

EFFICIENT CONTENT BASED IMAGE RETRIEVAL USING GLCM AND SVM

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ABSTRACT

Content Based Image Retrieval (CBIR) uses the image features like visual contents of an image. The visual contents is having two types global features-color feature, shape feature, texture feature, and local features-spatial domain features to signify and index the image that divide the image into sub regions horizontal, vertical and center region. CBIR method combines global and local features. In this paper worked on Discrete Wavelet Transform (DWT) for decaying an image into horizontal, vertical and diagonal region and Gray Level Co-occurrence Matrix (GLCM) for texture feature extraction. In classification process, Support Vector Machine (SVM) used. The experimental results calculated using mean, standard deviation, precision and recall it shows improved results in comparison to previous methods. In this paper, proposed a calculation which gives the advantages over previous methods it also improve the exactness of recovery.

KeywordsCBIR; DWT; GLCM; Global feature; Local feature;Color Correlogram; Color Histogram; SVM; Standard Deviation; Confusion matrix.

I INTRODUCTION

Information retrieval (IR) is the science of searching for documents, for information within documents, and for metadata about documents, as well as that of searching relational databases and the World Wide Web. There is overlap in the usage of the terms data retrieval, document retrieval, information retrieval, and text retrieval, but each also has its own body of literature, theory and technologies. IR is interdisciplinary, based on computer science, mathematics, cognitive psychology, linguistics, statistics, and physics. Automated information retrieval systems are used to reduce what has been called “information overload”. Web search engines are the most visible IR applications. Images do have giant share in this information being stored and retrieved [1].

1.1 Content Based Image Retrieval (CBIR)

The images are very rich in the content like color, texture, and shape information present in them. Retrieving images based on color similarity is achieved by computing color histogram for each image that identifies the proportion of pixels within an image holding specific values (that humans express as colors). Color searches will usually involve comparing color histograms, though this is not the only technique in practice. Texture measures look for visual patterns in images and how they are spatially defined. The identification of specific textures in an image is achieved primarily by

modeling texture as a two-dimensional gray level variation[3]. The relative brightness of pairs of pixels is computed such that degree of contrast, regularity, coarseness and directionality may be estimated. Shape does not refer to the shape of an image but to the shape of a particular region that is being sought out. Shapes will often be determined first applying segmentation or edge detection to an image. Other methods use shape filters to identify given shapes of an image.

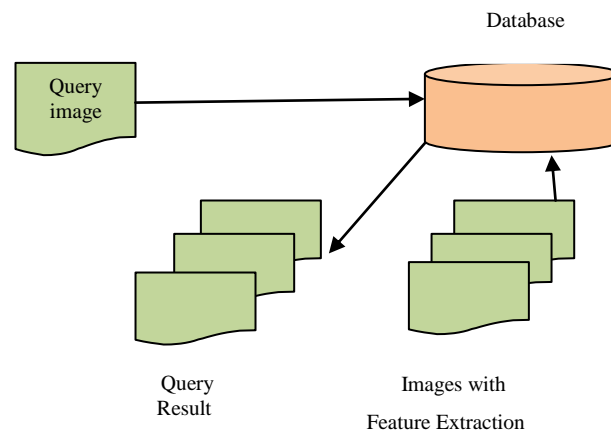


Figure1 : Basic CBIR System

II RELATED WORK

The paper discusses novel image retrieval methods based on shape features extracted using gradient operators and slope magnitude technique with Block Truncation Coding (BTC). Image retrieval techniques are proposed using gradient masks like Robert, Sobel, Prewitt and Canny. The performance ranking of the masks for proposed image retrieval methods can be listed as Robert, Prewitt, Sobel and lastly the Canny [3].

This paper defines a method for managing large image database Image retrieval is the best option and efficient tool. CBIR provides the user a similar image from a large database with retrieval through a query image. In this paper they presented color feature extracted using color histogram, correlogram and HSV histogram. The key focus on this paper is support vector machine (SVM) Algorithm and Relative Standard Deviation. By using two methods measure similarity of two images and computes the precision and recall [1]. This paper defines a method which is based upon the HSV color space and texture characteristics of the image retrieval through the quantification color space of HSV, joining of color feature and gray level co-occurrence matrix as well as CCM separately, using normalized Euclidean distance classifier [8].

This paper defines a method CBIR (Content-Based Image Retrieval) permits to automatically extract and images according to the purpose of the image visual contents itself. Illustrations of visual skin and similarity comparison are significant problems in CBIR. Texture, shape and Color data have been primitive picture descriptors in the CBIR systems. It offerings a new structure for joining totally the three i.e. texture, color and shape features, and reach higher retrieval effectiveness [6].

III PROPOSED METHODOLOGY

In CBIR the feature extraction plays very important role retrieval accuracy is depend on the feature extraction so for that the color correlogram, color moment, color histogram, Gabor filter, SVM and GLCM is proposed. In our technique we have considered both local as well as global features.

3.1 Computation of Global Features

This method deals with image worldwide and tries to differentiate it by using visual/statistical features calculated from the entire image. Visual features are divided into three features: primitive features such as shade or figure rational skin texture such as identity of objects shown and abstract features such as significance of scenes depicted.

1) *Color:*

In domain of photograph retrieval, color has been the most efficient feature and almost all systems employ colors. There are three colors in image are red, green, blue (RGB) color space. Color histograms are used to match up to images in many applications. The main advantages are effectiveness, and insensitivity to small changes in camera viewpoint. However, color histograms need spatial information.

2) *Texture:*

Some of the most shared measures for taking the texture of images are wavelets and Gabor filters. These texture events try to imprisonment the characteristics of the image or image parts with respect to changes in certain directions and the scale of the changes. This is most valuable for regions or images with similar texture. Again, invariance's with admiration to rotations of the image shifts or scale changes can be included into the feature space.

3) *Shape features:*

Shape description or representation is an important issue both in object recognition and classification. It has been used in CBIR in conjunction with color and other features for indexing and retrieval. Many methods described chain code, polygonal approximations, curvature, Fourier descriptors and moment descriptors have been proposed and used in various applications. [9].

Color Histogram, Color moments, Color Correlogram

Color Histogram-Color histogram gives HSV color space and RGB color space. The matching method then retrieves the images whose color histograms equivalent those of the query most narrowly.

Color Moment-Color moments are used to distinguish images on the basis of their color features. These moments give a dimension for color similarity between the images. These similarity values can be matched to the values of images indexed in a catalog for content based image retrieval.

Color Correlogram-Color correlogram are the color feature information. The advantages of the color correlogram that contains the spatial correlation of colors can be used to describe the global sharing of local spatial correlation of colors and is simple for calculation [4].

Stationary Wavelet Transformation

Discrete wavelet transformation (DWT) is used to transform an image from spatial domain into frequency domain. The wavelet transform signifies a function as a superposition of a family of basic functions called wavelets. Wavelet transforms extract information from signal at different scales by passing the signal through low pass and high pass filters. Wavelets provide multi resolution capability and good energy compaction. Wavelets are robust with respect to color intensity shifts and can capture both texture and shape information efficiently. The wavelet transform calculation of a two-dimensional image is also a multi-resolution approach, which applies recursive filtering and sub-sampling. At each level (scale), the image is decomposed into four frequency sub-bands, LL, LH, HL, and HH where L denotes low frequency and H denotes high frequency as shown in Figure1. Mathematically, the wavelet decomposition can be described [9].

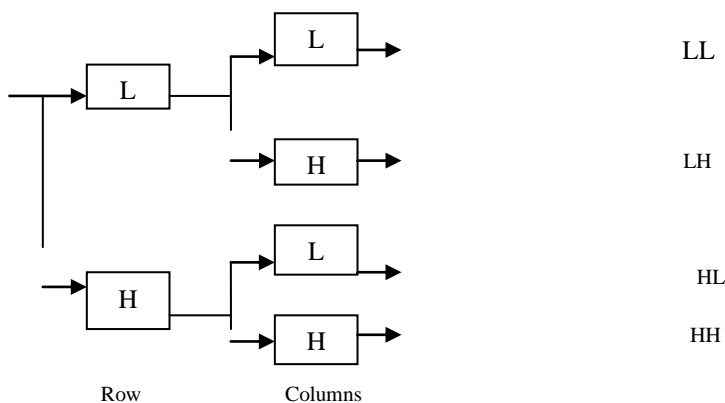


Figure 2. Stationary Wavelet Decomposition of a Two-dimensional Image

$$LL_{j+1}(x, y) = \sum_{(m,n)} L[n]L[m]LL_j(2^{j+1}m-x, 2^{j+1}n-y)$$

$$LH_{j+1}(x, y) = \sum_{(m,n)} L[n]H[m]LL_j(2^{j+1}m-x, 2^{j+1}n-y)$$

$$HL_{j+1}(x, y) = \sum_{(m,n)} H[n]L[m]LL_j(2^{j+1}m-x, 2^{j+1}n-y)$$

$$HH_{j+1}(x, y) = \sum_{(m,n)} H[n]H[m]LL_j(2^{j+1}m-x, 2^{j+1}n-y)$$

Gray-level Co-occurrence Matrix (GLCM)

GLCM creates a matrix with distances and directions among the pixels, and then removes significant figures from the matrix as texture features. This kind of analysis would have required the supervised selection of a combination of several texture types in order to stress some generic properties of the different texture parameters. This supervised process would have been very complex to implement. For this reason, an alternative strategy was developed to verify the theoretical deliberations.

Homogeneity- It is a grayscale image texture calculates of homogeneity varying, shiny the distribution of images grayscale regularity of weight and texture.

Contrast-Contrast is the main diagonal near the instant of inertia.

$$Ene = \sum_{i=0}^{n_g-1} \sum_{j=0}^{n_g-1} g^2(i, j)$$

$$Con = \sum_{i=0}^{n_g-1} \sum_{j=0}^{n_g-1} (i, j)^2 g(i, j)$$

$$Cor = \sum_{i=0}^{n_g-1} \sum_{j=0}^{n_g-1} \frac{(i - \mu)(j - \mu) g(i, j)}{\sigma^2}$$

$$Idm = \sum_{i=0}^{n_g-1} \sum_{j=0}^{n_g-1} \left[\frac{1}{(1 + (i - j)^2)} \right] g(i, j)$$

3.2 Computation of Local Features

A global descriptor uses the visual features of the whole image, while a local descriptor takes into account the regions or objects to describe the image. To compute local features we first divide the processed image into blocks and obtain a descriptor for each block. Figure 2 shows the method of splitting the image into three different sub regions into three different sub regions.

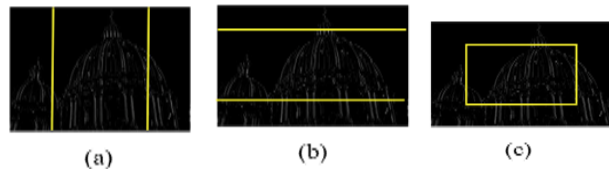


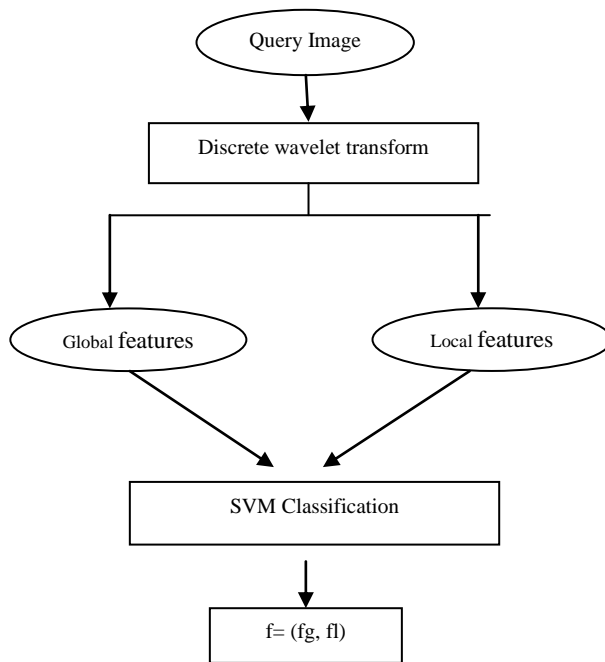
Figure 3. Different Templates for Splitting Images into (a) Vertical Crop;(b) Horizontal Crop;(c) Central Crop

After splitting the image into sub-regions, two statistical measures are computed for each region. These measures are mean (μ) and standard deviation (σ).

$$\mu = \frac{\sum_{i=1}^M \sum_{j=1}^N f(i, j)}{M \times N}$$

$$\sigma = \sqrt{\frac{\sum_{i=1}^M \sum_{j=1}^N (|f(i, j)| - \mu)^2}{M \times N}}$$

Here M, N represent the dimensions of the image and f (i, j) represents the intensity value at an index (i, j). Mean describes the average intensity over the image, while standard deviation shows amount of variation or dispersion from the mean value[9].



$$f = (fg, fl)$$

Figure.4: Block Diagram of Proposed System

1. Image Database



Figure.5: Image Database

2. Query Image



Figure.6 : Query Image

3. Retrieved Images

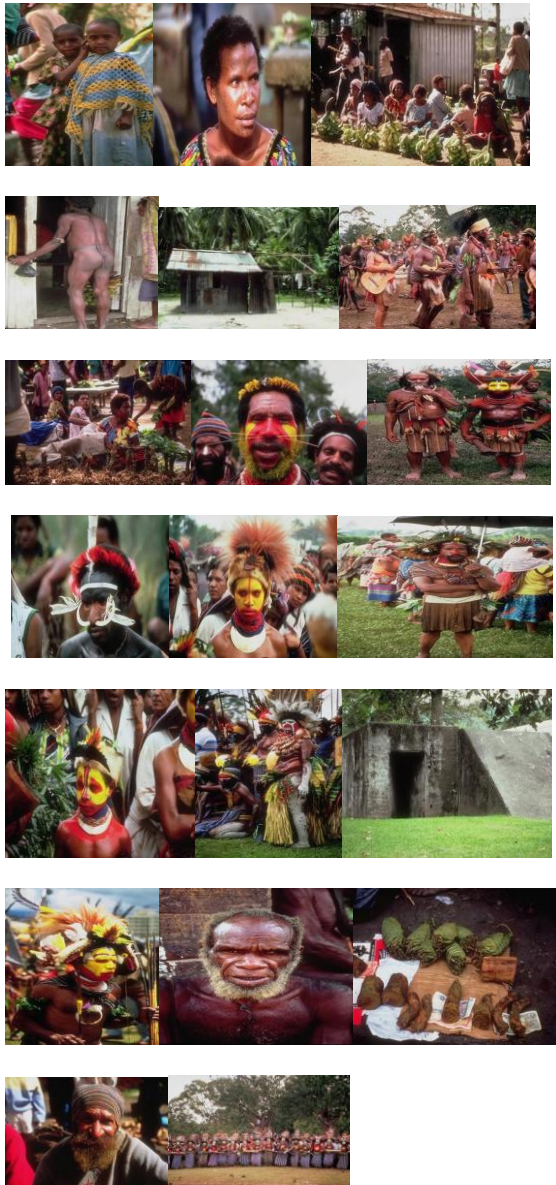


Figure.7: 20 Retrieved Images using Relative Deviation

II RESULT ANALYSIS

2.1 Performance Evaluation

CBIR performance is analyzed by computing the values of precision and recall. Content Based Image Retrieval includes the standard measures. Those measures are the initial measures of the image retrieval process. The measures are Recall, Precision. These measures are used to improve the image retrieval process with various measures.

Precision is the fraction of retrieved images that are relevant to the input image

$$\text{Precision} = \frac{\text{Total no. of Retrieval Relevant image}}{\text{Total no. of Retrieval image}}$$

Recall is the fraction of the images that are relevant to the query that are successfully retrieved.

$$\text{Recall} = \frac{\text{Total no. of Retrieval Relevant image}}{\text{Total no. of relevant image}}$$

Similarity Measurement

For similarity comparison, this proposed work has to use Relative standard Derivation (RSD) using below equation, Methods used to arrange images, moreover, compute the distinction or comparison between two vectors. In this paper used Euclidean distance which is the most predictable metric for calculating the lack of involvement between two vectors [4]. Given two vectors Q and D , where

$$Q = \begin{pmatrix} q_1 \\ q_2 \\ q_3 \end{pmatrix}$$

$$D = \begin{pmatrix} d_1 \\ d_2 \\ d_3 \end{pmatrix}$$

$$RSD = \sqrt{\sum_{i=1}^n (Q_i - D_i)^2}$$

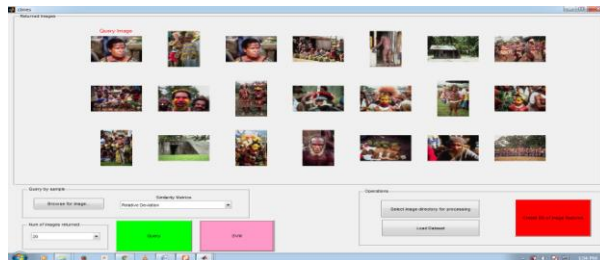
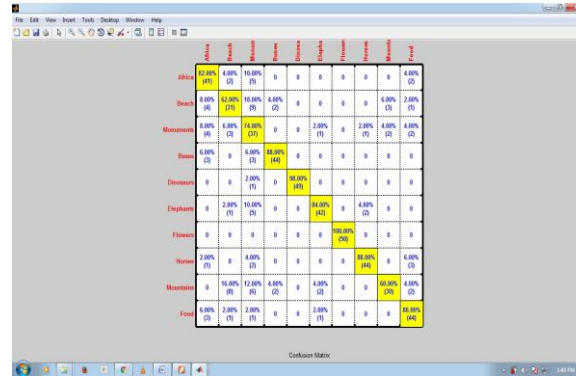


Figure.8: Relative deviation Similarity Metrics Results on African images

	Actual	Classified	True	False	True	False	True	False
Actual	23.00% (23)	0	18.00% (18)	2.00% (2)	2.00% (2)	2.00% (2)	2.00% (2)	4.00% (4)
Classified	0	52.00% (52)	2.00% (2)	2.00% (2)	0	2.00% (2)	28.00% (28)	2.00% (2)
True	18.00% (18)	18.00% (18)	0	0	0	0	0	0
False	2.00% (2)	4.00% (4)	54.00% (54)	0	0	0	0	0
True	0	0	0	18.00% (18)	0	0	0	0
False	0	0	0	0	0	0	18.00% (18)	0
True	0	0	0	0	0	0	0	75.00% (75)
False	0	0	0	0	0	0	0	0
True	18.00% (18)	0	0	0	0	0	2.00% (2)	82.00% (82)

Graph.1: Confusion Matrix Overall accuracy = 72%



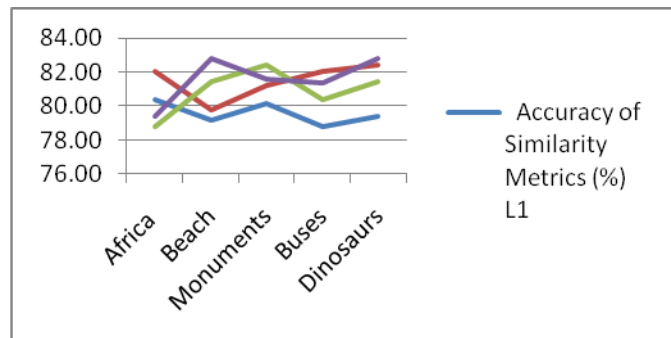
Graph.2: Confusion Matrix Overall accuracy = 82%

Confusion Matrix- The confusion matrix presents the percentages of right and wrong classifications. Right categorizations are the yellow squares on matrices diagonal.

Incorrect categorizations form white squares.

Query Image	Accuracy of Similarity Metrics (%)			
	L1	L2	Relative	Correlation
Africa	80.40	82.00	78.80	79.40
Beach	79.20	79.80	81.40	82.80
Monuments	80.20	81.20	82.40	81.60
Buses	78.80	82.00	80.40	81.40
Dinosaurs	79.40	82.40	81.40	82.80

Table.1: Similarity matrix



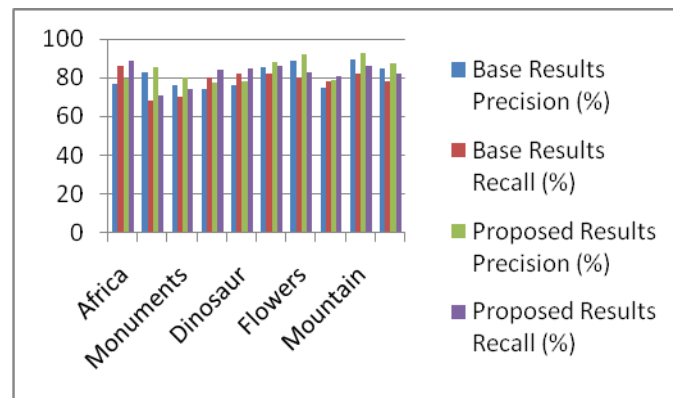
Graph.3: Accuracy of similarity metrics

Category	Base Results		Proposed Results	
	Precision (%)	Recall (%)	Precision (%)	Recall (%)
Africa	76.78	86	86.34	90
Beach	82.92	68	87.68	76
Monuments	76.08	70	85	77
Buses	74.07	80	82.24	84
Dinosaurs	75.92	82	83.41	85
Elephants	85.41	82	92.07	88

Flowers	88.88	80	94.92	87
Horses	75	78	84.78	84
Mountain	89.13	82	93.45	86
Food	84.78	78	89.13	83

Table 2: Precision and Recall Comparison between Base and

Proposed System



Graph.4: Precision and Recall Comparison between Base and

Proposed System

III CONCLUSION

Content based Image Retrieval System is a method to retrieve the related image from collection of images. Our proposed paper used texture, color and shape feature extraction, color features are extracted using three methods such as the color Correlogram, color moment, Color histogram extracted Texture features are using gray level co- occurrence matrix. This process calculated energy, correlation, contrast and homogeneity for texture analysis. Shape features are extracted using noise removal. In this paper, the relative standard deviation (RSD) and SVM is used for classification and RSD for calculation of similarity involving two images. The proposed paper result better than the other retrieval methods in terms of average accuracy In this system, the overall accuracy has reached up to 90%. Moreover, the computational steps are effectively reduced with the use of Wavelet transformation Furthermore, This process will work on combinations of texture, shape and color features.

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