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Content Based Image Retrieval Using Multifeaturefusion Extraction

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***Abstract*— the development of multimedia technology in Content Based Image Retrieval (CBIR) System is one of the prominent area to retrieve the images from a large collection of database. The feature vectors of the query image are compared with feature vectors of the database images to obtain matching images.**
It is practically observed that any one algorithm is not efficient in extracting all different types of natural images. Hence a thorough analysis of certain color, texture and shape extraction techniques are carried out to identify an efficient CBIR technique which suits for a particular type of images. The Extraction of an image includes feature description and feature extraction. In this paper, we proposed Color Layout Descriptor (CLD), Gray Level Co-Occurrences Matrix (GLCM), Marker-Controlled Watershed Segmentation feature extraction technique which extract the matching image based on the similarity of Color, Texture and Shape in the database. For performance analysis, the image retrieval timing results of the proposed technique is calculated and compared with each of the individual feature.

Keywords*— Color Layout Descriptor (CLD), Gray Level Co-Occurrences Matrix (GLCM), Marker-Controlled Watershed Segmentation etc.

I. Introduction

Content primarily based Image Retrieval (CBIR) is that the methodology of retrieving images from the big image databases prioring visual contents in images. It is additionally called query By Image Content (QBIC) and Content Visual data Retrieval (CBVIR). In CBIR, looking of image takes place on the particular content of image instead of alternative helpful information. Reasons for its development are that in several giant image databases, previous old strategies of image classification have proved to be low, laborious, and very time overwhelming. These recent strategies of image classification, starting from storing an image within the information and associating it with a keyword or variety, to associating it with a categorized description, became obsolete. The Content primarily based Image Retrieval System is employed to extract the features and assign index those features exploitation acceptable structures and supply satisfactory answer to the user's question. To attain this, CBIR provides some flow of work. First off CBIR system takes the RGB or HSV image as an input, performs feature extraction, performs some similarity computations with the images keep in information and retrieves the output image on the idea of similarity computation. There are some basic CBIR fundamentals and are divided into 2 elements: feature extraction and matching.

A. Feature Extraction

Features are divided into 2 classes severally text based and visual based. Textual features are keywords, tags, caption etc. Visual features are color, space and texture etc. Visual features are the key features of an image for pattern identification.

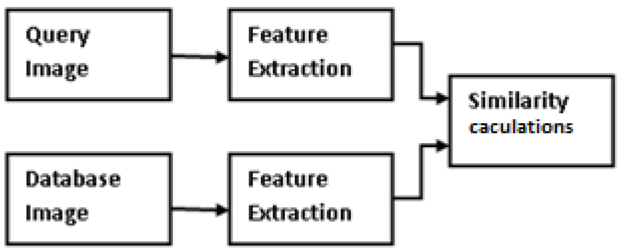

Fig 1: Block Diagram of CBIR

- *Color*

Color represents one of the most widely used visual features in CBIR systems. First a color space is used to represent color images. We have various ways to denote the color content of an image such as color histograms, color correlograms, color coherence matrix, dominant color descriptors and color sets etc.

- Texture

Texture is that innate property of all surfaces that describes visual patterns, every having properties of homogeneity as well as cloud, trees, bricks, hair and cloth and its relationship to the encircling atmosphere.

- Shape

Shape is also outlined because the characteristic surface configuration of associate object; an overview or contour. It permits associate object to be distinguished from its surroundings by its define that classes in two: boundary based mostly and region based.

B. Matching

Similarity matching analysis is finished between the features of the query image and also the features of the target image within the database. Similarity images ought to have smaller distance between them and totally different images ought to have giant distance.

II. Color Feature Calculations

A. Color Layout Descriptor (CLD)

The CLD [6] represents the spatial distribution of colors in an image. To extract this feature, the input image array is first partitioned into 8 × 8 blocks. Representative colors are then selected and expressed in YCbCr color space and each of the three components (Y, Cb and Cr) is transformed by 8 × 8DCT (Discrete Cosine Transform). The resulting sets of DC coefficients are zigzag-scanned and the first few coefficients (6 from the Y-DCT-matrix and 3 from each DCT matrix of the two chrominance components) are nonlinearly quantized to form the descriptor. The Descriptor is saved as an array of 12 values. For further details, please refer to [6].

To visualize the CLD descriptor, the above process should be reversed using only the information remaining in the final descriptor. The following steps were involved in there construction process:

1) From the descriptor, the DCT coefficients of each color component were separated, repositioned into their zigzag indices in the matrix and the rest of each matrix was filled with zeros to replace those values which were lost in the formation of the descriptor.

2) The three DCT matrices were now transformed back into the spatial domain using the 8 × 8 IDCT (Inverse Discrete Cosine Transform).

3) The spatial domain matrices were converted from the YCbCr color space back to the RGB color space.

4) The visualization image of the reconstructed RGB 8×8 matrices is created which has the size (blockwidth ×8) × (block height× 8).

It should be noted that the reconstructed image could besmaller than the original image if the original dimensions were not divisible by 8.

III. Texture Calculation

A. Grey Level Co-occurrences Matrix (GLCM)

GLCM creates a matrix based on the directions and distances between pixels, and extracts the statistics from the matrix as texture features. GLCM texture features commonly used are shown in the following [11]:

GLCM is composed of the probability value, it is defined P(i,j│d,) which express the probability of the couple pixel at ɵ direction and d interval. When ɵ and d is determined, P(i,j│d,) is showed by $P_{i,j}$. Distinctly GLCM is a symmetry matrix, Elements in the matrix are computed by the below equation:

$$P(i,j \mid d,\theta)= P(i,j \mid d,\theta))/(\Sigma i \Sigma j P(i,j \mid d,\theta))$$

GLCM expresses the texture feature according the correlation of the couple pixels Gray level at different positions. It direction describes the texture features. But here mainly four things are considered they are energy, contrast, entropy and the inverse difference.

1) *Energy*

It is a gray scale image texture measure of the homogeneity changing reflecting the distribution of the image gray-scale uniformity of the image and the texture.

$$E = \sum_x \sum_y p(x,y)^2$$

2) *Contrast*

It is a gray scale image texture measure of the homogeneity changing reflecting the distribution of the image gray-scale uniformity of the image and the texture.

$$I = \sum \sum (x-y)^2 \, p(x,y)$$

3) *Entropy*

Entropy measures image texture irregular, when the space co-occurrence matrix for all values are equal, it achieved the minimum value; on the other hand, if the value of co-occurrence matrix is very uneven, its value is greater. Therefore, the maximum entropy implied by the image gray distribution is random.

$$S = -\sum_x \sum_y p(x,y) log p(x,y)$$

4) *Inverse difference*

It measures local changes in image texture number. Its value in large is illustrated that image texture between the different regions of the lack of change and partial very evenly.

Here p(x, y) is the gray level.

$$H = \sum_x \sum_y \frac{1}{1+(x-y)^2} p(x,y)$$

IV. Shape Calculation

A. Marker-Controlled Watershed Segmentation

Separating touching objects in an image is one of the more difficult image processing operations. The watershed transform is often applied to this problem. The watershed transform finds “catchments basins” and “watershed ridge lines” in an image by treating it as a surface where light pixels are high and dark pixels are low. One of the most important drawbacks associated to the watershed transform is the over segmentation that commonly results. The usual way of predetermining the number and approximate location of the regions provided by the watersheds technique consists in the modification of the homotopic of the function to which the algorithm is applied. This modification is carried out via a mathematical morphology operation, geodesic reconstruction [13], by which the function is modified so that the minima can be imposed by an external function (the marker function). All the catchment basins that have not been marked are filled by the morphological reconstruction and so transformed into no minima plateaus, which will not produce distinct regions when the final watersheds are calculated. Segmentation using the watershed transforms works well if you can identify, or “mark,” foreground objects and background locations. Marker-controlled watershed segmentation follows this basic procedure:

1. Compute a segmentation function. This is an image whose dark regions are the objects you’re trying to segment.
2. Compute foreground markers. These are connected blobs of pixels with in each of the objects.
3. Compute background markers. These are pixels that are not part of any object.

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4. Modify the segmentation function so that it only has minima at the foreground and background marker locations.
5. Compute the watershed transform of the modified Segmentation function.

V. SIMILARITY MATCHING

Once the features vectors are created, the matching process becomes the measuring of a metric distance between the features vectors. Understanding the relationship among distance measures can help choosing a suitable one for a particular application.

We apply Euclidean Distance Metric for similarity Matching. The following equation shows Euclidean Distance calculation:

$$d = \sqrt{\sum_{i=1}^{n} (x_i - y_i)^2}$$

Euclidean distance is square root of the sum of the squares of the distance between corresponding values where ***i*** represents the image in the database, and d is the Euclidean distance between the query image feature vector ***x*** and the i^{th} database image feature vector y_i.

VI. RESULTS

A. WANG Database

The database we used in our evaluation in WANG database. The WANG database is a subset of the Corel database of 1000 images.

B. Feature Extraction and Matching

From the database, we have extracted and matched color, texture and shape features using extraction algorithm and matching algorithm to get 6 top results as follows:

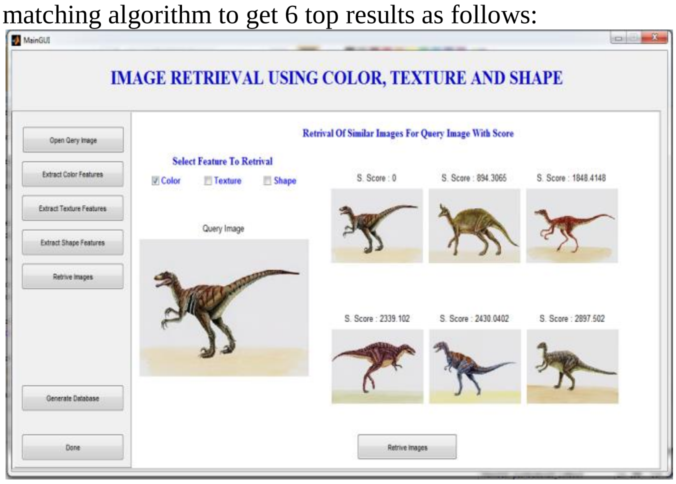

Figure 2: Color Feature Extraction and Matching Results

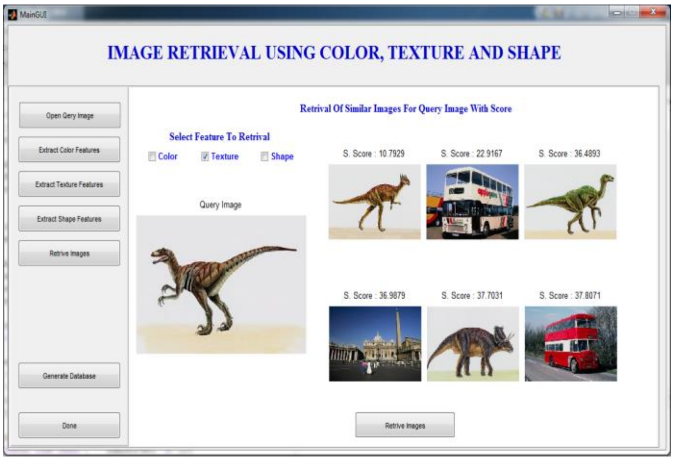

Figure 3: Texture Feature Extraction and Matching Results

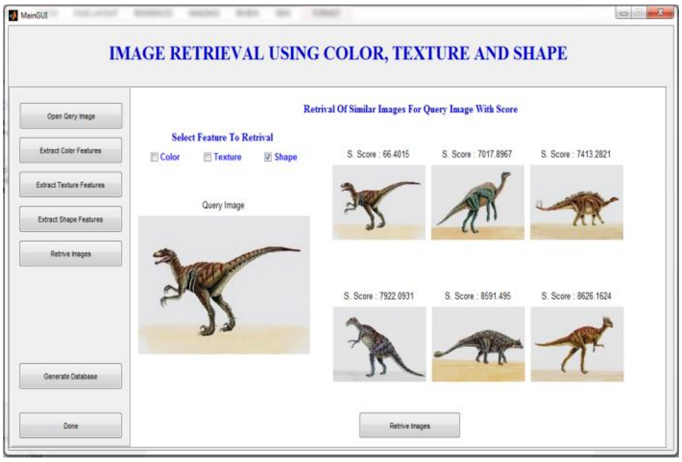

Figure 4: Shape Feature Extraction and Matching Results

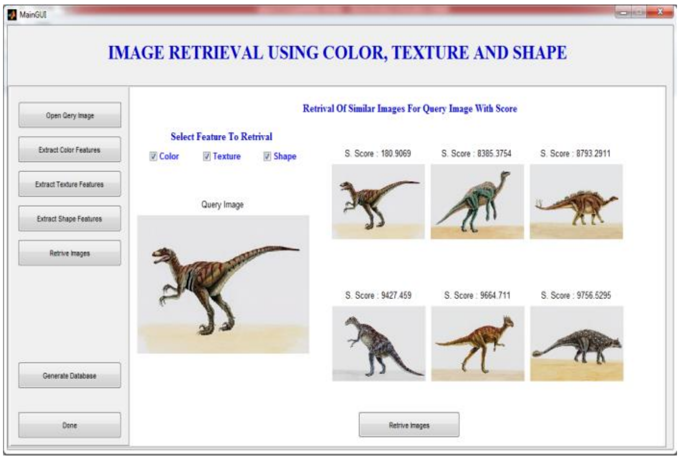

Figure 5: Combine Features Extraction and Matching Results

C. Performance Evaluation of CBIR

The performance of a CBIR system can be measured in terms of time results. We have calculated time duration for each color, texture and shape features. Then, we calculated for combines features. The following table shows the performance evaluation of CBIR in terms of time:

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Wang Images	Color	Texture	Shape	Combined
400.jpg	0.611	0.628	0.531	0.594
452.jpg	0.579	0.568	0.583	0.695
245.jpg	0.688	0.672	0.601	0.647
263.jpg	0.589	0.545	0.59	0.641
319.jpg	0.679	0.721	0.685	0.695
301.jpg	0.612	0.648	0.625	0.677

Table 1: Performance Evaluation Using Time

VII. CONCLUSION

The application performs a simple color-based search in an image database for an input query image, using Color Layout Descriptor (CLD). Further enhancing the search, the application performs a texture-based search in the color results, using Gray Level Co-occurrences Matrix (GLCM) and its statistics calculation. A more detailed step would further enhance these texture results, using a shape-based search by using the Marker-Controlled Watershed Segmentation and finally, these extracted features are matched by Euclidean Distance Metric to get top 6 results. Then, we tested Performance Evaluation on images of the databases and we found that the timing results for the integrated approach will be less and accurate, this can be improved by integrating other spatial relationship.

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