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Image Compression Analysis using Haar, Bior Discrete Wavelet Transform

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Abstract

The rapid growth of technology in recent few years has changed the whole dimension of Image compression technology. Today people are more interested in transfer of pictorial information through face book, whatsapp, and hike etc. through hands-free communication. To achieve the transfer of digital image information through limited bandwidth at higher rate of transmission, it is required that we compress the digital images. There are many algorithms and technologies available in market for compressing the image, fundamental of all these technology to remove the residual information from the digital images without affecting the quality of the same. There is another way to compress the image is to utilizing the code transformation which utilize the coding efficiency and Hauffman, DCT, and DWT transformation of codes. The combinations of two technology, first residual information removal and second source coding results better compressed image. There is a drawback that in terms of image quality, whenever we compress the information through quantization and residual information removal method we lose sharp edges and resolution of the picture degrades.The objective of this research is to compress the image through the discrete wavelet transform and analyze the effect of methods used in compression and effect of level of decomposition of the wavelet. The method used for transformation is wavelet rather than cosine transforms, the wavelet transform produce better compression then cosine in terms of compression ratio and PSNR when there is a gradual change in the color of image. It has been analyzed in this thesis that when the level of decomposition increase it produce better quality picture and if we use less encoding loops than number of bits per pixel reduces and results good compression ratio.

Keywords: *Image Compression, Haar, Discrete Wavelet Transform, Signal, PSNR.*

Introduction

Image is a 2-D signal processed by the human visual system through the eyes. To represent and capturing the image usually analog form is used. However in the era of information technology images are processed, stored and transmitted by converting analog images into digital form. A digital image is represented by an array of 2-D pixels. Images play an important role in remote sensing, biomedical and video conferencing applications as an important information mine. In the era of information technology, need to store and transmit large amount of data in efficient ways is increasing.

In digital image, a pixel is defined as the smallest unit of picture which can be controlled in a raster image. It is the single and smallest addressable screen element as shown in Fig. 1.1. As in the 2-D geometry system every point has unique co-ordinate in similar way each and every pixel has its own address in terms of co-ordinate. Pixels are normally arranged in a 2-D grid pattern and are represented with dots or squares.

A pixel can be seen as a sample of the original image captured via camera. As the numbers of sample increase more precise reconstruction can be obtain of a signal; in a similar way as the number of pixels increase resolution of the picture increases. The magnitude of a pixel is represented in terms of intensity; and intensity of each pixel is variable in nature. In color image systems, a color is typically represented by three component of intensities which are red, green, and blue.

This ratio is often used as a quality measurement between the original and a compressed image. Higher is the PSNR, the better the quality of the compressed or reconstructed image. The Mean Square Error (MSE) and the Peak Signal to Noise Ratio (PSNR) are the two error metrics used to compare image compression quality. The MSE represents the cumulative squared error between the compressed and the original image, whereas PSNR represents a measure of the peak error.

Then the block computes the PSNR using the following equation:

$$PSNR = 10log_{10}(\frac{R^2}{MSE})$$

Image Compression is the process of reduction in the size of any object; similarly image compression is the process of reduction in number of bits required to represents digital image as compare to original image without losing the quality constraints.

Image compression systems are composed of two distinct structural blocks: an encoder and a decoder, as shown in figure.

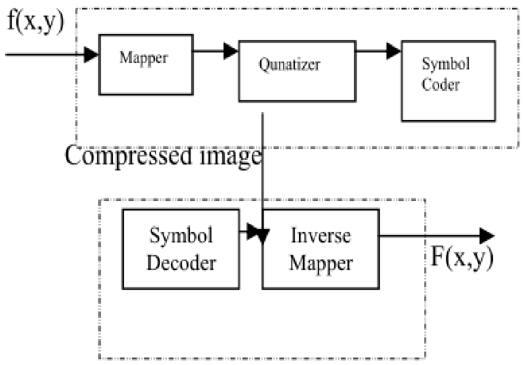

Figure 1: Image Compression System

The benefits of image compression can be listed as follows:

1. It provides a potential cost savings associated with sending less data over switched telephone network where cost of call is really usually based upon its duration.
2. It not only reduces storage requirements but also overall execution time.
3. It reduces the transmission errors since fewer bits are transferred.
4. It also provides a level of security against illicit monitoring.

Wavelet Transform-Thewavelet transform is similar to the Fourier transform (or much more to the windowed Fourier transform) with a completely different merit function. The main difference is this: Fourier transform decomposes the signal into sines and cosines, i.e. the functions localized in Fourier space; in contrary the wavelet transform uses functions that are localized in both the real and Fourier space. Generally, the wavelet transform can be expressed by the following equation:

$$F(a,b) = \int_{-\infty}^{\infty} f(x)\psi^{*}_{(a,b)}(x)d(x)$$

We can use orthogonal wavelets for discrete wavelet transform development and non-orthogonal wavelets for continuous wavelet transform development. These two transforms have the following properties:

1. The discrete wavelet transform returns a data vector of the same length as the input is. Usually, even in this vector many data are almost zero. This corresponds to the fact that it decomposes into a set of wavelets (functions) that are orthogonal to its translations and scaling. Therefore we decompose such a signal to a same or lower number of the wavelet coefficient spectrum as is the number of signal data points. Such a wavelet spectrum is very good for signal processing and compression, for example, as we get no redundant information here.

2. The continuous wavelet transform in contrary returns an array one dimension larger that n the input data. For a 1D data we obtain an image of the time-frequency plane. We can easily see the signal frequencies evolution during the duration of the signal and compare the spectrum with other signals spectra. As here is used the non-orthogonal set of wavelets, data are correlated highly, so big redundancy is seen here. This helps to see the results in a more humane form.

Results and Discussion

In the present work, using wavelets tool different compression method and different wavelets are compared in terms of different parameters like PSNR, BPP, Comp Ratio, and MSE, which in results gives an analysis of different method in terms of quality in different aspects.

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Simulation of Image Compression with HAAR Wavelet

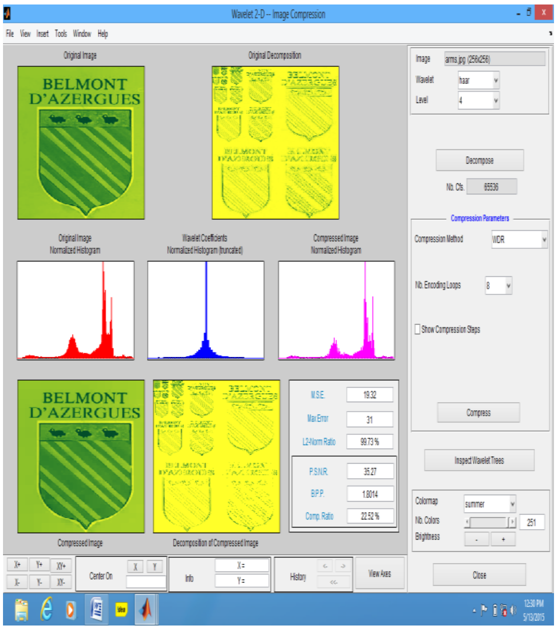

Figure 2: Haar wavelets with level 4

Simulation of Image Compression with Bior Wavelet

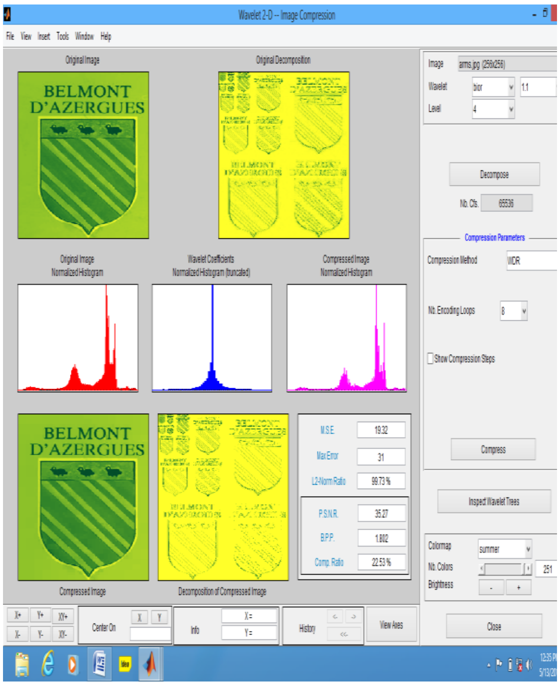

Figure 3: Bior Wavelets with Level 4

It can be observed that as the level of wavelet decomposition decrease the PSNR increase and output quality also good results less comp ratio and greater number of BPP, but as the level of wavelet decomposition increase the histogram show compactness and image quality decrease as well as PSNR. The BPP also decrease which is direct indication of increase in comp ratio. If we compare the two wavelets results it can be concluded that with changing the type of wavelets does not results any significant change unless until we don't change the level of decomposition.

Simulation with Different Compression Method

If we observe the results generated from three methods we find that EZW is better them all, and it can be concluded from given figure that as the number of encoding loops increase the PSNR also increase. And on simulation the model presented in chapter 3 it has been calculated that DWT is best for the image where high peaks and valley are available in the intensity of pixels as compared to the DCT, but where the smoothness in the picture's pixel intensity is high DCT should be preferred.

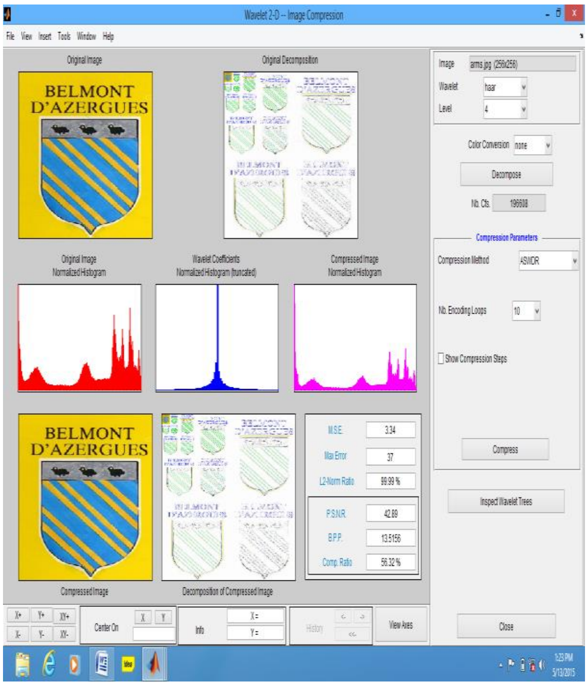

Figure 4: Compression Method ASWDR with 10 number of Encoding Loop

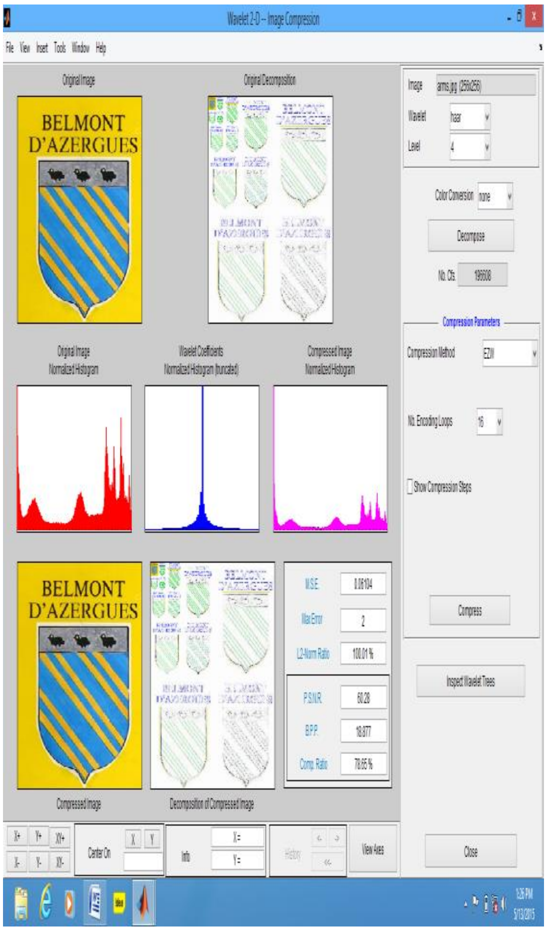

Figure 5: Compression Method EZW with 16 Number of Encoding Loop

Conclusion

This work presents a study and analysis of the Image compression using DWT and DCT technologies. The process of compression is modeled in matlab and simulated using matlab simulink. The process of data compression using Wavelet has been simulated on wavelet tool with different level of decomposition and no. of encoding loops. The resulted figures from the process of compression using different wavelet and at different level with different compression method has been produced which gives results on different parameter that includes PSNR, MSE, Comp Ratio, L2R and BPP. The output of compression shows that as the level of wavelet and encoding numbers of loops increase PSNR, BPP increase and Comp ratio decrease.

It is believed that PSNR below 30 does not produce the satisfactory results in decoding the image and here what we got from the process is that as the wavelet level is 4 or less, the PSNR is greater than 30, keeping in mind that number of encoding loop also should be greater than 10. The results we got is favoring the process of compression using wavelet but favoring only when there is lots of transients in the picture.

Future Scope

In the era of digital communication most of the RF spectrum is already occupied by the users. And bandwidth for use of particular kind of communication is limited. To utilize the bandwidth and to transfer the data at higher rate with less consumption of bandwidth compression of data is must. There are many image and data compression technique available in the market, but image compression using DWT is better for business than DCT in many specific areas. The scope of DWT in audio and video compression is much more and gives better results than DCT. It can be used in medical engineering and mining operation. In data acquisition system also it is worthy than other methods used for compression. So scope of this technology in the field of video processing as well as in image processing is vast.

References

[1] Kerur, S.S, "Implementation of vedic multiplier in image compression using DCT algorithm", Devices, Circuits and Systems (ICDCS), 2014 2nd International Conference, pp 1 – 6, March 2014.

[2] Jaffar Iqbal Barbhuiya, A.H.M et.al., "An Approach for Color Image Compression of JPEG and PNG Images Using DCT and DWT", Computational Intelligence and Communication Networks (CICN), 2014 International Conference, pp. 129 – 133, Nov 2014.

[3] Ukasha, A et.al., "An efficient zonal sampling method for contour extraction and image compression using DCT transform", Multimedia Computing and Systems (ICMCS), 2012 International Conference,

pp 318-323, May 2012.

[4] Phamila, Y.A.V et. al., "Low complexity image compression using Half Zonal Binary DCT for wireless sensor networks", Computing Communication & Networking Technologies (ICCCNT), 2012 Third International Conference, pp 1 - 7, July 2012.

[5] Benchikh, Salam et. al. , "A hybrid image compression technique based on DWT and DCT transforms", Advanced Infocom Technology 2011 (ICAIT 2011), International Conference, pp 1 – 8, July 2011.

[6] Kondo, H et.al., "Wavelet image compression using sub-block DCT", Networks, 2001. Proceedings, Ninth IEEE International Conference, pp 327-330, Oct 2011.

[7] Heideman, M., "Computation of an odd-length DCT from a real-valued DFT of the same length", Signal Processing, IEEE Transactions, Volume:40, pp 54 – 61, 2009.

[8] Shaofeng An et. al., "A computation structure for 2-D DCT watermarking", Circuits and Systems, 2009. MWSCAS '09. 52nd IEEE International Midwest Symposium, pp 577 – 580, Aug. 2009.

[9] Farhad Keissarian, "A New Predictive Image Compression Scheme Using Histogram Analysis and Pattern Matching", pp-375-379, ICCEA 2009.

[10] Kilari Veeraswamy, B. Chandra Mohan et. al., "Energy Based Quantization for Image Compression Using Contourlet Transform", IEEE Transaction 2009, pp 230-234.

[11] Y. Guo, Y.K. Wang, and H. Li, "Priority-Based Template Matching Intra Prediction," ICME 2008.

[12] T.K. Tan, C.S. Boon, and Y. Suzuki, "Intra Prediction by Averaged Template Matching Predictors," IEEE 2007

[13] Chai Beng Seow et. al. , "Wavelet-DCT based image coder for video coding applications", Intelligent and Advanced Systems, 2007. ICIAS 2007, pp 748 – 752, Nov 2007.

[14] J.-J. Ding and J.-D. Huang, "Image Compression by Segmentation and Boundary Description", National Taiwan University, Taipei, 2007

[15] Suzuki et al., "Intra Prediction by Template Matching," ICIP 2006

[16] Yang and Bourbakis,"An Overview of Lossless Digital Image Compression Techniques," Circuits & Systems, 2005 48th Midwest Symposium ,vol. 2 IEEE,pp 1099-1102,7–10 Aug 2005

[17] Wen-Chien Yen et.al. , "DCT-based image compression using wavelet-based algorithm with efficient deblocking filter", Computer and Information Science, 2005. Fourth Annual ACIS International Conference, pp 489-494.

[18] Yen-Yu Chen ,"Embedded medical image compression using DCT based subband decomposition and modified SPIHT data organization", Bioinformatics and Bioengineering, 2004. BIBE 2004. Proceedings. Fourth IEEE Symposium, pp 167 – 174, May 2004.

[19] Gaetano Impoco, "JPEG2000 – A Short Tutorial", April 1, 2004.

[20] Lengwehasatit, K et. al., "Scalable variable complexity approximate forward DCT", IEEE Transaction, pp. 1236 – 1248, June 2004.

[21] Avcibas, Memon, Sankur, Sayood, "A Progressive Lossless/Near Lossless Image Compression Algorithm,"IEEESignal Processing Letters, vol. 9, No. 10, pp 312-314, October 2002.

[22] Junqiang Lan et. al., "Embedded image compression using DCT based subband decomposition and SLCCA data organization"' Multimedia Signal Processing, 2002 IEEE Workshop, pp 81-84, Dec 2002.Trutna et al. "An Introduction to JPEG Compression", 2001

[23] Subramanya, "Image Compression Technique," Potentials IEEE, Vol. 20, Issue 1, pp 19-23, Feb-March 2001.