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EFFICIENT COLOR IMAGE RETRIEVAL USING ERROR DIFFUSION BLOCK TRUNCATION CODING FEATURES

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ABSTRACT— A new approach to index color pictures exploitation the features extracted from the error diffusion block truncation coding (EDBTC). The EDBTC produces two color quantizes and a bitmap image, which are additional processed exploitation vector quantization (VQ) to get the image feature descriptor. Herein two features are introduced, namely, color coherence vector(CCV) and bit pattern histogram feature(BHF), to live the similarity between a input image and also the target image in database. The CCV and BHF are computed from the VQ-indexed color quantization and VQ-indexed bitmap image, respectively. The distance computed from CCV and BHF may be used to measure the similarity between two pictures. As documented within the experimental result, the proposed indexing technique outperforms the previous block truncation coding based image indexing and the also the alternative existing image retrieval schemes with natural and textural information sets. Thus, the projected EDBTC is not only examined with sensible capability for compression, however conjointly offers an effective way to index pictures for the content based image retrieval system.

INDEX TERMS — Error Diffusion Block Truncation Coding (EDBTC), Vector Quantization (VQ), Color Coherence Vector (CCV), Bit Pattern Histogram Feature (BHF).

I. INTRODUCTION

The aim of this project is to review this state of the art in content-based image retrieval **(**CBIR**),** a method for retrieving picture on the basis of automatically-derived features like color, texture and shape. Our findings are based mostly each on a review of the relevant literature and on discussions with researchers within the field.

The need to search out a desired image from a group is shared by many skilled teams, together with journalists, design engineers and art historians. Whereas the necessities of image users will vary significantly, it may be helpful to characterize image queries into 3 levels of abstraction: primitive features like color or shape, logical features like the identity of objects shown and abstract attributes like the importance of the scenes pictured. Whereas CBIR systems presently operate effectively only at the bottom of those levels, most users demand higher levels of retrieval.

A. *Content Based Image Retrieval*

Content-based image retrieval (CBIR), also called as query by image content (QBIC) and content-based visual information retrieval (CBVIR) is that the application of computer vision to the image retrieval downside, that is, the problem of finding out digital images in massive databases.

"Content-based" implies that the search can analyze the particular contents of the image. The term 'content' in this context would possibly refer colors, shapes, textures, or the other information which will be derived from the image itself. While not the flexibility to look at image content, searches must rely on metadata like captions or keywords. Such metadata should be generated by a human and stored alongside every image within the database.

II. PROPOSED SYSTEM

In this proposed system, the EDBTC is projected. The EDBTC bitmap image is made by considering the quantized error that diffuses to the close pixels to compensate the general brightness, and thus effectively take way the annoying blocking effect and false contour, whereas maintaining the low computational complexity. The low-pass nature of Human Visual System (HVS) is utilized in [3, 4] to access the reconstructed image quality, in which the continual image and its halftone version are perceived equally by human vision once these two images viewed from a distance. The EDBTC methodology divides a given image into multiple non-overlapped image blocks, and every block is processed severally to get two extreme quantizes. This distinctive feature of independent processing enables the parallelism scenario. In bitmap image generation step, the component values in every block are thresholded by a fixed average value within the block with the using error kernel to diffuse the quantization error to the neighboring pixels throughout the encoding stage. The EDBCT provides higher reconstructed image quality than that of the BTC scheme.

III. ERROR DIFFUSION BLOCK TRUNCATION CODING FOR COLOR IMAGE

This section introduces an EDBTC image compression for the color image. Herein, the compression is given in RGB color image. However, this methodology are often extended into the opposite color spaces like YCbCr, or the other color channels. In an easy approach, the EDBTC compresses a picture patch in RGB color space into a new representation, i.e. two color quantizer of the equivalent size as one color component and its corresponding bitmap image of the same size as original.

The bitmap image bm(x, y) is subsequently created using the following thresholding methodology image patch. The two EDBTC color quantizers are simply set with the min and max pixel values found in a picture patch. On the opponent hand, the EDBTC employs the error kernel to generate bitmap image. The EDBTC methodology produces higher image quality compared to that of the classical BTC approach because it has been according and deeply investigated in [11, 12].

Suppose a color image of size M × N is divided into multiple non-overlapping image patches of size m×n. Let $\bar{f}(x, y) = \{f_R(x, y), f_G(x, y), f_B(x, y)\}$ be an picture patch, for x = 1, 2, . . . , m and y = 1, 2, . . . , n.

The inter-band average value of image patch f(x, y) are often simply computed as:

$$\bar{f}(x,y)=1/3(f_R(x,y)+f_G(x,y)+f_B(x,y)) \qquad (1)$$

where $f_R(x, y)$, $f_G(x, y)$, and $f_B(x, y)$ denote the image pixels within the red, green, and blue color channels, respectively. The EDBTC produces a one bitmap image bm(x, y) of an equivalent size as image patch by incorporating error kernel. In this chapter, we have a tendency to use Floyd-Steinberg error kernel for generating bitmap image. For performing the EDBTC thresholding, we have a tendency to first compute the minimum, maximum, and mean value of the inter-band average pixels as follows:

$$x_{min}=\min_{\forall x,y}\bar{f}(x,y) \qquad (2)$$

$$x_{max}=\max_{\forall x,y}\bar{f}(x,y) \qquad (3)$$

$$x=\sum_{x=1}^{m}\sum_{y=1}^{n}\bar{f}(x,y) \qquad (4)$$

$$bm(x,y)=\begin{cases}1, & if\ \bar{f}(x,y)\geq x' \\ 0, & if\ \bar{f}(x,y)\geq x'\end{cases} \qquad (5)$$

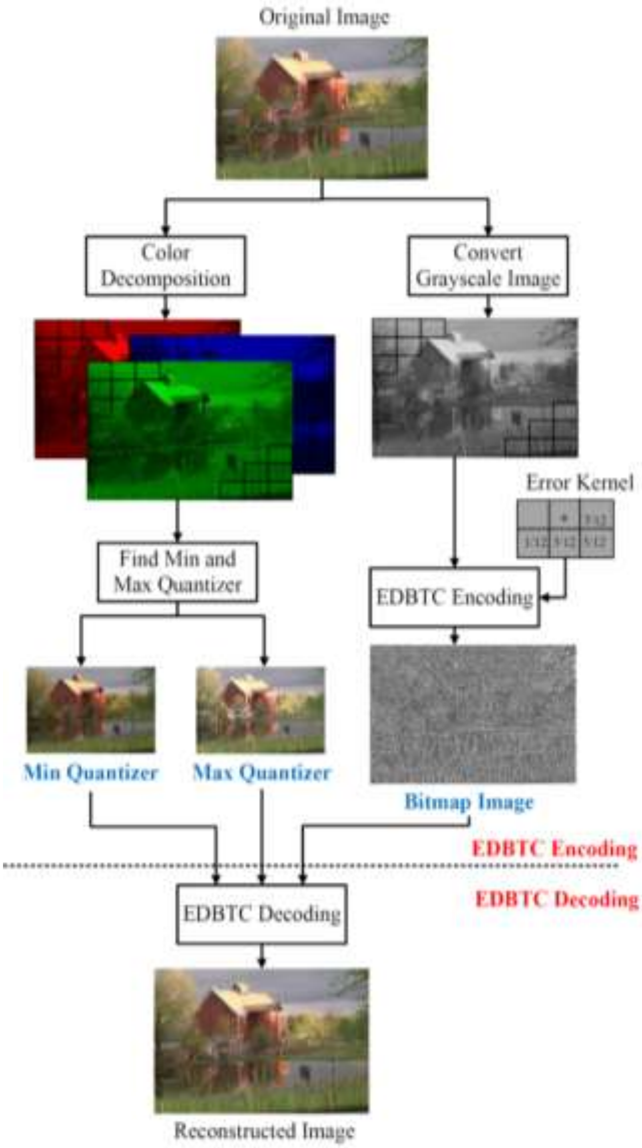

Fig 1.Schematic diagram of EDBTC processing for color image.

The intermediate value o(x, y) is additionally generated at the equivalent time with the bitmap image generation as follows

$$o(x,y)=\begin{cases} x_{max}, & \text{if } bm(x,y)=1 \\ x_{min}, & \text{if } bm(x,y)=0 \end{cases} \qquad (6)$$

The EDBTC residual quantization error are often simply calculated as follow

$$e(x,y)=\bar{f}(x,y)-o(x,y) \qquad (7)$$

The EDBTC processes a picture pixel in an exceedingly consecutive approach within which one component is simply processed once, and therefore the residual quantization error is then diffused and accumulated into its unprocessed neighboring pixels. The unprocessed pixel value $\bar{f}(x, y)$ is updated using

$$\bar{f}(x,y)=\bar{f}(x,y)+e(x,y)*\epsilon, \qquad (8)$$

where * and ϵ denote the error kernel and convolution operation, respectively. Two EDBTC color quantizers are simply set with the minimum and maximum pixel values found in a picture patch as follows:

$$q_{min}(i,j) = \left\{\min_{\forall x,y} f_R(x,y), \min_{\forall x,y} f_B(x,y), \min_{\forall x,y} f_G(x,y)\right\} \qquad (9)$$

where qmin and qmax are the EDBTC min and max quantizer, respectively. The EDBTC encoder module sends the two color quantizer and bitmap image into decoder side via transmission channel. For decoding this EDBTC data stream, the decoder merely replaces the bitmap image of having value 1 with the max quantizer, vice versa. In the YCbCr color space, the bitmap image is just generated from the Y color value, while the two color quantizers are obtained from all color channels. The EDBTC offers an efficient and effective approach in compression with lower computational complexity.

IV. COLOR COHERENCE VECTOR

Content Based Image Retrieval (CBIR), in brief, suggests that extracting a variety of pictures that has is relevant with the given image from vision database. CBIR produced to 1990s, it retrieves picture by some visual feature, just like color, shape, texture. Usually, human feel more sensitive to the color feature than to texture and shape. Also, computer used to describe pictures by RGB type, color feature extraction will save much time because of computing a lot of simply. So, retrieval systems using color is most popular. In the early time, global histogram was used most often. But in fact, histogram can't describe partial characteristics. That means two images with different vision might have a histogram. Also, the histogram feature has too several dimensions. Considering the disadvantages of histogram, Pass

[1] and his team have propounded Color Coherence Vector (CCV) methodology. Its kernel plan is divided to color histogram into two components. A CCV stores the number of coherent versus incoherent pixels with every color. By separating coherent pixels from incoherent pixels, CCV contains some spatial information. Therefore it provides finer distinctions than color histograms.

This system provides an improved CCV methodology with lot of spatial information and without much added computing work. First, the standard CCV methodology will be introduced; then, a selected description of improved CCV methodology will be given; following, we have a tendency to describe computation of the distance between two vectors; at last, we'll analyze the improved CCV and provide our analysis and prospect.

A. *Color Coherence Vector (CCV) method*

Before, several CBIR systems retrieve pictures by color histogram. However color histogram is not efficient to small changes for images' comparing. Often, completely different images may have the same histogram. It is not hard to find that color histogram is a globe feature, and contains very little spatial information. In order to contain lot of spatial information, CCV was propounded. CCV divided each component region of color histogram into two parts. Following words provide the detailed definition.

We classify the pixels inside a given color bucket as either coherent or incoherent. A coherent pixel is component of a large group of pixels of an equivalent color, while an incoherent pixel is not. We determine the pixel groups by computing connected components. If a same color cluster contains more coherent pixels than a threshold value defined beforehand, it belongs to coherence pixels. And therefore the rest pixels are incoherent.

For a given discretized color, a number of the pixels with that color will be coherent and some will be incoherent. Let us call the number of coherent component of the j'th discretized color α_j and the number of incoherent pixels β_j. Clearly, the overall variety of pixels with that color is $\alpha_j + \beta_j$, so a color histogram would summarize an picture as:

$$\langle(\alpha_1+\beta_1),(\alpha_2+\beta_2),\cdots,(\alpha_n+\beta_n)\rangle.$$

Instead, for every color we compute the pair (α_j, β_j) which we will call the coherence pair for the j'th color. The color coherence vector for the image consists of $\langle(\alpha_1,\beta_1),(\alpha_2,\beta_2),\cdots,(\alpha_n,\beta_n)\rangle$ .Obviously, CCV contains some spatial information by computing the distribution of coherent and incoherent pixels.

B. *Improved Color Coherence Vector*

When CCV was propounded, the author emphasized that it contained spatial information. CCV counts the coherent and incoherent pixels employing a two-dimension vector, that describes the color distribution. So, it is a promotion of color histogram which is a popular and traditional method for CBIR.

Now, let's assume something about the computing progress of CCV. Due to CCV pays attention to the "coherent" pixels, we have a tendency to should check and find the connected pixels within the image matrix. At last, we get α and β, therefore because the CCV. When we found the connected pixels, inevitably, the position information of the connected pixels conjointly appeared at an equivalent time. For the j'th discretized color, we define γ_j to be the mean of coordinates of the pixels which is in the maximum connected region in the coherent pixels. γ is different from α (the number of coherent pixels), as a result of it represents max-connected pixels' position information however α represents variety of coherent pixels. So, we describe the improved CCV as:

$$\langle(\alpha_1,\beta_1,\gamma_1),(\alpha_2,\beta_2,\gamma_2),\cdots,(\alpha_n,\beta_n,\gamma_n)\rangle.$$

Compared with the traditional CCV, the improved CCV more γ, however it absolutely was gained with α, so it didn't cost more added computation amount. The efficiency of CBIR system is not diminished patently.

Following, an example of improved CCV are going to be given. We make a threshold value τ=4, and provides a gradation image with simply 3 colors. The digital variety matrix of the given image is:

$$\begin{matrix} 2 & 1 & 2 & 2 & 1 & 1 \\ 2 & 2 & 1 & 2 & 1 & 1 \\ 2 & 1 & 3 & 2 & 1 & 1 \\ 2 & 2 & 2 & 1 & 1 & 2 \\ 2 & 2 & 1 & 1 & 2 & 2 \\ 2 & 2 & 1 & 1 & 2 & 2 \end{matrix}$$

First, we discover the connected regions. We define A, B, C …… as which DN=1, 2, 3 …… A1 to be the first connected region which DN=1, so, A2 is the second. Also, C suggests that the only connected region that DN=3. Following the above rules, the image matrix becomes:

$$\begin{matrix} B1 & A2 & B1 & B1 & A1 & A1 \\ B1 & B1 & A2 & B1 & A1 & A1 \\ B1 & A2 & C & B1 & A1 & A1 \\ B1 & B1 & B1 & A1 & A1 & B2 \\ B1 & B1 & A1 & A1 & B2 & B2 \\ B1 & B1 & A1 & A1 & B2 & B2 \end{matrix}$$

TABLE I. CONNECTED REGIONS OF EACH COLOR

Label	A 1	A2	B 1	B 2	C
Color	1	1	2	2	3
Size	12	3	2	5	1

According to the definition of improved CCV, we then find regions that have quite than τ=4 pixels. Obviously, A1, B1, B2 are classified as coherent. A2, C1 are classified as incoherent. Now, we have got α and β. For color=1, A1 is that the maximum connected region in coherent pixels, so γ_1=(4,5); for color=2, B1 is max, so γ_2=(3,2); for color=3, no coherent pixels, α=0 and no γ=(0,0). The improved CCV of this image is:

TABLE II.CCV OF THE IMAGE

Color	1	2	3
A	12	20	0
B	3	0	3
Γ	(4,5)	(3,2)	(0,0)

It also can be written:

<(12,3,(4,5)), (20,0,(3,2)), (0,3,(0,0))>.

γ provide the mid-point of the max-connected coherent region. So it adds spatial information of the image. γ don't would like additional computation, it are often got when we computing α.

C. *Distance computation for Improved CCV*

Improved CCV contains four columns really. It costs many steps to get the ultimate distance between two pictures. First, we compute the standard CCV distance with α and β. The distance formula:

$$\Delta D_1 = \sum_{j=1}^{n} \left|(\alpha_j - a_j')\right| + \left|(\beta_j - \beta_j')\right| \quad (10)$$

This is an efficient and simple distance formula. Second, we have compute the γ distance between two images. Formula as follows:

$$\Delta D_2 = \sum_{j=1}^{n} \sqrt{(\gamma_j(1) - \gamma_j'(1))^2 + (\gamma_j(2) - \gamma_j'(2))^2} \quad (11)$$

Third, ΔD_1 and ΔD_2 are different features. And their numbers are far, so we must build them unitary and weight them before computing the ultimate distance. We assume that there are M images looking ahead to retrieval. So, the distance between reference image and image information is that the matrix $[\Delta D_1, \Delta D_2]$ that has the size 2×M, then we do a Gauss normalization on each vector ΔD_1 and ΔD_2. Normalized matrix is $[\Delta D_1', \Delta D_2']$. Final distance vector:

$$\Delta D = \Delta D_1' + \omega \Delta D_2' \quad (12)$$

V. PROPOSED METHODOLOGY

In early era of this rising filed the image was retrieved by text description known as Text Based Image Retrieval [TBIR].Complete surveys of this method are often viewed in Chang S.K. and Hsu A [2]. All text based image retrieval systems need the text description with pictures in large scale data bases and manually this task is not possible.

Image retrieval systems conceive to search through a information to find images that are perceptually the same as a query image. Content based image retrieval (CBIR) is an important alternative and complement to ancient text based image searching and may greatly enhance the accuracy of the information being returned.

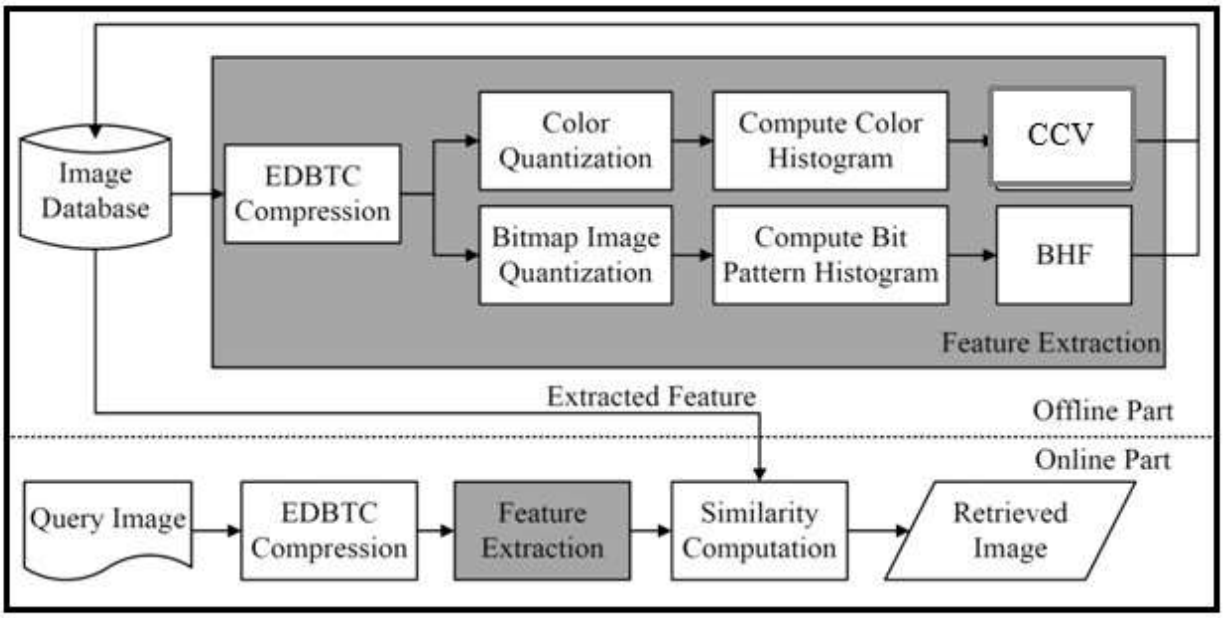

Fig 2.The Proposed Image Retrieval Framework

As a result, text based image retrieval systems were not applicable for task dependent queries [3].General image retrieval method are often visualized as in Fig-3.

Figure illustrates the schematic diagram of the EDBTC image compression system. The EDBTC is not only able to compress an image, but also able to index an image in a CBIR system.At the end of the EDBTC encoding process, two color quantizers and a bitmap image are sent to the decoder via a transmission channel. The decoder simply replaces the bitmap image which has value 1 with the maximum quantizer, while the value 0 is substituted with the minimum quantizer.

There is no computation required within the decoder side, creating it very attractive in the real-time application. Fig 3 shows an picture quality comparison of the EDBTC reconstructed image under Floyd-Steinberg, Stucki, and Stevenson error kernels over various image block sizes as 4 × 4, 8 × 8, 16 × 16, and 32 × 32.Compared with the BTC scheme, the EDBTC over comes the blocking effect and false countur artifacts manufacturing within the EDBTC image reconstructed.

In this section using the equations from equ(1) to equ(9) EDBTC compression is implemented.

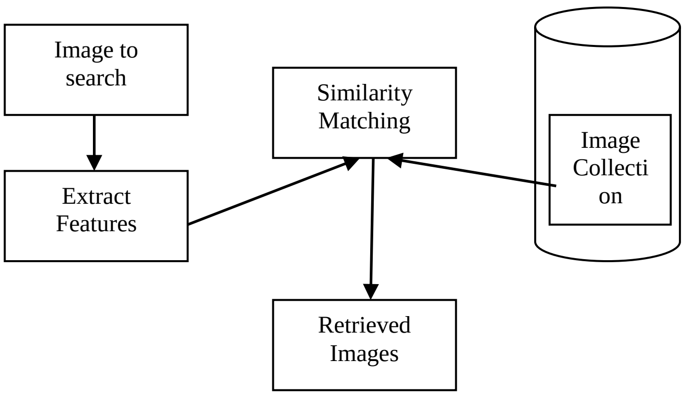

Fig 3.General Image Retrieval

VI. IMPLEMENTATION

Implementation consists of the subsequent modules,

- EDBTC Image Indexing
- Vector Quantization
- Color Features
- Bit Pattern Histogram Feature(BHF)
- Image Retrieval With EDBTC Features

A. IMAGE PREPROCESSING

preprocessing of the image is that the primary step which removes noise and smooth the image, to prevent misclassification of Region of Interest and Non Interest.

The image should be increased to enhanced accuracy of the method also, wiener filter is used to remove the noise and smoothing the image.

Wiener Filter :

- A degraded image are often more or less represented by the expression
- g = H[f] + n ,
- where: g is that the degraded (blurred) image, H is the degradation operator, f is that the original image, and n is an additive noise. In space domain, H is delineate by the PSF – Point Spread Function that describes the distortion or blur.

Wiener Filter Formulation :

where,

Power spectra of the original image

Additive noise of the image

Image blurring filter

B. SEGMENT IMAGE INTO ROI AND RONI

The original or cover image is separated into two set of images known as ROI and RONI image of same size with its original one, on the basis of morphological operations or by specifying two dimensional region of interest.

In a morphological operation, the value of every component within the output image is based on a comparison of the corresponding pixel in the input image with its neighbours i.e. in morphological image process operation an picture get processed on the basis of its shape.

By using some (dilation, erosion, closing and thickening) morphological operation. In the white portion of an picture contained ROI and therefore the black portion contained RONI.

C. INTEGER WAVELET TRANSFORM

In all pictures, like an 8-bit grayscale image, the component values are integer numbers. The integer wavelet transform maps integers to integers and permits for good invertibility with finite precision arithmetic(i.e) reversible.

Thus the integer wavlet transform can be implemented with only three operations, addition, subtraction, and shift, on a digital computer. The fast multiplication-free implementation is another advantages of the integer wavelet transform over normal discrete wavelet transform.

D. REVERSIBLE CONTRAST MAPPING

A simple reversible integer to integer transformation called reversible contrast mapping (RCM) is defined and applied to pick pixels for embedding embed data.

Apply forward transform to a selected pair of component according to the following conditions:

Subset 1: If the component pair (x, y) belongs to the RCM domain and if each the numbers are not odd in nature transform the pixel pair using chosen forward transform pair and set the Least Significant Bit (LSB) of x' as 1 and therefore the LSB of y' by corresponding watermark bit (0 or 1).

Subset 2: If the component pair (x, y) belongs to the RCM domain and if each the numbers are odd in nature, don't transform the pixel pair, simply set the LSB of x as 0 and LSB of y by corresponding watermark bit (0 or 1).

Subset 3: If the pixel pair (x, y) does not belongs to the RCM domain simply set the LSB of x as 0 and save the true value of y for retrieving method. Now for multi times embedding we are able apply the complete process for many times in a cyclic manner.

E. *DETECTION AND RECOVERING*

The process to recovery of the original images and watermark bits can be summarized by the subsequent steps:

- The watermarked pictures is classified into pair of pixels in a same fashion used during embedding and consider the actual reverse transform pair from table 1 with its correspondence forward transform pair.
- For every transformed pair (x',y') perform the following operation under subjected conditions:
- If the transformation had done in keeping with subset 1, i.e. if the LSB of x' is 1, extract the LSB of y' and store it as detected watermark bit into its correspondence positions. Also set the LSB of (x',y') by 0 and reconstruct the original pair by applying chosen reverse transform.
- If the transformation had done according to subset 2, i.e. if the transformed pair belongs to RCM domain and contained odd values extract the LSB of y' and store it as detected watermark bit into its correspondence positions. Also set the LSB of (x',y') by 1 to reconstruct the original pair.
- If the transformation had done keeping with subset 3, i.e. if the transformed pair does not belongs to the RCM domain, the original pair is recovered by substitution the LSB of X' with the Corresponding true value extracted from the watermark sequence.

VII. **RESULTS AND DISCUSSION**

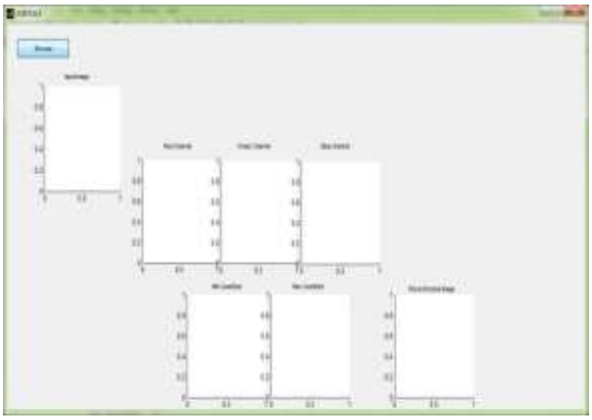

Fig 4.Content Based Image Retrieval Window

Fig 5.Choosing the Image for Content Based Image Retrieval

- Select an image for content based image retrieval from the database.

Fig 6.Given Image

- This is the input image

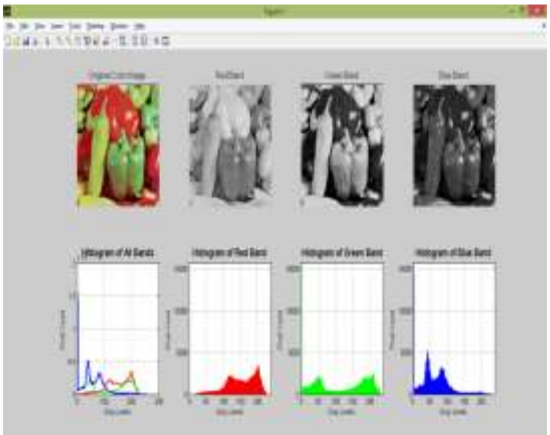

Fig 7.Identifying Red, Green, Blue Band Values using Color Coherence Value

- This window to measure a red, green, blue band values by using a color coherence vector feature.

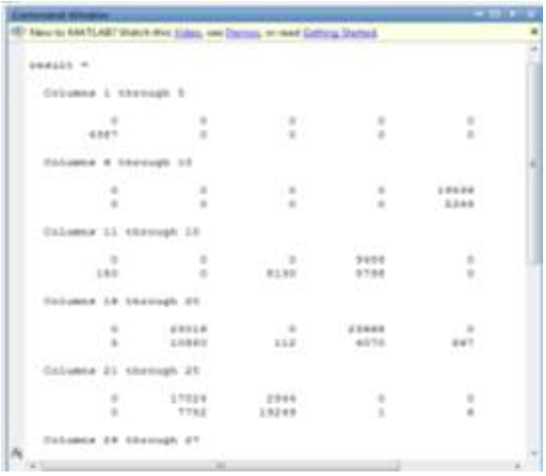

Fig 8.Color Coherence Vector for the Given Image

- This is vector values for the input image.

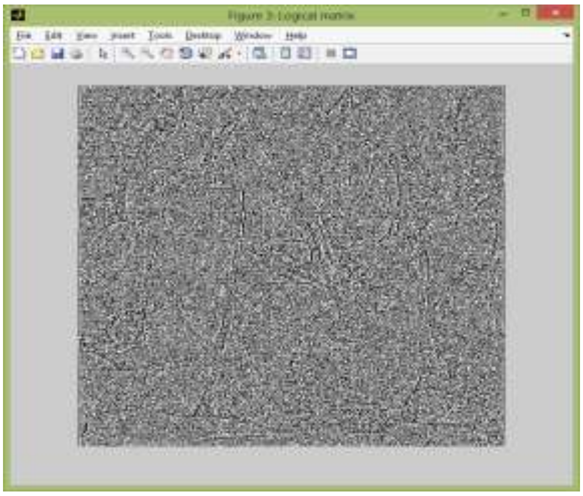

Fig 9.Color Coherence Matrix Display

- To display the color coherence matrix for the given image.

Fig 10.Reconstructed Image

- This is reconstructed image from the input image by using the EDBTC techniques.

Fig 11.Identifying Red, Green, and Blue Channel Values for Image Reconstruction

- To identify the red, green and blue channel values for the reconstructed image.

VIII. CONCLUSION

A quantitative comparison of EDBTC image feature for color picture retrieval and classification has been conducted and according in this chapter. In the image retrieval and classification task, a picture feature descriptor is just derived and constructed from the EDBTC encoded data stream, i.e. two color quantizers and the bitmap image. The two EDBTC color quantizers turn out the CCV that is effective for representing the color distribution of a picture, whereas the bitmap image results the BHF for characterizing the image textural information as well as a picture edges, lines, shapes, etc. The experimental results show that the projected methodology offers a promising result in the image retrieval and classification task, and at the equivalent time, the proposed methodology outperforms the previous existing ways. The EDBTC image retrieval and classification system are often extended for the video processing.

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