Volume 6, Issue 3, March 2016 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Survey on Content Based Image Retrieval Technique

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Abstract— As there is a rapid development in the multimedia technologies,the users find difficulties in retrieving information with traditional image retrieval techniques. The CBIR techniques are becoming a efficient techniques for exact and fast retrieval. CBIR is the technique which uses visual features of image such as color, shape, texture etc, to search the image based on the user requirements from large database according to the user request in the form of a query. In this paper various techniques of CBIR such as k-means clustering, k-nearest neighbors Algorithm(KNN), colorstructure descriptor(CSD), Text based image retrieval (TBIR) techniques which increase the effectiveness of fast retrieval are discussed and analysed.

Keywords— k-mean clustering; content based image retrieval(CBIR); shape; color; texture; color structure descriptor(CSD); text based image retrieval(TBIR).

I. INTRODUCTION

Image retrieval process is searching and retrieving images from large data sets .As the images grow diverse and complex, retrieving the right images becomes a difficult challenge. With the development of internet and the inventions of image capturing devices like digital cameras, image scanners , the size of the digital image collection has increased rapidly it is very difficult for storing and retrieving digital images which have different application such as fashion design, medicine, architecture, crime prevention, virtual museums, military and security features and personal photo albums. Therefore an efficient image retrieval system is required. The image retrieval system is classified into two types such as Text based image retrieval and Content based image retrieval. The text based image retrieval was introduced in the year 1970s in this method the images are manually tagged by text descriptors which are used by database management system(DBMS) for performing image retrieval. But the text based retrieval method has a lot of demerits such as loss of information, time consuming, more expensive task, inaccuracy and decreased efficiency. To overcome these problems the content based image retrieval method is proposed.

II. CONTENT BASED IMAGE RETRIEVAL

Content Based Image retrieval is the process of searching and retrieving images from the huge set of database based on the automatically derived features or visual content such as color, texture, shape and edge on the basis of user's request by means of query. In other words the content based image retrieval (CBIR) is explained as follows the term 'content' refer to the color, shape, texture and image layout which describes the image. "content based" means the search is performed using the actual content like the color, shapes and texture of the image."Image retrieval" means searching and retrieving images from large datasets of digital images[1]. The main objective of CBIR is increased retrieval accuracy with the reduced retrieval time. In order to meet the above requirements the CBIR works in two steps, the first one is the 'feature extraction'which identifies the feature vectors also known as the unique features of the image based on the pixel value.Another step is the 'similarity matching' which compares the features of the query image with the image in the database and match the image according to their similarity. The difference between the query image and the retrieved image is the 'semantic gap' in the CBIR system. The system is said to be efficient only if the 'semantic gap' is minimum[2].

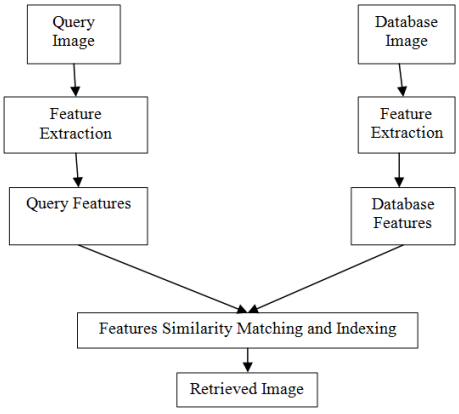

Fig 1 Process flow of Image Retrieval System

The Fig 1 shows the process flow of the image retrieval system and is described as follows:

- Collection of Database: The database contains the collection of images which are stored in any one of the formats .jpg, .bmp, .tiff.
- Query: The user provides the sample image or the sketch of the image as a query for the system.
- Feature extraction: There are various kinds of visual features to represent an image such as color, texture, size and spatial relationship. Single feature can represent the part of the image property. Hence the combination of all the features of an image are used for effective image retrieval. The details of different features are mentioned as follows:
  (a) General feature: features which are independent on applications such as color, shape and texture
  (b) Domain specific features: Features which depend on applications such as human faces, finger prints. These features are only used in specific domains.
- Similarity matching:
  Similarity matching involves matching the features which are visually similar, the most widely used similarity measure is the distance measure. The different distance measures are used such as Euclidean distance, City Block distance, Caneberra distance.
- Retrieval:
  The system retrieves the images based on the sequence of ranked images with the decreasing order of similarities.

III. RETRIEVAL BASED ON COLOR FEATURE

The color is the most important feature used in retrieving the images mostly based on color histogram. Color are defined on the selected color space. Common color features in CBIR system include color histogram, color moment and color correlogram.

A. Color Histogram

Color histogram describes the proportion of specific colors in an image and has been widely used technique used for content based image retrieval because of its efficiency and effectiveness. Color histograms have many advantages such as speediness and low demand of memory space. Color histogram provides HSV color space and RGB color space. Color histogram is computed based on the proportion of pixels of each color within the image. Once it is done. The color histogram of all computed image is stored in the database. While searching the image, the user can either specify the proportion of each color or submit the sample image from which the color histogram is calculated. Then the images which match with the images stored in the color histogram and the query most closely is finally retrieved[3]. The color structure descriptor represents an image by the image region which is similar to the color histogram and the local spatial structure of the color. To facilitate faster search over large database collection, Smith and Chang proposed color sets as the approximation of histograms.

1) RGB color space: The important color space is RGB color space which stands for Red-Green-Blue. This space consists of primary colors such as light Red, Green, Blue. It is the most widely used histogram in the field of computer graphics. This color histogram combines the Red, Blue, Green components to create a new color. To create a new color it is essential to increase the one or more components of the RGB color components.

2) HSV color space: HSV color space is defined based on the terms of three constituent components: Hue, Saturation, Value. Hue varies from the range of 0 to 1.0, the corresponding colors vary from red through yellow, green, cyan, magenta, and then again back to red. So that red takes both the values of 0 and 1.0. Saturation varies from 0 to 1.0, the corresponding values varies from unsaturated colors to fully saturated. As value(brightness) varies from 0 to 1.0, the corresponding colors become more brighter.

B. Color Correlogram

Color correlogram are the special feature about the color information of an image. Color correlogram and the color coherence vector has the advantage of combining the spatial correlation of color regions to describe the global distribution of local spatial correlation of colors[2]. It also produces better results in retrieving the images when compared to the traditional color histogram methods.

C. Color Moments:

The color moments are used to differentiate the image based on the color feature of the image. It provides the measure of color similarities existing between the images. These similarity values are used to compare the images stored in the database for effective image retrieval. The color histogram, color correlogram and the color sets only describes the color feature of an image but the color moments calculate the measure of color similarity between the images and the calculated measure is used to retrieve the image from the large set of database with more accuracy in less computational time.

IV. RETRIEVAL BASED ON TEXTURE FEATURE

The texture feature is the important visual information used for image retrieval. Textures are defined as the differences in brightness with high frequencies in image spectrum. They are used to differentiate the images with same color. Large amount techniques are available for measuring the texture similarity. There are different approaches for extracting and representing the textures, they are classified as space based, frequency based and texture signatures and the techniques used are wavelet transform, co-occurrence matrix and Gabor filter[2]. Most techniques rely on comparing the values known

as second order statistics which are calculated from the query and the stored images. These methods calculate the measures of image texture such as contrast, coarseness, directionality, randomness, stiffness, roughness, line likeness and regularity[4].

A. Wavelet Transform:

Wavelet transform transforms the image in the form of multiscale representation with spatial and frequency characteristics. It allows effective image analysis with lower computational cost. Wavelet transform is the popular tool used in the field of image processing and computer vision. Wavelet transform is used in both the texture and shape feature. It is used in many applications such as detection, compression, image retrieval and recognition.

B. Gabor Filter:

Gabor filter is the most widely used technique to extract texture features for image retrieval[5]. Manjunath and ma[6] proposed that gabor filter outperforms by using Pyramid-structure wavelet transform(PWT) features and tree structure wavelet transform (TWT) feature.

V. RETRIEVAL BASED ON SHAPE FEATURE

It the important requirement at the primitive level. It is known that all the natural objects are recognized by their shapes. Inimage retrieval methods, depending on the applications some needs the shape representation such as translation, rotation and scaling. Two important types of shape features are commonly used –global features such as circularity, aspect ratio and moment invariants and the local features such as consecutive boundary segments[2]. The shape representation can be classified into two category :

- Boundary based which uses the boundary or the outline of the shape.
- Region based which uses the entire region of the shape.

The techniques used for shape feature are fourier descriptor, template matching, elementary descriptor, canny edge detection, quantized descriptor[7]. Shape features are not mostly used in retrieval process when compared to the color and texture feature because of inherent complexity of representing shapes.

VI. RETRIEVAL BASED ON CLUSTERING TECHNIQUES

Clustering is the technique that can be classified into supervised clustering and unsupervised clustering. The former method uses hierarchical clustering and needs human interaction for generating the clusters. In the later method no labeled data are used. The main objective of clustering is to separate the finite unlabeled date set into the finite hidden data structures.

A. Relevance feedback:

A relevance feedback method allows the user to interact with the image retrieval algorithm by representing the information of an image which the user thinks that it is relevant to the query. Keyword based image retrieval in performed by matching the keyword based on the user input with the image in the database. However some images may not have correct keywords to describe the image and therefore the image retrieval becomes difficult. Relevance feedback provides the solution to the above mentioned problem and uses user feedback to reduce the error and redundancy[8]. It also uses Bayesian classifier to generate positive and negative feedback. To produce more accuracy log based clustering methods are used.

B. Log based clustering:

Log based clustering clusters image based on the logs maintained by the image retrieval system. The session keys are generated and used for retrieval. By using this session clusters are formed. Each and every session cluster generates log based documents and similarity image matched is retrieved. Log based vector is generated for each session vector based on the log based documents. The unaccessed documents generates its own vector, the each session cluster is replaced with the vector. Hybrid cluster is created with one document vector and one log based clustered vector. With this combination hybrid matrix is created and it is difficult to perform on multidimensional images.To overcome this problem hierarchical clustering created.

C. Hierarchical clustering:

Hierarchical clustering(HC) algorithm organize the data in the hierarchical structure based on the proximity matrix. The result of the HC are usually described by binary or the dendrogram[7]. The root node of the dendrogram describes the entire data set and the leaf nodes represent the data object. The intermediate node represents that the objects are proximal to each other. The height of the dendrogram is expressed as the distance between the cluster or each pair of objects. HC algorithm is classified into two methods such as agglomerative method and divisive method. Agglomerative method starts with the forming clusters and each cluster has exactly one object. The divisive cluster is opposite to the agglomerative cluster. In divisive cluster initially the whole data set belong to the same clusters and is divided until each object forms a single cluster. With the requirements of handling large data sets in data mining the HC clustering algorithms have greatly improved the clustering performance. Some techniques used in the clustering algorithm are CURE, ROCK, BIRCH.

D. Retrieval dictionary based clustering:

A rough classification retrieval system is generated. This is generated by calculating the distance between the two learned patterns and these learned patterns are categorized into different clusters and then the retrieval is carried out. The drawback of this method is the determination of distance.

To overcome this problem retrieval dictionary based clustering is developed. This method uses the image retrieval unit that classifies the learned patterns into clusters and generate the retrieval dictionary using clusters. Then the image is retrieved between the spheres with different radii. An image which is similar to the query is retrieved using retrieval dictionary.

E. NCut algorithm:

The NCut algorithm organizes the nodes to from a group so that the similarity within the group is high or the similarity between the groups is low. This method is repeatedly applied to get more than two clusters. In this method each time the subgraph with more nodes is separated. The process continues until the threshold T is exceeded. The recursive NCut is similar to the hierarchical divisive clustering method which results in the formation of the tree structure.

F. K- Means clustering:

It is the non hierarchical clustering method it takes the number of components of the population equal to the final number of clusters required. The total number of clusters needed at the end is chosen at the beginning stage itself. Then it examines each component in the population and assigns it to the cluster with minimum distance. The centroid's position is calculated every time a each component is added to the cluster and continues until all the components form a number of clusters needed at the end. The K-Means algorithm is very simple and can be implemented easily. The time complexity of K-means algorithm is O[9].

G. Graph theory based clustering:

The concepts and the properties of graph theory make it easy to produce clustering problem based on graphs. The nodes in the weighted graph represents the data points in the pattern space and the edge represents the proximities between each pair of data points. The graph based clustering techniques is used in the construction of the minimum spanning tree MST. The MST is used for detecting clusters of any size and shape regardless of the number of the cluster.

H. Divide and conquer K-means:

When the data set size is too large, the data set is divided into different subsets and the different cluster algorithm is applied on different subsets. It is called as divide and conquer method. The divide and conquer algorithm first divide the data set into subsets based on the specific requirements, and again the subsets are clustered based on the K-means clustering algorithm[10]. The advantage of this method is it reduces complexity produce accuracy in search.

I.K-Nearest neighbor algorithm:

K-Nearest neighbor algorithm is also known as KNN, whish classifies the data set in order to distinguish which data belongs to which data set. The main objective of this algorithm is to classify objects based on the attributes. KNN algorithm classifies the query image and the database image.

VII. PERFORMANCE MEASURES

The performance of CBIR is defined by the terms precision and recall. These are the standard measures used by CBIR. These measures are used to improve the image retrieval[11].

A. Precision:

Precision is defined as the ratio of the number of relevant images retrieved to the total number of images retrieved.

$$\text{Precision} = \frac{\text{Number of relevant images retrieved}}{\text{Total number of images retrieved}}$$

B. Recall:

Recall is defined as the ratio of the number of relevant images retrieved to the total number of relevant images

$$\text{Recall} = \frac{\text{Number of relevant images retrieved}}{\text{Total number of relevant images}}$$

VIII. APPLIACTIONS

- The advantages of the CBIR system ranges from the simple user searching for the image in the web
- Picture Recognition in Crime Prevention
- Geographical Information and Remote Sensing
- Medicine Diagnosis
- Fashion and Publishing
- Architectural and Engineering Design

IX. CONCLUSION

The purpose of this survey is to provide an overview in the functionality of content based image retrieval. Some of the methods use color and texture feature to retrieve the images and few methods use shape features. CBIR method has been widely used in various areas to improve the performance of the system and achieve better results in different applications. In this paper the efficiency of the image retrieval is improved by means of K-Means clustering algorithm. The experiments achieve good performance and demonstrate the efficiency and robustness of the system.

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