International Journal for Innovative Engineering and Management Research

A Peer Revieved Open Access International Journal

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IJIEMR Transactions, online available on 8th Sept2017. Link :http://www.ijiemr.org/downloads.php?vol=Volume-6&issue=ISSUE-8

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Volume 06, Issue 08, Pages: 102– 108.

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CBIR USING STATISTICAL TEXTURE AND EDGE EXTRACTION FEATURES IN WAVELET DOMAIN

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ABSTRACT— Content based image retrieval (CBIR) is also termed as QBIC (Query by Image Content). CBIR desires efficient extraction of low level features like shape, color and texture or any other information or content that can be acquired from the image itself. For database images and query image the feature vector can be computed by using statistical texture and Edge extraction features with the help of approximation and detailed coefficients obtained from the wavelet transform blocks of the image. The similitude between the query image and the database images is achieved by calculating the difference between the feature vectors of query and the database images by using distance metrics. The vectors of the images with lesser distances are most related to the query image. Experiments are executed on Corel image database .Finally, the retrieval performance of CBIR is assessed by using precision, recall and F-Score.

Keywords—CBIR, Wavelets, Statistical texture and Edge extraction features, Precision, Recall, F-Score.

I.INTRODUCTION

An enormous number of images are accessible in the internet. For retrieving the images an efficient and effective image retrieval system is desirable based on the contents of an image like shape, texture and color or any other information or content that can be acquired from the image itself. This type of system is known as Content-based image retrieval (CBIR) or query by image content (QBIC). Without the ability to test image content, searches must rely on description such as keywords or titles, which may be difficult, ambiguous. It is also probable to miss images that use different synonyms in their titles.CBIR is performed mainly in 2 phases i.e., indexing and searching. In indexing phase contents of the image are extracted and stored in the form of a feature vector in the feature database. In searching phase, feature vector of the user query image is computed and compare with all feature vectors in the feature database for similarity and retrieve the most relevant images to the query image from the image database.The applications for CBIR technology contains photo archives , biometrics, textiles industry, satellite image analysis , trademark databases, medical diagnosis, civil infrastructure, archaeology, architecture design, environment monitoring ,automobile traffic monitoring, logos, weed identification in Farming, fashion designing, cartoon database, museum images, crime prevention, forensic, military, image search

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on the Internet. In this paper, we show the efficiency of the relevant image retrieval by extracting the statistical texture and edge extraction features efficiently and matching the query image with database images effectively using distance metrics in wavelet domain. The proposed method is started with the input RGB color image is transformed into YCbCr color space. In this color space Y represents the luminance components which characterize the texture information. Cb and Cr are Chroma components which characterizes the color information. Latter, 4-level DWT is applied to the non-overlapping 32×32 blocks of intensity plane (Y-component) in an image. The coefficients obtained from the blocks of image are used to build statistical texture and edge features. These extracted features are used to calculate the resemblance between the query image and database images by using distance metrics. The retrieval efficiency is computed on the basis of performance parameters.

The rest of the paper is organized in different sections. Section II describes the construction of feature extraction using and statistical texture and edge extraction features and proposed algorithm is discussed in section III. Section IV shows the experimental outcomes. Finally, conclusion is presented in section V.

II.FEATURE EXTRACTION

A. Statistical Texture Features:

The statistical texture features [3] are useful for classification of retrieving similar images. These texture features gives the data about the characteristics of the intensity level distribution in the image like evenness, consistency and divergence. The statistical texture features energy, mean, standard deviation and entropy are calculated by using the wavelet coefficients of LL sub band at level 4. These texture features are computed by following equations

$$\text{Mean } (\mu_i) = \frac{\sum_{x=1}^{M}\sum_{y=1}^{N} I_i(x,y)}{M \times N} \quad (1)$$

$$\text{Standard deviation } (\sigma_i) = \sqrt{\frac{\sum_{x=1}^{M}\sum_{y=1}^{N} \left(I_i(x,y)-\mu_i\right)^2}{M \times N}} \quad (2)$$

$$\text{Energy } (e_i) = \frac{1}{MN}\sum_{x=1}^{M}\sum_{y=1}^{N} I_i^2(x,y) \quad (3)$$

$$\text{Entropy}_i = \frac{1}{MN}\sum_{x=1}^{M}\sum_{y=1}^{N} I_i(x,y)(-\ln(I_i(x,y))) \quad (4)$$

After computation of statistical features, all these values are united to get a single feature vector FV1. FV1 can be represented by using following equation.

FV1= [mean, standard deviation, energy, entropy] (5)

B. Edge Extraction Technique:

Edge features [2] are extracted from the wavelet sub bands of LH, HH, and HL at level 4. To generate edges in the sub-bands are considered into five types i.e., vertical, horizontal, 45^0 diagonal, 135^0 diagonal and non-directional edges. Extraction of edge

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detection is computed by using following filter coefficients as shown in fig.

$$\begin{bmatrix} 1 & -1 \\ 1 & -1 \end{bmatrix} \quad \begin{bmatrix} 1 & 1 \\ -1 & -1 \end{bmatrix} \quad \begin{bmatrix} \sqrt{2} & 0 \\ 0 & -\sqrt{2} \end{bmatrix} \quad \begin{bmatrix} 0 & \sqrt{2} \\ -\sqrt{2} & 0 \end{bmatrix} \quad \begin{bmatrix} 2 & 2 \\ -2 & 2 \end{bmatrix}$$

Fig.1. Filter coefficients for edge detection

PROPOSED ALGORITHM

The detailed algorithm and Block diagram for the proposed method is presented below:

1. Read input RGB color image (I) from the image collection.
2. Convert RGB color image into YCbCr color space.
3. The intensity plane(Y component) is divided in to non-overlapping 32×32 blocks.

Each image block is decomposed by using 4-level pyramid structure DWT

4. The 4-level DWT gives the 4 matrices CA, CH, CV and CD of wavelet coefficients at level 4.
5. Compute statistical texture features like mean, standard deviation, energy and entropy using approximation coefficients .These 4 features are combined to get a single feature vector FV1.
6. Calculate Edge features using detail coefficients and construct a single feature vector FV2.
7. Compute statistical texture features like mean, standard deviation, energy and entropy using approximation coefficients
8. These 4 features are combined to get a single feature vector FV2.
9. Calculate feature vectors (FV1, FV2) for each image in the database and create a feature database.
10. The feature vectors of the query image are also built in the similar way of database image.
11. For similarity checking compare the query feature vector (FV1, FV2) with database feature vectors (FV1, FV2) using Manhattan and Euclidean distances and calculate the average of these distances.

    Euclidean distance (Δd) =

    $$\sqrt{\sum_{i=1}^{n} (|Q_i - D_i|)^2} \qquad (7)$$

    Manhattan distance (Δd) =

    $$\sum_{i=1}^{n} (|Q_i - D_i|) \qquad (8)$$

    Where Q is the Query feature vector and D is the database feature vector
12. The vectors of the images with lesser distances are most comparable to the query image.

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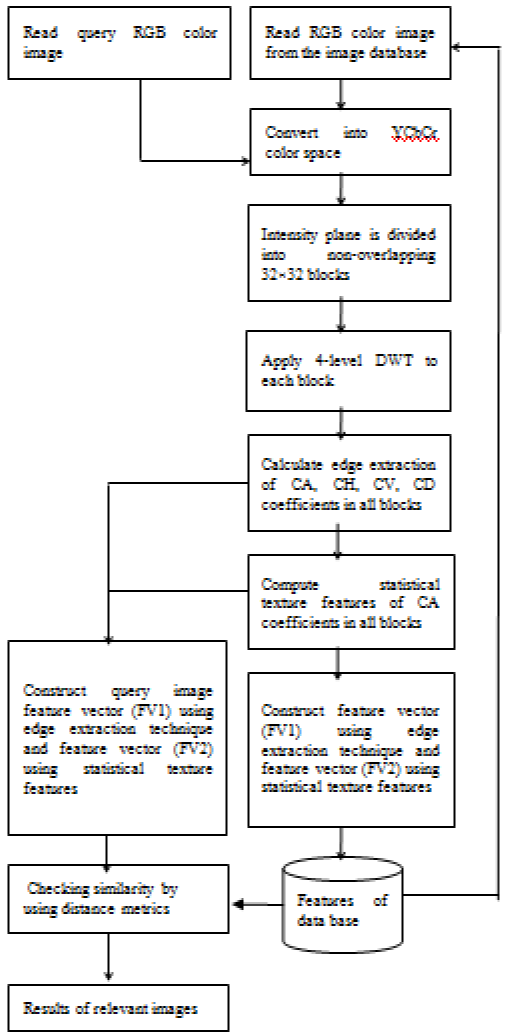

Fig.2. Block diagram of proposed method

EXPERIMENTAL RESULTS

This method is tested by Corel image database [7] .This data base contains 1000 images of 10 different classes. Each class belongs to 100 images. . All these images in the database are RGB color space and JPEG format with a size of 256×384 and 384×256 pixels.

Performance Measures

The efficiency of the retrieval system can be done performance of the feature vector generation and similarity measurement. To assess the retrieval performance of CBIR using precision, recall and F-Score.

Precision

Precision [1] is used for assessing the retrieval performance. It can be defined as the ratio of the relevant retrieval images to the query of the total retrieval images.

$$\text{Precision} = RRI/TRI \quad (9)$$

Where RRI is ‘‘the relevant retrieval images’’ and TRI is ‘‘the total retrieval images”.

Recall

In the image retrieval system Recall [1] can be defined as the ratio of the relevant retrieval images to the query of the total database images.

$$\text{Recall}=RRI/TDI \quad (10)$$

Where RRI is ‘‘the relevant retrieval images’’ and TDI is ‘‘the total database images”.

F-score:

The precision and recall measures the efficiency of image retrieval system and always these two parameters shows the performance of image retrieval. However these two parameters cannot be consider as complete exactness for the effective image retrieval. Hence they can be merged to give a single value which gives the accuracy of retrieval system and this is known as F-Score [1] or F-measure or weighted average or harmonic mean of the precision and recall.

$$\text{F-score}=2\times\frac{\Pr ecision \times \operatorname{Re} call}{\Pr ecision + \operatorname{Re} call}$$

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Table 1 show the precision, recall and F-score values of proposed method using all image categories in Corel image database in and Table 2 compares the average precision value of proposed method with other methods. Fig.4 and Fig.5 shows the results of user queries.

TABLE 1
Precision, Recall, F-Score of proposed method category wise based on Corel image data base

Category	Precision	Recall	F-Score
Dinosaur	100	73	84.4
Roses	99	71	82.7
Horses	94	70	80.2
Elephants	91	69	78.5
Mountains	87	69	77.0
Beaches	80	67	72.9
Buses	79	63	70.1
Buildings	77	64	69.9
People	65	61	62.9
Food	60	57	58.5
Average	**83.2**	**66.4**	**73.9**

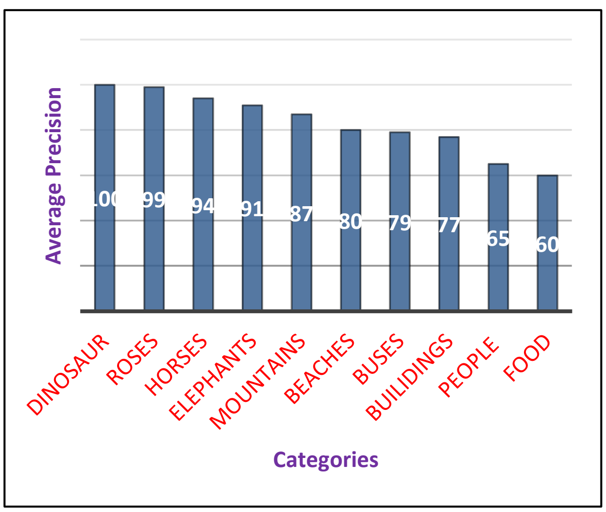

Fig.3. Average Precision of all image categories

Query image

Fig.4. Retrieval results for query image ‘Dinosaur’ from Corel image database

Query image

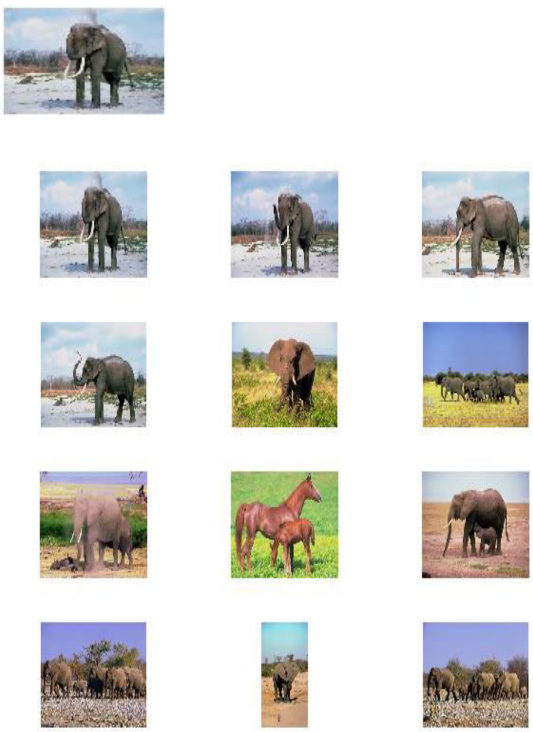

Fig.5. Retrieval results for query image ‘Elephant’ from Corel image database

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TABLE 2
Comparison of proposed method with other methods based on average precision in category wise

Categories	Alnihoud J. Liu et al., (2007)	Mohamed A, et al., Vailaya (1998)	Murala S. et al., Mohamed and Khellif (2009)	Thawari and janwe et al., (2011)	Hiremath, pujari et al., (2007)	Fazal Malik et al., (2013)	proposed method
Dinosaur	100	99	100	90	95	100	100
Roses	97	N/A	80	N/A	61	96	99
Horses	85	40	91	N/A	74	93	94
Elephant	50	70	62	N/A	48	79	91
Mountain	32	N/A	28	N/A	42	60	87
Beaches	68	N/A	50	40	34	82	80
Buses	84	N/A	52	50	61	86	79
Builidings	70	N/A	47	35	36	77	77
People	87	N/A	76	50	48	88	65
Food	63	N/A	63	N/A	50	82	60
Average	**74**	**70**	**65**	**53**	**55**	**82**	**83.2**

CONCLUSION

CBIR using statistical texture and edge extraction features are presented in this paper. Feature vectors are generated and used for retrieving relevant images. The results of proposed method show good performance not only in retrieval but also in efficiency. The overall average precision of our proposed method is 83.2% which gives better efficiency compared to other methods by using statistical texture and edge extraction features.

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