International Journal on Emerging Technologies 11(2): 411-415(2020)

ISSN No. (Print): 0975-8364
ISSN No. (Online): 2249-3255

# Content Based Image Retrieval with integrated Techniques

**A.P. Nilawar[1] and C.G. Dethe[2]**

[1]Assistant Professor, Department of Electronics & Communication Engineering,
Shri Ramdeobaba College of Engineering and Management, Nagpur (Maharashtra), India.
[2]Director, UGC HRDC, R.T.M.N.U., Nagpur (Maharashtra), India.

(Corresponding author: A.P. Nilawar)
(Received 30 December 2019, Revised 26 February 2020, Accepted 29 February 2020)
(Published by Research Trend, Website: www.researchtrend.net)

**ABSTRACT: Retrieving of similar images from a large image database is a vital issue having a solution as content based image retrieval. Content Based Image Retrieval performs retrieval of the images from large image databases, which is similar to the image given as a query image. The images are described by its content, there is three major content present in an image like color, shape, and texture. The challenging part is to select the appropriate feature for the retrieval process. In this paper, we have proposed a content based image retrieval with the integrated technique, which is based on color and shape features extraction. For extracting color features we use Block Truncation Coding (BTC) integrated with a Gray level co-occurrence matrix (GLCM). For extracting shape features we use gradient operators integrated with a figure of merit (FOM). Four different gradient operators are considered as Sobel, Roberts, Prewitt, and Canny. The feature extraction process is accomplished based on an input query image from the database and features are stored in a feature dataset. The Euclidean distance is applied to the query image and feature vector computed from the image database for measuring similarity. A proposed technique retrieves images from a database that satisfies the user's expectation. The performance of the retrieval system has been analyzed by two performance parameters Precision and Recall. After the experimentation, we can summarize as results of the retrieval system are enhanced when color and shape features are combined with each other.**

**Keywords:** CBIR, Euclidean distance, Block Truncation Coding, Grey Level Co-occurrence Matrix, Figure of Merit.

**Abbreviations:** CBIR, Content Based Image Retrieval; BTC, Block Truncation Coding; FOM, Figure of Merit.

## I. INTRODUCTION

In today's world, there is an increase in the size of multimedia databases. It contains information like image, audio, video, etc. The use of images in the field of medical, personal, journalism creates lots of image databases. Thus, the Content Based Image Retrieval system invented to handle large image databases. Content Based Image retrieval system returns a set of images from a collection of images in the database to meet user's demand with similarity evaluation. CBIR system is based on visual features like color, shape and texture information.

CBIR includes extraction of features from image based on its content, measuring similarity between the query image and image in the database, and ranking from most similar to dissimilar image. CBIR system has two major stages in the first stage the pre-processing for image database called image feature extraction based on the type of features like color, shape, and texture. And in the second stage measurement of similarity from database image referring query image provided by the user.

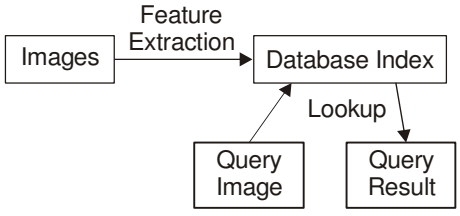


**Fig. 1.** Basic CBIR System.

The above figure explains the basic operation of the CBIR System.

In the retrieval system, there are basically three major fields text based image retrieval, retrieval based on visual feature and semantic features. In text based image retrieval system images are provided by labels and for retrieval purpose similarity of these labels are used.

A major disadvantage of these kinds of systems is that a lot of human work evolved for image labeling and if the database of images in a large number than it is quite difficult. And labeling of images is not user friendly it depends on database creators labeling techniques [6]. Then the visual based image retrieval system used for image retrieval purpose and low level features is considered for feature extraction [7]. Presently CBIR based on visual features along with semantic features in use. There are three major features are present in an image namely color, texture and shape.

Most of the past studies related to CBIR include consideration of only single content in the image. The content has to be considered for retrieval like color, shape or texture. The drawback of such a system is only one content or feature in the image is not sufficient to describe a complete image [17, 18].

In this paper integration of color, shape and texture features are used. The advantage of the proposed system is "Extracting color features using BTC integrating with GLCM which is texture feature and extracting shape features using integrating gradient operator with the figure of merit"

## II. MATERIALS AND METHODS

**Block Truncation Coding (BTC):** As explained in [3-5] BTC has demonstrated its use in the compression domain and also we can effectively use it in the CBIR application. Basically, BTC is an image ciphering technique, several advanced ciphering techniques developed using BTC [2]. BTC can be used in image compression, ciphering and retrieval application. It consists of two processes encoding and decoding. In the encoding process, it will divide the complete image into several image blocks having two quantizers namely high and low. In this method mean value and standard deviation calculated for each block. Then the mean value compared with each pixel in an image if mean value is greater than pixel value replaced by 1 otherwise pixel value replaced by 0. First we will convert image into a grayscale image, then grayscale image divided into several blocks of different size like 2 by 2, 4 by 4, 16 by 16 and so on. In the next stage, we will compute the mean value and standard deviation. After computing, the mean value bit map pattern of an image generated.

**Table 1: Gray Scale Image.**

| | | | |
|---|---|---|---|
| 140 | 142 | 144 | 145 |
| 146 | 141 | 146 | 142 |
| 145 | 141 | 144 | 142 |
| 142 | 138 | 141 | 144 |

**Table 2: Binary bitmap pattern.**

| | | | |
|---|---|---|---|
| 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 |
| 0 | 0 | 0 | 1 |

In Table 1 grayscale image of block size 4 by 4 considered. The mean value for this block is 142.5 and the standard deviation is 2.199. If the mean value greater than pixel value, than pixel value replaced by 1 otherwise pixel value replaced by 0. By using this method Table 2 generated. In decoding two quantization levels as high and low are used to reconstruct value from the encoded block. Fig. 2 shows the encoding and decoding process using BTC.


**Fig. 2.** Illustration of BTC.

**Gradient Operators With Slope Magnitude:** Gradient operators provide edges of an image and it contains information. For image analysis edge detection is a very important parameter. It provides information about the shape of an object present in the image. The cross-section of an edge having the shape of the ramp [8, 9]. An edge can be termed as a ramp with an infinite slope. There are four major gradient operators considered for shape feature extraction purposes. Sobel, Prewitt, Roberts and canny are the gradient operators.

The Sobel operator is comparatively less complex as compared with others. It computes an approximation of the gradient of image intensity function. It based on the principle of convolution having a mask of size 3 by 3 matrixes. The mask is applied to the horizontal and vertical axes of an image. The Prewitt operator also has a mask of 3 by 3 matrixes. It contains mask values +1, 0 or –1. Robert filters having a mask size of 2 by 2 matrix. While the canny operator provides a gradient of Gaussian filtered image.

When these operators are applied on an image it provides output containing discontinuous edges of an object present in an image. For observing continuous boundary there needs to be some mechanism that will provide proper boundary with continuity in edges. The solution is the slope magnitude method. It extracts shape features in the form of continuous boundary. The process for slope magnitude needs to follow the given steps. The convolution of an image needs to be taken by the mask of the gradient operator in the horizontal and vertical direction. After completing this step squaring of both direction gradients to be taken. Let's consider Prewitt operator with mask Ix in horizontal direction and Iy in Vertical direction. These masks applied to an image. After this process squaring of an individual mask i.e. Ix and Iy applied to an image with a mathematical expression,

$$I = \sqrt{Ix^2 + Iy^2} \quad (1)$$

Fig. 3 shows the application of the slope magnitude method along with the gradient operator

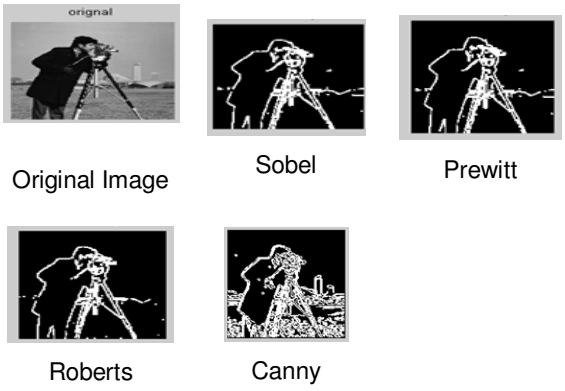


**Fig. 3.** Illustration of the Slope Magnitude method with gradient operators.

**Similarity Measurement:** Euclidean distance is the most commonly used method to find similarity between images [10]. Euclidean distance measures the similarity between the query image and images present in the database. Assume X is a set of query images and Y is a set of images in the database. The measuring process can be performed on X = [X1, X2….Xm] to every element in Y= [Y1, Y2…Yn] using the following equation

$$d = \sqrt{\sum_{i=1}^{k} (Xi - Yi)^2} \quad (2)$$

where,

Xi and Yi represents the feature vector of the query image and image in the database at element i respectively

K represents the total number of element in individual feature vectors

d represents the similarity score between query and image database.

**Proposed Methods:** In this paper, we are proposing two methods of block truncation coding with a fusion of GLCM and Slope magnitude with a fusion of figure of merit.

**Technique 1 : Block Truncation coding with GLCM:** In this method users having the option to select a rectangular block of size 2 × 2, 4 × 4 or 16 × 16. After selecting the block size training process starts. During the training process the image in the database first applied by BTC then GLCM applied to an image. At the end of the training process feature vector forms which consist of feature element for each image in the database.

During retrieval, the user has to provide a query image than using Euclidean distance measurement similar images are displayed. Algorithm for this technique is explained below

Step 1: User has to select rectangular block of size 2 × 2, 4 × 4 or 16 × 16

Step 2: Then depending on the selection of block size image divided into non overlapped blocks

Step 3: the Preprocessing process starts where each image in the database applied by BTC

Step 4: After application of BTC, GLCM applied to an image

Step 5: For every image, feature extracted and indexed in the database with the feature vector

Step 6: After preprocessing done user has to provide query image

Step 7: Using Euclidean distance similar images are displayed

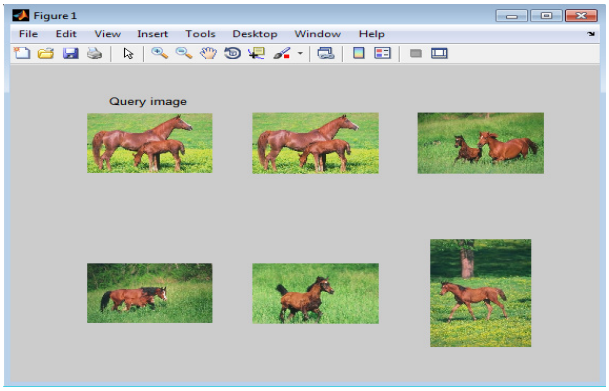


**Fig. 4.** Sample Results for the technique 1.

**Technique 2: Slope Magnitude with Figure of Merit:** In this method users having the option to select gradient operators from Sobel, Prewitt, Roberts or Canny. After selecting the gradient operator training process starts. During the training process, the image in the database first applied by slope magnitude with the selected operator then Figures of Merit applied to an image. The mathematical equation used for the Figure of merit explains in Eqn. 3. At the end of the training process feature vector forms which consist of feature element for each image in the database.

During retrieval, the user has to provide a query image than using Euclidean distance measurement similar images are displayed.

$$\mathrm{FOM} = \frac{1}{\max(\mathrm{Ii},\mathrm{Ia})} \sum_{i=1}^{Ia} \frac{1}{1+\alpha d\hat{}2} \qquad (3)$$

where,

Ii and Ia are the numbers of ideal and actual edge points d is pixel miss distance of ith edge detected alpha is scaling constant having value 1/9 to provide offset edges. Algorithm for this technique is explained below

Step 1: The user has to select one of the gradient operators form Sobel, Prewitt, Roberts and canny.

Step 2: Then depending on the selection of the operator with slope magnitude method preprocessing starts.

Step 4: After application of Slope magnitude, FOM applied to an image

Step 5: For every image, feature extracted and indexed in the database with a feature vector

Step 6: After preprocessing done user has to provide query image

Step 7: Using Euclidean distance similar images are displayed

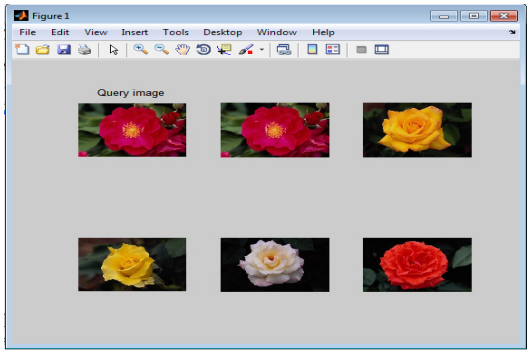


**Fig. 5.** Sample Results for technique 2.

**Implementation:** We are implementing these proposed methods on the Wang image database [11, 12]. It consists of 1000 variable size images in the database spread across different categories. The database having 10 different class namely African people, the beach, the building, buses, dinosaurs, elephants, flowers, horses, mountains and food [13]. Each class having 100 images. The following figure shows the example of an image database.

**Fig. 6.** Sample image database with four classes.

## III. RESULTS AND DISCUSSION

After evaluating different block sizes in BTC it is found that block size 4 × 4 provides better results as compared to others. Hence for enhancing the performance of the technique I block size 4 × 4 considered for further evaluation. Similarly, for gradient operators, the canny operator provides better results as compared to others.

Hence for enhancing the performance of the system Canny operator considered for further evaluation. The precision and recall are two parameters used to evaluate the performance of proposed CBIR system. The precision is the ratio of a number of relevant images retrieved to the total number of images retrieved. The recall is the ratio of the number of relevant images retrieved to the total number of relevant images in the database. The performances of the system evaluated on the basis of the query image and retrieve the image from the database. The output provides a query image along with 10 matching images. Here as per the proposed two techniques considered along with the combination of mentioned techniques. The results for precision and recall provided in Table 3 and 4 respectively. We compare the combination of proposed methods with other methods in Table 5.

**Table 3: Results for Precision.**

| Category | Technique 1 | Technique 2 | Combination 1+2 |
|---|---|---|---|
| African People | 0.51 | 0.60 | 0.66 |
| Beach | 0.46 | 0.52 | 0.45 |
| Building | 0.42 | 0.60 | 0.64 |
| Buses | 0.76 | 0.54 | 0.80 |
| Dinosaurs | 0.80 | 0.62 | 0.84 |
| Elephants | 0.42 | 0.54 | 0.66 |
| Flowers | 0.66 | 0.32 | 0.74 |
| Horses | 0.72 | 0.82 | 0.64 |
| Mountains | 0.42 | 0.26 | 0.46 |
| Food | 0.38 | 0.42 | 0.44 |

**Table 4: Results for Recall.**

| Category | Technique 1 | Technique 2 | Combination 1 + 2 |
|---|---|---|---|
| African People | 0.07 | 0.09 | 0.08 |
| Beach | 0.05 | 0.03 | 0.06 |
| Building | 0.06 | 0.04 | 0.07 |
| Buses | 0.10 | 0.08 | 0.12 |
| Dinosaurs | 0.13 | 0.14 | 0.11 |
| Elephants | 0.08 | 0.12 | 0.14 |
| Flowers | 0.06 | 0.08 | 0.09 |
| Horses | 0.09 | 0.11 | 0.12 |
| Mountains | 0.04 | 0.02 | 0.05 |
| Food | 0.02 | 0.03 | 0.04 |

**Table 5: Comparison with other methods.**

| Category | Technique [14] | Technique [15] | Technique [16] | Proposed |
|---|---|---|---|---|
| African People | 0.53 | 0.58 | 0.69 | 0.55 |
| Beach | 0.45 | 0.41 | 0.55 | 0.72 |
| Building | 0.46 | 0.42 | 0.56 | 0.64 |
| Buses | 0.84 | 0.71 | 0.89 | 0.80 |
| Dinosaurs | 0.90 | 0.74 | 0.93 | 0.84 |
| Elephants | 0.72 | 0.65 | 0.70 | 0.76 |
| Flowers | 0.74 | 0.83 | 0.88 | 0.78 |
| Horses | 0.72 | 0.69 | 0.81 | 0.85 |
| Mountains | 0.53 | 0.45 | 0.64 | 0.74 |
| Food | 0.46 | 0.44 | 0.69 | 0.76 |

If only technique 1 considered it combines BTC with GLCM provides better results where color features are more prominent like the color of flowers, animals like horses, elephants. If only technique 2 is considered it combines slope magnitude with FOM provides better results where shape features are more prominent like the shape of faces, buses. After observing results from the precision and recall table we can say that combining both color and shape features provides better results in many categories as compared to individual features considerations. Table 5 shows comparison results with the existing system, it shows that the combination of color and shape features performs better than using the traditional feature extraction method.

The traditional feature extraction method includes a color histogram, texture features like skewness, kurtosis, etc.

## IV. CONCLUSION

The combine feature vector proposed in this paper which is a combination of color and shape feature. It provides better results in many categories. Since the limitation of the technique, I specified up to color domain and technique II up to shape domain. Both techniques having some pros and cons for some categories. They provide excellent results in some categories. So the combination of features is a solution to enhance the performance of the system. After evaluating result we can conclude that instead of using single content or feature, combining content or features provide enhanced results.

## V. FUTURE SCOPE

In this paper, we have combined color and shape features. In the future, we can consider Texture features like skewness and kurtosis for analyzing the performance of the system. We can use machine learning or deep learning techniques for feature extraction. The convolution neural network can be used for feature extraction.


## ACKNOWLEDGEMENT

The authors are thankful to Dr. B. A. M. University, Aurangabad and NIELIT, Aurangabad for their support and cooperation.

**Conflict of Interest.** The author declares that there is no conflict of interest between any organization and author.


## REFERENCES


[1]. Guo, J. M., & Prasetyo, H. (2014). Content-based image retrieval using features extracted from halftoning-based block truncation coding. *IEEE Transactions on image processing*, *24*(3), 1010-1024.

[2]. Yadav, P., Gupta, R., & Kumar, S. (2017). Content Based Image Retrieval Using Dither BTC with similarity comparison algorithm. *ICCCE, MNIT Jaipur*, 489-493.

[3]. Alhassan, A. K., and Alfaki, A. (2017). Color and Texture fusion-based algorithm for CBIR. *ICCCEE, Sudan.*

[4]. Yu, F. X., Luo, H., & Lu, Z. M. (2011). Colour image retrieval using pattern co-occurrence matrices based on BTC and VQ. *Electronics letters*, *47*(2), 100-101.

[5]. Somnugpong, S., & Khiewwan, K. (2016). Content-based image retrieval using a combination of color correlograms and edge direction histogram. In *2016 13th International Joint Conference on Computer Science and Software Engineering (JCSSE)* (pp. 1-5). IEEE.

[6]. Song, H., Li, X., & Wang, P. (2009). Multimodal image retrieval based on annotation keywords and visual content. In *2009 IITA International Conference on Control, Automation and Systems Engineering (case 2009)* (pp. 295-298). IEEE.

[7]. Ganar, A. N., Gode, C. S., & Jambhulkar, S. M. (2014). Enhancement of image retrieval by using colour, texture and shape features. In *2014 International Conference on Electronic Systems, Signal Processing and Computing Technologies* (pp. 251-255). IEEE.

[8]. Bhagyalakshmi, A., & Vijayachamundeeswan, V. (2014). A survey on content based image retrieval using various operators. In *Proceedings of IEEE International Conference on Computer Communication and Systems ICCCS14* (pp. 18-23). IEEE.

[9]. Li, X. W., & Zhang, X. R. (2008). A perceptual color edge detection algorithm. In *2008 International Conference on Computer Science and Software Engineering, 1*, 297-300).

[10]. Wang, L., Zhang, Y., & Feng, J. (2005). On the Euclidean distance of images. *IEEE transactions on pattern analysis and machine intelligence*, *27*(8), 1334-1339.

[11]. Li, J., & Wang, J. Z. (2003). Automatic linguistic indexing of pictures by a statistical modeling approach. *IEEE Transactions on pattern analysis and machine intelligence*, *25*(9), 1075-1088.

[12]. Wang, J. Z., Li, J., & Wiederhold, G. (2001). SIMPLIcity: Semantics-sensitive integrated matching for picture libraries. *IEEE Transactions on pattern analysis and machine intelligence*, *23*(9), 947-963.

[13]. Rai, H. G., Shen, X., Deepak, K. S., & Krishna, P. R. (2011). Hybrid feature to encode shape and texture for Content Based Image Retrieval. In *2011 International Conference on Image Information Processing* (pp. 1-6). IEEE.

[14]. ElAlami, M. E. (2011). A novel image retrieval model based on the most relevant features. *Knowledge-Based Systems*, *24*(1), 23-32.

[15]. Yue, J., Li, Z., Liu, L., & Fu, Z. (2011). Content-based image retrieval using color and texture fused features. *Mathematical and Computer Modelling*, *54*(3-4), 1121-1127.

[16]. Kang, J., & Zhang, W. (2012). A framework for image retrieval with hybrid features. In *2012 24th Chinese Control and Decision Conference (CCDC)* (pp. 1326-1330). IEEE.

[17]. Rajkumar, R., & Sudhamani, M. V. (2019). Content Based Image Retrieval System using combination of Color and Shape Features and SNN. *IJITEE*, *9*(2), 71-77

[18]. Latif, A., Rasheed, A., Sajid, U., Ahmed, J., Ali, N., Ratyal, N. I., & Khalil, T. (2019). Content-based image retrieval and feature extraction: a comprehensive review. *Mathematical Problems in Engineering*, 1-21.



**How to cite this article:** Nilawar, A. P. and Dethe, C. G. (2020). Content based Image Retrieval with integrated Techniques. *International Journal on Emerging Technologies*, *11*(2): 411–415.