Ordered Dither Block Truncation Coding For Content Based Image Retrieval Using Relevance Feedback

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Abstract: *Now a days, content based image retrieval (CBIR) plays an important role in the image retrieval systems. Ordered dither block truncation coding (ODBTC) is applied in proposed system for CBIR which have relevance feedback mechanism. In this system features of an image are extracted using ODBTC for the generation of image content descriptor. ODBTC offers a simple and effective way to index images in CBIR system. ODBTC compresses an image block into minimum quantizer, maximum quantizer and bitmap image. The proposed image retrieval system generates Color co-occurrence feature (CCF) and bit pattern feature (BPF) from the maximum quantizer, minimum quantizer and bitmap image respectively .To be more profitable, relevance feedback technique is applied into CBIR so that more precise results can be obtained by taking users feedback into account. The method proposed here is superior to the block truncation coding and earlier methods.*

Keywords: Bit pattern feature, Block Truncation Coding, color co-occurrence feature, Content Based Image Retrieval,Ordered dither block truncation coding, relevance Feedback..

1. Introduction

The most promising computer technique i.e. content based image retrieval is used to solve searching problem for digital image in the huge database. In content based image retrieval, various image features such as color, texture and shape are considered for retrieving an image. For getting these features, Feature Extraction technique is projected. An image retrieval system returns a set of images from a collection of images in the database to meet user's demand with similarity evaluations such as image content similarity, edge pattern similarity, color similarity, etc. An image retrieval system offers an efficient way to access, browse, and retrieve a set of similar images in the real-time applications. Several approaches have been developed to capture the information of image contents by directly computing the image features from an image.

2. Literature Survey

In CBIR system an image features are extracted using different techniques. In paper [2] the Block Truncation Coding (BTC) technique is given which requires simple process on both encoding and decoding stages. The BTC compresses an image in a simple and efficient way [2].The first CBIR system which uses BTC can be found in [12]. The method exploits the nature of BTC to generate the image feature in which an image block is merely represented using two quantized values and the corresponding bitmap image. In the early work [12], two image features have been proposed which are namely block color co-occurrence matrix and block pattern histogram, to index a set of images in database. The paper [12] uses the RGB color space, whereas the image indexing scheme in [14] employs the YCbCr color space for the generation of image feature. In [14], an image with RGB color space is firstly converted into the YCbCr color space, subsequently, the BTC encoding is performed only for Y color space. By employing VQ, two images features (contrast and visual pattern co-occurrence matrix and color pattern co-occurrence matrix) are generated from aYCbCr image. In paper [14] the methods yields a better result in terms of the retrieval accuracy compared to that of the

former methods as reported in [14]. Some improvements on the BTC-based image retrieval system can also be found in [13] and [15], in which both methods utilize the RGB color space for the extraction of the image feature descriptor. In [13], the BTC encoding is performed on each color space (red, green, and blue) separately. A different approach for CBIR system incorporating the color moments and K-means clustering can and ability in the compression domain.

Several improvements and enhancements in the BTC scheme have been reported in literature [3],[4],[5],[6],[7],[8],[9],[10],[11] to further reduce the computational complexity, improve image quality, and achieve a higher compression ratio. HBTC is an extended compression technique derived from BTC scheme, in which the BTC bitmap image is replaced with the halftone image.

The HBTC quantizers are obtained by very simple method i.e. from the minimum and maximum values found in an image block. The example of HBTC is dithering-based BTC in which the bit pattern configuration of the bitmap is merely generated from the dithering approach. The dithering-based BTC, namely Ordered Dither Block Truncation Coding (ODBTC) [8], [9], involves the low-pass nature of the Human Visual System (HVS) for achieving an acceptable perceptual image quality. It is based on the fact that the continuous and halftone images are perceived similarly by human vision when they are viewed from a certain distance. In encoding stage, the ODBTC scheme utilizes the dither array Look-Up-Table (LUT) to speed up the processing speed. The dither array in ODBTC method substitutes the fixed average value as the threshold value for the generation of bitmap image. The extreme values in ODBTC are simply obtained from the minimum and maximum value found in the image blocks. Given the high efficiency and low computational complexity of the ODBTC, some interesting applications have been developed based on it such as watermarking schemes [10], [11]. Thus, it offers a good solution for application requiring privacy and ownership protection.

3. Implementation Details

3.1 System Overview

In this project, a new approach is proposed to index images in database using features generated from the ODBTC compressed data stream. This indexing technique can be extended for CBIR. ODBTC compresses an image into a set of color quantizers and a bitmap image.The proposed image retrieval system generates two image features namely Color co-occurrence feature (CCF) and bit pattern feature (BPF) from the minimum quantizer, maximum quantizer and bitmap image respectively by involving the visual codebook. To be more profitable, relevance feedback technique can be applied into CBIR such that more precise results can be obtained by taking users feedback into account. The proposed method is superior to the block truncation coding image retrieval system and the other earlier method.
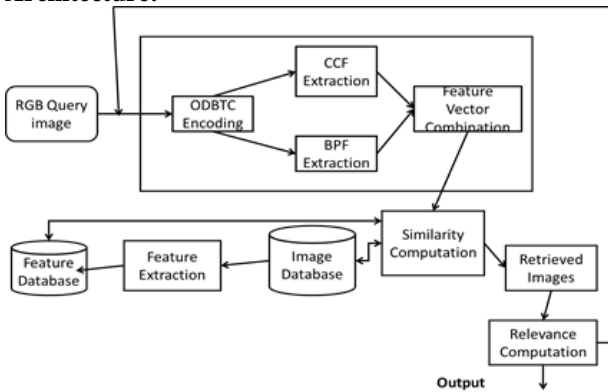
Architecture:

Figure 1: Block Diagram of proposed system.

As shown in Figure.1 the RGB color image is an input to the system. First the ODBTC encoding is performed on that image. The output of ODBTC encoding is bitmap image, maximum quantizer & minimum quantizer. Then Color co-occurrence features are extracted using codebooks & quantizers. Then bit pattern features are extracted which uses LBG-VQ algorithm. Then similarity is calculated with all images in database and top k images are retrieved to the user.

3.2 Ordered Dither Block Truncation coding

ODBTC compresses an image block into corresponding quantizers and bitmap image. The main advantage of the ODBTC image compression is on its low complexity in generating bitmap image by incorporating the Look-Up Table (LUT), and free of mathematical multiplication and division operations on the determination of the two extreme quantizers. It will reduce computation time and yield better image quality. Conversely, ODBTC identifies the minimum and maximum values each image block as opposed to the former low and high mean values calculation, which can further reduce the processing time in the encoding stage. In addition, the ODBTC yields better reconstructed image quality by enjoying the extreme-value dithering effect.

ODBTC Encoding Steps: ODBTC encoding is divided into two parts one is generation of bitmap image and second is calculation of minimum quantizer and maximum quantizer.

a. Generation of bitmap image:

1. Original RGB color image of size M × N is divided into multiple non-overlapping image blocks of size m×n, and each image block then processed independently.

2. The original image block b(i, j) is then converted into the inter-band average image and compute grayscale image i.e. inter-band average image.

$$\bar{b}_{k,l}(i,j) = \frac{1}{3}\left[b_{k,l}^{red}(i,j) + b_{k,l}^{green}(i,j) + b_{k,l}^{blue}(i,j)\right];$$
$$k = 1, 2, \ldots, m; \quad l = 1, 2, \ldots, n,$$

3. On inter-band average image, ODBTC apply the thresholding with pre-computed scaled version of dither array for each image block to generate bitmap image bm(i, j).

$$bm_{k,l}(i,j) = \begin{cases} 1; & \text{if } \bar{b}_{k,l}(i,j) \geq \bar{b}_{min}(i,j) + D^d(k,l) \\ 0; & \text{if } \bar{b}_{k,l}(i,j) < \bar{b}_{min}(i,j) + D^d(k,l) \end{cases},$$

b. Calculate Min and Max Quantizer:

1. By applying RGB decomposition, convert original image into three red, green and blue color images and divide each image into multiple non-overlapping image block.

2. Find minimum and maximum pixel value on each block for red, green and blue images independently.

$$x_{min}(i,j)$$
$$= \left[\min_{\forall k,l} b_{k,l}^{red}(i,j), \min_{\forall k,l} b_{k,l}^{green}(i,j), \min_{\forall k,l} b_{k,l}^{blue}(i,j)\right],$$
$$x_{max}(i,j)$$
$$= \left[\max_{\forall k,l} b_{k,l}^{red}(i,j), \max_{\forall k,l} b_{k,l}^{green}(i,j), \max_{\forall k,l} b_{k,l}^{blue}(i,j)\right],$$

For all i=1,2,…,M/m;j=1,2,..,N/n.

3. Then combine minimum value and maximum value from red, green and blue pixel value and calculate Min. Quantizer and Max. Quantizer respectively

$$X_{min} = \left\{x_{min}(i,j); i = 1, 2, \ldots, \frac{M}{m}; j = 1, 2, \ldots, \frac{N}{n},\right\}$$
$$X_{max} = \left\{x_{max}(i,j); i = 1, 2, \ldots, \frac{M}{m}; j = 1, 2, \ldots, \frac{N}{n},\right\}$$

Finally, the bitmap image bm, the minimum quantizer Xmin, and maximum quantizer Xmax are generated as encoded data stream. This encoded data stream then transmitted to the decoder module over the transmission channel. The receiver decodes this encoded data stream to reconstruct the image. The decoder simply replaces the element of value 0 in the bitmap by the minimum quantizer, and elements of value 1 in the bitmap by the maximum quantizer.

Except for the image compression, ODBTC compressed data stream, i.e., the bitmap image and two extreme color quantizers, is then used as an image descriptor for BPF and CCF respectively. In this paper, easy method for CBIR is implemented using the image feature extraction derived from the ODBTC encoded data stream.

3.3 Feature Extraction

Mainly two features are used here color co-occurrence feature and Bit pattern feature.

Color co-occurrence feature:

In the proposed scheme, from the two ODBTC color quantizers CCF is computed. Firstly using a specific color codebook generated using LBG-VQ algorithm, the minimum and maximum color quantizers are indexed and using this indexed values construct the color co-occurrence matrix. Next, the CCF

is constructed from the color co-occurrence matrix at the end of computation.

Color indexing process:

1. Find closest matching between minimum quantizer value of each image block over red, green, blue channel and codebook.

$$\tilde{i}_{min}(i, j) = \underset{q=1,2...,N_c}{\arg\min} \left\| x_{min}(i, j), c_q^{min} \right\|_2^2,$$

For all i=1,2,…,M/m;j=1,2,..,N/n.

2. As similarly, find closest matching between minimum quantizer value of each image block over red, green, blue channel and codebook.

$$\tilde{i}_{max}(i, j) = \underset{q=1,2...,N_c}{\arg\min} \left\| x_{max}(i, j), c_q^{max} \right\|_2^2,$$

For all i=1,2,…,M/m;j=1,2,..,N/n.

3. Calculate color co-occurrence matrix as CCF given by

$$CCF(t_1, t_2) = \Pr \left\{ \tilde{i}_{min}(i, j) = t_1, \tilde{i}_{max}(i, j) = t_2 \mid \right.$$
$$\left. i = 1, 2, \ldots, \frac{M}{m}; j = 1, 2, \ldots, \frac{N}{n} \right\},$$

For all t1,t2=1,2,…,Nc.

Bit Pattern Feature:
Next feature is called Bit Pattern Feature (BPF), characterizes the edges, shape, and image contents. Bitmap image is indexed using bit pattern codebook and result BPF. These bit pattern codebooks are generated using binary vector quantization and many bitmap images are involved in the training stage. At the codebook generation stage, all code vector components may have intermediate real values between zero (black pixel) and one (white pixel) as opposed to binary values. At the end of training stage, the hard thresholding performs the binarization of all code vectors to yield the final result.

BPF indexing process:

1. Find similarity between bitmap of each image block bm(i, j) and codeword Qq.

$$\tilde{b}(i, j) = \underset{q=1,2...,N_b}{\arg\min} \ \delta_H\{bm(i, j), Q_q\},$$

For all i=1,2,…,M/m;j=1,2,..,N/n.

2. Compute occurrence probability of bitmap image indexed into bit pattern codebook. This is considered as BPF
for all= 1,2,..,.

$$BPF(t)$$
$$= \Pr \left\{ \tilde{b}(i, j) = t \mid i = 1, 2, \ldots, \frac{M}{m}; j = 1, 2, \ldots, \frac{N}{n} \right\},$$

for all t = 1,2,..,Nb.

3.4 Similarity Measure

After calculating CCF & BPF of query image , next similarity is measured. For similarity measure following formula is used.

d(query,target)=

$$\alpha 1 \sum_{t=1}^{Nc} \frac{\left| CCF^{query}(t) - CCF^{target}(t) \right|}{CCF^{query}(t) + CCF^{target}(t) + \varepsilon} + \alpha 2 \sum_{t=1}^{Nb} \frac{\left| BPF^{query}(t) - BPF^{target}(t) \right|}{BPF^{query}(t) + BPF^{target}(t) + \varepsilon}$$

Where α1 and α2 denote the similarity weighting constants,

representing the percentage contributions of the CCF and BPF in the proposed image retrieval system. A small number ε is placed at the denominator to avoid the mathematic division error.

3.5 Relevance Feedback

If user is not satisfied from the results then he may choose some relevant images from results and can click on relevance feedback. After this user will get more improved results as compared with previous. Hence customer satisfaction is improved in this system.

4. Results

Ordered Dither Block Truncation Coding For Content Based Image Retrieval using relevance feedback system improve result accuracy and efficiency than existing technique. ODBTC technique is used to compress an image as it exploiting encoded data stream to construct image descriptor. Over image descriptor CCF and BPF are performed to extract features of images. System returns a set of similar images from the pre-computed database based on their similarity. Proposed scheme provide best precision rate and by adopting relevance feedback customer satisfaction is improved.Finally, the image retrieval performance is tested when several images are turned as queries.

A. Data Set
This research uses image dataset which is freely available on internet Here I have used Corel dataset of 1000 images.It has total 10 classes and each class contains 100 similar images.

B. Comparison with Former Scheme.
Average precision is calculated for every class. Randomly 5 images are selected from every class and precision is calculated. Then overall average is calculated. It is greater than all previous schemes. Hence its results is improved. Here user feedback is also taken into account. Hence user satisfaction is improved here.

Table 1: Average Precision for 10 categories of Images from Corel Database at Recall=5

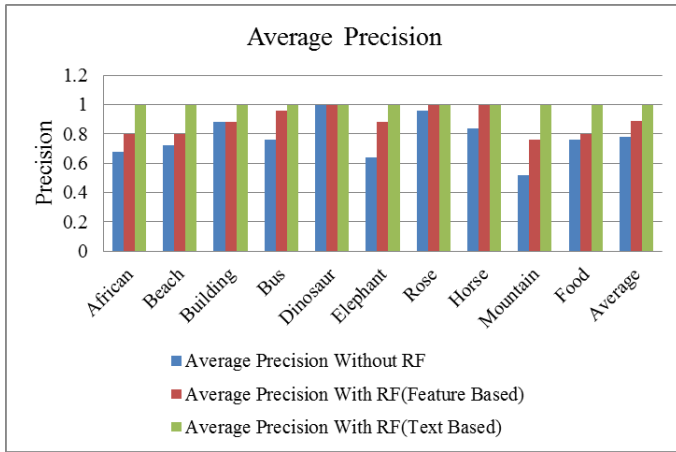| Sr. No.	Class	Average Precision Without RF	Average Precision With RF(Feature Based)	Average Precision With RF(Text Based)
1	African	0.68	0.8	1
2	Beach	0.72	0.8	1
3	Building	0.88	0.88	1
4	Bus	0.76	0.96	1
5	Dinosaur	1	1	1
6	Elephant	0.64	0.88	1
7	Rose	0.96	1	1
8	Horse	0.84	1	1
9	Mountain	0.52	0.76	1
10	Food	0.76	0.8	1
	Average	0.78	0.89	1

Figure 2: Graph for average precision for each category in corel dataset for recall=5

The average precision by this method is increased where it was 0.779 in previous method. Also user satisfaction is also improved here. Hence this method is better as compared with previous all.

5. Conclusion and future work

In this project, the Ordered Dither Block Truncation Coding (ODBTC) is proposed to solve the problems which occurred due to block truncation coding. Block truncation coding causes severe perceptual artifact in high compression ratio applications. The dither array approach is proposed in this system which significantly reduce the complexity of the BTC. In this system, an image retrieval system is presented by exploiting the ODBTC encoded data stream to create the image features Color Co-occurrence feature and Bit Pattern features. Proposed scheme can provide the best average precision rate compared to various previous schemes in the literature. As relevance feed- back is added in the system, user satisfaction is improved in proposed system. As a result, the proposed scheme can be considered as a very competitive in color image retrieval application. In future such a CBIR system can be used in many applications like medical, academic, art, fashion, entertainment which makes user satisfied.

Acknowledgement

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