Color Averaging Technique using Dominant Color for Content Based Image Retrieval

Prabhakar Sharma1, Deepty Dubey2

1 Department of Computer Science and Engineering
Chhatrapati Shivaji Institute of Technology, Durg, C.G., India,

2 Department of Computer Science and Engineering
Chhatrapati Shivaji Institute of Technology, Durg, C.G., India,

Abstract

In many areas of commerce, government, academia, and hospitals, large collections of digital images are being created. Many of these collections are the product of digitization of existing analogue photographs, diagram, drawings, paintings, and prints. Usually these collections were merely searched by means of textual annotations. This huge digital image database causes the need to develop an efficient image retrieval system. Content based image retrieval CBIR has been one of the most important research area in the field of computer science. There were many CBIR techniques have been proposed in the last decade [1]. This paper provides a method for content based image retrieval using only color aspect. In this paper we regard as the dominant pixel intensity values to shrink the feature vector and performed similarity measure between pixel intensities present in both query image and database image for same positions.

Keywords: *CBIR, feature vector*

1. Introduction

In the past access to collection of digital images were provided by librarians, curator and archivists through the manual assignment of textual descriptor and classification code. Automatic assignment of text attributes to images was developed by utilizing captions and transcripts later. Text based image retrieval (TBIR) makes use of text descriptors to retrieve relevant images. Past research shows that some of the useful text descriptor such as time, location, event objects, and aboutness of image content and topical terms are most helpful to users. The advantage of this approach was that it enabled widely approved text information system to be used for visual retrieval systems. However manual assignment is time consuming and costly while automatic assignment may not be possible if the image collections do not have accompanied text [2]. In literature the term content based image retrieval (CBIR) has been used for the first time by Kato et.al. [3], to describe his experiments into automatic retrieval of images from a database by color and shape feature [4].CBIR is an exciting and in-depth area of research, which has garnered much interest over the past few years [5]. Application of World Wide Web (www) and the internet is increasing exponentially, and with it the amount of digital image data accessible to the users. A huge amount of image databases are added every minute and so is the need for effective and efficient image retrieval systems [6]. The relevance of visual information retrieval in many areas such as fashion and design, crime prevention, medicine, law, and science makes this research field one of the important and fastest growing in information technology. Image retrieval has come a long way where it started off with text based retrieval. However, there are many problems associated with retrieving images based on text such as manual annotation of keywords, differences in perception and interpretations, and few others. Due to this researchers came up with CBIR where images are retrieved based on low-level features (human vision related), middle-level features (objects related), or low-level features (semantic related). Among these features low-level features are the most popular due to its simplicity compared to other level of features plus automatic object recognition and classification is still among most difficult problems in image understanding and computer vision [5]. The low-level features are color, texture, shape, and spatial properties. However spatial properties are implicitly taken into account so the main features to

investigate are color, texture and shape. Color feature is one of the most widely used features in low level feature [7]. Compared with shape feature and texture feature, color feature shows better stability and is more insensitive to the rotation and zoom of image. Color not only adds beauty to objects but also more information [8]. Texture generally refers to the presence of a spatial pattern that has some properties of homogeneity. Directional features are extracted to capture image texture information. The four extraction methods available for texture feature retrieval are The Steerable Pyramid; The Contour let Transform, The Gabor wavelet Transform, and The Complex Directional Filter Bank [9].

2. Previous Work

A method proposed by Dr. H.B.Kekre, Sudeep D. Thepade, Akshay Maloo all image pixels are considered as feature vector and Euclidean distance is used in RGB plane to find the best match, which is used to calculate precision and recall. Another method proposed by Dr. H.B.Kekre, Sudeep D. Thepade, and Akshay Maloo row mean of image is calculated to be feature vector and then Euclidean distance is used in RGB plane to find the best match, which is used to calculate precision and recall. In column method proposed by Dr. H.B.Kekre, Sudeep D. Thepade, and Akshay Maloo feature vector is composed of column mean of image is calculated and then Euclidean distance is used in RGB plane to find the best match, which is used to calculate precision and recall. In row and column mean of image method proposed by Dr. H.B.Kekre, Sudeep D. Thepade, Akshay Maloo row and column mean of image are considered together as feature vector and then Euclidean distance is used in RGB plane to find the best match, which is used to calculate precision and recall. In forward diagonal method, backward diagonal mean of image is considered as feature vector and then Euclidean distance is used in RGB plane to find the best match, which is used to calculate precision and recall. In forward diagonal method, forward diagonal mean of image is calculated and then Euclidean distance is used in RGB plane to find the best match, which is used to calculate precision and recall. Both methods were proposed by Dr. H.B.Kekre, Sudeep D. Thepade, and Akshay Maloo. They also purposed another method in which both forward and backward diagonal mean both are considered together as feature vector of image and then Euclidean distance is used in RGB plane to find the best match, which is used to calculate precision and recall[4][10].

3. Proposed Method

The concept behind this proposed method is that if two images are very relevant then in both images at same positions there will be same or very nearest intensity values will present. In this proposed work, we consider the dominant pixel intensity values to reduce the feature vector and performed similarity measure between pixel intensities present in both query image and database image for same positions. We proposed a modified color averaging technique in which we consider the positions of pixel's intensity values present both in query image and database image. In this proposed method we take the average of intensity values present in corresponding location of database image for respective intensity values present in query image. If the average from database image and intensity present in query image are same or near to same, then query image and database image will be similar to each other. In this method we have to first find out the intensity values present in query image with their respective positions in query image. In the next Step for each intensity values present in query image we calculate average of intensity values present in corresponding positions in database image. To perform this calculation it is required to have both images should be of same size. The steps of algorithms are as follows.

Step1: Find out the dominant intensity values present in query image. To find out dominant intensity values present in query image, we determine the frequency of occurrences of all intensity values present in query image and considering only those intensity values whose frequency of occurrences is very high in query image.

Step2: **Find out the position of dominant intensity values present in query image.** Because digital images are represented in the form of matrix, it is difficult to find the location of any intensity values present in image. To resolve this problem we need to represent the image into vector form. In this representation we can easily find the location of an intensity value present in query image.

$$\begin{pmatrix} a_{11}\ a_{12}\ldots\ldots\ldots\ldots a_{1n} \\ \\ \\ a_{m1}a_{m2}\ldots\ldots\ldots\ldots a_{mn} \end{pmatrix} = \begin{pmatrix} a_{11}\ a_{21}\ldots a_{m1}\ldots a_{1n}\ldots a_{mn} \end{pmatrix}$$

(a)Digital image in Matrix form (b) Digital image in Vector form

Fig. 1 Digital image in matrix form and Digital image in vector form

Fig. 1 shows the matrix and vector representation of digital image, in which a_{11}, a_{12}….a_{1n}…a_{m1}, a_{m2}…a_{mn} are intensity value of pixels present in digital image.

Step 3: Find the average of intensity values present in database image for corresponding positions of an intensity value in query image. To perform this operation, it is require representing the database image in vector form. In this way we can easily locate the positions of intensity vales found in query image into database image. But before performing this operation it is necessary to make the database image size same as query image size. For example

1	2	3
1	2	1
3	1	2

(a) Query image

1	3	2
2	1	1
3	1	2

(b) Database Image

Fig. 2 Sample of Query image and Database image

For intensity value '1' in query image positions are 1,2,6,8.For this corresponding positions in database image, average of intensities will be

$$\frac{1+2+1+1}{4} = \frac{5}{4} = 1.25$$

Step 4: Perform the similarity measure between query image and database image by taking difference of an intensity value in query image and average intensity for that intensity in database image. This similarity measure is performed using Euclidean Distance formula

$$D = \sqrt{\sum_{i=1}^{N} (V_{pi}-V_{qi})^2} \qquad (1)$$

Equation (1), calculates the Euclidian distance between two pixel values, where, Vpi and Vqi are the feature vectors of image P and Query image Q respectively with size 'N'.

Step 5: Retrieve those images for which Euclidean distance is minimum.

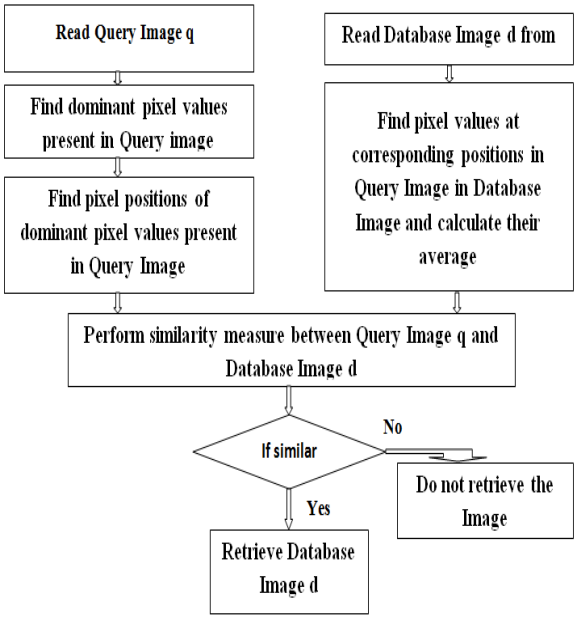


Fig. 3 Flow Diagram of proposed Color averaging technique

4. Result and Discussion

We have used Wang Database for image retrieval. The WANG database is a subset of 1,000 images of the Corel stock photo database which have been manually selected and which form 10 classes of 100 images each.

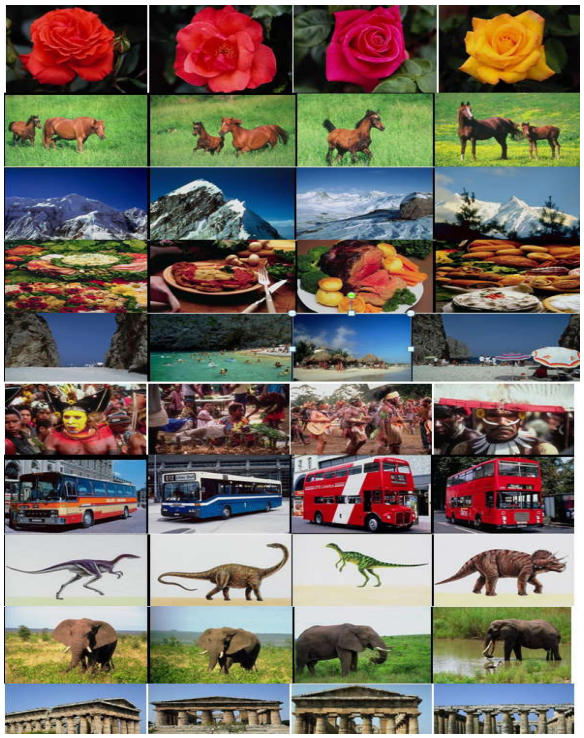
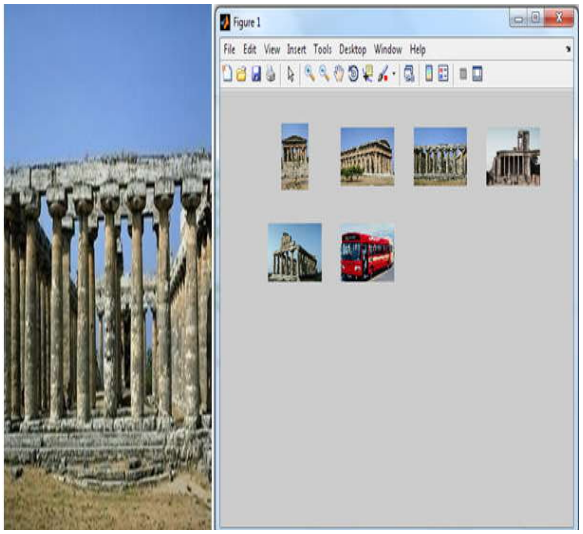


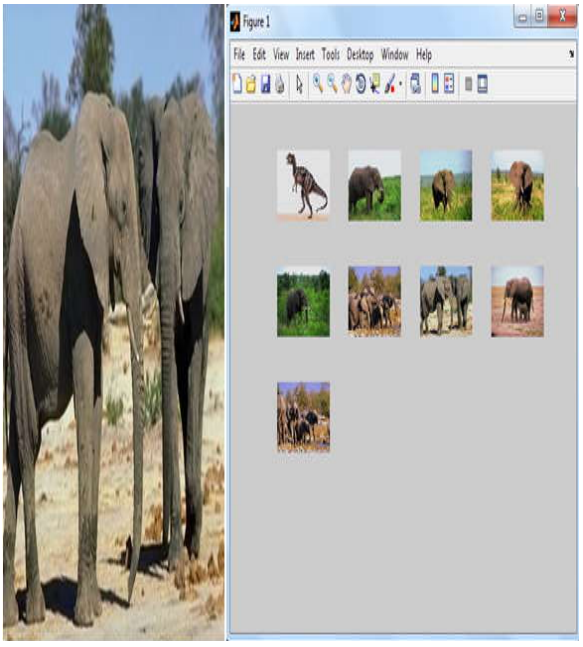
Fig. 4 Database images

The performance evaluation of retrieval system is measured by means of precision and recall values. The precision is defined as number of relevant images retrieved to total number of images retrieved; whereas recall is defined as number of relevant images retrieved to total no of relevant images in database [1.4, 10]. For each category 10 queries were fired. The results are as follows.



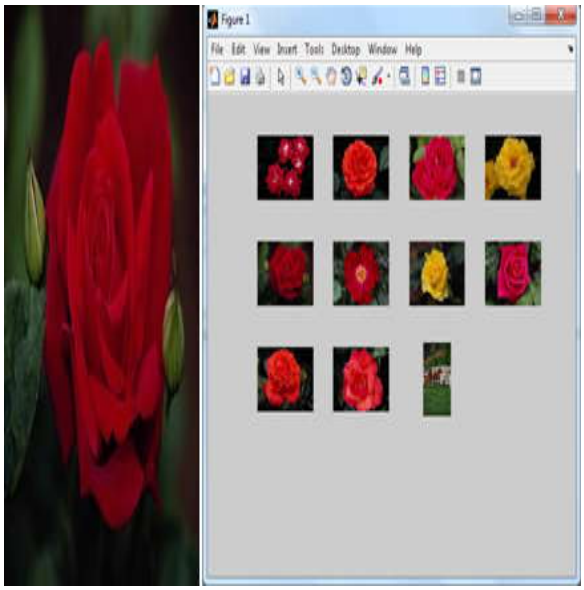
Input image Output image

Fig.5 output for category "Architect"



Input image Output image

Fig.6 output for category "Elephant"



Input image Output image

Fig.7 output for category "Flower"

Table 1: Average precision and recall values category wise

Sr. No.	Category	Average Precision	Average Recall
1	Tribe	92.5	24
2	Architect	78.4848	35.5372
3	Bus	82.9167	28.6364
4	Dinosaur	100	100
5	Elephant	72.0545	58
6	Flower	98.1818	99
7	Horse	71.4535	41
8	Mountain	74.2738	49
9	Meals	62.6667	25
10	Beach	81.1825	48

Table 2: overall precision and recall value of proposed CBIR system

Average precision value	81.2438
Average recall value	52.58326

5. Conclusion

The experimental outcome shows that precision value of proposed CBIR system is **81.2438** and recall value is **52.58326**. From result it has concluded that precision is high and recall is low for proposed CBIR system, which means that the system is able to find good match in concerned class but in a small amount of numbers only. The high precision values indicates that when two similar images of same class consist of small number of different color intensities and very few colors are dominant then a good match found but when two similar images of same category contains blend of large number of different color intensities and every color intensity values are present with approximately same population then it is complicated to find a good match thereby recall value decreases.

References

[1] Prabhakar Sharma, Deepty Dubey," A Modified Color Averaging Technique for Content based Image Retrieval" International Journal of Computer Applications (0975 – 8887) Volume 51– No.20, August 2012.

[2] Christopher C. Yang," Content –based image retrieval:a comparison between query by example and image browsing map approaches", Journal of information Science, 30(3) 2004 pp. 254-267

[3] Hirata K. and Kato T. "Query by visual example – content-based image retrieval", In Proc. of Third International Conference on Extending Database Technology, EDBT'92, 1992, pp 56-71

[4] Dr. H.B.Kekre1, Sudeep D. Thepade2, Akshay Maloo3," Query by Image Content Using Color Averaging Techniques", Dr. H.B. Kekre et al. / International Journal of Engineering Science and Technology.Vol. 2(6), 2010, 1612-1622.

[5] Mas Rina Mustaffa, Fatimah Ahmad, Rahmita Wirza O.K. Rahmat, Ramlan Mahmod." Content-based image retrieval based on color-spatial features" Malaysian Journal of Computer Science, Vol. 21(1), 2008.

[6] P. V. N. Reddy, K. Satya Prasad, " Color and Texture Features for Content Based Image Retrieval", P V N Reddy et al, Int. J. Comp. Tech. Appl., Vol 2 (4), 1016-1020.

[7] Th.Gevers (2001). "Color Based Image Retrieval". *Springer Verlag GmbH*. pp.886-917

[8] Manesh Kokare, B.N. Chatterji and P.K. Biswas, "A survey on current content based image retrieval methods", IETE Journal of Research, Vol. 48, No.3 and 4, May-Aug 2002.

[9] H.B.Kekre, Sudeep D. Thepade, "Rendering Futuristic Image Retrieval System", National Conference on Enhancements in Computer, Communication and Information Technology, EC2IT-2009, 20-21 Mar 2009, K.J.Somaiya College of Engineering, Vidyavihar, Mumbai-77.

[10] Dr. H.B.Kekre, Sudeep D. Thepade, Akshay Maloo," Image Tiling to Improve Performance of Image Retrieval Using Color Averaging Techniques", IJCA Special Issue on "Computer Aided Soft Computing Techniques for Imaging and Biomedical Applications" CASCT, 2010