

Efficient Content Based Image Retrieval System with Metadata Processing

R.Sivasenthil

Abstract— The content based image retrieval (CBIR) is one of the most popular, rising research areas of the digital image processing. Most of the available image search tools, such as Google Images and Yahoo! Image search, are based on textual annotation of images. In these tools, images are manually annotated with keywords and then retrieved using text-based search methods. The performances of these systems are not satisfactory. The goal of CBIR is to extract visual content of an image automatically, like color, texture, or shape. This paper aims to introduce the problems and challenges concerned with the design and the creation of CBIR systems, which is based on the accurate image search mechanism. For efficient data management, a system is proposed which generates metadata for image contents. This system is using Content-Based Image Retrieval System (CBIR) based on Mpeg-7 descriptors. First, low-level features are extracted from the query image without metadata and the images with similar low-level features are retrieved from the CBIR system. Metadata of the result images which are similar to the query image are extracted from the metadata database. From the resulting metadata, common keywords are extracted and proposed as the keywords for the query image. The extraction of color features from digital images depends on an understanding of the theory of color and the representation of color in digital images. Color spaces are an important component for relating color to its representation in digital form. The transformations between different color spaces and the quantization of color information are primary determinants of a given feature extraction method. The approach is found to be robust in terms of accuracy and is 92.4% amongst five categories.

Index Terms— Content Based Image Retrieval, Digital Image Processing, Metadata, Query Image

I. INTRODUCTION

The term Content-based image retrieval was originated in 1992, when it was used by T. Kato to describe experiments into automatic retrieval of images from a database, based on the colors and shapes present. Since then, this term has been used to describe the process of retrieving desired images from a large collection on the basis of syntactical image features. The techniques, tools and algorithms that are used originate from fields such as statistics, pattern recognition, signal processing, and computer vision. In content-based image retrieval (CBIR), the image databases are indexed with descriptors derived from the visual content of the images.

Most of the CBIR systems are concerned with approximate queries where the aim is to find images visually

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similar to a specified target image. In most cases the aim of CBIR systems are to replicate human perception of image similarity as much as possible. The CBIR gained good amount of popularity due to its large application base such as crime investigation and prevention, Medical diagnosis, Military, Photograph archives, Retail catalogues, face finding, Architectural and engineering design, Art collections etc.

The general stages involved in development of CBIR are Data collection; Image preprocessing, Feature extraction, Classification and Resultant Retrieved images. The system 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.

A. Content Based Image Retrieval

The literature reveals that the CBIR has become a topic of great interest in recent years mainly due to the large collection of images over the Internet, and there has been some substantial and progressive research in the area. The majorly approaches in CBIR are based on object model creation called query image and retrieval of the same from the large data set. During the process of model creation large set of features which are based on texture and color are found to be addressed. After extracting the shape feature, the classified images are indexed and labeled for making easy for applying retrieval algorithm in order to retrieve the relevant images from the database. In their work, retrieval of the images from the huge image database as required by the user can get perfectly by using canny edge detection technique according to results. From the literature it is evident that there are methods which are robust in terms of accuracy but are consuming large amount of time in retrieval of the query image or there are methods fast enough but fail to give desired level of accuracy. Hence there is a scope to develop new method which balance the both criteria and a new method is proposed.

B. Color Histogram

The color histogram is most important component in image retrieval. It is a vector which is collection of element with each element representing number of pixels in a bin of image. A color histogram represents the distribution of colors in an image, through a set of bins, where each histogram bin corresponds to a color in the quantized color space. A color histogram for a given image is represented by a vector:

$$H = \{H[0], H[1], H[2] \dots H[i] \dots H[n]\}$$

Where 'i' is the color bin in the color histogram and $H[i]$ represents the number of pixels of color 'i' in the image, and 'n' is the total number of bins used in color histogram. Typically, each pixel in an image will be assigned to a bin of a color histogram. Accordingly in the color histogram of an image, the value of each bin gives the number of pixels that has the same corresponding color. In order to compare images of different sizes, color histograms should be normalized. The normalized color histogram H_{norm} is given as:

$$H' = \{H'[0], H'[1], H'[2] \dots H'[i] \dots H'[n]\} \text{ where}$$

$$H'[i] = H[i]/p.$$

'p' is the total number of pixels of an image.

C. Wavelet Based Features

The wavelet transform represents a function as a superposition of a family of basic functions called wavelets. Wavelet transforms extract information from signal at different scales by passing the signal through low pass and high pass filters. Wavelets provide multi resolution capability and good energy compaction. Wavelets are robust with respect to color intensity shifts and can capture both texture and shape information efficiently. The wavelet transforms can be computed linearly with time and thus allowing for very fast algorithms. Discrete wavelet transformation (DWT) is used to transform an image from spatial domain into frequency domain. In applied mathematics simplest wavelets are a family of wavelets and are a modified version of Daubechies wavelets but with increased symmetry. The dwt2 command performs single-level two dimensional wavelet decomposition shown in fig.1.3.1 with respect to either a particular wavelet or particular wavelet decomposition filters (Lo_D and Hi_D) which are specified.

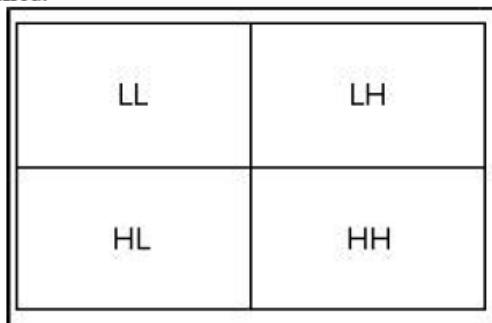


Fig.1. Level 1 of the 2D wavelet transforms rgb2hsv conversion

D. Classifier

The nearest neighbor technique simply classifies an unknown sample as belonging to the same class as the most similar or “nearest” sample point in the training set of data, which is often called a reference set. Nearest can be taken to mean the smallest Euclidean distance in n dimensional feature space, which is the usual distance between two coordinate points $a = (a_1 \dots a_n)$ and $b = (b_1 \dots b_n)$, defined by:

$$d_e(a, b) = \sqrt{\sum_{i=1}^n (b_i - a_i)^2}$$

Where n is the number of features. This is an extension of Pythagorean Theorem to n dimensions, and would be the distance measured by a ruler in one-, two-, or three dimensional spaces. Euclidean distance is probably the most commonly used distance function or measure of dissimilarity between feature vectors.

E. Efficiency of Content Based Image Retrieval

This approach presents a novel technique that employs both the color and edge direction features for Content-Based Image Retrieval (CBIR). In this method, a given image is first divided into sub-block which has the same size and then the color and edge direction features of each sub-block can be extracted. Next, it constructs a codebook of color feature using clustering algorithm and then each sub-block is mapped to the codebook. Finally, it uses the color index codes to image retrieval and uses the edge direction feature as the color feature's weight which belongs to the same color feature's sub-block. The effectiveness of this technique is demonstrated with the experiments.

F. Color Matching for Image Retrieval

Color is an important attribute for image matching and retrieval. We present a new method for color matching based on a clustering algorithm in the 3-D color space. We define a new color feature to characterize the color information and a distance measure to compute the color similarity of images

G. Color Based Image Retrieval

Nowadays, quick search and retrieval is needed in all kinds of growing database to find relevant details quickly. Content Based Image Retrieval (CBIR) plays a significant role in the image processing field. Based on image content, CBIR extracts images that are relevant to the given query image from large image archives. Images relevant to a given query image are retrieved by the CBIR system utilizing either low level features such as shape, color, texture and homogeneity or high level features such as human perception. Most of the CBIR systems available in the literature extract only concise feature sets that limit the retrieval efficiency. In this paper, we are using Medical images for retrieval and the feature extraction is used along with color, shape and texture feature extraction to extract the query image from the database medical images. When a query image is given, the features are extracted and then the Genetic Algorithm-based similarity measure is performed between the query image features and the database image features. The Squared Euclidean Distance (SED) computes the similarity measure in determining the Genetic Algorithm fitness. Hence, from the Genetic Algorithm-based similarity measure, the database images that are relevant to the given query image are retrieved. The proposed CBIR technique is evaluated by querying different

medical images and the retrieval efficiency is evaluated in the retrieval results. We prove our system secure using the recent dual system encryption methodology where the security proof works by first converting the challenge cipher text and private keys to a semi-functional form and then arguing security.

H. A Survey of Content Based Retrieval

In order to improve the retrieval accuracy of content-based image retrieval systems, research focus has been shifted from designing sophisticated low-level feature extraction algorithms to reducing the ‘semantic gap’ between the visual features and the richness of human semantics. This paper attempts to provide a comprehensive survey of the recent technical achievements in high-level semantic-based image retrieval. Major recent publications are included in this survey covering different aspects of the research in this area, including low-level image feature extraction, similarity measurement, and deriving high-level semantic features. We identify five major categories of the state-of-the-art techniques in narrowing down the ‘semantic gap’: (1) using object ontology to define high-level concepts; (2) using machine learning methods to associate low-level features with query concepts; (3) using relevance feedback to learn users’ intention; (4) generating semantic template to support high-level image retrieval; (5) fusing the evidences from HTML text and the visual content of images for WWW image retrieval.

LITERATURE SURVEY

Literature survey is the most important step in software development process. Before developing the tool it is necessary to determine the time factor, economy and company strength. Once these things are satisfied, then the next step is to determine which operating system and language can be used for developing the tool. Once the programmers start building the tool the programmers need lot of external support. This support can be obtained from senior programmers, from book or from websites. Before building the system the above consideration are taken into account for developing the proposed system.

I. A Survey, Content Based Image Retrieval Based on Color, Texture, Shape and Neurofuzzy

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, analyzed 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.

II. PROPOSED APPROACH

Relevance feedback is an interactive process that starts with normal CBIR. The user input a query, and then the system extracts the image feature and measure the distance

with images in the database. An initial retrieval list is then generated. User can choose the relevant image to further refine the query, and this process can be iterated many times until the user find the desired images.

Extracting the images based on two possibilities, one is by means of shape description and the other is by means of content description. Here three variations are used one is Region Based, Contour Based and the Content Based data retrieval schemes. User Query is deviated into database with proper content based schemes including RGB Color format. More defined ontology schemes are used to retrieve the data so the retrieval possibility is comparatively high and the user is escapes from the unwanted search results.

In earlier days, image retrieving from large image database can be done by following ways. We will discuss briefly about the image retrieving of various steps: Automatic Image Annotation and Retrieval using Cross Media Relevance Models. Concept Based Query Expansion. Query System Bridging the Semantic Gap for Large Image Databases. Ontology-Based Query Expansion Widget for information Retrieval. Detecting image purpose in World-Wide Web documents.

The k-means algorithm: Algorithm: k-means. The k-means algorithm for partitioning based on the mean value of the objects in the cluster.

Input: The number of clusters k and a database containing n objects.

Output: A set of k clusters that minimizes the squared-error criterion.

Method:

- (1) Arbitrarily choose k objects as the initial cluster centers;
- (2) Repeat
- (3) (Re) assign each object to the cluster to which the object is the most similar, based on the mean value of the objects in the cluster;
- (4) Update the cluster means, i.e., calculate the mean value of the objects for each cluster;
- (5) Until no change.

III. SYSTEM DESIGN

I) System Architecture

The major part of the project development sector considers and fully survey all the required needs for developing the project. Once these things are satisfied and fully surveyed, then the next step is to determine about the software specifications in the respective system such as what type of operating system the project would require, and what are all the necessary software are needed to proceed with the next step such as developing the tools, and the associated operations. Generally algorithms shows a result for exploring a single thing that is either be a performance, or speed, or accuracy, and so on. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system. System architecture can comprise system components, the externally visible properties of those

components, the relationships (e.g. the behavior) between them.

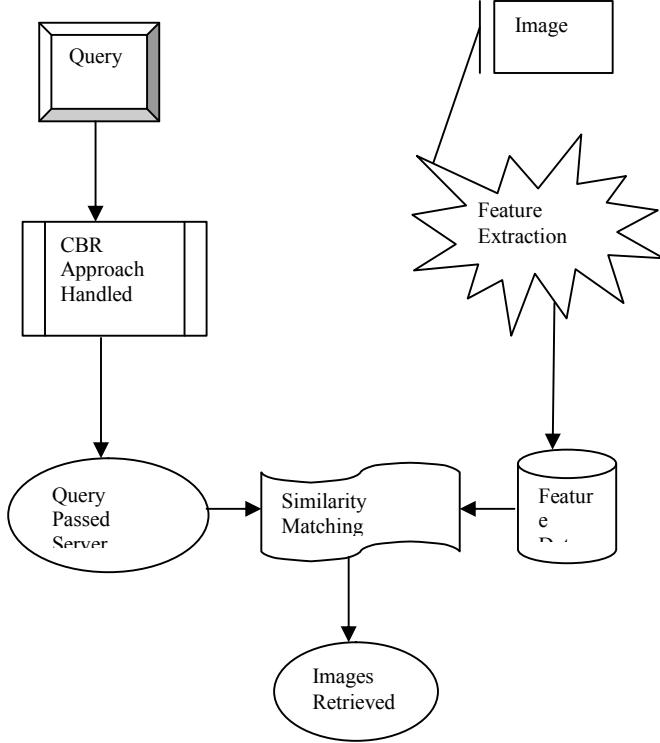


Fig.1 System Architecture

2) Modules

1. Content Based Image Retrieval
2. Querying Image Database
3. Ontological Approach
4. Wavelet Based Feature Identification

3) Content Based Image Retrieval

The content based image retrieval (CBIR) is one of the most popular, rising research areas of the digital image processing. Most of the available image search tools, such as Google Images and Yahoo! Image search, are based on textual annotation of images. In these tools, images are manually annotated with keywords and then retrieved using text-based search methods. The performances of these systems are not satisfactory. The goal of CBIR is to extract visual content of an image automatically, like color, texture, or shape. This paper aims to introduce the problems and challenges concerned with the design and the creation of CBIR systems, which is based on a free hand sketch (Sketch based image retrieval – SBIR). With the help of the existing methods, describe a possible solution how to design and implement a task specific descriptor, which can handle the informational gap between a sketch and a colored image, making an opportunity for the efficient search hereby. The used descriptor is constructed after such special sequence of preprocessing steps that the transformed full color image and the sketch can be compared.

4) Querying Image Database

The ideal approach of querying an image database is using content semantics, which applies the human understanding about image. Unfortunately, extracting the semantic information in an image efficiently and accurately is still a question. Even with the most advanced implementation of computer vision, it is still not easy to identify an image of horses on a road. So, using low level features instead of semantics is still a more practical way. Until semantic extraction can be done automatically and accurately, image retrieval systems cannot be expected to find all correct images. They should select the most similar images to let the user choose the desired images. The number of images of retrieved set can be reduced by applying similarity measure that measures the perceptual similarity.

5) Ontological Approach

A well known method to implement the ontological model is called OWL (Web Ontology Language), which is the leading data-mining and personalization package for managers and business-people. Simple and intuitive to use, yet powerful enough to provide you with accurate answers, Owl gives you results that you can understand. Owl uses the three capabilities of Understanding, Visualization, and Prediction to perform "unsupervised clustering" and tell you about what groups of customers you have; to let you see how your customers group together; and to predict what your customers are going to want to buy next.

6) Wavelet Based Feature Identification

The wavelet transform represents a function as a superposition of a family of basic functions called wavelets. Wavelet transforms extract information from signal at different scales by passing the signal through low pass and high pass filters. Wavelets provide multi-resolution capability and good energy compaction. Wavelets are robust with respect to color intensity shifts and can capture both texture and shape information efficiently. The wavelet transforms can be computed linearly with time and thus allowing for very fast algorithms. Discrete wavelet transformation (DWT) is used to transform an image from spatial domain into frequency domain. The wavelet transform computation of a two dimensional image is also a multi-resolution approach, which applies recursive filtering and sub-sampling.

IV. CONCLUSION

A novel feature extraction a technique is designed which consists of textural features, and are combined with color features. The features are extracted based on color histogram and wavelet based techniques. Further the classification of the images is carried out based on minimum distance classification technique known as nearest neighbor classification. The method is found to be effective and robust, in terms of accuracy and variety of images considered. The aggregate accuracy of method is found to be 92.4% which is effective and is comparable with other methods in this area. The developed system which uses textural features and color

histogram features has more favorable results for images with similar color appearances but has limitation in selecting images with finer changes.

FUTURE WORK

The method is found to be effective and robust, but in terms of accuracy and variety of images will be more considered in our future analysis. The aggregate accuracy of method will be extracted by 92.4% in future, which is more effective and is comparable with alternate methods like Content Based Image Retrieval in this area. The developed system is improvised by means of its accuracy and performance improvements, in which it uses textural features and color histogram features has more favorable results for images with similar color appearances and also it overcomes the limitation in selecting images with finer changes.

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