzzy color and texture histogram, FCTH, see [3] 6. Auto color correlation feature defined by Huang et al. [6] While LIRe itself is a development library there is also an additional demo package called LIRe Demo, which allows to test selected CBIR features of LIRe with a graphical user interface as shown in Figure 1. For the sake of speed indexing is done in parallel using multiple threads and for sake of simplicity photos from Flickr can be indexed instead of specifying a local image collection for testing purposes. LIRe Demo also integrates an application built on the capabilities of LIRe for creating image mosaics. LIRe has been first released in February 2006 and is currently available in release v0.6. Both, LIRe and LIRe Demo, are available licensed under GPL online1 . In addition to the Java class documentation there is also a documentation wiki for users and developers giving code samples, answering FAQs and describing best practice approaches. Latest development code can be accessed on the subversion (SVN) server on http://www.sourceforge.net. Note that LIRe is hosted as sub project within the project Caliph & Emir, which provides Java based tools MPEG-7 image annotation and retrieval.

III. Image Decomposition With Wavelets

We used two wavelet approaches for color image decomposition, namely Haar, D4 wavelets. These resulting decomposition coefficients are employed to perform image feature extraction and similarity match by virtue of F-norm theory

A. Haar Wavelet Transform

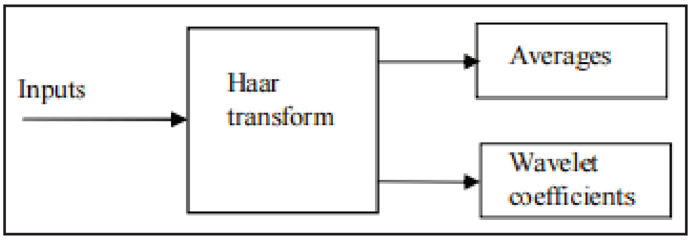

Fig. 1: Haar Wavelet Forward Transform

If a data set S0, S1 ….SN-1 contains N elements, there will be N/2 averages and N/2 wavelet coefficient values. The averages are stored in the upper half of the N element array and the coefficients are stored in the lower half as shown in the Fig.2. The averages become the input for the next step in the wavelet calculation, where for iteration i+1, Ni+1 = Ni /2. The recursive iterations continue until a single average and a single coefficient are calculated. This replaces the original data set of N elements with an average, followed by a set of coefficients whose size is an increasing power of two (Ex: 2 0 , 2 1 , 2 2 ... N/2).

B. The Daubechies D4 Wavelet Transform

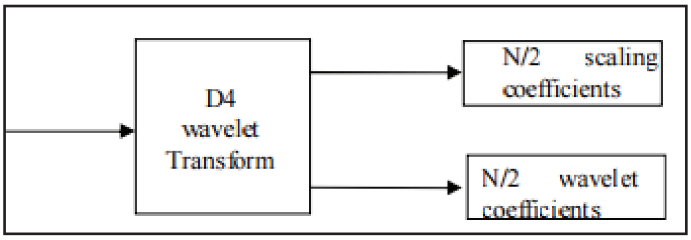

Fig. 2: D4 Wavelet Forward Transform

The D4 transform has four wavelet and scaling function coefficients as shown in the Fig. 2. Each step of the wavelet transform applies the scaling function to the data input. If the original data set has N values, the scaling function will be applied in the wavelet transform step to calculate N/2 smoothed values. In the ordered wavelet transform the smoothed values are stored in the lower half of the N element input vector. The wavelet function coefficient values are:

$$g0 = h3 ; g1 = -h2 ; g2 = h1 ; g3 = -h0 \quad (1)$$

Each step of the wavelet transform applies the wavelet function to the input data. If the original data set has N values, the wavelet function will be applied to calculate N/2 differences (reflecting change in the data). In the ordered wavelet transform the wavelet values are stored in the upper half of the N element input vector. The scaling and wavelet functions are calculated by taking the inner product of the coefficients and four data values. Each iteration in the wavelet transform step calculates a scaling function value and a wavelet function value. The index i is incremented by two with each iteration, and new scaling and wavelet function values are calculated.

IV. Wavelet Decomposition

The basic idea is to separate the higher half and the lower half of the spectrum of a signal by using a second order bandpass filter and a low pass filter, to subsample the image corresponding to the lower half of the spectrum and to iterate the process. The result of the first band-pass filtering will give us the difference of information between resolution 2j and resolution 2j-1. The result of the next band-pass filtering will give us the difference of information between resolution 2j-1 and resolution 2j-2 and so on. The theory of wavelets shows that we can obtain filters which are very well localized both in the Fourier and spatial domain -thus preserving the locality of information- and that we can achieve a representation which is complete.

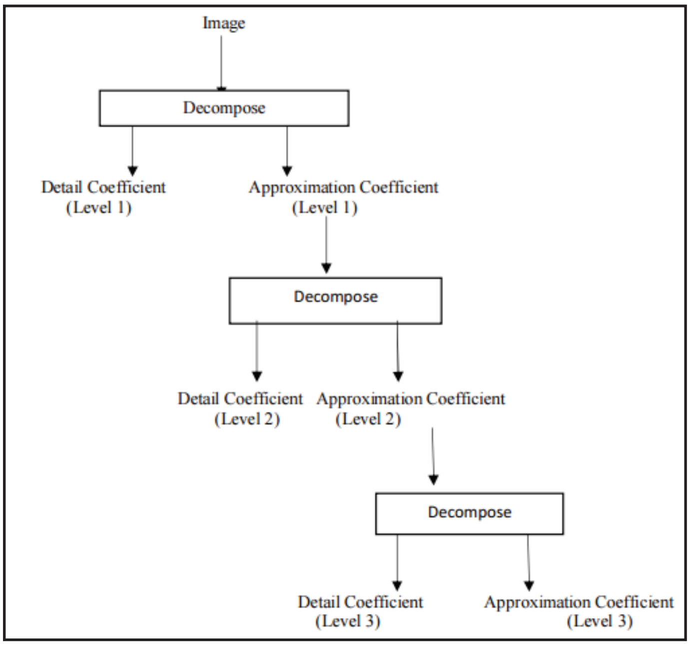

Fig. 3: Wavelet Decomposition

V. Feature Extraction

Feature Extraction is done by using colors, using textures or by using shapes. For color feature extraction, color histograms such as Local Color Histogram (LCH), Global Color Histogram (GCH) and Fuzzy Color Histogram (FCH) are used. For extracting textures Statistical, Structural, Spectral approaches are used. In addition to this, Tammura Texture and Wavelet Transform are also used [5]. In this paper wavelet feature extraction has been used. Firstly we extract the Red colors of the each image & decompose red color up to third level decomposition. Find the image decomposition factor like mean, standard deviation & entropy. Same procedure is followed for the Green & Blue color. The feature matrix of 1000X9 (1000 images & 9 columns) has been used. Feature vector of query image is compared with this feature matrix & retrieve the images.

VI. Experimental Result

With wavelet decomposition, color descriptor, texture descriptor and edge descriptor, a similarity function is calculated.To make a comparison between the query image with the image in database, Euclidean distance is calculated. Accordingly, the retrieval result is not a single image but a list of images ranked by their similarities with the query image. To improve the result, the user can rate the images which are retrieved with an impact factor which lies in the range of 0-1. It should be multiples of 0.1. then using feedback algorithm, the chromosomes are mated that is the features from the images which are more similar to the query image are combined for the effective retrieval. In this way user can iterate the result till he is satisfied.

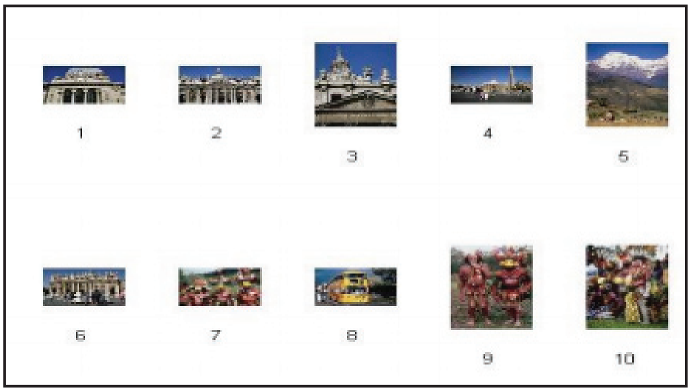

Fig. 4: Retrieved Result

VII. Conclusion

Content based image retrieval using wavelet transform and threshold algorithm not only recognizes the images that have been stored in database, but also be able to find some resemblance ornament image or texture as well.It will display the image based on the representation of the highest grade in each query image, which has been compared with the image database. LIRe is a light-weight Java library for content based image retrieval provided under GPL license. LIRe is fast enough to provide a platform for applied research relying on standard CBIR techniques. Due to the fact that it uses the Lucene text search engine and not a database server it is easy to integrate LIRe in existing prototypes and applications. Due to Java background of LIRe and it can be used on many different platforms. For applications retrieving images from big databases or applications with many concurrent users, the linear search approach of LIRe is not appropriate.

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