Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 89 (2016) 778 – 784

Procedia Computer Science

Twelfth International Multi-Conference on Information Processing-2016 (IMCIP-2016)

Color Image Compression using Vector Quantization and Hybrid Wavelet Transform

H. B. Kekre[a], Prachi Natu[b,*] and Tanuja Sarode[c]

[a]*MPSTME, NMIMS University, Mumbai 56, India*
[b]*MPSTME, Mumbai 56, India*
[c]*TSEC, Mumbai 50, India*

Abstract

This paper presents simpler image compression technique using vector quantization and hybrid wavelet transform. Hybrid wavelet transform is generated using Kronecker product of two different transforms. Image is converted to transform domain using hybrid wavelet transform and very few low frequency coefficients are retained to achieve good compression. Vector quantization is applied on these coefficients to increase compression ratio significantly. VQ algorithms are applied on transformed image and codebooks of minimum possible size 16 and 32 are generated. KFCG and KMCG are faster in execution and beats performance of LBG algorithm. KFCG combined with hybrid wavelet transform gives lowest distortion and acceptable image quality at compression ratio 192.

Peer-review under responsibility of organizing committee of the Organizing Committee of IMCIP-2016

Keywords: Hybrid Wavelet Transform; Image Compression; Kronecker Product; SSIM; Vector Quantization.

1. Introduction

With advances in technology, need for storing more and more multimedia data arises. Images are integral part and comprise large volume of this data. Hence efficient storage and transmission of images is necessary. Compression facilitates this as it uses fewer bits for image representation. Compression is classified as lossy compression and lossless compression. In lossy compression approximated image is obtained with some loss of information. It is not exact replica of original image. In lossless compression, image is reconstructed without any loss of information. Hence use of lossless compression is observed in text data compression, medical imaging etc. On the other hand lossy compression can be used in image, video compression where some loss of information occurs and it is not detected by human eyes.

Since last two decades many compression techniques have been proposed. Compression using transforms has gained immense popularity due to their energy compaction property. Initially Fourier transform[1] was used which focused on global features of an image. Local properties cannot be detected using Fourier analysis. This drawback is overcome using Short Time Fourier Transform (STFT)[2]. But it gives only local properties. Further Discrete Cosine Transform

*Corresponding author. Tel.: +91 -9881357811.
E-mail address: prachinatuproject@gmail.com

Peer-review under responsibility of organizing committee of the Organizing Committee of IMCIP-2016
doi:10.1016/j.procs.2016.06.059

(DCT)[3] was introduced. It compacts energy in few low frequency coefficients located at top left corner of transformed image. Wavelet transform[4] was introduced as it analyzes the signal in time as well as in frequency domain[5]. Wavelet transform became popular as it has greater energy compaction property and it reduces blocking effect observed in DCT based compression. Further advancements have shown that hybrid methods of image compression give better results than mere orthogonal transforms or wavelet transforms as they combine two different techniques of compression. Hybrid wavelet transform has been recently studied[6] and has shown better image quality than one obtained in wavelet transform also. It extracts properties of component transforms used to generate it. Generation procedure is quite simpler and faster and hence promotes its use for image compression. Wavelet transform coupled with SPIHT has been proposed by Kabir *et al.*[7]. Vector quantization based color image compression is proposed by Hiroki Matsumoto[8] where fixed and variable block sized image is used for vector quantization. Perceptual image quality measure and bits per pixel are the criteria used to measure efficiency of algorithm. Combination of wavelet transform, multistage vector quantization and Huffman coding is given in[9].

This paper proposes fusion of hybrid wavelet transform and vector quantization for image compression. Vector quantization algorithm is applied to increase compression ratio. Three different VQ algorithms are used and their performance is analyzed.

Organization of paper is as below. Section 2 briefs the concept of hybrid wavelet transform. Section 3 describes vector quantization and different VQ algorithms used in this paper. Section 4 briefs about the algorithm used. In section 5 results are discussed and section 6 concludes the work done.

2. Hybrid Wavelet Transform (HWT)[10]

Two different transforms are combined using Kronecker product. Here Discrete Kekre Transform (DKT)[10] and Discrete Cosine Transform (DCT) are used to get DKT-DCT HWT.

Kekre transform matrix is given in eq. (1)

$$K = \begin{bmatrix} 1 & 1 & 1 & \dots & 1 \\ -N+1 & 1 & 1 & \dots & 1 \\ 0 & \cdot & \cdot & \dots & \cdot \\ \cdot & \cdot & \cdot & \dots & \cdot \\ 0 & 0 & 0 & \dots & 1 \\ 0 & 0 & 0 & -N+(N-1) & 1 \end{bmatrix} \tag{1}$$

Transform matrix is obtained using eq. (2)

$$T_{AB} = \begin{bmatrix} Ap \otimes Bq(1) \\ Ip \otimes Bq(2) \\ Ip \otimes Bq(3) \\ \cdot \\ \cdot \\ \cdot \\ Ip \otimes Bq(n) \end{bmatrix} \tag{2}$$

3. Vector Quantization (VQ)

For similar group of vectors it gives representative code vector. Indices of these code vectors are transmitted to achieve compression.