International Journal of Enhanced Research in Management & Computer Applications, ISSN: 2319-7471
Vol. 3 Issue 1, January-2014, pp: (42-48), Impact Factor: 1.147, Available online at: www.erpublications.com

A novel approach of image retrieval based on texture

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Abstract: Image retrieval is the basic requirement task in the present scenario. In this research paper we propose a CBIR system based on texture features. In proposed system firstly the feature vectors based on texture is extracted from the query image. Secondly a similarity measurement algorithm is applied to the extracted feature vector and relevant images are retrieved from database. The performance of the system is evaluated on most common evaluation method namely, Precision and Recall method. The proposed Texture based Image Retrieval system achieves higher efficiency than the shape features of an image.

Keywords: CBIR, Feature Extraction, Texture, Visual Content.

I. Introduction

Content Based Image Retrieval is an emerging research area for multimedia databases and digital libraries [1]. Convenience of capturing the digital image and transmitting them through network and other image acquisition system are the factors that contribute to the growth of image databases. Using Content based Image Retrieval techniques [10]; a user can query an image database by content of interest such as colors, textures, shapes and visual example [2] like sketch. The images that satisfy the perceptual similarity to the user's query may be retrieved from the image database [11].

In case of small collection of images, it is feasible to identify a desired image simply by using browsing and indexing, but in many large image databases, traditional methods of image indexing have proven to be insufficient and time consuming. Traditional image retrieval system was based on indexing images in the database and associating it with a keyword or a categorized description. In CBIR features of the images are extracted and stored in the database and these features are processed with some similarity measurement algorithms with the extracted features of query image at the time of image retrieval [3].

CBIR is based on visual characteristics of images. The fig.1 shows CBIR based Image Retrieval model. CBIR involves following two steps:

1. Feature Extraction
2. Query Compression

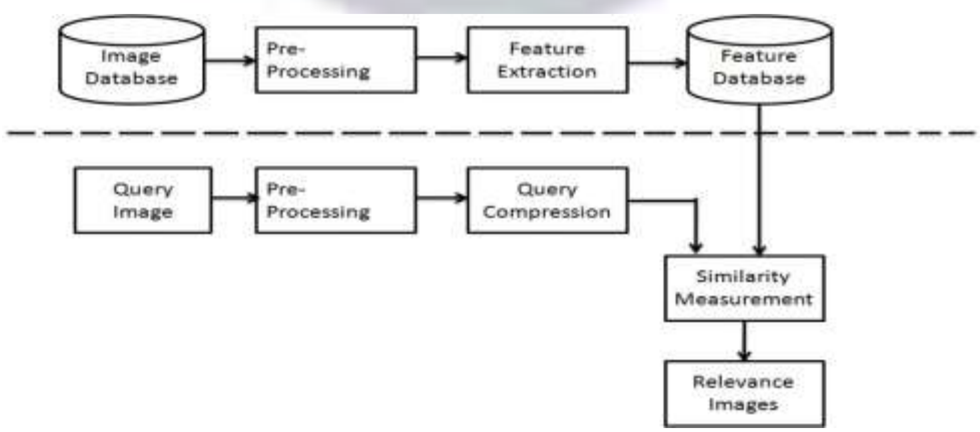

Fig.1: Image Retrieval Model

II. Texture Features

Texture is the property of all surface that describes visual patterns, each having properties of homogeneity [4]. Texture measures look for visual patterns in images [5]. Textures are represented by Texel's which are then placed into a number of sets, depending on how many textures are detected in the image. These sets not only define the texture, but also where in the image the texture is located. Texture is an important characteristic for the analysis of many types of the images including natural scenes, remotely sensed data and biomedical modalities [12]. The perception of texture is believed to play an important role in the visual system for recognition and interpretation [5]. Texture analysis is an important research field in computer vision, image processing and pattern recognition. Texture property of an image includes:

Coarseness,
Contrast,
Directionality,
line-likeness,
Regularity,
Roughness,
Entropy and
Energy

Texture is important characteristic while describing the features of image. It is categorized by the spatial distribution of gray level values in a neighborhood [14]. Many Texture based CBIR techniques have been proposed during the last decade based on similarity measurement of feature vectors extracted from image database and the feature vectors extracted from query compression.

Statistical and structural approaches are the principle approaches used to describe texture [6]. In structural approach an image texture is a set of primitive texels, in some repeated or regular pattern [7] [8]. While in statistical approach an image texture is a quantitative measure of arrangement of intensities in a region [9].

Based on Psychological measurements for human subjects Tamura [5] has described six basic texture features namely, coarseness, contrast, directionality, line-likeness, regularity and roughness.

III. Proposed Methodology

In propose method, we initially create a feature vector database by extracting the primitive features of database images. After creating the feature vector database the retrieval system accepts a query image from the user. The query compression method is applied to the query image as a result feature vectors from the query image are generated. The image features under consideration are texture based features. Using the similarity measurement algorithms the texture features are compared with the features stored in database. After the comparison the relevant images are retrieved from the image database.

The three primitive texture features [II] which have been used in this proposed image retrieval system are:

1. Contrast
2. Coarseness
3. Directionality

The extracted values of above features are stored in database in the form of matrix. Then these values are compared with the extracted feature values of query image.

1. Image Contrast:

Contrast is the measurement of vividness of the texture pattern in an image [16]. The simple method of varying picture contrast is stretching or shrinking of its grayscale [5]. In proposed image retrieval system value of contrast is calculated as follows:

1. Select input image as I.
2. Find size of image
   [Nx,Ny]=size(I)
3. Calculate gray Levels of input image
   [counts,graylevels]=imhist(I);

$$\mathrm{PI} = \frac{\mathrm{counts}}{\mathrm{Nx} * \mathrm{Ny}}$$

4. Find the average value of image
   averagevalue=∑(graylevels.*PI);
5. Find the value of contrast in the image

$$\mathrm{alpha4} = \frac{\sum((\mathrm{graylevels} - \mathrm{repmat}(\mathrm{averagevalue}, [256,1]))^4 * \mathrm{PI})}{(\sigma)^2}$$

$$\mathrm{contrast} = \frac{\sqrt{\sigma}}{\sqrt[4]{\mathrm{alpha4}}}$$

2. Image Coarseness:

Coarseness is the most fundamental textural feature and has been much investigated since early studies [5]. Some time in narrow sense the texture means coarseness.

Image coarseness is the measurement of granularity of an image. Coarseness has a direct relationship to scale and repetition rates and was seen by Tamura et al as the most fundamental texture feature. An image will contain textures at several scales; coarseness aims to identify the largest size at which a texture exists, even where a smaller micro texture exists [13]. In proposed image retrieval system value of *coarseness* is calculated as follows:

1. Select input image I.
2. Calculate no of rows and columns as Nx & Ny
   [Nx,Ny] = size(I)
3. Calculation for the repetition rate between the neighboring pixels.
4. The average over the neighborhood of size $2^k * 2^k$ at the point (x, y) is Calculated using following formula

$$A_k(x,y) = \sum_{i=x-2_{k-1}}^{x+2_{k-1}-1} \sum_{j=y-2_{k-1}}^{y+2_{k-1}-1} \frac{f(i,j)}{2^{2k}}$$

5. Calculate the difference between pairs of averages corresponding to non-overlapping neighborhoods

$$E_{k,h}(x, y) = |A_k(x + 2_{k-1}, y) - A_k(x - 2_{k-1}, y)|$$

6. Using the above difference formula we will find the coarseness in the image.

3. Directionality:

Directionality is the global property over the given region. Directionality involves both the element shape and placement rule. Here the orientation of the texture pattern does not matter, that is, the two patterns which differ only in orientation should have same degree of directionality [5]. In proposed system value of *Directionality* is calculated as follows:

1. Select input image I.
2. Calculate no of rows and columns as Nx & Ny
   [Nx,Ny] = size(I)
3. Form horizontal and vertical difference matrix as PrewittH and PrewittV.
4. Multiply horizontal difference matrix mask with 3*3 matrix of the image

   deltaH(i,j)=∑(∑(double(I)(i-1:i+1,j-1:j+1) * PrewittH))

5. Find first and last row by subtracting the present column from the next column
   deltaH(1,j)=G(1,j+1)-G(1,j);

   deltaH(i,1)=G(i,2)-G(i,1);
6. Find first column by subtracting the 1st column from the 2nd column
7. Similarly repeat the process for vertical difference matrix
   deltaV(i,j)=∑(∑(G(i-1:i+1,j-1:j+1).*PrewittV))

   deltaV(Nx,j)=G(Nx,j)-G(Nx-1,j);

8. Find the magnitude out

   $$x = \frac{(|\text{deltaH}\ | + |\text{deltaV}\ |)}{2}$$

9. Find the value of directionality using difference matrix and magnitude

IV. Proposed Algorithm

Method of retrieving the relevant images from database is based on texture features that are contrast, coarseness and directionality which can be implemented by using the following algorithm:

Step1. Select the query image as input image

Input_Image =Query Image

Step2. Convert the Input image from RGB to Gray.

Input_image=rgb2gray(Input_Image)

Step3. Calculate value of Contrast .

Step4. Calculate value of Coarseness.

Step5. Calculate value of Directionality

Step6 Form the feature vector

Fvector=[Contrast, Coarseness, Directionality]

Step7. Calculate the feature matrices stored in MS access Database.

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The algorithm works on the basis of flow control shown in fig.2.

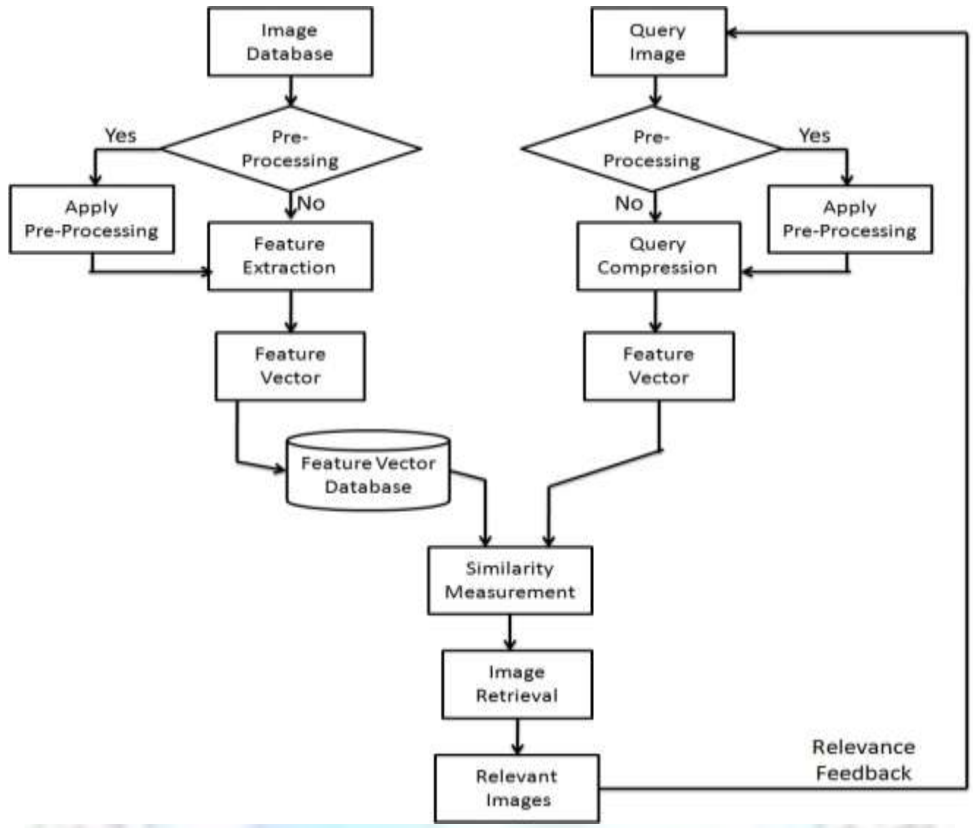


Fig. 2: Architecture of proposed image retrieval system

V. Performance Analysis

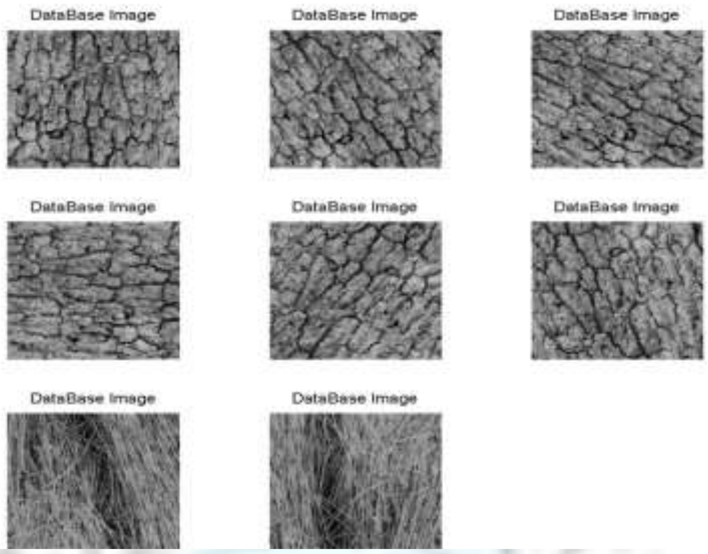
Image retrieval has been classified as accurate if for a given query image the system retrieved the perceptually (to human) most similar images. The image database usually has a large set of image therefore it is desired to have an efficient retrieval scheme. For each query images similar to the query image are manually listed from the database to evaluate the retrieval performance the standard evaluation method that is Precision- Recall pair is used.

Precision is defined as ratio of number of relevant image retrieved to the total number of images retrieved.
Recall is defined as ratio of number of relevant image retrieved to the total number of relevant images in database.
Total number of images in database [15] = 91

The performance is being shown in tabular and graphical form:

Total no. of Relevant Image	No. of relevant Image Retrieved	Total no. of Image Retrieved	Precision	Recall
7	6	8	.75	.85
6	5	7	.71	.83
5	4	6	.67	.8
4	4	6	.67	1
3	3	5	.6	1
2	2	4	.5	1
1	1	3	.3	1

Retrieved Relevant Images



Precision = 0.75
Recall = 0.85

VI. Future Scope

The result from the proposed image retrieval system are good but can be further improved with the use of other features like shape and color. The database can be clustered based on color or shape to increase the speed of retrieval system. The performance of proposed system can be further improved by applying fuzzy logic, neural network and genetic algorithm. Clustering will be more advantage for reducing the searching time of images in database.

VII. Conclusion

The main objective of the proposed image retrieval model is to develop an efficient image retrieval scheme. The proposed methodology is based on texture content of the image i.e. Coarseness, Contrast, and Directionality. The performance analysis of the images for texture based image retrieval technique has given an average precision of 0.7. The result can be further improved by using fuzzy clustering algorithm on texture element in the above proposed texture based image retrieval system.

References

[1]. Kato,T. (1992) “Database architecture for content-based image retrieval” in Image Storage and Retrieval Systems, Proc SPIE 1662, pp112-123.
[2]. Lin.,H.-C,.Chiu C.-Y, and Yang, S.-N., “ Finding textures by textual descriptions, visual examples, and relevance feedbacks”, Pattern Recognition Letters, 24(12):2255-2267, October 2003.
[3]. Grigorova, Anelia. Francesco. De Natale, G. B., Charl, “ Content-Based Image Retrieval by Feature Adaptation and Relevance Feedback”, IEEE Transactions on Multimedia, Vol. 9, No. 6, October 2007.
[4]. W. Ma and B. Manjunath, “Texture-based Pattern Retrieval from Image Database”, Journal of Multimedia Tools and Application, Vol. 2, No1,pp. 35-51,1996.
[5]. Tamura,H. S, Mori and Yamawaki,T., “Texture features corresponding to visual perception”, IEEE Trans. Systems Man Cybernet. 8 (6), 1978, 460–473.
[6]. Umarani,C. Ganesan,L, “Combined Statistical and Structural Approach for Unsupervised Texture classification”, International Journal OF Imaging science and Engineering (IJISE) ISSN: 1934-9955, Vol.2, No.1, January 2008.
[7]. Michael Beil, Theano Irinopoulou, Jany Vassy, Günter Wolf, “A dual approach to structural texture analysis in microscopic cell images ” Computer Methods and Programs in Biomedicine, Volume 48, Issue 3, December 1995, Pages 211-219.
[8]. Ismet Zeki Yalniz, Selim Aksoy ,“Unsupervised detection and localization of structural textures using projection profiles” Pattern Recognition, Volume 43, Issue 10, October 2010, Pages 3324-3337.
[9]. André Ricardo Backes, “A new approach to estimate lacunarity of texture images” Pattern Recognition Letters, Volume 34, Issue 13, 1 October 2013, Pages 1455-1461.
[10]. Jun Yue, Zhenbo Li, Lu Liu, Zetian Fu, “Content-based image retrieval using color and texture fused features” Mathematical and Computer Modelling, Volume 54, Issues 3–4, August 2011, Pages 1121-1127.

[11]. P.W. Huang, S.K. Dai, "Image retrieval by texture similarity" Pattern Recognition, Volume 36, Issue 3, March 2003, Pages 665-679.
[12]. Hsin-Chih Lin, Ling-Ling Wang, Shi-Nine Yang "Regular-texture image retrieval based on texture-primitive extraction" Image and Vision Computing, Volume 17, Issue 1, January 1999, Pages 51-63.
[13]. Peter Howarth and Stefan Ruger,"Evaluation of Texture Features for Content-Based Image Retrieval." CIVR 2004, pp. 326–334.
[14]. http://km.doc.ic.ac.uk/pr-p.techasith-2002/docs/ose.doc
[15]. http://sipi.usc.edu/
[16]. S Jayaraman, S. Esakkirajan, T. Veerakumar ,"Digital Image Processing".