Review of Techniques used for Content based Image Retrieval

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Abstract— Now-a-days in research field Content-Based Image Retrieval has gained a significant importance. As collections of images are growing at a rapid rate, need of effective tools for retrieval of query images from database has increased significantly. Among them, content-based image retrieval systems (CBIR) have become very much popular. Content Based Image Retrieval method uses various visual features of image such as color, shape, texture, etc., it thus provide a way to find images in large databases by using unique descriptors. This paper reviews various CBIR methods. Also we propose a CBIR method that uses a combination of wavelet transform and color histogram that increases the efficiency and performance of the CBIR which can further determined by experimental results.

Keywords— Content Based Image Retrieval, Color, Texture, shape, Color Histogram, Color Spaces, Quantization, Similarity Matching, Wavelet Transform.

I. INTRODUCTION

Content Based Image Retrieval (CBIR) is a technique which helps us in accessing and arranging the digital images from large databases by using the image features. In today’s world with the enhancement of social networks many images in digital form are uploaded daily. In order to handle this huge data new methods are required. Thus CBIR is a technique that provides easy data handling so that user can easily access the data. The rapid increase in amount of digitally produced images requires new methods for collections and access. The images can be retrieved using image features such as color, texture and shape.

Unlike the traditional approach of using keyword annotation as a method for searching images, a CBIR system performs retrieval based on the similarity of feature vectors such as color, texture, shape and other image content.

Most CBIR systems work in similar fashion. A feature vector is extracted from each image in the database and the set of all feature vectors is organized as a database index. When images having similarity are searched with a query image, a feature vector is extracted from the query image and is matched against the one present in the index. Differences between systems actually lie in the manner in which features they extract and also algorithms used to extract those features. The block diagram of a basic CBIR system is shown in Figure 1.

A. Color Based Retrieval

Most important feature in retrieving a digital image is color. There are various methods used to retrieve the color feature. Color is independent of the size and orientation of the digital image. Color histogram is the commonly used method for color feature extraction in digital images. Color histograms are widely used for CBIR systems in the image retrieval area. Thus it is one of the most common methods. The image histogram shows the variations of gray levels from 0 to 255, these all values cannot be used as a feature vector as the dimension is too big to be stored or compared. The image histogram must be sampled into the number of bins to reduce the size of feature vector. Color histograms have the advantages of speed and low memory space [5].

B. Texture Based Retrieval

Texture is the regular pattern on the surface of any object. The texture of an image can be extracted using GLCM (Grey level co-occurrence matrix), Wavelets, Fourier transform, entropy, correlation are the methods used. GLCM feature extraction technique is most commonly used, because of its similarity to the human visual system features. The features extracted by use of GLCM are energy, entropy, correlation etc. Wavelets are the complex form for texture feature extraction. In wavelets, the wavelets are discretely sampled and separated in to different sub bands [5].

C. Shape Based Retrieval

There are various methods for the extraction of shapes from digital images. Some of them include contour based shape extraction, Region based shape extraction, Boundary based methods and generalized Hough transform (GHT) etc. GHT is most common method used in shape extraction technique.
II. RELATED WORK

Authors in [2], learning to combine ad-hoc Ranking Functions for Image Retrieval, this approach used is ad-hoc Ranking Functions with Support vector machines (SVM). This method cannot construct the ranking features by investigating the various image visual features. In [4], Navigation-Pattern-based Relevance Feedback (NPRF) Approach is used by researchers. This Approach has very high efficiency and effectiveness of CBIR in handling with the large-scale image databases. In terms of efficiency, the iterations of feedback are reduced substantially with use of navigation patterns that are discovered from the user query log. It supports a large set of downloaded images. It supports the minimum number of logs, and most relevant seeds. In [4], latent semantic indexing (LSI) method is used that supports the downloaded natural images. This method is especially suitable for mass image databases such as web environment. In [6], algorithm used is Recursive orthogonal least squares (ROLS). The advantages of this approach are less computer memory, Network reduction to achieve smaller architectures with acceptable accuracy and without retraining. Online adaptation cannot be done in this method. So the future work can lead to an approach for on-line adaptation of both the structure and weights of an RBF network, which is useful for application to time-varying problems.

In [5], “Learning from Negative Example in Relevance Feedback for Content-Based Image Retrieval”, a method which is a combination of Relevance Feedback with discriminators are used. Here negative examples are combined with positive example to identify important features to be used in retrieval process. In [6], random walker algorithm is used. Each unlabeled image is ranked according to the probability that a random walker starting from that image will reach a relevant seed before encountering a non-relevant one. This method it’s easy to implement, it has no parameters to tune and scales well to large datasets. It can give a performance of 95% and can extend to other visual features too. In [7], Geometric Optimum Experimental Design for Collaborative Image Retrieval, the algorithm used is GOED algorithm (geometric optimum experimental design). Collaborative image retrieval in this approach aims to reduce the labeling efforts of the user by resorting to the auxiliary information. Enhance the performance of image retrieval. By minimizing the expected average prediction variance on the test data, GOED has a clear geometric interpretation to select a set of the most representative samples in the database iteratively with the global optimum. This approach retrieved only shape and texture from synthetic datasets and real world image database. The retrieval performance is good .In [8], Combining positive and negative examples in relevance feedback for content-based image retrieval minimize the intra dispersion between positive examples. Here the partial information needs of the user are totally denied. This method is implemented in a set of downloaded natural images. Euclidean distance is used as the similarity measure here. It gives a better accuracy compared to existing approaches. In [9], Radial basis functions are used for implementation. Neuro-Fuzzy control (NFC) exhibits greater robustness with large changes in plant dynamic. And moreover no tuning is needed. By using Tuning Parameters, good classification accuracy can be used. In [10], Radial basis functions are used to implement Satellite images of land region. This approach is most useful for queries involving texture patterns that represent a region of interest, nonlinear kernel for the evaluation of image similarity.

A. Content-Based Image Retrieval Using Wavelet-based Salient Points

In this authors idea is first to extract salient points in the image and then in their location to extract local color and texture features. It is quite easy to understand that using a small amount of such points instead of all images reduces the amount of data to be processed. Moreover, local information extracted in the neighborhood of these particular points is assumed to be more robust to classic transformations (additive noise, affine transformation including translation, rotation and scale effects, partial visibility, etc.). The content-based image retrieval can be improved by using the local information provided by the wavelet based salient points. The salient points are able to capture the local feature information and therefore, they can provide a better characterization for object recognition. [13]

B. Content Based Image Retrieval Systems Using Wavelet And Curvelet Transform

In this authors have implemented a CBIR system using different feature of images through four different methods, two were based on analysis of color feature and other two were based on analysis of combined color and texture feature using wavelet coefficients of an image. To extract color feature from an image, one of the standard ways i.e. color histogram was used in YCbCr color space and HSV color space. Daubechies’ wavelet transformation and Symlet’s wavelet transform were performed to extract the texture feature of an image. In this paper a color image retrieval system is illustrated, in which the novelty lies in the use of a fuzzy partition of the HSV color space and wavelet transformation of the fuzzified new image. To increase efficiency of the system finally an image retrieval method was proposed using curvelet transform of an image, which provides an opportunity to extract more accurate texture feature for image retrieval [12].

C. Content Based Image Retrieval Using Curvelet Transform

In [14] a new image feature based on curvelet transform has been explained in which first they apply discrete curvelet transform on texture images and compute the low order statistics from the transformed images. After that images are represented using the extracted texture features. Also they describe the theory and implementation of curvelet, apply curvelet transform to a standard image database, and compare its retrieval result with the best texture features in literature Gabor filter feature and wavelet feature. The digital curvelet transform is employed using the fast discrete curvelet transform. Basically, it is implemented in the spectral domain to employ the advantage of FFT, Given an image, both the image and the curvelet are transformed into Fourier domain, and then the convolution of the curvelet with the image in spatial domain becomes the product in Fourier domain. Finally the curvelet coefficients are obtained by applying IFT on the spectral product. Figure 4 illustrates the complete feature extraction process using a single curvelet.
D. Localized Image Retrieval Based on Interest Points

This is a novel method for content-based image retrieval based on interest points. Interest points are being detected from the scale and rotation of normalized image. Then this image is divided into a series of sector sub-regions with different area as per the distribution of interest points. With robustness to the image’s scale, rotation and translation, local features of every sector sub-region are extracted for describing the image and also to make the similarity measure. In the relevant feedback phase, images are regarded as multi-instance (MI) bags, and to compute the target image feature MI learning algorithm is used. At last, the similarity is recalculated. Due to localized content-based image retrieval method by using interest points. The image gets divided into a series of sector sub-region with different area according to the distribution of interest points, also local features with the spatial distribution of interest points are extracted, which is robust to the image’s rotation, scale and translation. By the introduction of MI learning, it is assumed that the method further improves the accuracy of image retrieval.

Another one in this is retrieval based on Neuro Fuzzy, this technique divide into two stages. Stage 1: the query to retrieve the images from database is prepared in terms of multi-instance (MI) bags, and to compute the target image feature MI learning algorithm is used. At last, the similarity is recalculated. Due to localized content-based image retrieval method by using interest points. The image gets divided into a series of sector sub-region with different area according to the distribution of interest points, also local features with the spatial distribution of interest points are extracted, which is robust to the image’s rotation, scale and translation. By the introduction of MI learning, it is assumed that the method further improves the accuracy of image retrieval.

In our proposed method we are going to use a combination of wavelet transform and color histogram for Content Based Image Retrieval from large dataset [17] of images taken for experimental results. The algorithm explaining the project flow shall be as follows.

a) Load a Query Image for test.
b) Ask from user how many images are to be retrieved.
c) Apply the Wavelet Transformation and Color Histogram using RGB and HSV model for feature extraction.
d) After Feature Extraction apply similarity measures and at same time distance calculated shall be the Euclidean distance not the Canberra distance obtained by combining separate feature extracted.
e) Number of similar images would be in output and image that has a lower distance value is considered the similar image.

The general flowchart of proposed system is as shown in figure 4.

IV. APPLICATIONS

CBIR has many applications in almost all fields of life. Some software manufactures are using CBIR based applications into the internet medium and law enforcement fields for identifying the criminals and to censor the images with skin-color. Zoomy Images, a stock photo enhanced its service by utilizing CBIR in its Visually Similar Images and Reverse Image Search functions, allowing clients to view more accurate search results. In fine arts, Medical Image Databases, for example CT, MRI, Ultrasound, also Scientific Databases and general Image Collections for Licensing along with Architectural and engineering design including fashion and publishing.

CONCLUSIONS

The main contribution of this paper 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. There are various applications of CBIR in every fields of life like blood cell detection, archeology, criminal investigation, satellite etc. Thus, field of CBIR is very useful and it’s a real boon to the human life. Apart from this we propose a system in future using combination of techniques available so that the efficiency and accuracy of image retrieval is increased accordingly. Also we have tried to review the work done by researchers for implementation of CBIR in different way such by using curvelet transform, use of fuzzy logic as well as based of local point of interest. Thus after reviewing different techniques it can be concluded that as an interesting research area with many methods available a new approach can be still devised to give a better result in retrieving much similar image for large database. To propose such a method still remains a challenging issue.
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