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Content Based Image Retrieval System using Clustering with Combined Patterns

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ABSTRACT

This paper presents content-based image retrieval (CBIR) system for the multi object images and also a novel framework for combining all the three i.e. color, texture and shape information, and achieve higher retrieval efficiency. Color, texture and shape information have been the primitive image descriptors in content based image retrieval systems. The goal is to retrieve those images from the database, which contains the query object, which is a difficult problem when an image consists of multiple objects with arbitrary pose. The color moments and moments on Gabor filter responses of these tiles serve as local descriptors of color and texture respectively. The combination of the color, texture and shape features provide a robust feature set for image retrieval. The experimental results demonstrate the efficiency of the method. The proposed approach is simple and easy to adopt. The proposed system shows good results in terms of improvement in retrieval quality, in comparison with the literature.

Keywords : Content-Based Image Retrieval, Clustering, Region Based Image Retrieval, CBVIR, CBIR

I. INTRODUCTION

In the past many content-based image retrieval systems have been proposed using different visual features. Shape is one of key feature used by humans to differentiate between two objects. However the success of shape based image retrieval has been limited to image databases containing single object or for domain specific application. This is because the automatic shape segmentation of different objects from the image is a difficult problem .Color, texture and shape features have been used for describing image content. Different CBIR systems have adopted different techniques. Few of the techniques have used global color and texture features where as few others have used local color and texture features. The latter approach segments the image into regions based on color and texture features. The regions are close to human perception and are used as the basic building blocks for feature computation and similarity measurement. These systems are called region based image retrieval (RBIR) systems and have proven to be more efficient in terms of retrieval performance. Few of the region based retrieval systems, e, g, compare images based on individual region-to-region similarity. These systems provide users with rich options to extract regions of interest. But precise image segmentation has still been an open area of research. It is hard to find segmentation algorithms that conform to the human perception. For example, a horse may be segmented into a single region by an algorithm and the same algorithm might segment horse in another image into three regions.

II. CONTENT BASED IMAGE RETRIEVAL (CBIR) TECHNOLOGY

Content based image retrieval (CBIR), also known as query by image content (QBIC) and content-based

visual information retrieval (CBVIR) is the application of computer vision techniques to the image retrieval problem, that is, the problem of searching for digital images in large databases.

Content-based image retrieval is opposed to traditional concept-based approaches."Content-based" means that the search analyzes the contents of the image rather than the metadata such as keywords, tags, or descriptions associated with the image. The term "content" in this context might refer to colors, shapes, textures, or any other information that can be derived from the image itself. CBIR is desirable because searches that rely purely on metadata are dependent on annotation quality and completeness. Having humans manually annotate images by entering keywords or metadata in a large database can be time consuming and may not capture the keywords desired to describe the image. The evaluation of the effectiveness of keyword image search is subjective and has not been well-defined.

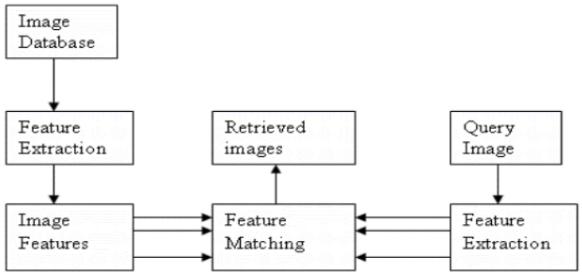

Fig. 1Architecture of CBIR system

CBIR Classification

Content-based retrieval methods can be classified into classes depending on the features they use such as color, texture, and shape. Each features class is further divided into subclasses by the type of the algorithm used for constructing the feature vector. Shape features are further divided as boundary based and region based feature extraction methods. In the literature, some researchers classify spatial features of images into a separate class.

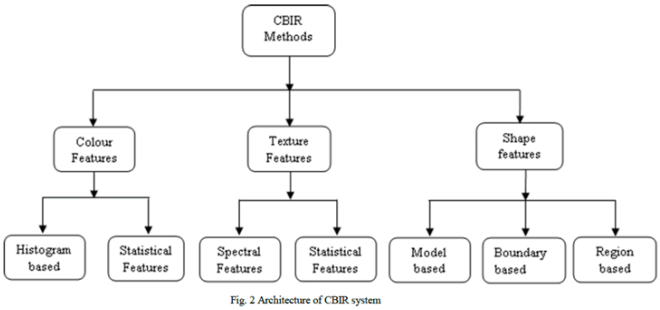

Fig. 2 Architecture of CBIR system

III. COLOR FEATURE

Color feature is the most significant one in searching collections of color images of arbitrary subject matter. Color plays very important role in the human visual perception mechanism. All methods for representing color feature of an image can be classified into two groups: color histograms and statistical methods of color representation. The most frequently used color spaces are as follows: RGB (red, green, and blue used in color monitors and cameras), CMY (cyan, magenta and yellow), CMYK (cyan, magenta, yellow, and black used in color printers), Lab (CIE L*a*b, lightness, a and b are two color dimensions, from green to red and from blue to yellow) HSI, HSV (hue, saturation, and value).

TEXTURE

Texture gives us information on structural arrangement of surfaces and objects on the image. Texture is not defined for a separate pixel; it depends on the distribution of intensity over the image. Texture possesses periodicity and scalability properties; it can be described by main directions, contrast, and sharpness. Texture analysis plays an important role in comparison of images supplementing the color feature.

Step 1: Initialization

Randomly select k centroids (m1, m2, ..., mk)
For each point x
Find $1 \leq l \leq k$ such that distance(x, ml) is minimum
Add x to cluster Cl and update centroid ml.
End For

Step 2: Negative Contribution Points

For each cluster Cl
For each point x א Cl
If contribution(x, Cl) < 0
Move x to a cluster Cp such that contribution (x,Cp) is maximum Update
centroid mp
End If
End For
End For

Step 3: Positive Contribution Points

For each cluster Cl
For each point x א Cl
If contribution(x, Cl) ≥ 0
Move x to a cluster Cp such that
is maximum
Update centroid mp
End if
End for
End for

IV. EXPERIMENTS AND RESULTS

Our test data consisted of 777 images belonging to 18 categories obtained from the University of Washington's Object and Concept Recognition for CBIR research project image data set . Each category contained varying number of images. All the images contained a textual description mentioning the salient foreground objects. The images were clustered using our algorithm with the initial centroids chosen at random. The cluster whose centroid was closest in distance to the given test image was determined and the images belonging to the cluster were retrieved. The results were then compared with images retrieved using the k-means clustering algorithm with the same set of initial centroids. Some of the retrieved images for sample test images are given in Table I. The following performance measures were used to evaluate the performance of the algorithm.

Precision =Total number of retrieved relevant images /Total number of retrieved images
Recall =Total number of retrieved relevant images/ Total number of relevant images

V. CONCLUSION

In this survey the different clustering techniques are discussed, which are used in existing CBIR systems. Earlier CBIR systems consist of low level feature extraction such as color, texture and shape and similarity measures for the comparison of images. But later on different image features and clustering techniques are used for Image retrieval. It is observed that among all clustering techniques, K-Means is widely used clustering technique in the process of content based image retrieval. K-Means performs efficiently and reduce elapsed time.

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