ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 6, June 2015

Image Compression Using DCT and DWT

Banti Dabas[1], Vivek Arora[2]

M.Tech Student, GITAM, jhajjar, India

Asst. Professor, Dept. of ECE, GITAM, jhajjar, India

ABSTRACT*:* Image Compression is the process of reduction in the number of bits required to represent the digital image. There are various methods to compress the image. Compression can be achieved by the removing redundancy bits from the digital image. There are three types of data redundancy removal schemes. Data redundancies scheme is used, when Coding redundancy have less than optimal code words; Inter pixel redundancy finds the correlations between the pixels of an image & psycho visual redundancy removes the data which can't be captured by human eyes visual system. Huffman coding scheme for source coding also make the efficient data represents scheme and reduce the average length of symbol size. So, Huffman coding when combines with Discrete Cosine Transform results compression with great extent. DCT relocates the highest energies elements of a block into the upper left corner of blocks of the image and lesser energy or information in other areas. The wavelet transform is the major and modern technique of image compression. Image passed through wavelet transform gets separated into a set of sub-bands and coefficients so obtained are quantized. By using an error metric, we approximate the reconstituted coefficients quantization error and thus minimize the distortion**.**

KEYWORDS: DCT (discrete cosine transform), DWT (discrete wavelet transform).

1. INTRODUCTION

Compression is the technique of reducing the numbers of bits required to store and/or transmit a digital image or video content without losing the quality of the original data. Compression means we have a piece of data and we decrease its size. For compression the digital image best technique is JPEG algorithm. The Joint Photographic Expert Group (JPEG) system, based on the Discrete Cosine Transform (DCT), has been the most widely used compression method [1][2]. Before processing through DCT an image is firstly divided into n*m number of blocks and then DCT converts the spatial image representation into a frequency map: the average value in the block is represented by the low-order term, strength and more rapid changes across the width or height of the block represented by high order terms. DCT is simple when JPEG used. But when we try to achieve higher compression ratio a noticeable blocking artifacts across the block boundaries is come across.

Discrete wavelet transform (DWT) is the new emerging technique which gained worldwide acceptance in the area of signal processing and image compression. A Huffman coding which is a source coding technique based on the frequency of appearance of same kind pixels in an image. It helps to represent a string of symbols with lesser number of bits. The shorter codes are assigned to mostly frequent symbols and longer codes to less frequent symbols in the string. This algorithm works when only the frequencies of individual letters are used to compress the data. When Huffman coding used in combination with Discrete Cosine Transform (DCT); it helps in compressing the image data to a great level. The Discrete Cosine Transform (DCT) is an example of transform coding. The DCT coefficients are all real numbers unlike the Fourier Transform. The Inverse Discrete Cosine Transform (IDCT) can be used to retrieve the image from its transform representation. The one-dimensional DCT is useful in processing speech waveforms. The two dimensional (2D) signals useful in processing images, for compression the image we uses a 2D version of the DCT data, for optimal performance. JPEG is a commonly used standard method of compression for photographic images. The name JPEG stands for Joint Photographic Experts Group, the name of the committee who created the standard. JPEG provides for lossy compression of images. Lossy compression means that some data is lost when it is decompressed. Lossless compression means that when the data is decompressed, the result is a bit-for-bit perfect match with the original one.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 6, June 2015

The wavelet decomposition method for decomposition of an image uses two types of filters, i.e low pass filter and high pass filter which decompose image splits into several sub bands(LL,LH,HL,HH); only LL sub band is decomposed further, because it has low frequency and noise compare to other sub band levels[3]. The basic steps for a wavelet based image compression are as shown in figure 1 below [4]:

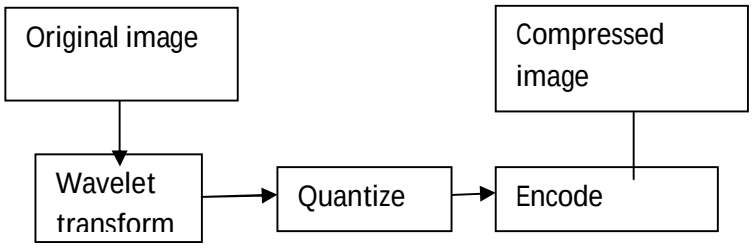

Figure 1 wavelet based image compression

The basic steps for a wavelet based image de-compression are as shown in figure 2 below.

II. TODAY'S SCENARIO

The JPEG standard for image compression is currently most acceptable compression method for digitized image. JPEG treats each image as a separate gray scale picture. Although JPEG allows color images separated into Red, Green, and Blue (RGB) or Luminance (Y), with Blue and Red color differences (U = B – Y, V = R – Y).

Figure 2 wavelet based de-compression

Separation into YUV color components allows the algorithm to take the advantages of human eyes' lower sensitivity to color information. For quantization, JPEG uses quantization matrices. JPEG allows a different quantization matrix to be specified for each color component [5]. Though the JPEG provides good results previously, it is not perfectly suited for modern multimedia applications because of blocking artifacts.

Wavelet theory and its application in image compression had been well developed over the past decade. The field of wavelets is still sufficiently new and further advancements will continue to be reported in many areas. Many authors have contributed to the field to make it what it is today, with the most well known pioneer probably being Ingrid Daubechies. Other researchers whose contribution directly influences this work include Stephane Mallat for the pyramid filtering algorithm, and the team of R. R. Coifman, Y. Meyer, and M. V. Wickerhauser for their introduction of wavelet packet [6].

Further research has been done on still image compression and JPEG-2000 standard is established in 1992 and work on JPEG-2000 for coding of still images has been completed at end of year 2000. The JPEG-2000 standard employs wavelet for compression due to its merits in terms of scalability, localization and energy concentration [6, 7]. It also provides the user with many options to choose to achieve further compression. JPEG-2000 standard supports

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 6, June 2015

decomposition of all the sub-bands at each level and hence requires full decomposition at a certain level. The compressed images look slightly washed-out, with less brilliant color. This problem appears to be worse in JPEG than in JPEG-2000 [8]. Both JPEG-2000 and JPEG operate in spectral domain, trying to represent the image as a sum of smooth oscillating waves. JPEG-2000 suffers from ringing and blurring artifacts. [8]

Most of the researchers have worked on this problem and have suggested the different techniques that minimize the said problem against the compromise for compression ratio.

III. WAVELET AND WAVELET PACKET

In order to represent complex signals efficiently, a basis function should be localized in both time and frequency domains. The wavelet function is localized in time domain as well as in frequency domain, and it is a function of variable parameters.

The wavelet decomposes the image, and generates four different horizontal frequencies and vertical frequencies outputs. These outputs are referred as approximation, horizontal detail, vertical detail, and diagonal detail. The approximation contains low frequency horizontal and vertical components of the image. The decomposition procedure is repeated on the approximation sub-band to generate the next level of the decomposition, and so on. It is leading to well known pyramidal decomposition tree. Wavelets with many vanishing yield sparse decomposition of piecewise smooth surface; therefore they provide a very appropriate tool to compactly code smooth images. Wavelets however, are ill suited to represent oscillatory patterns [10, 11]. A special from a texture, oscillating variations, rapid variations in the intensity can only be described by the small-scale wavelet coefficients. Unfortunately, these small-scale coefficients carry very little energy, and are often quantized to zero even at high bit rate.

The weakness of wavelet transform is overcome by new transform method, which is based on the wavelet transform and known as wavelet packets. Wavelet packets are better able to represent the high frequency information [9].

Wavelet packets represent a generalization of multi resolution decomposition. In the wavelet packets decomposition, the recursive procedure is applied to the coarse scale approximation along with horizontal detail, vertical detail, and diagonal detail, which leads to a complete binary tree.

IV. CONCLUSION

Image compression is of prime importance in real time applications like video conferencing where data are transmitted through a channel. Using JPEG standard DCT is used for mapping which reduces the inter pixel redundancies followed by quantization which reduces the psycho visual redundancies then coding redundancy is reduced by the use of optimal code word having minimum average length. In JPEC 2000 standard of image compression DWT is used for mapping all other methods remaining same DWT is more general and efficient than DCT due to the following result:

- No need to divide the input coding into non-over lapping 2-D, it has higher compression ratios avoid blocking artifacts.
- Allows good localization both in time and spatial frequency domain.
- Transformation of the whole image introduces inherent scaling.
- Better identification of data which is relevant to human perception higher compression ratio.

REFERENCES

[1] K. Rao, P. Yip, "Discrete Cosine Transform: Algorithms, Advantages, and Applications", NY Academic, 1990
[2] C.P. Lui, and A. D. Poularikas, "A new sub band coding compression," in Proc., IEEE Southeastern symposium on system theory, Baton Rouge, LA, pp. 317-321, Mar. 1996.
[3] M. Antonini, et al., "Image Coding Using Wavelet Transform" IEEE Transactions on Image Processing, Vol.1, No. 2, pp. 205-220, April 1992.
[4] Refael C. Gonzalez and Richard E. Woods "Digital Image Processing" Delhi, India: Pearson Education, 2003.
[5]. "Video Compression- An Introduction" Array Microsystems Inc., White Paper, 1997.
[6]. Andrew B. Watson, "Image Compression Using the Discrete Cosine Transform," NASA Ames Research Center, Mathematical Journal, Vol.4, Issue 1, pp. 81-88, 1994.
[7]. Wayne E. Bretl, Mark Fimoff, "MPEG2 Tutorial Introduction & Contents: Video Compression Basics-Lossy Coding," 1999.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 6, June 2015

[8]. Aleks Jakulin, "Baseline JPEG And JPEG2000 Artifacts Illustrated," Visicron, 2002.
[9]. Deepti Gupta, Shital Mutha, "Image Compression Using Wavelet Packet," IEEE, Vol.3, pp. 922-926, Oct. 2003.
[10]. Francois G. Meyar, Amir Averbuch, Jan-Olvo Stromberg, Ronald R. Coifman, "Fast Wavelet Packet Image Compression," IEEE Transaction On Image Processing, Vol.9, No.5, pp. 563-572, May 2000.
[11]. Jose Oliver, Manuel Perez Malumbres, "Fast and Efficient Spatial Scalable Image Compression Using Wavelet Lower Trees," Proceedings Of The Data Compression Conference,pp.133-142,March2003.