Image Compression & Decompression using 4-level Discrete Wavelet Transform Approach

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Abstract- Image compression is used to represent an image in the least number of bits lacking behind the important information content within an original image. To characterize a digital image used image compression. It reduces the amount of data. For more storage and broadcast bandwidth uncompressed multimedia is required. The latest developments of data thorough multimedia-based web applications have not just determined the need for extra efficient ways to storage and communication technology. The difficulty innate to several digital images is the huge quantity of bandwidth necessary for communication or storage space. Wavelets are attractive in image processing where high computational presentation and comparable architectures are required. In the research work, 4-level wavelet based compression algorithm is implemented.

Keywords— Discrete Wavelet Transform, Image compression, Discrete Cosine Transform, Haar wavelet.

I. INTRODUCTION

Image compression is the function of data compression on digital images. Image compression isthe method during which decrease the amount of data necessary to signify a digital image. Image compression isused for avoiding the duplicate data and also used for redundancy that willbe reduced that can be helpful to increase storage and transmission development performance.An image isan artefact to facilitate depicts or records visual perception. Nowdays, Images are imperative documents to effort through them in several applications present is require tobe compressed [8]. Compression is mostly used in the applications. Image compression plays an extremely essential function in the transmission and storage of image data asa result of and storage limitations. The main aim of image compression isto represent an image in the fewest number of bits without losing the essential information content within an original image. There are extra image sources that create higher data rates. Data requires for storage and transmission contains large capacity and bandwidth that can be very expensive [5]. The reductions of number of bits thatare used to store or transmit images are required for image data compression techniques. Image transmission applications are mainly usedin some types of broadcast television that means remote sensing via satellite, aircraft, radar or sonar, teleconferencing, computer communications etc. In educational and business documents, medical images used in patient monitoring systems etc used image compression. Image compression play very important role in digital image processing. Image compression is the ordinary skill for managing the increased spatial resolutions of imaging sensors and evolving broadcast television standards. [1].

In the research work, 4-level wavelet based compression algorithm is implemented. To represent an image used image compression with the large amount of data. To represent an image a large number of bits are used and ifthe image needs to be transmitted or stored, it is unreasonable toward perform so without somehow reducing the number of bits. The problem of transmitting or storing an image affects allof us daily. TV and fax machines are the examples of image transmission and the digital video players and web pictures arethe examples of image storage. Image compression is the procedure of reducing the amount of data necessary to represent an image.

The amount of memory to represent an image used image compression. A large number of bits are used to represent an image and ifthe image needs to be transmitted or stored, it is impractical to doso without somehow reducing the number of bits. The problem of transmitting or storing an image affects all of us daily. The examples of image transmission are TV and fax machines and the examples ofimage storage are digital video players and web pictures. Image compression is the procedure of reducing the amount of data necessary to represent an image.

II. IMAGE COMPRESSION ALGORITHM

Image compression deals with reducing the quantity of data required to signify adigital image. Uncompressed multimedia (graphics, audio and video) data requires significant storage ability and broadcast bandwidth. Eventhough fast improvement in mass-storage density, processor speeds and digital communication system performance, demand fordata storage capacity and data-transmission bandwidth continues to outstrip the capabilities of available technologies [7]. The recent growth of data intensive multimedia-based web applications has notonly sustained the need for more efficient waysto storage and communication technology. Wavelets are attractive inimage processing where High computational performance and parallel architectures are required.

Wavelet Transform is used different compression thresholds for achieving the wavelet coefficients.

DISCRETE WAVELET TRANSFORM

The discrete wavelet transform (DWT) is a technique of image compression. Discrete wavelet transform arethe wavelet transforms from which the wavelets are discretely sampled. Both space and scaling are localized using transform and hassome desirable properties compared to the Fourier transform. The transform which can be computed quickly than Fourier matrix is based ona wavelet matrix. The discrete wavelet transform is used for signal coding, where the properties of the transform are exploited to represent a discrete signal in amore redundant form, often as a preconditioning for data compression. A huge number of applications are used in discrete wavelet transform thatis in Science, Engineering, Mathematics and Computer Science [11].

Image compression uses wavelet compression thatcan be well suited for image compression (sometimes also video compression and audio compression). The main goal isto store the image in afile as possible as in the memory space in image compression.

The basic structure of baseline wavelet based coder is illustrated in figure1 and 2. This structure shows thewavelet based algorithms. They contain both encoder and decoder. The encoder consists of four processes: wavelet transform, quantization, and encoder. The decoder has the inverse operations of encoder [9].

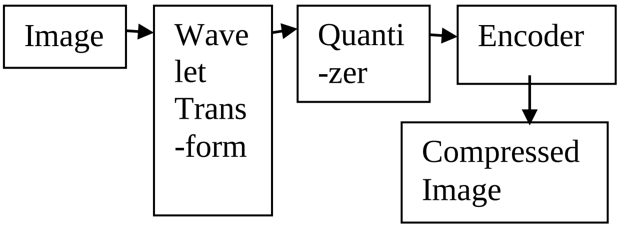


Figure 1: Compression of image

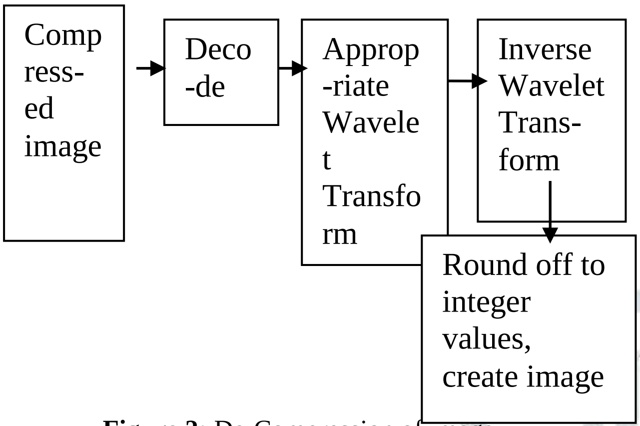


Figure 2: De-Compression of image

a) Wavelet-based Compression

A wavelet is a waveform that contains a value of zero for the limited duration. In shifted and scaling version ofthe original wavelet using wavelet analysis for breaking the signals. Because of the space-frequency localization characterization using wavelet transform image coding algorithms. The compact supported, symmetrical and biorthogonal wavelet has linear phase, soit is applied on image compression area widely [4]. To decompose aninput signal into a series of successive lower resolution reference signals used wavelet transform and their associated detail coefficients, which contains the information needed to reconstruct the reference signal atthe next higher resolution level.

Wavelet-based coding is extra dynamic under transmission and decoding errors and furthermore facilitates progressive transmission of images. In addition, they arebetter matched to the HVS characteristics. Because of their innate multi resolution setting wavelet coding schemes are mainly suitable forapplications where scalability & tolerable degradation are important.

b) Haar Wavelet Transform

The simplest transform for image compression is Haar wavelet transform, the principle behind this is very simpleas calculating averages and differences of adjacent pixels. The Haar DWT is more computationally efficient than the discrete transforms, but this quality isa tradeoff with decreased energy compaction compared to the DCT. "The Haar transform operates as asquare matrix of length N. Implementing the discrete Haar transform consists of acting on a matrix row-wise finding thesums and differences of consecutive elements. If the matrix is split in half from topto bottom the sums are stored in one side and the differences in the other [2]. Next operation occurs column-wise, splitting the image in half from left to right, and storing the sums on one half and the differences in the other. The process is repeated on thesmaller square, power-of-two matrix resulting in sums of sums. The number of times this process occurs can be thought ofas the depth of the transform. In our project, we worked with depth four transforms changing a 256x256 images to a new 256x256 image with a16x16 purely sums region in the upper-left hand corner".

There are various steps for implementation of the image compression algorithm; they are following as [5]:

- calculate the sums and differences of every row ofthe image
- calculate the sums and differences of every column of the resulting matrix
- repeat this process until we get downto squares of 16x16
- quantize the final matrix using different bit allocation schemes
- write the quantized matrix out toa binary file

By calculating the sums and differences of adjacent elements use Haar wavelet transforms. First of all, Haar wavelet operates on adjacent horizontal elements and then on adjacent vertical elements [5].

Compression ratio (CR) is defined as to represent the size of original image to the sizeof compressed image. Compression ratio shows that how much time the image hasbeen compressed [10].

As each transform is computed the energy in the data inrelocated to the top left i.e. after each transform is performed the size of the square which contains the most important information is reduced by afactor of 4 (shown in figure 3, 4 & 5).

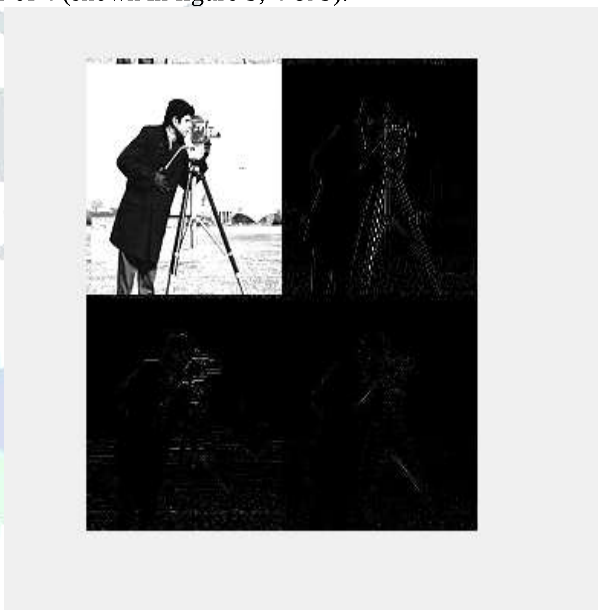


Figure 3: The image of a Cameraman after one Haar wavelet transform.

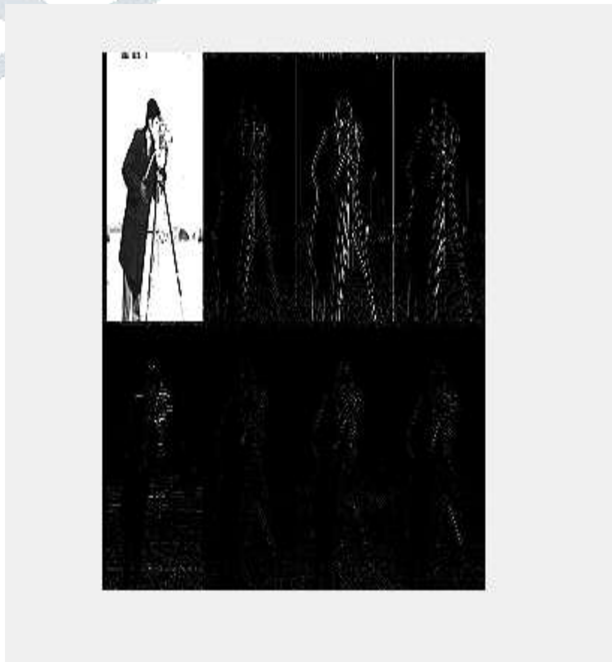


Figure 4: The image of Cameraman after two Haar wavelet transform

Figure 5: The image of Cameraman after three Haar wavelet transform

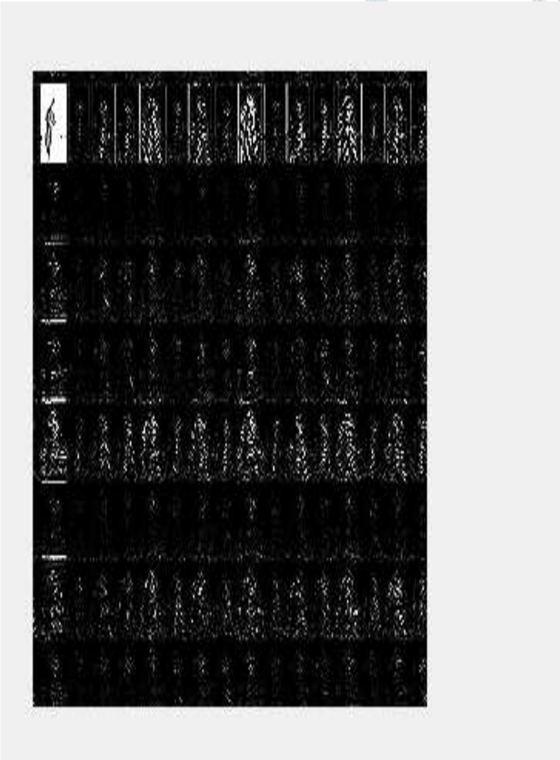


Figure 6: The image of Cameraman after fourth Haar wavelet transform

III. RESULT

The proposed algorithm is tested in MATLAB for popular Internet image & following results are obtained.

Figure 7: Original image of Cameraman (181 kb)

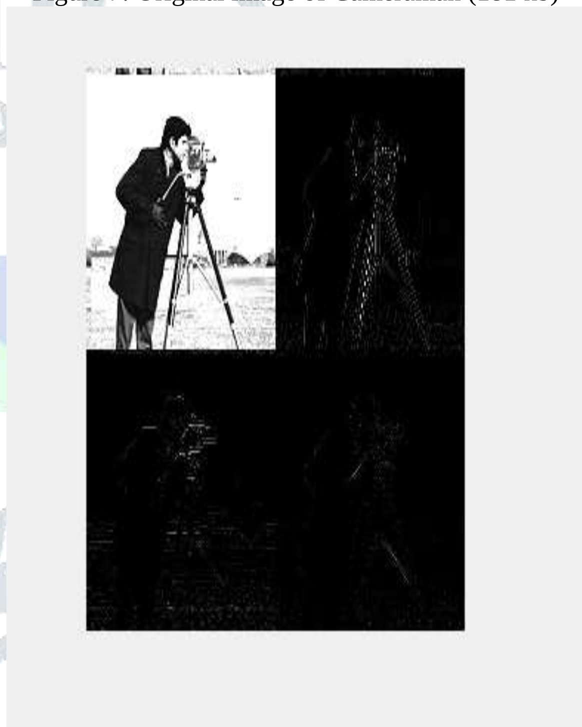


Figure 8 shows the compressed image of Cameraman after applying 1st discrete wavelet transform.

After 1st haar wavelet transform, the size of compressed image is 74 kb.

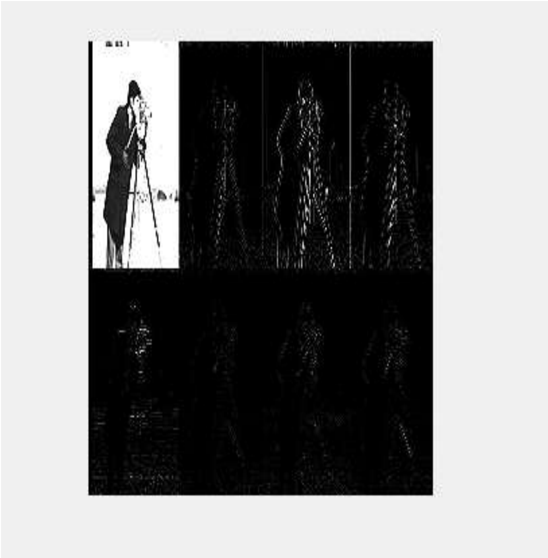


Figure 9 shows the compressed image of Cameraman after applying second haar discrete wavelet transform.

After 2nd haar wavelet transform, the size of compressed image is 70.5 kb.

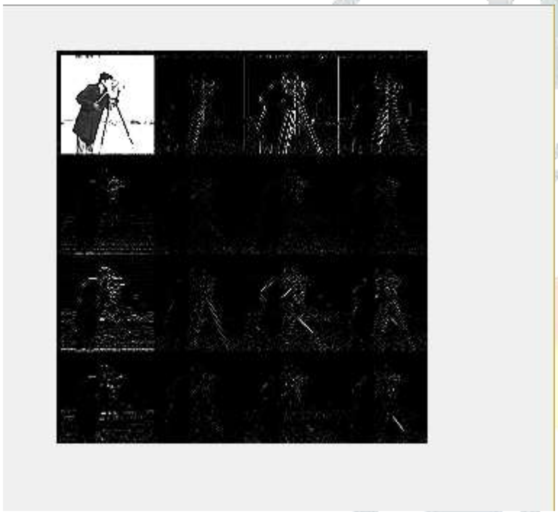


Figure 10 shows the compressed image of Cameraman after applying 3rd haar discrete wavelet transform.

After 3rd haar wavelet transform, the size of compressed image is 69.2 kb.

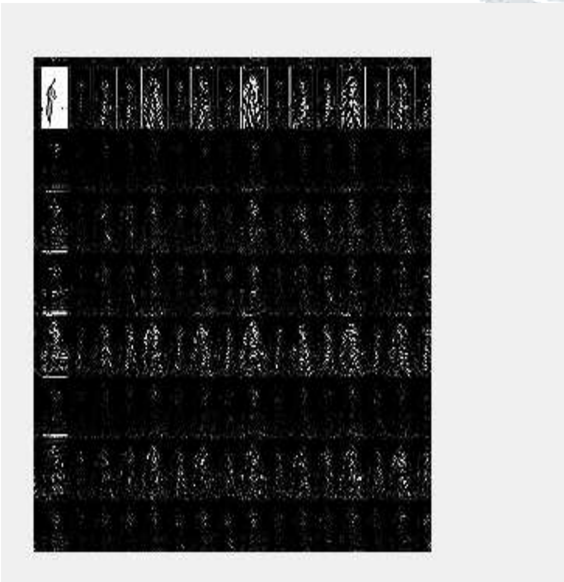
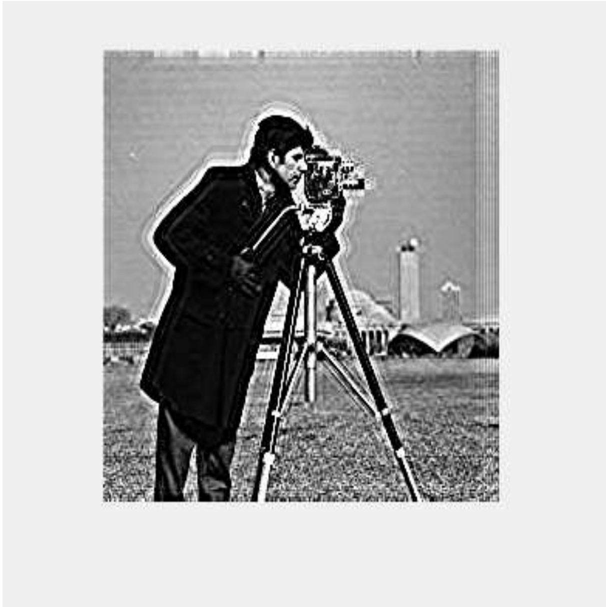


Figure 11 shows the compressed image of Cameraman after applying 4th haar discrete wavelet transform.

After 4th haar wavelet transform, the size of compressed image is 65.9 kb.



Uncompressed Image (65.9 kb)

Figure 12 shows the uncompressed images after applying inverse 1st, 2nd and 3rd, 4th discrete wavelet transform.

IV. CONCLUSION

Uncompressed graphics, audio and video data require considerable storage capacity and transmission bandwidth. Inthe work, 4-level wavelet based compression algorithm is implemented. Wavelet analysis is very powerful and extremely usefulfor compressing data such as images. Multi resolution contains its power in the image compression. Although other transforms havebeen used, for example the DCT wAs used for the JPEG format to compress images; wavelet analysis can be seen to be far superior. This is because the wavelet analysis is done on the entire image rather than sections at a time. A well known application of wavelet analysis is the compression of fingerprint images.

REFERANCES

[1] R. C. Gonzalez and R. E. Woods, "Digital Image Processing", Addison Wesley, 2004.

[2] Anuj Bhardwaj, Rashid Ali, "Image Compression Using Modified Fast Haar Wavelet Transform", World Applied Sciences Journal, Vol. 7, No. 5, pp. 647-653, 2009.

[3] R. D. Aneja, S. Gupta, V. Batra, "An Enhanced Bi-Orthogonal Wavelet Filter For Image Compression", International Journal of Computer Science and Communication Vol. 2, No. 2, pp. 351-354, July-December 2011.

[4] Vaishali G. Dubey, Jaspal Singh, "3D Medical Image Compression Using Huffman Encoding Technique", International Journal of Scientific and Research Publications, Volume 2, Issue 9, September 2012.

[5] Bhonde Nilesh, Shinde Sachin, Nagmode Pradip, D.B. Rane, "Image Compression Using Discrete Wavelet Transform", International Journal of Computer Technology and Electronics Engineering (IJCTEE) Volume 3, Special Issue, March-April 2013.

[6] K. Rajakumar and T. Arivoli, "Implementation of Multiwavelet Transform coding for lossless image compression", IEEE, pp. 634-637, 2013.

[7] S. Dharanidharan , S. B. Manoj kumar and D. Senthil kumar, "Modified International Data Encryption Algorithm using in Image Compression Techniques", IJESIT , pp. 186-191,2013.

[8] A. M. Raid, W. M. Khedr, M. A. El-dosuky and Wesam Ahmed, "Jpeg Image Compression Using Discrete Cosine Transform - A Survey", International Journal of Computer Science & Engineering Survey (IJCSES) Vol.5, No.2, April 2014.

[9] Bhawna Gupta Manju Gupta Banita Chadha "Image Compression Technique under JPEG by Wavelets Transformation",

International Journal of Advanced Research in Computer Science and Software Engineering, Volume 4, Issue 6, June 2014.

[10] Sharan Kumar, Dr. Jayadevappa, Santosh D. Bhopale, Radhika R. Naik, "Implementation of Huffman Image Compression and Decompression Algorithm", International Journal of Innovative Research In Electrical, Electronics, Instrumentation And Control Engineering, Vol. 2, Issue 4, April 2014.

[11] Xiao Zhou, Yunhao Bai and Chengyou Wang, "Image Compression Based on Discrete Cosine Transform and Multistage Vector Quantization", International Journal of Multimedia and Ubiquitous Engineering Vol.10, No.6 2015.

[12] Zhang Ning and Zhu Jinfu "Study on Image Compression and Fusion Based on the Wavelet Transform Technology", International Journal on Smart Sensing and Intelligent Systems Vol. 8, No. 1, March 2015.