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COMPARATIVE STUDY OF CONTENT BASED IMAGE RETRIEVAL BY MULTI FEATURES

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Abstract: Finding specific digital images from large resources has become an area of wide interest nowadays. Among image retrieval approaches, text based retrieval is widely used as it has been commercialized already. But it is not effective as it involves time consuming text annotation process. Also there is difference in understanding of image content which affects image annotation process. Content based image retrieval is another method of retrieving images from large image resources, which has been found to be very effective. CBIR involves the use of low-level image features, like, color, texture, shape, and spatial location, etc. to represent images in terms of their features. To improve existing CBIR performance, it is very important to find effective and efficient feature extraction mechanisms. . This paper presents a new approach of CBIR system in which the information of image features color, shape and texture are combined and higher retrieval efficiency is achieved. The color feature is extracted using color histogram for image blocks, for shape feature Canny edge detection algorithm is used and the HSB extraction in blocks is used for texture feature extraction. The feature vector of the query image is compared with the feature vector of the each image present in the database. The experiments show that the fused features retrieval gives better retrieval results than another approach used by Sandhu et al. In this research we have proposed a method in which fusion of color, texture and shape feature is used for CBIR. The results of proposed method are compared with the results of another paper which use the same three features. The comparative shows that proposed method gives better performance for image retrieval.
Keywords: Content Based Image Retrieval, color histogram, Canny edge detection, eucliedian distance, HSV, HSB, color, texture, shape, precision, recall

I. INTRODUCTION

The increase in computing power and electronic storage capacity has lead to an exponential increase in the amount of digital content available to users in the form of images and video, which form the bases of many educational, entertainment and commercial applications [1]. There are two types of promising technique image retrieval processes such as, text based image retrieval and content based image retrieval. In text based image retrieval method, users use keyword or description to the images as query so that they can use the retrieved images, which are relevant to the keyword. Text based retrieval has several disadvantages. First of all, there is inconsistency in labeling by different annotators due to different understanding about image contents. Second, it consumes a lot of time to annotate each image in a large database and makes the process subjective [2]. Third, there is a high probability of error occurrence during the image tagging process when the database is large. As a result, text based image retrieval cannot achieve high level of efficiency and effectiveness. The main challenge lies in the reduction of the semantic gap between low-level features extracted from the image and high-level user semantics. A typical image retrieval system includes three major components:

- feature extraction (usually in conjunction with feature selection)
- high dimensional indexing and
- system design [3].

Images of the same category are expected to have similar characteristics. Therefore, when similarity measurement is performed on the basis of image features, the output set achieves a high level of retrieval performance. CBIR has several advantages over the traditional text based retrieval. Due to using the visual contents of the query image in CBIR, it is a more efficient and effective way at finding relevant images than searching based on text annotations. Also CBIR do not need the manual annotation process of text based approach. These advantages have motivated us to employ a CBIR technique for our research. In this work, we have used the low level features color, shape and texture to achieve the high retrieval performance than the methods in which only one or two features are used. The results are compared with one of the papers that also used the color, shape and texture feature for CBIR. The key factors affecting CBIR are [2]

- Selection of image database
- Low-level image features extraction
- Similarity measurement
- Performance evaluation of the retrieval process and

II. IMAGE DATABASE SELECTION

Data set selection must be good in order to ensure good performance of CBIR system and to establish a relevant analysis of various CBIR techniques. For any database, it is important to determine the ground truth, on the basis of which retrieval is performed and performance is measured. Size and variety are other two properties of a database, which also affects the retrieval outcome. If the database size is large consisting of multivariate images, a good retrieval result ensures the acceptance of the database as well as the implied method as a standard. Retrieval result varies significantly by selecting different databases as the ground truth definition, size, and variety of the databases are different. From recent literature we found the data set of Wang's [14] dataset comprising of 1000 Corel images with ground truth. The image set comprises 100 images in each of 10 categories. The images are of the size 256 x 384 or 384X256. But the images with 384X256 are resized to 256X384. We have used the same Wang data set for CBIR using color, shape and texture features.

III. LOW-LEVEL FEATURES IN CBIR

A number of low-level image features can be extracted from an image. Detailed study on image features are presented in [2, 28]. Some commonly used low-level image features in recent literature includes the application of color, texture, shape, spatial location, etc. Some CBIR approaches use a combination of more than one low-level feature to improve retrieval performance. Here, we briefly describe the features color, shape and texture used in the proposed method. Color is one of the most prominent visible properties of an image. The color feature is one of the most widely used visual features in image retrieval. The appearance of the color of real world objects is generally altered by surface texture, lighting and shading effects, and viewing conditions. Images characterized by color features have many advantages like robustness, effectiveness, implementation simplicity, computational simplicity, low storage requirement [6]. In our system we are using histograms in blocks and respective block histograms are matched. Shape is an important and most powerful feature used for image classification, indexing and retrievals. Shape information extracted using histogram of edge detection. In this paper, the edge information in the image is obtained by using the canny edge detection. Texture features are intended to capture the granularity and repetitive patterns of surfaces within a picture. For example, cloth, grass, and flower petals differ in texture, by smoothness as well as patterns. Texture features have long been studied in image processing, computer vision, and computer graphics, such as multi orientation filter banks and wavelet transforms. In image processing, a popular way to form texture features is by using the coefficients of a certain transform on the original pixel values, or, more sophisticatedly, by statistics computed from these coefficients. Examples of texture features using the wavelet transform. We have used HSB based extraction in blocks for texture feature extraction.

IV. SIMILARITY MEASUREMENT

After extracting the features from our query image and the data set in CBIR next crucial step is the similarity measurement. Similarity measurement is the process of finding the difference or similarity between the database images and the query image using their features. The database image list is then sorted according to the ascending order of distance to the query image and images are retrieved from the database according to that order. There are various methods of calculating this distance, such as the Minkowski-Form distance, quadratic form distance, Mahalanobis distance, Kullback-Leibler divergence, and Jeffrey-Divergence [2]. The Euclidean distance, also known as L2 distance, is one variety of the Minkowski-Form distance [2]. It has been used in many content based image retrieval approaches. It is applicable when the image feature vector elements are equally important and the feature vectors are independent of one another. The Euclidean distance has been used in color based CBIR [29].

V. PERFORMANCE EVALUATION METHODS OF CBIR

The level of retrieval accuracy achieved by a system is important to establish its performance. The system can be used as a standard in future research works if the outcome is satisfactory and promising. In CBIR, precision-recall is the most widely used measurement method to evaluate the retrieval accuracy. We have found some recent literature [30-33] use this pair to measure the retrieval performance. Precision P is defined as the ratio of the number of retrieved relevant images A to the total number of retrieved images N [2]. Precision measures the accuracy of the retrieval.

Precision (P) = Number of Relevant Images Retrieved / Total Number of Retrieved Images = A/N

Recall is defined by R and is defined as the ratio of the number of retrieved relevant images A to the total number M of relevant images in the whole database [2]. Recall measures the robustness of the retrieval.

Recall (R) = Number of Relevant Images retrieved / Total Number of Relevant Images=A/M

Generally, precision values fall with increases in the recall values. A retrieval system can be called 'ideal' if both the precision and recall values remain high. However, in reality, no such image retrieval system has yet been found. Precision-recall pair is a good standard of performance evaluation. It provides meaningful result when the database type is known and has been effectively used in some earlier research. For other data sets, the result may vary due to different human concepts of image classification. The precision-recall pair behavior of our method is shown in table 1.

VI. ALGORITHM FOR FUSION OF FEATURE EXTRACTION

Step 1: Load database in the Mat lab workspace.
Step 2: Convert image from RGB to HSV.
Step 3: Get the block size from user
Step 4: Generate the histogram of hue, saturation and value per block
Step 5: Store it into the mat file
Step 6: Load the Query image.
Step 7: Apply the procedure 2-5 to find histogram per block of Query image.
Step 8: Determine the distance of signature of Query image with stored signature of database for each block.
Step 9: Sort the distance values to perform indexing.
Step 10: Apply Canny edge detection algorithm for extracting the shape feature of image database.
Step 11: Apply Canny edge detection algorithm for extracting the shape feature of Query image.
Step 12: Compare the Query image with image database.

Step 13: Compute the HSB for image database per block for texture feature
Step 14:Compute the HSB for Query image per block
Step 15: Compare HSB per block of Query image and images in database if they are same images match in texture.
Step 16: Get the composite result of the features
Step 17: Create a folder in the name of corresponding variants
Step 18: Create a file in the name of corresponding variants & save

VII. RESULT AND CONCLUSION

The result shows that retrieved images after fusing all the three feature extraction method are better than those when these features were compared individually. Therefore, when the features are combined together it increases the retrieval efficiency of the system. The results of the CBIR system using color, shape and texture feature are computed individually in terms

Texture based	Proposed	Sandhu et al
Precision	0.504	0.50
Recall	0.928	0.70
Color based		
Precision	0.568	0.50
Recall	0.875	0.72
Shape based		
Precision	0.408	0.40
Recall	0.91	0.80
Color + texture + shape		
Precision	0.768	0.30
Recall	0.872	0.70

Table 1: Comparison on the basis of precision and recall

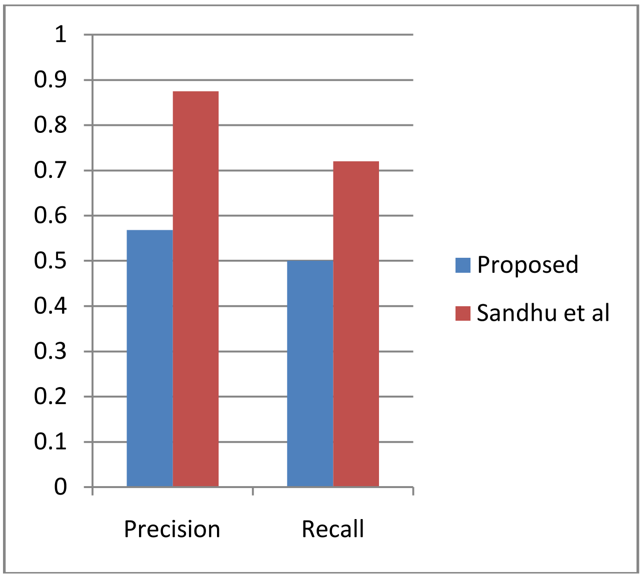

Figure 1: Comparison of precision and recall for color based CBIR

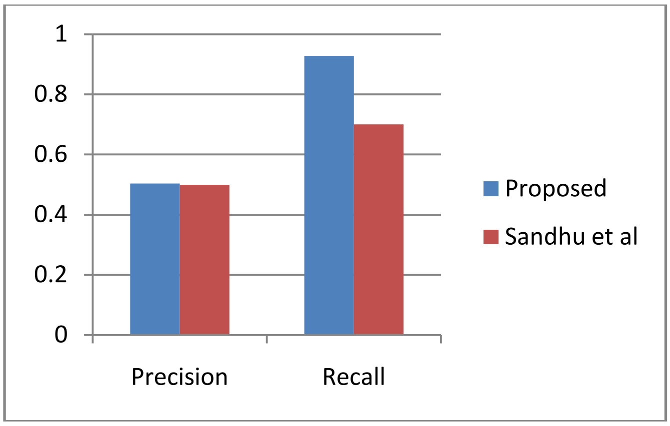

Figure 2: Comparison of precision and recall for texture based CBIR

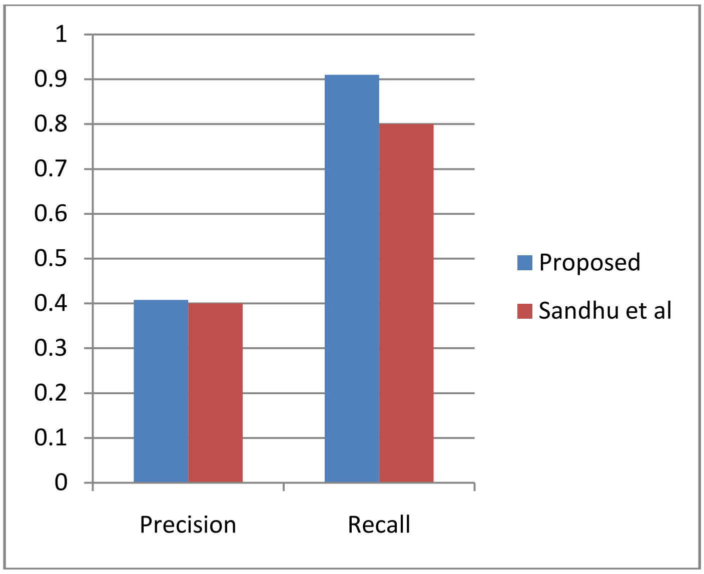

Figure 3: Comparison of precision and recall for shape based CBIR

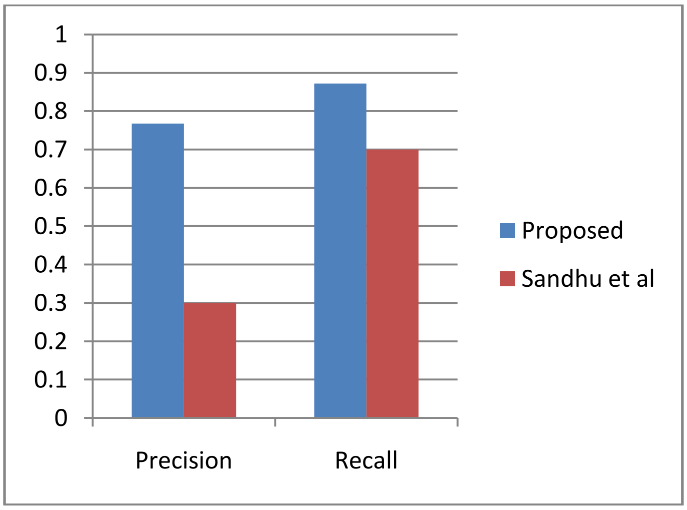

Figure 4: Comparison of precision and recall for color+texture+shape based CBIR

The result shows that retrieved images after fusing all the three feature extraction method are better than those when these features were compared individually. Therefore, when the features are combined together it increases the retrieval efficiency of the system. The results of the CBIR system using color, shape and texture feature are computed individually in terms of precision and recall. Then result of CBIR using combination of Color and texture are calculated. Finally, all the three feature extraction are fused and the results are computed. Results of the proposed system are compared with that of one of the papers of Sandhu et al[13]. They have used GLCM for texture feature extraction[27], histogram is used for color feature extraction and different shape features are extracted from the query image. Table 1 shows the comparison of proposed method and Sandhu et al in terms of CBIR by color, CBIR by color and texture and finally CBIR by fusing color, texture and shape. The figure 2, 3 and 4 clearly shows that our approach gives better image retrieval in all scenarios.

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