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A Research Paper on Content Based Image Retrieval Techniques

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Abstract – ***CBIR is the field of representing, organizing and searching images based on their content rather than image annotations. The image retrieval is interesting and fastest developing methodology in all fields. In CBIR system the images are stored in the form of low level visual information due to this the direct correlation with high level semantic is absent. Content-based image retrieval uses the visual contents of an image such as color, shape, texture, and spatial features to extract and index images.***

Keywords-component – CBIR, SVM, Fuzzy C Mean, Relevance Feedback

I. INTRODUCTION

Content-based retrieval uses the contents of images to represent and access the images. A typical CBIR system is divided into online image retrieval and off-line feature extraction. In off-line stage, the system automatically extracts visual attributes (color, shape, texture, and spatial information) of each image in the database based on its pixel values and stores them in a different database within the system called a feature database. In on-line image retrieval, the user can submit a query example to the retrieval system in search of relevant images. The system represents this example with a feature vector. The distances (i.e., similarities) between the feature vectors of the query example and those of the media in the feature database are then computed and ranked.

Components of CBIR System

1) Query Image: In this the image is found from the image database whether the image is present or not related to the input query.
2) Image Database: It consists of the collection of n numbers of images.
3) Feature Extraction: It separates visual information from the image and saves them as features vectors in a features database. Feature Vector compares the query image to another image.
4) Image matching: It compares the feature vector of images in the database to the feature vector of query images.
5) Resultant retrieved images: It finds the previously maintained information to find the matched images from database. The output will be the similar images having same or closest features as that of the query image.

Types of CBIR

1) General: We try to match a query image to an arbitrary collection of images.
2) Application specific: We try to match a query image to a collection of images of a specific type e.g. Finger prints, X-ray images of specific organs.

II. RELATED RESEARCH

Feature Extraction for CBIR

The CBIR system relies on color, texture and shape which are low level image features .The low level features are extracted from the database images and stored in a feature database. Similarly, the low level features are extracted from the query image and the query image features are compared with the database image features using the distance measure. Images having the least distance with the query image are displayed as the result.

Color Features

Color feature is the most intuitive and obvious feature of the image, and generally adopt histograms to describe it.

Color histogram's method has the advantages of speediness, low demand of memory space and not sensitive with the images 'changes of the size and rotation, it wins extensive attention consequently**.** Color features are extracted using color moments, color histogram, and dominant color.

Color Moments

The color distribution of the image is characterized by its moments. The first, second and third central moment of each of the color channels is stored as a color feature. If the value of the ith color channel at the jth pixel is pij, then the first moment mean ( ) is given by equation (1). The second moment standard deviation () is given by equation
(2). The third moment skewness () is given by equation (3).

$$\mu_i = \frac{1}{N}\sum_{j=1}^{N} P_{ij} \quad (1)$$

$$\sigma_i = \left(\frac{1}{N}\sum_{j=1}^{N}(P_{ij}-\mu_i)^2\right)^{\frac{1}{2}} \quad (2)$$

$$\gamma_i = \left(\frac{1}{N}\sum_{j=1}^{N}(P_{ij}-\mu_i)^3\right)^{\frac{1}{3}} \quad (3)$$

N in equation (1) to (3) is the total number of images.

Color Histogram

The histogram of an image is a graph which contains the occurrence of each intensity value found in that image, obtained by counting all image pixels having that intensity value. For an 8-bit grayscale image there are 256 different possible intensities. So, the histogram will graphically display 256 grayscale values showing the distribution of pixels amongst those numbers. Histograms can also be taken of color images. A color histogram is the representation of the distribution of colors in an image. It is a standard statistical description of the color distribution in terms of the occurrence frequencies of the different regions in a color. To create a color histogram, the color space has to be partitioned into regions. The 24 bit RGB color space has 224 different color regions. A histogram containing 224 bins is too large to be dealt. Hence the color space is quantized into a number of bins, where each bin represents a range of color values. The number of pixels in the image that falls in each of these ranges is counted to get the color histogram. The number of bins is decided based on the loss of precision tolerated and the memory requirement. Color histograms can be built in various color spaces.

Dominant Color

In region based image retrieval, the regions are segmented and the features are extracted for the regions. Due to the inaccuracy of the segmentation, the average color of a segmented region may be different from that of the original region. To obtain the dominant color of the image, first the histogram is obtained and then the bin with the maximum size is taken as the dominant color of the region. When the segmented region does not have a homogeneous color, then, the average color will not be a good choice for the color feature.

Texture Features

When it refers to the description of the image's texture, we usually adopt texture's statistic feature and structure feature as well as the features that based on spatial domain are changed into frequency domain. Texture features are extracted using Gray Level Co-occurrence matrix (GLCM), Gabor Transform and Tamura Features. These methods of extracting texture features are explained in the following section.

Gray Level Co-occurrence matrix (GLCM) The GLCM is created from a gray-scale image. The GLCM finds how often a pixel with a gray-level value i occurs either horizontally, vertically, or diagonally to adjacent pixels with the value j. It is given by the relative frequency of the occurrences of two gray-level pixels i & j, separated by d pixels in the θ orientation, where d is the displacement and θ is the direction. The _d' can take values 1, 2, 3, etc., and θ can take values 0° (horizontal), 90° (vertical), 45° and 135° (diagonal) (Rahman et al., 2007). The construction of the GLCM is shown in Figure 1. Several statistical texture properties like contrast, correlation, energy, homogeneity and entropy can be derived from the GLCM and the formulae are given in equations (5) through (9).

Tamura Features

Coarseness, contrast, directionality, line-likeness, regularity and roughness are the six Tamura features. Coarseness, contrast and directionality correlate strongly with the human perception, and hence they are very important.

Shape Features

Shape may be defined as the characteristic surface configuration of an object; an outline or contour. It permits an object to be distinguished from its surroundings by its outline. Shape representations can be generally divided into two categories:

Boundary-based, and Region-based.

Boundary-based shape representation only uses the outer boundary of the shape. This is done by describing the considered region using its external characteristics; i.e., the pixels along the object boundary. Region-based shape representation uses the entire shape region by describing the considered region using its internal characteristics; i.e., the pixels contained in that region.

III. PROPOSED WORK

CBIR Techniques

1) SVM Technique

Support vector machine is a supervised learning technique that analyzes data and identify pattern used for classification. Every image contains lots of information from which lots of information can be extracted. The first step in this method is to preprocess the image before storing them into the database. The aim of preprocessing is to enhance the quality of image and to remove noises from the image. The next step involves clustering of images using RGB components. The top ranked images are again clustered using SVM. Then comparison between target image and query image is done to retrieve the image based on input query.

2) Relevance Feedback

The concept of relevance feedback, consists of using user feedback to judge the relevance of search results an d therefore improve their quality through iterative steps .Moreover, by gathering feedbacks from the user a CBIR system can dramatically boost its performance by reducing the gap between the high-level semantics in the user's mind and low-level image descriptors.

Every use's need will be different and time varying. A typical scenario for relevance feedback in content-based image retrieval is as follows:

Step 1: Machine provides early retrieval results

Step 2: User provides opinion on the currently exhibited images based on the degree whether they are relevant or irrelevant to her/his request

Step 3: Machine learns the judgment of the user and again search for the images according to user query. Go to step 2

3) Fuzzy C-means Algorithm (FCM) based approach

It is an improved algorithm by extracting feature vector which comprises of shape and color from image. Fuzzy C-Mean clustering algorithm is used for segmentation. After successful segmentation boundary of the extracted object is converted into signature whose Fast Fourier Transform is calculated. FFT provide the array vector corresponding to the number of regions obtained after segmentation and is stored in database as first feature vector.

Segmentation based on FCM

Step 1: For query image, find out the clusters and its corresponding centre using FCM clustering approach.

Step 2: Apply connected component procedure in order to get connected regions or mask using segment mask and number of segments as input. For connected component procedure we use 4-connectivity.

Signature Development

For signature development use the actual image, region mask and number of regions obtained using segmentation as inputs. Generate the signature of the query image by combining the signature of the region mask.

4) Ranklet Transform Based Approach for Texture Extraction

Early studies on CBIR used a single visual content such as color, texture, or shape to describe the image. The drawback of this method is that using one feature is not enough to describe the image since the image contains various visual characteristics. Here, both color and texture features extraction from the image is used. Color and texture feature extract are simpler compared to other features.

Before we extract the texture feature from the image, we perform a pre-processing step using Ranklet Transform. The result of applying Ranklet Transform on the image is 3 Ranklet images in different orientation (vertical, horizontal, and diagonal). Ranklet Transform belongs to a family of nonparametric, orientation-selective, and multi resolution features that has the wavelet style. It has been used for pattern recognition and in particular to face detection. Later on, it has been used for testing and estimating 3D structure and motion of Objects .Ranklet Transform has been used in medical fields. It has been applied to the problems of tumoral masses detection in digital mammograms. Some tests show that Ranklet Transform performs better than some methods such as pixel-based and wavelet-based image representations. Ranklet Transform has three main properties. First, it is nonparametric that it is based on nonparametric statistics that deal with a relative order of pixels instead of their intensity values. Second, it is orientation selective that it is modelled on Haar wavelets. This means that for an image, vertical, horizontal, and diagonal Ranklet coefficients are computed. Finally, it is multi resolution that the Ranklet Transform can be calculated at different resolutions using Haar wavelet supports. The powerful of using Ranklet Transform as a pre-processing step is to make the image invariant to rotation and any image enhancement operations To calculate the texture moments for each ranklet image ,we have to calculate the ranklet histogram (*rh*) and the ranklet co-occurrence matrix (*rcmd,θ*), where

$$rh(i) = \frac{n(i)}{\sum_{j=1}^{21} n(j)} \qquad i,j = 1,2,\dots,21$$

$$rcmd,\theta = \frac{n_{d,\theta}(i,j)}{\sum_{l=1}^{21}\sum_{k=1}^{21} n_{d,\theta}(l,k)}$$

Where *n(i)* is the number of ranklet coefficients in the ranklet image taking value *rv(i)* = (- 1, -0.9, …, -0.1, 0, +0.1,…, +0.9, +1).

Now we can calculate Texture feature by using formulas for Code Entropy and Variance.

proposed method will use the randomly selected images to retrieve similar images from the database using the color feature only. The precision is calculated for each experiment and for each category. In the second phase, the proposed method will retrieve similar images from the database using the texture feature only. Also, the precision is calculated for each experiment. In the third phase, the proposed method will retrieve images similar to the input image according to the color feature and the texture feature. It is clear that it works very well when we use both color and texture feature to retrieve images similar to the input image. Also, using the combination of color and texture features to represent the image and retrieve images similar to it has more accuracy compared with only color feature or only texture feature.

V. CONCLUSION & FUTURE WORK

Almost all the tradition methods for CBIR uses metadata such as keywords, or descriptions to the images. So that retrieval can be performed over the annotation words. In this paper we conclude that CBIR involves the four parts data collection, build up feature database, search in the database, arrange the order and deal with the results of the retrieval. The real world requirements are Face Recognition, Biodiversity, Information System Art Collections, Scientific Databases, Medical science and so far.

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