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A Review on CBIR by Cascading Features & SVM

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Abstract: In the field of computer vision and image processing CBIR (Content based image retrieval) system become an active research area. The CBIR technique involves feature extraction based on image features (like color, shape and texture) and defining rules for comparing image. A classifier is also used by authors for image classification. For this purpose an image database taken from James Z. Wang research group website is used by many authors. Due to enormous increase in the size of database traditional methods of image retrieval by using keywords does not provide accurate result. Thus the concept of CBIR system is emerged. In last couple of years many method of feature extraction is developed but since now researcher are not able to develop a system which has gained high accuracy of human visual perception in distinguishing pictures. Therefore earlier researchers have concentrated to increase the retrieval accuracy of CBIR system by using different combination of features. The objective of this paper is to present review on a CBIR technique which combined four kinds of features set including every kind of feature for developing feature vector. Color based features (histogram), statistical features (mean, median and standard deviation), spatial features (Gabor feature and wavelet features) and texture features (GLCM) is used for forming feature vector. A SVM classifier is used with CBIR system to increase retrieval accuracy. SVM (support vector machine) is a machine learning classifier which provides good classification accuracy.

Keywords: CBIR, SVM, NN, GLCM, HSV Color space, Euclidean distance matrix.

I. INTRODUCTION

In this digital age we have large collection of images from all spheres of human life collected in an image database. In CBIR technique an image is retrieved from dataset by extracting feature of an image which includes color, shape & texture based features and a mechanism for CBIR is shown in figure 1 [8].The CBIR feature extraction technique is divided into three parts, these are

- Feature extraction.
- Similarity matching.
- Retrieved images.

The most commonly used feature for retrieving an image is color but with advance in technology we have different method for retrieving an image. During the improvement of internet services and ease of use of the capturing devices, the main requirement is to build up efficient and effectual methodologies to retrieve image and manage image database. Therefore we have some approach for feature extraction, these are

- Text Based Image Retrieval.
- Content Based Image Retrieval.
- Hybrid Based Retrieval.

A. *Text Based Image Retrieval*

Here image are annotated using classification codes, keywords or subject headings, which are used for retrieving image [8].This approach is not standard because different annotation or naming schemes is used for indexing of images and create a semantic gap .This technique give low precision rate because contents are not fully described, presence of many irrelevant words and polysemy problem, which mean that same annotation or word is used for different objects. [11]. Due to increase in database and presence of above stated problems, it gives rise to CBIR technique.

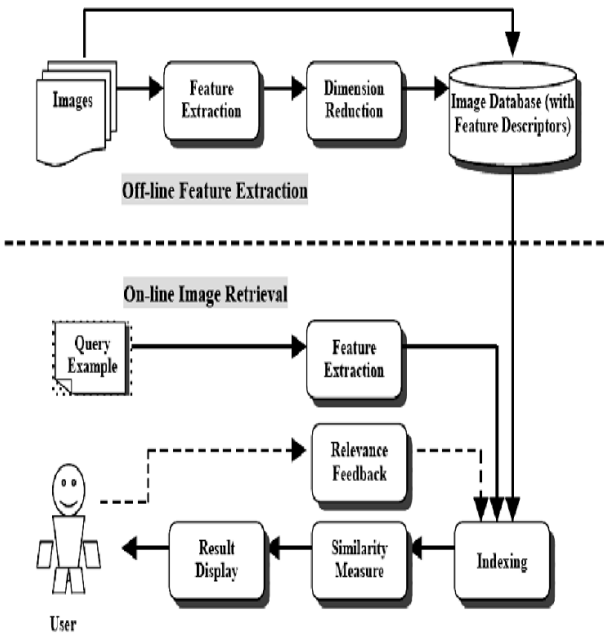

Figure 1 Mechanism of CBIR Method

B. *Hybrid Based Image Retrieval*

In this approach both technique Content based and text based are fused to get improved results. First method is based on occurrence frequency of words for indexing and extended by adding weights to words. Second method finds the correlation between visual and textual contents on unsupervised basis. But also this approach is not sufficient for solving retrieval problem [11].

II. CONTENT BASED IMAGE RETRIEVAL

CBIR system overcome the issue occurs during annotation of images. Here image is retrieved from an image database

based on image features which are automatically derived. For extracting an image we have different feature extraction techniques like color, shape and texture. As shown below:

A. Feature Extraction Based On Color

This feature generally used as it is the most well-known low level features and invariant to scaling, rotation and spatial transformation on the images. We have different color space for developing color histogram of an image for extracting color feature [1].To extract feature in RGB color space we construct probability histogram. First, we take RGB image as input and decompose into 3 color component (Red, Green and Blue) and then construct histogram of each color. For each color component probability histogram is calculated and further divides into n no. of non uniform bins. Then compute statistical features for each color component. A feature vector is formed by using the statistical feature which contains information about an image as shown in figure 2 [1]. These statistical features include mean, standard deviation, skewness and kurtosis.

1) Mean: It is calculated over a specific intensity range.

2) Standard Deviation: It measures the contrast exists in an image in a particular significant histogram bin. More the difference between standard deviation of a block histogram, more the contrast occurs in an image.

3) Skewness: It measure skewed intensity values in each block of the image about mean of that block. If skewness value is negative of a specific block, then most intensities values occurs on the right side of the mean and if having negative value then most intensities values occurs on then the left side of the mean. If skewness is zero then distribution of the intensity values about mean is equal.

4) Kurtosis: It measure the peak distribution of the intensity values about mean in a particular bin of the histogram. Kurtosis with high value represents sharp peak distribution and longer and fat tail occurs. Kurtosis with low value represents short and thin tail of intensity values and flat distribution.

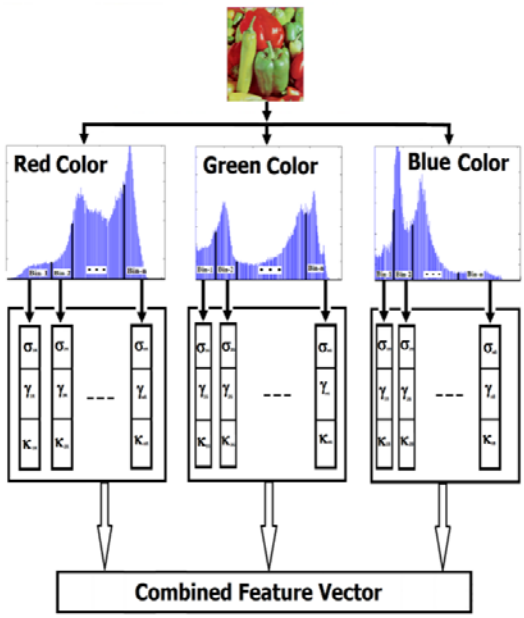

Figure 2 Feature Extraction Process

For similarity matching Euclidean distance matrix is used, which calculate distance between feature vector of query and retrieved image. Thus the retrieved image are index according to their distance between retrieved and query image. CMYK.YUV, CIE and HUV different types of color space are used for feature extraction. Like Hue saturation and value is used for developing color histogram in HSV color space [9].

B. Feature Extraction Based on Shape

Feature extraction using shape feature is important in object classification and recognition. This feature has been used with color and texture features. One of the shape feature extraction techniques is Hu-Moment shape features. Hu-moment [5] proposed seven properties that are invariant to RTS (Rotation, Scaling and Translation) used in feature extraction. Thus image become independent of position, orientation and size. Feature vector is formed by computing moment invariants from each of the window. For shape and class identification calculated property of region is used.

C. Feature Extraction Based on Texture

There is no clear-cut definition of texture in the domain of computer vision and image processing. Definition of texture is defined according to the analysis methods and feature extraction technique of texture. In a spatial domain a texture is defined as a repeated pattern of pixels. Due to noise and repetition of frequencies in a texture it appears as unstructured and random. A human eye perceives some texture property like regularity, directionality, smoothness and coarseness. Texture perception can be far more complicated in real world scenes. Due to many brightness intensities it gives rise to merging of the different human perception of texture. Texture property of an image describes visual patterns. This feature provides information about spatial relationship of intensities in an image. We have different texture feature techniques which are GLCM, Gabor Filter and Wavelet Transform feature extraction technique [5]. According to Manjunath and Ma, the generally used ways for texture feature description are applied mathematics, transform-based and model-based methods. The texture feature description categories are explained below.

1) Statistical Method: The statistical ways analyze the spatial distribution of gray values by calculating native options for every purpose in an image. By using Distribution of native options set of statistics is derived. They contain co-occurrence matrix illustration, statistical moments, autocorrelation function, gray-level variations and grey-level run lengths. Gray-level Co-occurrence Matrix (GLCM) is mostly used for texture property. The GLCM method finds the spatial relationship of pixels as shown in figure 3. GLCM matrix show spatial relation between picture elements with intensity value i and picture element with intensity value j. The GLCM consider some statistical features for feature extraction which are as follows:

- Correlation: This feature determines how much correlation occurs between a pixel and its neighbor over the whole image.

$$\sum_{i,j} \frac{(i-\mu_i)(j-\mu_j)p(i,j)}{\delta_i \, \delta_j} \qquad (1)$$

- Contrast: Measure variation in pixel intensity with its neighbor over the whole image.

$$\sum_{i,j}(i-j)^2 p(i,j) \quad (2)$$

- Energy: Sum of squared elements in GLCM.

$$\sum_{i,j}(i,j)^2 \quad (3)$$

- Entropy: Measures the complexity of the image.

$$\sum_{i,j} p(i,j) \quad (4)$$

The matrix consists by using two dimensions, which contain joint probabilities P□,(i, j) between pairs of pixels. These pair of pixel is separated by a specific distance 'd' in a specific direction 'r'. GLCM is used in texture description and is predicated on the recurrent prevalence of some grey level configuration within the texture. The configuration is depending on texture. If distance in fine texture is considered, the configuration varies speedily and if coarse texture is considered, configuration varies slowly. Texture classification using GLCM Haralick [5] defined fourteen applied math options, like energy, autocorrelation, contrast, entropy, maximum chance and inverse difference moment. GLCM method of representing texture options has found helpful applications in recognizing material defects, in rock texture classification and retrieval.

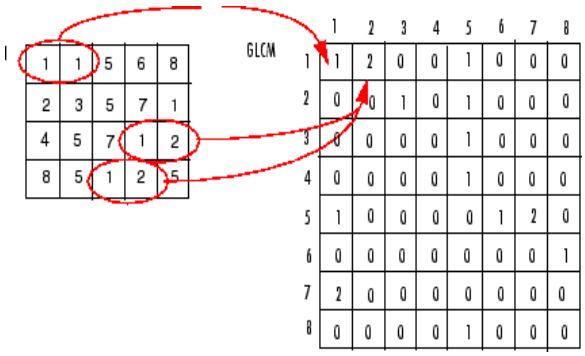

Figure 3 An example of GLCM

2) Transform Domain Features: By using this feature we can make mathematical illustration of an image. Many transform domain options are available, like discrete Fourier transform, Gabor filter and discrete wavelet transform. For verifying texture options this feature strategies analyze the frequency content of an. image. Fourier analysis consists of ending an indication into sine waves of varied frequencies. Where, wavelet analysis breaks up a signal into scaled and shifted versions of the initial wavelet. Which refers to decomposition of a signal into a family of basis operates obtained through translation and dilation of a special function. For representation of texture moments of wavelet coefficients have been shown to be effective in varied frequency bands.

a) Discrete Wavelet Transformation (DWT): It transforms an image from spatial domain into frequency domain. Signals with different scales are passed through low and high filters to extract information. Texture and shape information are captured efficiently and give better result in case of color information. Because Wavelet transforms is computed linearly with time, it allows for fast algorithms. This computation of a two-dimensional applies sub-sampling and recursive filtering. The image is decomposed at each scale into four frequency sub-bands, which are LL, LH, HL, and HH. Here L, H denotes low and high frequency respectively [3].

b) Gabor Filters: In this band pass filter is used for texture feature extraction and analysis. It gives representation similar to human visual system in terms of frequency and orientation. Gabor filter in spatial domain having 2D is a Gaussian kernel function which is modulated by a sinusoidal plane wave. Impulse response is calculated by using sinusoidal wave multiplied by a Gaussian function [3]. For medium and low frequency it gives consistent measurements but for higher frequency it gives inconsistent measurements and more sensitive to noise. According to Manjunath and Ma, Gabor filter (or Gabor wavelet) is terribly efficient.

III. PREVIOUS WORK

In this paper authors [1] presented a CBIR technique using statistical features of color histogram. They used basic color space (RGB) for retrieving the statistical features of an image. For each color component they have constructed probability histograms and probability histograms are divided into numerous numbers of considerable bins and each bins is used to compute statistical features like skewness and kurtosis. Similarity of retrieved image with query image is measured using Euclidean distance matrix. For feature extraction they used database of 10 classes having 100 each. This method gives 100% result in case of dinosaur and horses. But image having more details gives worst results. Processing cost of this technique is low and satisfactory results are achieved.

Here authors [2] present CBIR system using combination of soft computing techniques (SVM, fuzzy logic and artificial neural network). Features are extracted by using Wavelet decomposition. These features are used as input to fuzzy interface system and for training of multilayer feed forward back propagation algorithm. The authors conclude that performance in terms accuracy, efficiency and precision can be improved by using soft computing techniques.

Due to increase in database sizes many CBIR systems have been developed. The authors [3] presented CBIR techniques using combination of multiple feature extraction techniques and on the basis of similarity images are extracted from image database.

Here authors [4] presented CBIR method by using color and texture feature, called WBCHIR (wavelet based color histogram image retrieval) for extraction of images. Shape and shade features are extracted in the path of wavelet transformation and color histogram. The arrangements of these features are vital to scaling and conversion of objects in an image. They presented fusion of local and global features with k-means clustering algorithm.

In this paper author [5] presented Comparison between combination of GLCM with Hu-moments and combination of shape invariant with tamura texture. Both GLCM and Hu-moment method is stated above which are used by authors in their research. Tamura texture feature used six properties for texture feature. Each property (Regularity, line-likeness, roughness, coarseness, contrast and directionality) defines a specific characteristic of texture image. Precision and recall methods are used for performance evaluation..

In this paper authors [6] presented the importance of color space on the performance of CBIR systems. They study the effect of choosing color space using wavelet decomposition of each color channel. They present some division scheme for improving results and tackle restriction, namely, the challenge between the accuracy of retrieval and its time complexity.

In this paper authors [8] used soft system for CBIR method..Based Image recovery system is used for estimation. This system finds similarity between query and database image according to diverse visual contents. Using NN & SVM features are extracted by using feature weight. For neural network classification they apply back propagation or feed forward algorithm to calculate cross connection. For feature matching they used weakening model.

A CBIR technique using combination of HSV color, GLCM texture and shape feature is presented in this paper [9] to obtain high degree of similarity between images in database and query image.

Here authors [10] presented the merging concept of CBIR and segmentation. For segmentation medical database is used with fuzzy values. This technique is used for mining of visual content of medical image. To extract medical image GLCM texture feature is used and segmented to achieve exact area of medical image or query image affected by any diseases.

IV. CONCLUSION

This paper provides review on different types of features used in feature extraction algorithm. Till now many algorithms are developed by considering any one of the feature. The most commonly used feature is color. Color feature extraction method is not sufficient for gaining the desired result, so different color space (HSV, RGB and CIE) is used. Thus researchers developed algorithm by combining different features. An algorithm formed using combination of Tamura texture feature with Hu-moment shape feature is developed is an example of cascading features. Thus the performance of system is increased in terms of accuracy and efficiency. Some researchers used soft computing methods like artificial neural network and fuzzy logic to improve performance of system. Further system is made advanced by adding a classifier. Many classifiers are presented like K-nearest neighbor classifier and SVM classifier. For further improvement different distance matrix like Euclidean distance matrix is used with combination of different methods for feature extraction. But till now no CBIR system is developed which give desired results considering different methods.

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