ISSN: 2277-9655
Impact Factor: 4.116

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

IMAGE COMPRESSION USING MODIFIED FAST HAAR WAVELET TRANSFORM (MFHWT)

Mrs. Yewale Varsharani Balaso *, Prof. Shinde S.S, Prof. Tamboli S.S.
* Department of E&TC, ADCET , Ashta, Tal.Walwa, Dist.Sangli, (MH-India) 416301.

DOI: 10.5281/zenodo.59969

ABSTRACT

Image compression plays an important role in multimedia applications. It reduces memory requirements for storage of images. The most distinctive feature of Haar Transform lies in the fact that it lends itself easily to simple manual calculations. Modified Fast Haar Wavelet Transform (MFHWT), is one of the algorithms which can reduce the calculation work in Haar Transform (HT) and Fast Haar Transform (FHT). This project attempts to describe the algorithm for image compression using MFHWT. It includes a number of examples of different images to validate the utility and significance of algorithm's performance. Comparison of HT and MFHWT is done for different images and compared by PSNR, MSE and CR. It is seen that MFHWT is more efficient compression method than HT.

KEYWORDS: Image compression, Haar Transform (HT), Modified fast haar wavelet transform (MFHWT).

INTRODUCTION

As computers have become more and more powerful, the temptation to use digital images has become irresistible. Image compression plays a vital role in several important and diverse applications, including tele-video conferencing, remote sensing, medical imaging and magnetic resonance imaging and many more.The basic idea behind the image compression is that in most of the images we find that their neighboring pixels are highly correlated and have redundant information. The wavelet transform is often used for signal and /or image smoothing keeping in view of its "energy compaction" properties, i.e. large values tend to become larger and small values smaller, when the wavelet transform is applied. Since the Haar Transform (HT) is memory efficient, exactly reversible without the edge effects, it is fast and simple. As such the Haar Transform technique is widely used these days in wavelet analysis. Modified Fast Haar Transform (MFHWT) is one of the algorithms which can reduce the tedious work of calculations.

MATERIALS AND METHODS

Haar Transform

The Haar Transform (HT) is one of the simplest and basic transformations from the space domain to a local frequency domain. A HT decomposes each signal into two components, one is called average (approximation) or trend and the other is known as difference (detail) or fluctuation.

The Haar transform $\mathrm{HT}^n(f)$ of an *N*-input function $\mathrm{X}^n(f)$ is the 2^n element vector

$$\mathrm{HT}^n(f) = \mathbf{H}^n\mathrm{X}^n(f)$$

The Haar transform cross multiplies a function with Haar matrix that contains Haar functions with different width at different location. The Haar transform is performed in levels. At each level, the Haar transform decomposes a discrete signal into two components with half of its length: an approximation (or trend) and a detail (or fluctuation) component. The first level of approximation $\boldsymbol{a}^1 = \left(a_1, a_2, \cdots, a_{N/2}\right)$ is defined as,

ISSN: 2277-9655
Impact Factor: 4.116

$$a_m = \frac{X_{2m-1} + X_{2m}}{\sqrt{2}}$$

Modified Fast Haar Wavelet Transform

In modified fast haar wavelet transform, first average subsignal, $a^1 = (a_1, a_2, ..., a_{N/2})$, at one level for a signal of length N i.e. $f = (f_1, f_2, \ldots\ldots f_N)$ is,

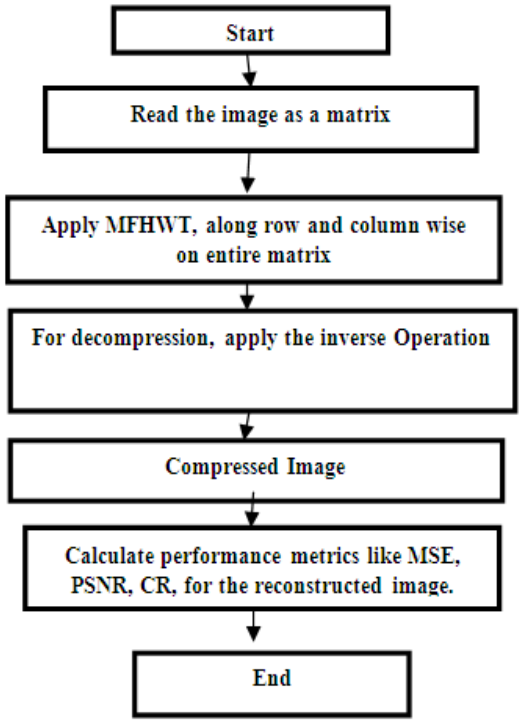
$$a_m = \frac{f_{4m-3} + f_{4m-2} + f_{4m-1} + f_{4m}}{4}, \quad m = 1,2,3,\ldots,N/4,$$

and first detail subsignal, $d^1 = (d_1, d_2, \ldots\ldots d_{N/2})$ at the same level is given as,

$$d_m = \begin{cases} \dfrac{(f_{4m-3} + f_{4m-2}) - (f_{4m-1} + f_{4m})}{4}, & m = 1,2,3,\ldots,N/4, \\ 0, & m = N/2,\ldots,N. \end{cases}$$

Here four nodes are considered at a time instead of two nodes as in HT.

Flow chart of Modified Fast Haar Wavelet Transform:



Flow chart of Modified Fast Haar Wavelet Transform

Performance parameters

The performance parameters such as MSE (Mean Square Error), PSNR (Peak Signal to Noise Ratio) and Compression Ratio (CR) were used to compare the compression methods on different types of images including medical images.

The images X-Ray, Ligament, Knee, MRI, Brain, Parrot, Lena, M.Gandhi, N. Modi and Animal are used for the research purpose.

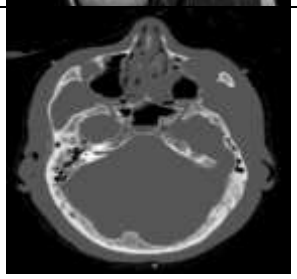
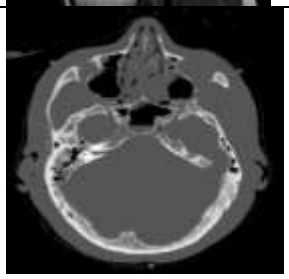
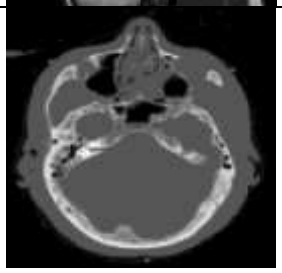
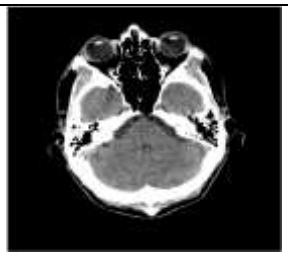
ISSN: 2277-9655
Impact Factor: 4.116

RESULTS AND DISCUSSION

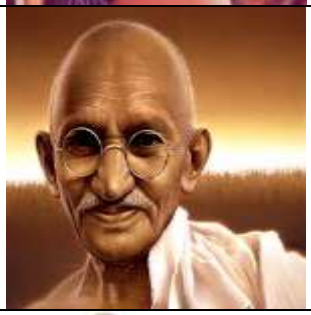
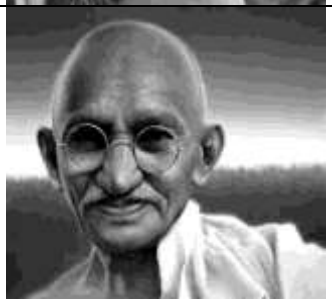
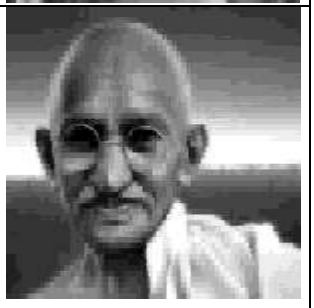
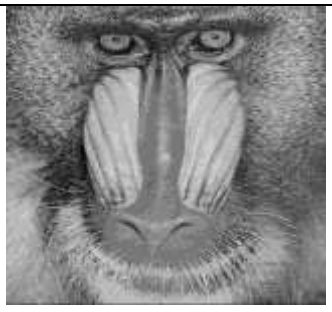
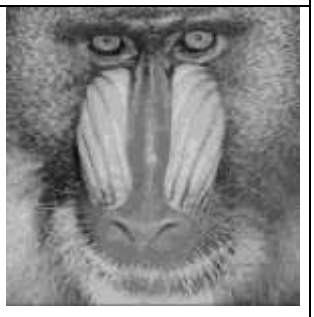
The HAAR and MFHWT Algorithm was successfully implemented on color images as well as on medical images which resulted in the compression of greater than 95% which is the highest compression as other approaches are seen. The reconstructed image has greater than 85% similarity factors with respect to original image .The experiment was computed on number of images, results were tested for medical images . From used techniques it is seen that the MFHWT method of compression gives good results in terms of qualitative, quantitative and visual quality measures.

Fig:

The original image, image compressed with HT and image compressed with MFHWT of X-Ray, Ligament, Knee, MRI, Brain, Parrot, Lena, M.Gandhi, N. Modi and Animal are shown in figures below

Image Name	Original Image	Reconstructed Image (HT)	Reconstructed Image (MFHWT)
X-Ray			
Ligament			
Knee			
MRI			
Brain			

ISSN: 2277-9655
Impact Factor: 4.116

Parrot			
Lena			
M Gandhi			
N Modi			
Animal			

Result of HAAR and MFHWT for Image Compression

ISSN: 2277-9655
Impact Factor: 4.116

Tables:

Table . Comparison 0f Haar and Modified Fast Haar Wavelet Transform

The performance parameters as Compression Ratio (CR), Peak Signal to Noise Ratio (PSNR) and Mean Square Error (MSE) obtanied and used for comparison of haar and modified fast haar wavelet transform are as below.

Sr. No.	Parameters				
	Images	Method	CR in%	PSNR	MSE
1	X-Ray	HT	35.32	60.74	0.054
		MFHWT	99.80	82.12	0.0003
2	Ligament	HT	43.58	57.85	0.106
		MFHWT	96.52	71.06	0.0050
3	Knee	HT	42.53	58.45	0.092
		MFHWT	98.72	75.65	0.0017
4	MRI	HT	51.68	57.72	0.109
		MFHWT	98.84	78.99	0.0008
5	Brain	HT	94.163	48.86	0.84
		MFHWT	95.49	72.24	0.0038
6	Parrot	HT	36.40	54.16	0.249
		MFHWT	98.69	71.23	0.004
7	Lena	HT	35.02	61.34	0.047
		MFHWT	98.94	75.04	0.002
8	M Gandhi	HT	35.36	60.41	0.059
		MFHWT	99.07	75.17	0.001
9	N Modi	HT	35.03	62.41	0.037
		MFHWT	99.75	77.68	0.001
10	Animal	HT	35.02	49.66	0.702
		MFHWT	97.17	69.57	0.007

Table: Experimental Results for Haar and Modified Fast Haar Wavelet Transform

CONCLUSION

We studied, the performance in terms of PSNR, CR and MSE that obtained with MFHWT (Modified Fast Haar Wavlet Transform) compression technique and compared with HT (Haar Transform). It is seen that,

1) The MFHWT is faster in comparison to HT and reduces the calculation work.
2) In MFHWT, we get the values of approximation and detail coefficients one level ahead than the HT.
3) The MFHWT is faster and memory efficient.

MSE and PSNR values of reconstructed images are as good as in HT.

It may be concluded that with compare to HT we get better results in MFHWT as,
a) 61% increase in CR
b) 20% increase in PSNR
c) 5% decrease in MSE

This approach has the potentiality of application in medical images. In short, the main benefit of MFHWT is sparse representation and fast transformation and possibility of implementation of fast algorithms.

ACKNOWLEDGEMENTS

I owe my sincere thanks towards my **Project Guide and Hod-PG Mrs. Sunita S.Shinde** and **coguide Tamboli S.S** for their constant guidance during my dissertation and for encouring me to do effective dissertation work. I am very much thankful to the **Director Prof.R.A.Kanai** and the **Principal Dr.A.M. Mulla** for their support during project work. I also take this opportunity to express my sincere thanks to all the staff memners of engineer and telecommunication department for their help whenever required.

REFERENCES

[1] Amit kumar and Rajnish Manwall, 'WAVELET BASED COMPRESSION OF BIOLOGICAL IMAGES', International Journal of data and network security, Volume 3-No-1, ISSN23191236, February 2011.
[2] Anuj Bhardwaj and Rashid Ali, 'Image Compression Using Modified Fast Haar Wavelet Transform world', Applied Sciences Journal 7 (5): 647-653, 2009 ISSN 1818-4952© IDOSI.
[3] Antonini, M., Barlaud, M., Mathieu, P., and Daubechies, I. 'Image coding using wavelet transform', IEEE Trans. Image Process., 1992,1,(2), pp.205-220.
[4] Anusorn Jitkam and Satra Wongthanavasu, 'Image Compression using Modified Haar Wavelet-Base Vector Quantization', ECTI TRANSACTIONS ON COMPUTER AND INFORMATION TECHNOLOGY Vol.3, No.1 MAY 2007.
[5] Bullmore, E.,J. Fadili, V. Maxim, L. Sendur, J. Suckling, B. Whitcher, M. Brammer and M. Breakspear, 2004. 'Wavelets and Functional Magnetic Resonance Imaging of the Human Brain.' NeuroImage, 23(1): 234-249.
[6] Chang, P. and P. Piau, 2007. 'Modified Fast and Exact Algorithm for Fast Haar Transform.' Proceedings of World Academy of Science, Engineering and Technology, 26: 509-512.
[7] Galli, A.W., G.T. Heydt and P.F. Ribeiro, 1996. 'Exploring the Power of Wavelet Analysis.' IEEE Computer Application in Power, pp: 37-41.
[8] G.Sadashivappa, K.V.S.AnandaBabu,'Performance analysis of Image Coding of Wavelets.' IJCSNS International Journal of Computer Science and Network Security, Oct 2008.
[9] Sadashivappa, K.V.S. AnandaBabu, 'Base color Compression, an using SPIHT algorithm.' International Journal of computer applications (0975-8887), Volume 16-No-7, February 2011.
[10] Joe, M.J., K.Y. Whang and S.W. Kim, 2001. 'Wavelet Transformation Based Management of Integrated Summary Data for Distributed Query Processing.' Data and Knowledge Engg. 39(3): 293-312.
[11] Kanwaljot Singh Sidhu, Baljeet Singh Khaira and Ishpreet Singh Virk. 2012, 'Medical Image Denoising In The Wavelet Domain Using Haar And DB3 Filtering.' International refereed journal of engineering and science (IRJES). Volume 1, Issue 1 (September 2012), PP.001-008.
[12] Kamrul Hasan Talukder, and Koichi Harada, 'Haar Wavelet Based Approach for Image Compression and Quality Assessment of Compressed Image'. International journal of applied mathematics, 36:1,1 february 2007.
[13] Kaiser, G., 1998. 'The Fast Haar Transform: Gateway to Wavelet.' Potentials, IEEE, 17(2): 34-37.
[14] L.N Sarma, S.R. Nirmala, M. Sabarimalai Manikandan and S. Dandpat, 'Compression of Multi-Lead ECG Signals and Retinal Images using 2-D Wavelet Transform and SPIHT Coding scheme for mobile telemedicine.' WISP-2007, IIT Guwahati, India. 28-29 Dec 2007.
[15] Meenakshi Chaudhary and Anupma Dhamija, 'Compression of Medical Images using Hybrid Wavelet Decomposition Technique.' International Journal of Science & research (IJSR). India Online. Volume 2, Issue 6, June 2013.
[16] Menegaz, G., L. Grewe and J.P. Thiran, 'Multirate Coding of 3D Medical Data.' In proceedings of the 2000 International Conference on Image Processing, 2000, IEEE, 3: 656-659.
[17] Mohannad Abid Shehab Ahmed, Haithem Abd Al-Raheem Taha, and Musab Tahseen Salah Aldeen. 'Image Compression using Haar and Modified Haar Wavelet Transform.' Tikrit Journal of Eng.

Science/Vol.18/No.2/June 2011, (88-101).
[18] Navjot Kaur and Preeti Singh, 'Medical Image Compression Using Improved SPHIT and MFHWT.' International Journal of Scientific & Engineering research. Volume 3, Issue 10, October 2012.
[19] Neeraj Kumar, Sugandha Sharma, 'A Review on Wavelet based Compression using Medical Images.' International Journal of Innovative Research in Computer and Communication Engineering. Volume 1, Issue 8, October 2013.
[20] Ridham Sharma and Gagan Jindal, 2013. 'Contrast Enhancement using modified fast Haar wavelet transform (MFHT) on Lung cancer images.' International Journal of Innovations in Engineering and Technology (IJIET). Volume 2, Issue 2, Aprir 2013.
[21] Roeser, P.R. and M.E. Jernigan, 1982. 'Fast Haar Transform Algorithm.' IEEE Transactions on Computer, C-31: 175-177.
[22] Saha S., 2000. 'Image Compression-from DCT to Wavelets: A Review.' ACM Cross Words Students Magazine,6(3).
[23] V.Ashok, T.Balakumaran, C.Gowrishankar, Dr.II.A. Venmila and Dr.A.Nirmal Kumar, 2010. 'The Fast Haar Wavelet Transform for Signal and Image Processing.' International Journal of Computer science and information security, vol. 7. No.1. 2010.
[24] Vandendrope, L., B. Maison and F. Labeau, 1997. 'An Adaptive Transform Approach for Image Compression.' IEEE Digital Signal Processing Workshop, pp: 41-44.
[25] Vitter, J.S. and M. Wang, 1999. 'Approximate Computation of Multidimensional Aggregates of Sparse Data using Wavelets.' In proceedings of the ACM SIGMOD International Conference on Management of Data, pp: 193-204.
[26] Wang, J. and H.K. Huang, 1996. 'Medical Image Compression by using Three-Dimensional Wavelet Transform.' IEEE Transactions on Medical Imaging, 15(4): 547-554.