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A Hybrid Scheme of EDBTC Encoding and CHF BHF Extraction for Image Ret Rival Process

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Abstract: **This paper presents a new approach to derive the image feature descriptor from the Error-diffusion based block truncation coding (EDBTC) compressed data stream. In the encoding step, EDBTC compresses an image block into corresponding quantizers and bitmap image using vector quantizer(VQ). Two image features are proposed to index an image, namely, color co-occurrence feature (CCF) and bit pattern features (BPF), which are generated directly from the EDBTC encoded data streams without performing the decoding process. The CCF and BPF of an image are simply derived from the two EDBTC quantizers and bitmap, respectively, by involving the visual codebook. Experimental results show that the proposed method is superior to the block truncation coding image retrieval systems and the other earlier methods, and thus prove that the EDBTC scheme is not only suited for image compression, because of its simplicity, but also offers a simple and effective descriptor to index images in CBIR system. EDBTC method is extremely fast and the image quality achieved is comparable to the previous BTC method. This proposed system is implemented in MATLAB.**

Keyword:-- **Content-based image retrieval (CBIR), Bit pattern feature, color co-occurrence feature, content-based image retrieval, error diffusion block truncation coding(EDBTC) vector quantization (VQ).**

I. INTRODUCTION

Content-Based Image Retrieval (CBIR) offers a convenient way to browse and search the desired image in the huge image database. The CBIR employs the image features of visual content to represent and index the image in database. These features can be color, texture, shape, etc.
The feature choice depends on the user's preference or is decided by the expert-system. Finding a single best representative feature of an image is very difficult because of the fact that the photographer may take several images under different conditions such as different lighting sources, various view angles, different illumination changes, etc.

Developing an effective and efficient image feature descriptor becomes a challenging task for CBIR system to achieve a high image retrieval performance. Many attempts and researches have been devoted to improve the retrieval accuracy in the CBIR system. One of these efforts is employing an image feature descriptor derived from the compressed data stream for CBIR task. As opposite to the classical approaches which extract an image descriptor from the original image, this image retrieval scheme directly generates image feature from the compressed data stream without firstly performing the decoding process. This type of image retrieval aims on reducing the computation time in feature extraction/generation since most of the multimedia contents and images are already converted into the compressed format before they are recorded in any storage devices.

A new CBIR system has been in which the image feature descriptor is simply derived from the compressed data stream. This new approach indexes the color images using the feature descriptor extracted from the Error-Diffusion Block Truncation Coding (EDBTC). The EDBTC is an improved version of Block Truncation Coding (BTC) which is an efficient image compression technique. The EDBTC has been demonstrated to yield a promising result on several image processing applications such as image compression], image watermarking , inverse halftoning , data hiding , image security, halftone image classification .CBIR system, etc. The EDBTC produces two color quantizers and a single bitmap image on the encoding stage. In the CBIR system, an image feature descriptor is directly derived from the EDBTC color quantizers and bitmap image in the compressed domain by involving the Vector Quantization (VQ). The two features are generated in the CBIR system, namely Color Histogram Feature (CHF) and Bit Pattern Histogram Feature (BHF), to measure the similarity criterion between a query image and a set target images stored in database. The CHF and BHF are computed from the VQ-indexed color quantizer and VQ-indexed bitmap image, respectively. The similarity distance computed from CHF and BHF can be further utilized for performing the similarity matching between two images. the image retrieval with EDBTC feature offers lower feature dimensionality compared to the former BTC-based image retrieval scheme, and at the same time, outperforms the former BTC-based CBIR system.The image retrieval system with EDBTC feature also performs better compared to the former competing schemes on natural and textural images. Triggered by efficiency and successfulness of the image retrieval system using EDBTC feature, we propose to develop a new way to further improve the EDBTC image retrieval performance.

a.Existing Drawbacks

1. Low accuracy in retrieving the images. i.e., the retrieved images not belong to the query image class. Mismatch occurs.
2. Retrieved image quality is low.
3. Computational complexity is high.
4. The features are extracted directly for the images.

b. Proposed System Advantages

1. **The reconstructed image quality is high.**
2. This method offers a promising result and outperforms the former existing methods in terms of the natural scene classification.
3. This yields a better result in terms of the retrieval accuracy compared to that of the former methods
4. **Computational complexity is low.**

c. Proposed system technique

1. Error-Diffusion Block Truncation Coding (EDBTC)
2. Color histogram feature
3. Bit pattern histogram feature

d. Applications

1. Given the high efficiency and low computational complexity of the EDBTC, some interesting applications have been developed based on it such as watermarking schemes.
2. Thus, it offers a good solution for application requiring privacy and ownership protection.

3. The proposed scheme can be considered as a very competitive candidate in color image retrieval application

II. SYSTEM IMPLEMENTATION

The EDBTC encoding is used to extract features from the images stored in the database. The EDBTC encoding uses two color quantizers and a bitmap image. Two features are extracted namely, Color Histogram feature and Bit pattern feature. These features are stored as feature vectors and processed using vector quantization. These features are classified using support vector machine.

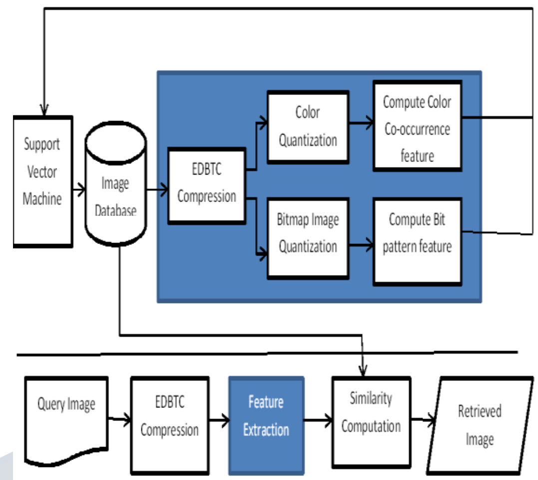

Fig.1 Schematic diagram of proposed image retrieval framework

The similarity between the features extracted from database image and query image is measured using Manhattan distance and Euclidean distance. The minimum and maximum values are determined from color quantizers. The color quantizers are used to reduce the input image which has a range of 256 colors into 64 colors RGB color. This RGB color is converted into indexed images. The mean and standard deviation for each RGB color is calculated.. A low pass filter is constructed for allowing pixels with the given cut-off frequency. The similarity between two images (i.e., a query image and the set of images in the database as target image) can be measured using the relative distance measure. The similarity distance plays an important role for retrieving a set of similar images.

III. RELATED WORK

A. Error Diffusion Block Truncation Coding for Color Image

This section introduces an EDBTC image compression for the color image. Herein,the compression is presented for RGB color image. However, this method can be extended into the other color spaces such as YCbCr, or the other color channels. In a simple way, the EDBTC compresses an image patch in RGB color space into a new representation, i.e. two color quantizer of the same size as a single color pixel and its corresponding bitmap image of the same size as original image patch. The two EDBTC color quantizers are simply set with the *min* and *max* pixel values found in an image patch. On the other hand, the EDBTC employs the error kernel to generate bitmap image. The EDBTC method produces better image quality compared to that of the classical BTC approach.

Suppose a color image of size $M \times N$ is partitioned into multiple non-overlapping image patches of size $m \times n$. Figure 2 illustrates the schematic diagram of the EDBTC compression for color image. The EDBTC produces a single bitmap image of the same size as image patch by incorporating error kernel. In this chapter, we employ Floyd-Steinberg error kernel for generating bitmap image. For performing the EDBTC thresholding, we firstly compute the minimum, maximum, and mean value of the inter-band average pixels as follows:

Euclidean distance:

$$d(x,y)=\sqrt{(x_2-x_1)^2+(y_2-y_1)^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

The inter-band average value can be computed as

$$f(x,y)=\frac{1}{3}(fR(x,y)+fG(x,y)+fB(x,y)) \quad \ldots\ldots\ldots\ldots (2)$$

The mean value of the inter-band average pixel can be computed as

The bitmap image h(x,y) is generated using the following rule:

$$h(x,y)=\begin{cases}1, & if\ f(x,y)\geq x' \\ 0, & if\ f(x,y)< x'\end{cases} \quad \ldots\ldots\ldots\ldots\ldots (3)$$

The query image is firstly encoded with the EDBTC, yielding the corresponding CCF and BPF. The two features are later compared with the features of target images in the database. A set of similar images to the query image is returned based on their similarity distance score, i.e. the lowest score indicates the most similar image to the query image.

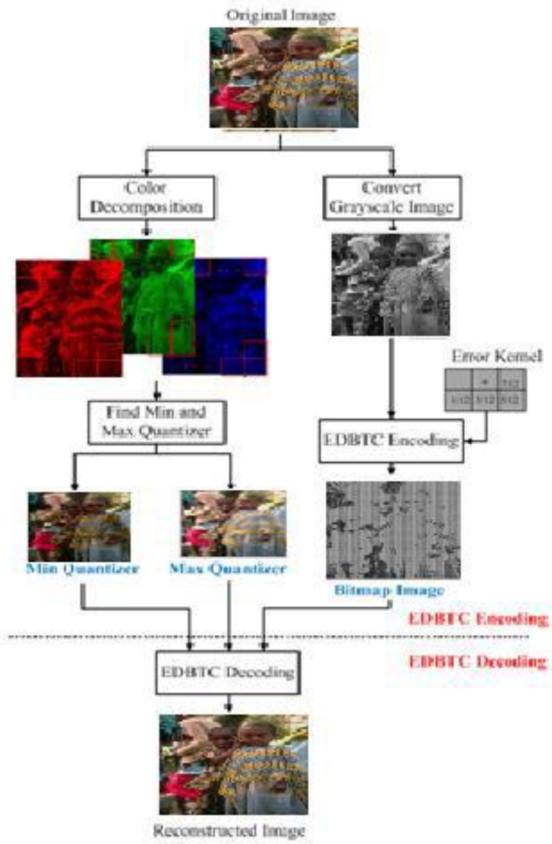

Fig 2: Schematic diagram of EDBTC processing for color image

Two EDBTC color quantizers are simply set with the minimum and maximum pixel values found in an image patch as follows:

$$q_{min}(i,j)=\left\{\min_{\forall x,y} f_R(x,y), \min_{\forall x,y} f_G(x,y), \min_{\forall x,y} f_B(x,y)\right\}$$
$$q_{max}(i,j)=\left\{\max_{\forall x,y} f_R(x,y), \max_{\forall x,y} f_G(x,y), \max_{\forall x,y} f_B(x,y)\right\} \quad (4)$$

B. EDBTC Image Indexing

This section presents the proposed image retrieval scheme using EDBTC feature. Herein, the proposed method is detail explained in RGB color space which can be easily extended for the other color spaces such as YCbCr, etc. Figure 2 illustrate the proposed image retrieval system using EDBTC image feature. Firstly, an image is decomposed using EDBTC to obtain the color quantizers and its corresponding bitmap image. The image feature is subsequently extracted from these EDBTC color quantizers and bitmap image to yield CHF and BHF, respectively.

C. Color and Bit Pattern Indexing

Let $C_{min} = \{c_1^{min}, c_2^{min}, \ldots, c_{N_{min}}^{min}\}$ and $C_{max} = \{c_1^{max}, c_2^{max}, \ldots, c_{N_{max}}^{max}\}$ be the color codebook from the EDBTC *min* and *max* quantizer, respectively. The *Nmin* and *Nmax* are the color codebook size for *min* and *max* quantizer, respectively. While the color quantizers are in RGB color space, then *Cmin* and *Cmax* are also in the same color space. Let $C = \{c1, c2, \ldots, cNc\}$be the color codebook obtained by concatenating the min and max quantizer as a single vector, i.e. [*qmin*; *qmax*]. The *Nc* denotes the color codebook size of *C*. These color codebooks (*Cmin*,*Cmax*, *andC*) can be trained by
means of Vector Quantization (VQ) using the *min* and *max* quantizer as a training set.
Let $B = \{B1, B2, \ldots, BNb\}$ be the bit pattern codebook of size *Nb*. This bit pattern codebook can be generated from a set of EDBTC bitmap images with soft centroid method. All bitmap images are treated as non-integer value during VQ training process. The hard thresholding is conducted at the end of VQ process to force all trained data into the binary form. Figure 4.4 shows an example of bit pattern codebook of size *Nb* = {16, 32, 64, 128}.
For obtaining the EDBTC image feature, the min and max quantizer are firstly (*Cmin andCmax*), the indexing process of EDBTC *min* and *max* quantizer can be defined as follows: *qmin* (*i*, *j*) , *cmin* for all *i* = 1, 2, . . . , *M m* ,and *j* = 1, 2, . . . , *N n* . Where (*i*, *j*) denotes the index of image block. Given the color codebook *C*, the indexing process of concatenated *min* and *max* quantizer [*qmin*; *qmax*] can be performed as follows:

$$\tilde{I}_{min}(i,j) = \arg\min_{k=1,2,\ldots,N_{min}} \left\| q_{min}(i,j), c_k^{min} \right\|_2^2$$

$$\tilde{I}_{max}(i,j) = \arg\min_{k=1,2,\ldots,N_{max}} \left\| q_{max}(i,j), c_k^{max} \right\|_2^2 \quad (5)$$

qmin (*i*, *j*) , *cmin* for all *i* = 1, 2, . . . , *M m* ,and *j* = 1, 2, . . . , *N n* . Where (*i*, *j*) denotes the index of image block. Given the color codebook *C*, the indexing process of concatenated *min* and *max* quantizer [*qmin*; *qmax*] can be performed as follows:

$$\tilde{I}(i,j) = \arg\max_{k=1,2,\ldots,N_c} \left\| [q_{min}(i,j); q_{max}(i,j)], c_k \right\|_2^2 \quad (6)$$

The stacking process of min and max quantizer reduces the computational time in the color indexing process and produces the lower feature dimensionality.
Given the bit pattern codebook *B*, the indexing process of EDBTC bitmap image
bm(*i*, *j*) is simply computed as follows:

$$\tilde{b}(i,j) = \arg\min_{k=1,2,\ldots,N_b} \delta_H \{bm(i,j), B_k\} \quad (7)$$

for all image blocks *i* = 1, 2, . . . , *M m* ,and *j* = 1, 2, . . . , *N n* . Where d*H* {·, ·} denotes the Hamming distance between two binary patterns (vectors). The indexing process of color and bit pattern reduce the required bits in the EDBTC image compression.

The entropy coding with lossless or lossy approaches can be further applied to reduce the required bits before transmitting into the decoder module.
Color Histogram Feature (CHF)

An image feature, namely Color Histogram Feature (CHF), can be simply obtained from the indexed EDBTC color quantizers. The CHF adequately describes an image brightness and its color distribution. This process can be viewed as computing the occurrence of specific indexed color quantizer in the whole image to produce a histogram.
The *CHFmin* and *CHFmax* are the image feature descriptor derived from the min and max quantizer, respectively. While the CHF denotes the image feature descriptor generated by concatenating the min and max quantizer. Figure 3 illustrates an example of CHF computation. The *CHFmin*, *CHFmax*, and CHF can be formally described as follows:

$$CHF_{min}(k) = Pr\left\{ \tilde{I}_{min}(i,j) = k \,\middle|\, i = 1,2,\ldots,\frac{M}{m}; j = 1,2,\ldots,\frac{N}{n} \right\},$$

$$CHF_{max}(k) = Pr\left\{ \tilde{I}_{max}(i,j) = k \,\middle|\, i = 1,2,\ldots,\frac{M}{m}; j = 1,2,\ldots,\frac{N}{n} \right\}, \quad (8)$$

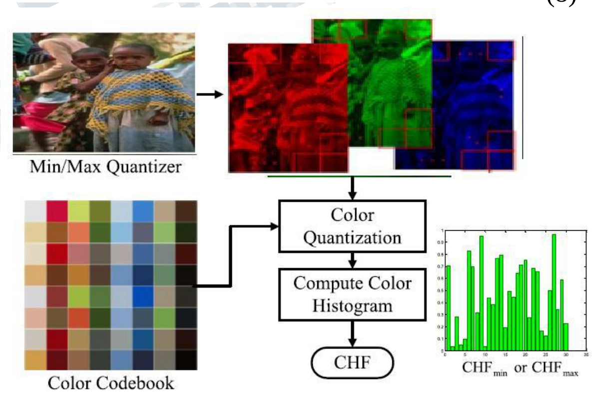

Figure 3: Illustration of CHF computation

$$CHF(k) = Pr\left\{ \tilde{I}(i,j) = k \,\middle|\, i = 1,2,\ldots,\frac{M}{m}; j = 1,2,\ldots,\frac{N}{n} \right\},$$

where *k* = 1, 2, . . . ,*Nmin* and *k* = 1, 2, . . . ,*Nmax* for *CHFmin* and *CHFmax*, respectively. While CHF simply requests *k* = 1, 2, . . . ,*Nc*. The feature dimensionality of *CHFmin*, *CHFmax*, and CHF are identical to the color codebook size, i.e. *Nmin*, *Nmax*, and *Nc*, respectively
Bit Pattern Histogram Feature (BHF)

The other image feature descriptor which can be derived from EDBTC bitmap image is called as Bit Patter Histogram Feature (BHF). This feature is similar to the CHF which tabulates the occurrence of a specific indexed bit pattern in whole image. This feature represents an image textural information as well as visual pattern, line, and edge, etc. Figure 4 shows an illustration of BHF computation. The BHF of an image can be formally defined as follow

$$BHF(k) = Pr\left\{\tilde{b}(i,j) = k \,\middle|\, i = 1,2,...,\frac{M}{m}; j = 1,2,...,\frac{N}{n}\right\},$$

for all k = 1, 2, . . . ,Nb. The feature dimensionality of BHF is identical to the bit pattern codebook size, i.e. Nb. for detail explanation on effect of color and bit pattern codebook size in the image retrieval task.

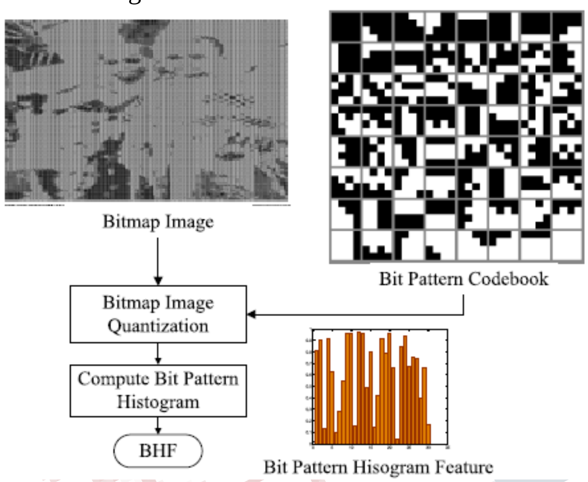

Figure 4: Illustration of BHF computation.

Image Retrieval with EDBTC Feature

The similarity distance computation plays an important role in the overall performance of image retrieval and classification task. Different choice of similarity distance influences the performance accuracy. The similarity degree between two images can be measured using similarity distance score between their descriptor in which smaller distance indicates more similarity. In our proposed method, the choice of similarity distance can be determined by experiment since the CHF and BHF are in the different modalities. In image retrieval system, a set of retrieved images are returned to the user in ascending order based on their similarity distance scores. Several similarity distance can be formally defined as follows to measure similarity degree between the query and target image:

$$\delta(\text{query}, \text{target}) = \alpha_1 \sum_{k=1}^{N_c} \frac{|\text{CHF}_{\min}^{\text{query}}(k) - \text{CHF}_{\min}^{\text{target}}(k)|}{\text{CHF}_{\min}^{\text{query}}(k) + \text{CHF}_{\min}^{\text{target}}(k) + \varepsilon} + \alpha_2 \sum_{k=1}^{N_c} \frac{|\text{CHF}_{\max}^{\text{query}}(k) - \text{CHF}_{\max}^{\text{target}}(k)|}{\text{CHF}_{\max}^{\text{query}}(k) + \text{CHF}_{\max}^{\text{target}}(k) + \varepsilon} + \alpha_3 \sum_{k=1}^{N_b} \frac{|\text{BHF}^{\text{query}}(k) - \text{BHF}^{\text{target}}(k)|}{\text{BHF}^{\text{query}}(k) + \text{BHF}^{\text{target}}(k) + \varepsilon}$$

where {_1, _2, _3} denotes the similarity weighting constants indicating the percentage contribution of the CHF and BHF in the similarity distance computation. Higher value of similarity weighting constants indicates the higher contribution of image feature descriptor usage in similarity distance computation. A small number ″ is added into denominator to avoid the mathematical division error.

D. Performance Measurement

The successfulness of the proposed EDBTC retrieval system is measured with the precision, recall, and average retrieval rate (ARR) values. These values indicate the percentage of relevant image returned by a CBIR system with a specific number of retrieved images L. The precision ($P(q)$) and recall ($R(q)$) values are defined as

$$P(q) = \frac{n_q}{L}$$

$$R(q) = \frac{n_q}{N_q}$$

where nq and Nq denote the number of relevant images against a query image q, and the number of all relevant images against a query image q in database.

IV. RESULT

The image retrieved from the database are similar to the query image is as follows

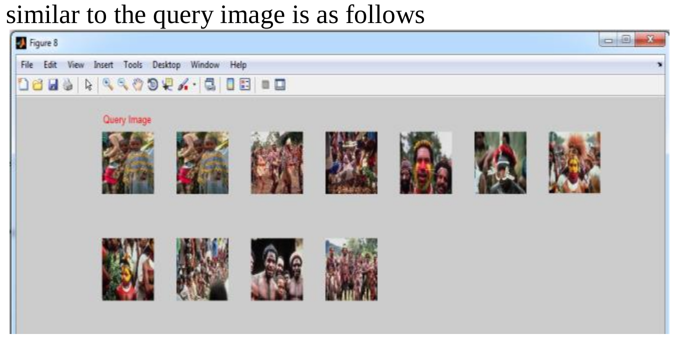

Figure 5: Image Retrived From Database

Confusion Matrix:

4	0	0	1	0	0	0	0	0	0
0	4	0	0	0	0	0	1	0	0
0	0	5	0	0	0	0	0	0	0
0	0	0	4	0	0	0	0	0	1
0	0	0	0	3	0	2	0	0	0
0	0	0	0	0	5	0	0	0	0
0	1	1	0	0	0	3	0	0	0
0	1	0	0	1	0	2	1	0	0
1	0	1	1	1	0	0	0	1	0
1	0	1	0	0	0	0	1	0	2

Predicted Query Image Belongs to Class = 1

FUTURE ENHANCEMENT

Another feature such as Gabor wavelet transform which comes under Texture Descriptor (TD) can be added along with CHF and BHF, to enhance the retrieval performance.

V. CONCLUSIONS

A quantitative comparison of EDBTC image feature for color image retrieval and classification has been conducted and reported in this chapter. In the image retrieval and classification task, an image feature descriptor is simply derived and constructed from the EDBTC encoded data stream, i.e. two color quantizers and the bitmap image. The two EDBTC color quantizers produce the CHF which is effective for representing the color distribution of an image, whereas the bitmap image results the BHF for characterizing the image textural information as well as an image edges, lines, shapes, etc. The experimental results show that the proposed method offers a promising result in the image retrieval and classification task, and at the same time, the proposed method outperforms the former existing methods. The EDBTC image retrieval and classification system can be extended for the video processing.

REFERENCES

[1] A. R. Backes, D. Casanova, and O. M. Bruno. Color texture analysis based on fractal descriptors. *Pattern Recognition*, 45(5):1984–1992, 2012.

[2] F. Bianconi, A. Fernandez, E. Gonzalez, D. Caride, and A. Calvino. Rotationinvariant colour texture classification through multilayer CCR. *Pattern Recognition Letters*, 30(8):765–773, 2009.

[3] G. J. Burghouts and J. M. Geusebroek. Material-specific adaptation of color invariant features. *Pattern Recognition Letters*, 30(3):306–313, 2009.

[4] B. J. L. Campana and E. J. Keogh. A compression-based distance measure for texture. *Statistical Analy Data Mining*, 3(6):381–398, 2010.

[5] J. Chen, S. Shan, C. He, G. Zhao, M. Pietikäinen, X. Chen, and W. Gao. WLD: a robust local image descriptor. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 32(9):1705–1720, 2010.

[6] T. W. Chiang and T. W. Tsai. Content-based image retrieval via the multiresolution wavelet features of interest. *Journal of Information Technology and Applications*, 1(3):205–214, 2006.

[7] J. J. de Mesquita Sa Junior, P. C. Cortex, and A. R. Backes. Color texture classification using shortest paths in graphs. *IEEE Transactions on Image Processing*, 23(9):3751–3761, 2014.

[8] E. J. Delp and O. R. Mitchell. Image coding using block truncation coding. *IEEE Transactions on Communications*, 27(9):1335–1342, 1979.

[9] M. R. Gahroudi and M. R. Sarshar. Image retrieval based on texture and color method in BTC-VQ compressed domain. In *9th International Symposium on Signal Processing and Its Applications (ISSPA)*, pages 1–4, 2007.

[10] T. Guha and R. K. Ward. Image similarity using sparse representation and compression , distance. *IEEE Transactions on Multimedia*, 16(4):980–987, 2014.

