

Quantization methodologies for image calibration and indication

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Abstract

Image can be encoded and decoded by ODBTC. Here we introduce a new quantization method for HVS (Human Visual System) to the image to feat the low-difficulty in ordered-dither block truncation coding to provide image content descriptor. In the perceptual quantization method an image block compresses into consistent quantizers and bitmap image. The color co-occurrence feature (CCF) and bit pattern features (BPF) of an image can be given by quantizes and bitmap, of the existing one respectively, by involving the visual codebook. As the results gives as that the proposed scheme is prior to the block truncation coding image retrieval and the other previous methods, proves that the ODBTC scheme is not only for image compression, it used also for decompression, it also gives as a simple and effective descriptor to index images in CBIR system. The quantization method used here will increase the image quality.

Keywords: CBIR, BTC, ODBTC, Vector Quantization, Perceptual Quantization.

1. Introduction

Images can be used in various fields and the periphery of application is also increasing. It has got applications in fields like medicine, biological research, photography and many more. With ever-booming growth of multimedia applications over network, data compression has become essential. Compression hardware having throughput matches the capacity of high-speed data communication channel which can be given as the backbone of on-line communication. This can be achieved by designing the compression /decompression algorithm An image is a two dimensional object that provides visual information such as colors, depth of image, brightness and so on for the human eyes.

A digital image is obtained by sampling the information at accepted intervals (pixel) in either direction. The information for each pixel is stored numerically in the binary base. The bits count of each pixel represents the precision of the sample. Higher the precision value higher up the picture quality. In case of digital images adjacent pixels are often related with each other as the pixel values have very less variation in between them. These sorts of redundancies are generally exploited to get compression. Images often use either 8-bit or 24-bit color. In

case of 8-bit the range of pixel value is from 0-255 means 256 different colors). By 24-bit scheme, each pixel values 24-bit and every 8-bit is used for representing three different primary colors red, green, blue.

Image compression algorithms are splitted into two types: Lossless and lossy compression. Lossless image compression techniques helps to compress image in a way that there is no data loss in decompressed image. Lossless compression technique generally can't give high compression ratio and there is no quality loss at all. Lossy image compression techniques, is a method in which the decompressed image suffers from some amount of data loss. All the data is not retrieved in case of lossy compression, the compression ratio achieved is generally higher but at the expense of image quality.

Image Retrieval systems maintain the following two-step progress to search image databases: (i) Indexing for each image in a database, a feature vector capturing certain conditional properties of the image is computed and stored in a feature-base, (ii) Searching given to a query image, its feature vector is computed, compared to the feature vectors in the feature base, and images that are nearly similar to the query image are returned to the user.

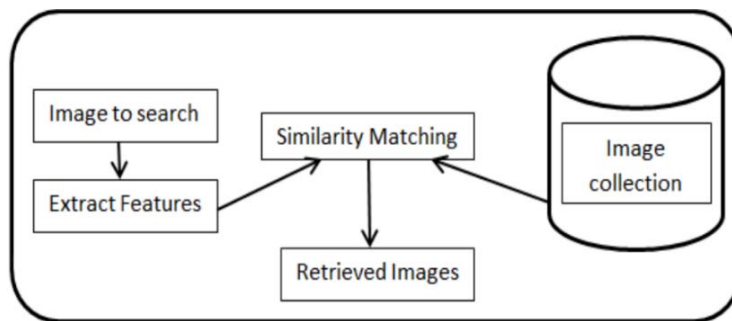


Fig 1: General Image Retrieval Process

One particularly favorable contact to image database indexing and retrieval is the query by image content (QBIC) method, the visual capacity of the images, such as color distribution (color

histogram), texture attributes and other image features are quoted from the image using computer vision/image processing techniques and used as indexing keys.

In an image database, these visual keys are stocked along with the actual imagery data and image retrieval from the database is based on the similar models of visual keys with those of the query images. QBIC is not efficient in terms of data storage. Not only is it inefficient, it is also intractable in the sense that image matching/retrieval can only be based on the pre-computed set of image features. DCT coefficients of JPEG can be used for image indexing and object recognition. JPEG methods are not clearly designed for image indexing purpose, models and features have to be derived from the transform coefficients, which usually involves hard and complex computation and also leads to an expansion of data. MPEG standards primarily distributed with efficient compression, and the signal-to-noise ratio (SNR) constituted an effective yardstick for comparison. MPEG-7 Visual Content Descriptor, including the Color Descriptors (CD), Texture Descriptor (TD), and Shape Descriptor (SD) to establish the international standard for the CBIR task. A color feature for image indexing/retrieval called the color correlogram. The highlights of color correlogram are it includes the spatial correlation of colors, it can be used to explain the global distribution of local spatial correlation of colors, it is easy to compute, and the size of the feature is fairly small.

Content-Based Image Retrieval (CBIR) values the visual contents of an image such as color, shape, texture, and spatial layout to express and index the image. 'Content Based' can be defined as that the search analyzes the contents of image rather than searching by its keywords, tags or description. The 'content' mean context that refers to color, shapes, textures or any other content which can be extracted from image. CBIR system which extracts an image feature descriptor from the compressed data stream has become an important issue. Since most of the images are recorded in the storage device in compressed format for reducing the storage space requirement. In this scenario, the feature extractor simply generates an image feature for the CBIR task from compressed data stream without performing the decoding (decompression). The algorithms used in these systems are usually splitted into three tasks - extraction, - selection, - classification.

CBIR can be given with the following stages

- **Pre-processing:** The image is first processed in order to extract the features, which explains its contents. The processing involves filtering, normalization, segmentation, and object classification. The output of this stage is a set of serious regions and objects.

- **Feature extraction:** Features such as shape, texture, color, etc. are valued to explain the content of the image. Image features can be classified into primitives. Block Truncation Coding or BTC is a sort of lossy image compression technique for grey scale images. It splits the original images into blocks and then needs a quantizer to reduce the number of grey levels in each block whilst maintain the same mean and standard deviation. The Block Truncation Coding (BTC) is an image compression method which requires simple process on both encoding and decoding stages.

Three main moments of an image's color distribution in which p^k_{ij} is the value of the k-th color component of the ij-image pixel and P is the height of the image and Q is the width of the image. They are Mean, Standard deviation and Skewness.

MOMENT 1 - Mean:

$$E_k = \frac{1}{PQ} \sum_{i=1}^P \sum_{j=1}^Q p^k_{ij}$$

Equation -1

Mean can be understood as the average color value in the image.

MOMENT 2 – Standard:

$$SD_k = \text{SQRT} \left(\frac{1}{PQ} \sum_{i=1}^P \sum_{j=1}^Q (p^k_{ij} - E_k)^2 \right)$$

Equation -2

The standard deviation is the square root of the variance of the distribution.

MOMENT 3- Skewness

$$S_k = \left(\frac{1}{PQ} \sum_{i=1}^P \sum_{j=1}^Q (p^k_{ij} - E_k)^3 \right)^{1/3}$$

Equation -3

Skewness can be understood as a measure of the degree of asymmetry in the distribution.

2. Related Works

The image quality metrics can be widely classified into two categories, subjective and objective. Subjective image quality is a method of estimation of images by the viewers read images directly to determine their quality. In objective measures of image quality metrics, some statistical indices are calculated to indicate the image quality.

BTC was compared with the DCT and hybrid coding techniques in the context of high resolution aerial reconnaissance imagery. Block Truncation Coding is generated for the purpose of gray scale image coding. divides the image to be coded into small non overlapping image blocks. For each block, the original pixels within the block are coded using a binary bit-map the same size as the original block and two mean pixel values. If a pixel is greater than or equal to the block mean, the conforming pixel position of the bitmap will have a value of 1, otherwise it will have a value of 0. The disadvantage of this method is that three bit planes are required hence the compression ratios achievable are low. To create a binary bitmap in the RGB space, we generate an inter-band average image (IBAI) and a single scalar value is found as the threshold value.

2.1. Block Truncation Coding Algorithm

- Split the image into Red, Green, Blue Components.
- Find the average of every components by using - Average of Red component, Average of Green component, Average of Blue component.
- Split every component image to achieve RH, RL, GH, GL, BH and BL images RH is obtained by taking only red component of all pixels in the image which are superior to red average and RL is obtained by taking only red component of all pixels in the image which are under red average. Similarly GH, GL, BH and BL can be obtained.

- d. Apply color moments to each splitted component like RH, RL, GH, GL, BH and BL.
- e. Apply clustering algorithm to find the clusters.

2.2. AMBTC

AMBTC has several advantages over BTC one asset is in the case that the quantizer is used to transmit an image from transmitter to a receiver, it is required to compute at the transmitter the two quantities, the sample mean and the sample standard deviation for BTC and sample first absolute central moment for AMBTC. By comparing the necessary computation for deviation information, we will see that in case of standard BTC it is needed to compute a sum of m values and each of them will be squared while in case of AMBTC it is only mandatory to compute the sum of these m values. Since the multiplication time is several times greater than the addition time in peak digital processors, thus using AMBTC the total calculation time at the transmitter is significantly reduced.

BTC has very few figuring, edge-preserving ability and single pixel resolution; but only a medium compression ratio. VQ provides high-compression ratio; fast, look-up-table (LUT)-based decoding and competitive subjective performance; but the encoding procedure is quite time consuming.

ADCT coding has high-compression ratio, especially at low bit rates, and good mean square error (MSE) performance but both encoding and decoding processes are computationally complex.

2.3 HBTC

The computational simplicity of the BTC and Halftone-based Block Truncation Coding (HBTC) techniques have made it as an attractive tools in applications requiring fast real-time implementation. HBTC is an extended compression technique derived from BTC scheme, in which the BTC bitmap image is replaced with the halftone image. The main difference between the BTC and HBTC is on the image block quantizers determination. In contrast to the BTC scheme which tries to maintain its mean value and standard deviation in an image block, the HBTC quantizers are simply obtained from the minimum and maximum values found in an image block. The dithering-based BTC is an example of HBTC, in which the bit pattern configuration of the bitmap is merely generated from the dithering approach (void-and-cluster half toning).

The hybrid BTC-VQ-DCT image coding algorithm presented combines the simple computation and edge preservation properties of BTC and the high fidelity and high compression ratio of adaptive DCT with the high-compression ratio and good subjective performance of VQ, and may be executed with significantly lower coding delays than either VQ or DCT alone.

2.3. BTC-VQ-DCT phases

Phase I: BTC coding of the input image, which compresses blocks of the original $N \times N$ image into a "bit-map" and two reduced-sized gray-level images which are composed of the "high-mean" and "low-mean" pixel values of each BTC block. The primary compression ratio of Phase I is 4:1 for 4×4 blocks. Phase II: VQ is implemented on the bit-map to further remove the intrablock redundancy. A universal 64 K codebook is built

to quickly vector quantize the bit-map through the use of a LUT. The compression ratio in this phase is between 1.6:1 and 2.67:1. Phase III: Adaptive DCT is implemented to compress the $N/4$ high- and low-mean sub-images, which removes both inter- and intrablock correlations among high- and low-mean pixel values. Residual error feedback is used to reduce the MSE and bit rate. The compression ratio is about 3:1.

3. Proposed Work

The dithering-based BTC, known as Ordered Dither Block Truncation Coding (ODBTC) 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 utmost 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. Thus, it offers a good solution for application requiring privacy and ownership protection. In existing we discuss about vector quantization for indexing the image blocks. For proposed the perceptual quantization is given to reduces unperceivable details and thus improves both visual impression and transmission properties. We use perceptual criteria in order to define a perceptual forward and inverse quantizer. It is based on the CIWaM, a low-level computational model that replicates color perception in the Human Visual System.

3.1. Perceptual Quantization

The Perceptual models are based on the properties of the visual system and measurements of the eye characteristics. Examples of those characteristics are contrast sensitivity function (CSF), light adaption masking etc. Perceptual metric for image quality is to determine the difference between two images that are visible to the human visual system. Commonly a image is a reference which is to be examined as 'original', 'perfect' or 'uncorrupted'. Also the image has been modified or distorted. It is difficult to evaluate image quality without these reference. We consider two images, to measure the image quality we require some parameters like viewing distance, image size, display parameters etc. The output can be given with number that represents probability that a human eye can detect a difference in that two images or a number that quantifies the perceptual dissimilarity between those images.

Image quality metric can be given with some stages the first is the calibration and then registration, i.e, point by point correspondence between two images which will not change the image but changes the image value and then the next stage is given by display model in which the perceptual model can be obtained empirically, the effects of display are incorporated. This stage has an disadvantage that when display changes a new set of model parameters must be obtained.

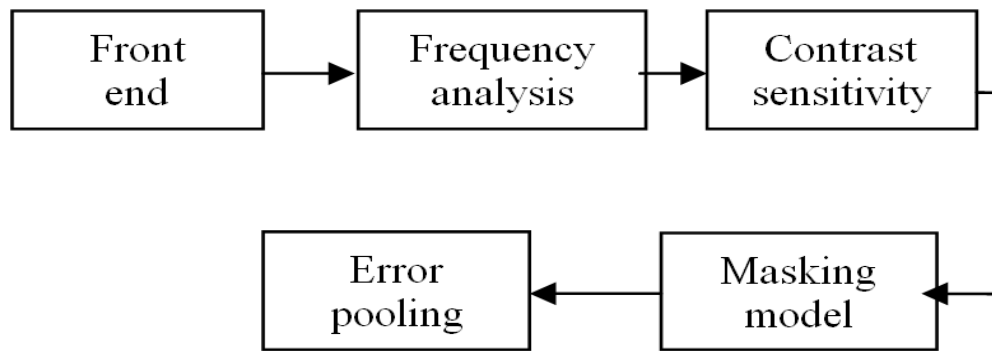


Fig 2: Basic Perceptual metric

3.2. CIWaM

In First BIWaM is created and works just only on brightness, CIWaM applies the same basic principles simultaneously to brightness and the chromatically opponent visual pathways. CIWaM stands for chromatic induction wavelet model. Chromatic induction is the process related to the change in the perceived color of a visual stimulus. This chromatic induction has two effects:

A green and a blue ring are perceived in left and right discs respectively. Although perceived as different colors but they are exactly the same physical colour. This effect is known as chromatic assimilation.

A green and a yellow ring are perceived in left and right discs respectively. Although perceived as different colors but they are exactly same physical colour. This effect is known as chromatic contrast.

4. Results & Discussion

As using the vector quantization method we can label the image blocks which helps the user for indexing by splitting it into minimum and maximum quantizer and also perceptual quantization to remove the unpredictable details and for quantizing the quality of image. These can be done by converting the RGB images into Gray Scale image and ODBTC for dithering the images by using two features to those images.

5. Conclusion

The evaluation of image quality are based on visual perception. In the proposed scheme can provide the best average precision rate compared to various former schemes. Also we consider two models for image quality one is the general models and the models that are designed for image compression, these models are given sequentially for the distortions which are near the threshold of perception. These models we discussed are to be used in many cases but their predictions of image quality may not be as accurate. The feature can be done for high quality image and their need for efficient storage and transmission and also in the future possibilities, the system shall be able to bridge the gap between explicit knowledge semantic, image content, and also the subjective criteria in a framework for human-oriented testing and assessment.

6. References

1. Guo JM, Wu MF. Improved block truncation coding based on the void-and-cluster dithering approach," IEEE Trans. Image Process., 2009; 18(1):211-213.
2. Guo JM. High efficiency ordered dither block truncation coding with dither array LUT and its scalable coding application, Digit. Signal Process., 2010; 20(1):97-110.
3. Qiu G. Color image indexing using BTC," IEEE Trans. Image Process., 2003; 12(1):93-101.
4. Gahroudi MR, Sarshar MR. Image retrieval based on texture and color method in BTC-VQ compressed domain, in Proc. 9th Int. Symp. Signal Process, 2007, 1-4.
5. Lu ZM, Burkhardt H. Colour image retrieval based on DCT-domain vector quantisation index histograms, Electron. Lett., 2005; 41(17):956-957.
6. Poursistani P, Nezamabadi-Pour H, Askari Moghadam R, Saeed M. Image indexing and retrieval in JPEG compressed domain based on vector quantization, Math. Comput. Model., 2011; 57:5-6, 1005-1017, [Online]. Available: <http://dx.doi.org/10.1016/j.mcm.2011.11.064>.
7. Silakari S, Motwani M, Maheshwari M. Color image clustering using block truncation algorithm, Int J Comput Sci. 2009; 4(2):31-35.
8. Lai CC, Chen YC. A user-oriented image retrieval system based on interactive genetic algorithm, IEEE Trans. Instrum. Meas., 2011; 60(10):3318-3325.
9. Manjunath BS, Ohm JR, Vasudevan VV, Yamada A. Color and texture descriptors, IEEE Trans. Circuits Syst. Video Technol., 2001; 11(6):703-715.
10. Huang J, Kumar SR, Mitra M, Zhu WJ, Zabih R. Image indexing using color correlograms, in Proc. IEEE Int. Conf. Comput. Vis. Pattern Recognit., San Juan, PR, USA, Jun. 1997, 762-768.
11. Jia Y, Huang C, Darrell T. Beyond spatial pyramids: Receptive field learning for pooled image features, in Proc. IEEE Conf. Comput. Vis. Pattern Recognit. (CVPR), Jun. 2012, 3370-3377.
12. Burghouts GJ, Geusebroek JM. Material-specific adaptation of color invariant features, Pattern Recognit. Lett., 2009; 30(3):306-313.
13. Marcia G. Ramos and Sheila S. Hemami Perceptual quantization for wavelet-based image coding in School of Electrical Engineering Cornell University Ithaca, NY 14853.
14. Jaime Moreno, ESIME-Zacatenco Φ SET: Perceptual Quantization using a Chromatic Induction Model National Council of Science and Technology of Mexico by means of Project No. 204151/2013, LABEX Σ -LIM France.
15. Aditya Kumar, Pardeep Singh. Enhanced Block Truncation Coding for Gray Scale Image Int. J Comp Tech Appl. 2(3), 525-529.
16. Andrew B, Watson, Perceptual optimization of DCT color quantization matrices in IEEE International Conference on Image Processing, Austin, TX, 1994.