Feature based image retrieval of images for CBIR

Pradnya Rane 1, Pallavi Kulkarni 2, Suchita Patil 3 and B.B.Meshram 4

1,2,3,4 Computer Department, VJTI, Matunga, Mumbai, India
1 pradnyarane@gmail.com
2 Pskulkarni77@gmail.com
3 Suchitapatil26@gmail.com
4 bbmeshram@vjti.org.in

Abstract

Extensive use of images in various applications gives immense importance to Content based image retrieval. There are many ways to retrieve image from image database depending upon various image features like DCT coefficients, mean, median entropy etc. Histogram [6] is very simple and old approach for image retrieval. This paper describes a combined approach to content based image retrieval considering DCT- coefficients of R,G,B planes separately and basic image features. The idea in this study to evaluate the effect of above image features to query image. Again the comparison of Database image and query image is done on the basis of similarity measures such as Euclidian distance in above specified methods. Finally a threshold is obtained based on sample basis. We applied our approach to a database of 25 JPG images which includes 10 dinosaurs and 10 flowers. We have determined the capability of automatic indexing by analyzing image contents as features. The results are far more accurate than conventional image indexing. Hence, there exists a tradeoff between accuracy and computational cost.

Keywords: CBIR, DCT, mean, median, standard deviation (SD), entropy.

1. Introduction

Content based image retrieval is becoming more and more important as many of the applications requires to query similar to images from the image database as the given query image. In recent years, there has been a growing interest in developing these effective methods for searching large image databases based on image content by ranking the relevance between query image feature vector and database image feature vector. The users provide an example image for the query, for which the database is searched exhaustively for images that are most similar.

To increase the efficiency of CBIR techniques, exactable visual features like color and texture are used. Those color and texture features are extracted from image database and compared with features of query image. Depending upon the similarity measure, threshold the result is displayed to user [2]. The result is similar images to query image and not the exact match. Thus content-based image retrieval attracted many researchers of various fields in an effort to automate data analysis and indexing. There exist many systems for image retrieval meanwhile.

We are focusing on distribution of color for each pixel of R, G, B components of an image and applying discrete cosine transform to obtain the DCT coefficients using which we are forming a feature vector by selecting some of the DCT coefficients. Again we are focusing on some image features like mean, median, entropy and standard deviation to form feature vector. We are applying the same technique to all database images in the database to create feature vector database. When user gives the query image feature vector is obtained in the same manner as it is done for database images.

In this paper, section 2 describes the architecture for CBIR. Section 3 describes architecture of our proposed system for CBIR using DCT coefficients for color feature extraction including other texture features with an algorithmic view. Selection of threshold, Image retrieval and experimental results are given in section 4. Finally analysis and conclusion is described in the section 5.

2. Related Work

Content based image retrieval is done in following ways
Fig1. Architecture of CBIR

Content based image retrieval system consists of following modules:
1. Feature Extraction: In this module the features of interest are calculated for image database. This step is done in offline manner.
2. Feature extraction of query image: This module calculates the feature of the query image. Query image can be a part of image database or it may not be apart of image database. This is online calculation.
3. Similarity measure: This module compares the feature database of the existing images with the query image on basis of the similarity measure of the interest[2].
4. Retrieval and Result: This module will display the matching images to the user based on threshold value of similarity measure.

Basic Components of the CBIR
1. Image Database: Database which stores images. It can be normal drive storage or database storage.
2. Feature database: All the offline extracted feature are stored in database like mat file, excel sheets etc.

3. Proposed System

There are two methods used for Content Based Image retrieval. These methods are used differently and checked for the results when combined. Algorithms for these methods are given bellow.
1. RGB Plane Based: Separation of R, G, B plane and DCT coefficients of these planes are taken. Sixteen DCT coefficients are taken for one image in each plane[4]. Euclidian distance[1] is calculated for each image to every other image. This is the offline processing. After Query image, check the Euclidian distance[3] of every image to the query image and store the result into array. And if distance is minimum then display that images as relevant image for the given query image.

2. Pixel Based and Texture based: Calculate different features of image like mean, median for color image. Mean is used for pixel value analysis and statistics of image. Entropy, standard deviation and store the average of all these features into array. Entropy is statistical measure of randomness that can be used to characterize the texture of the input image. Standard deviation is pixel value analysis feature. So to calculate entropy and standard deviation input image is converted to gray image and then values are calculated. Computed values are stored in .mat file.

Fig2: Architecture of the Proposed System

3.1 Data structures used

For storing DCT coefficients, mean and median mat file is used in which the mean_img and median_img these two columns are used to store the mean and median values. To store entropy and standard deviation values mat file is used in which entropy_img and std_img these two columns are used to store the entropy and the SD values.

3.2 Algorithm

3.2.1 Algorithm for RGB DCT coefficients
2. Preparation of vectors for each plane.
3. Calculate the intensities for each plane pixels as, Red plane, green plane and blue plane for R, G and B planes respectively.
Apply Discrete Cosine Transformation to row and column vectors obtained in above step.

\[
F = [C]. Vi \tag{1}
\]

Where Vi is row / column vectors for red, green and blue plane and
\[
C(u, v) = \sqrt{2/N} \cdot \cos\left(\frac{(2u+1)v}{2N}\right)
\]

for \( u = 0: N-1 \)

\( V = 0: N-1 \)

5. Select first 16 DCT coefficients from F to form a feature vector of 16 components for R, G, and B planes respectively.

6. Application of Similarity Measure: Euclidian Distance[3].

7. Between DCT Euclidian distance of database image and query image.

8. Similarly for green plane and for blue plane.

9. Select those images where the distances are less than preselected value for threshold T.

10. Selection of threshold T is by trial and error.

3.2.2 Algorithm for the other mean and median feature:

Compute the mean and median [5] for query image. And find the average of these two. Find the difference of stored values and query image and store that in array. Mean can be calculated using following equation (2).

\[
\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n}
\]  

(2)

Algorithm for the other entropy and standard deviation feature:

Convert the query image into gray image and then compute the entropy and SD for query image.

Set the threshold for the Entropy and SD[5]. Threshold is selected by trial and error basis.

If difference of query image and stored image values are less than threshold then mark the image as selected by creating array and making that particular value as 1 and 0 otherwise.

If for both entropy and SD that value for the image is 1 then display that on the output screen.

Standard deviation can be calculated using following equation (3)

\[
s = \sqrt{\frac{\sum_{i=1}^{N} (X_i - \bar{X})^2}{N - 1}}
\]

(3)

4. Retrieval and Results

Algorithm for retrieval:

Retrieval is done using double thresholds.

1. In DCT coefficient method while comparing the query image thresholding is done on sample basis for each R, G, B plane.

2. An array will contain 1 if image is equal or above threshold otherwise it will contain 0.

3. In above mentioned manner an array is prepared for mean, median, Entropy, SD features.

4. If more than one array contains the entry for the image, that image will be there as a result.

4.1 Output

Fig. 3 Query Image

Fig. 4. Red Plane for Query Image

Fig. 5. Green Plane for Query Image
5. Conclusion

Please After combining various methods following observations is found.

1. Entropy and standard deviation are the features for the images which are using grey level. Coloured image has to be converted into grey scale to get the entropy and SD features. If we try to combine the results of SD entropy and RGB plane then the results are not proper.

2. The combination of RGB and mean median features are giving accurate result. The result contains more appropriate results similar to the query image.

3. The threshold value in case of DCT of R, G, B planes has to be derived on sample basis. This will be different for different query images.

References


