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Image Compression using Hybrid Wavelet Transform

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ABSTRACT

Image Compression is used to decrease the storage of data and transmit the data easily without reducing or affecting the image quality. In this project, the hybrid wavelet transform, DWT-Lift hybrid wavelet transform is proposed for better image compression that improves the performance of the wavelet transform and implemented image security for the compressed image using the AES Algorithm. This hybrid wavelet transform gives better performance and less quantization error. This paper obtains a better compression ratio after multiple decomposition levels are held. The image can be recreated or reconstructed without losing the contents of the original image. Some IQA measurements using Peak Signal to Noise Ratio (PSNR) and Mean square error (MSE) are calculated for result performance.

Keywords : Image compression, Lifting Scheme, DWT, Haar, AES Algorithm, Image quality measurements.

I. INTRODUCTION

In computer operations, Digital images are extensively used. Digital images that aren't compressed bear further capacity for storing the data and transmission bandwidth. The effective way of image compression results is getting more critical with the recent growth of data-intensive, multimedia-based web operations.

Image contraction is used for numerous operations which may have huge data storage, transmission, and reclamation i.e., for multimedia, documents, videotape conferencing, and medical imaging.

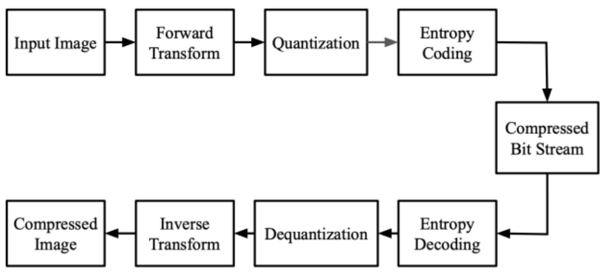


Figure 1 : Image Compression Model

The main goal of image compression is to lessen the redundancy of images for transmitting or storing information in a much more effective manner. This effective transmitting or storing of information could in turn cause the size of the file to get decreased. As a result, additional images could easily be stored in any taken quantum of memory or disk space.

A new and well-organized Image compressing schema has been devised by relying on DWT, which results in much-reduced sophistications in the computation and compromising the quality of the image could also be lesser. The IQA quantifications of the devised methodology have been differentiated from other compression standards.

II. RELATED WORK

H.singh et al. [1] executed image compression using Discrete Wavelet Transform, Discrete Cosine Transform & Huffman encoding mechanism. Image compression compacts lessen the number of bits needed to recognize an image by removing unnecessary data. Image Compression is distributed into two types, Lossy and Lossless depending on whether the original image can be recovered with fine perfection from the compressed image.

I.Daubechies et al. [2] discovered DWT which is used in lossless JPEG2000 contraction of grayscale images, reduced to rudiments. High-position DWT provides multi-resolution image representation attained by multi-level corruption. The Effective parcels of a lifting scheme have made it useful to make significant transforms for lossless images including separate sea transforms.

Chen et al. [3] admit that the discrete wavelets adaptively choose the best lifting way and use the interpolation procedure to make predictions according to their local characteristics. Discrete Wavelet Transform, which can flexibly select the best lifting ways and use the Large range interpolation technique to make predictions based on its local characteristics.

C.H.son et al. [4] JPEG 2000, a high-performance image compression algorithm. This algorithm has been divided into two types: Lossy and Lossless Image compression. The lossy compression technique focuses on high compression percentage compared with the Lossless technique.

G.BheemeswaraRao et al. [5] recognized the Lossy Compression image which may not give a good vision or quality of the image but achieved a good compression ratio. After DWT Processing the Bit plane Encoder handles the DWT coefficient for compression. Bit Plane encoder encodes an image segment from the most significant bit (MSB) to the least significant bit (LSB).

III. HAAR DWT

Alfred Haar (1885-1933) was a Hungarian mathematician who worked in analysis studying orthogonal systems of functions, partial discrimination equations, Chebyshev approximations, and direct inequalities. In 1909, Haar introduced the Haar wavelet proposition. A Haar proportion is the simplest type of wavelet. In separate forms, Haar wavelets are related to a fine operation called the Haar to transform

Haar also known as a simple possible wavelet. The fine prerequisites will be kept to a minimum; indeed, the main generalities can be understood in terms of addition, deduction, and division by two. We also present direct algebra perpetration of the Haar sea transfigure, and mention important recent conceptions. As all wavelet transforms, the Haar transform decomposes a separate signal into two sub-signals of half its length. The Haar wavelet transform has more advantages

1. It's conceptually simple and fast
2. Its memory is effective since it can be calculated in place without a temporary array.
3. It's exactly reversible without the edge goods that are a problem with other sea transforms.
4. It provides a high compression rate and high PSNR(Peak signal to noise rate).
5. It increases detail in a recursive manner.

Then both the high pass and low pass filters are used. In which the low pass filter is used for the approximation of the original image and the high pass filter is used to take out some features.

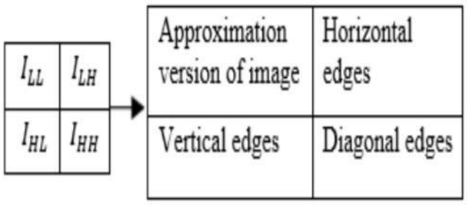


figure 2: Image Decomposition levels

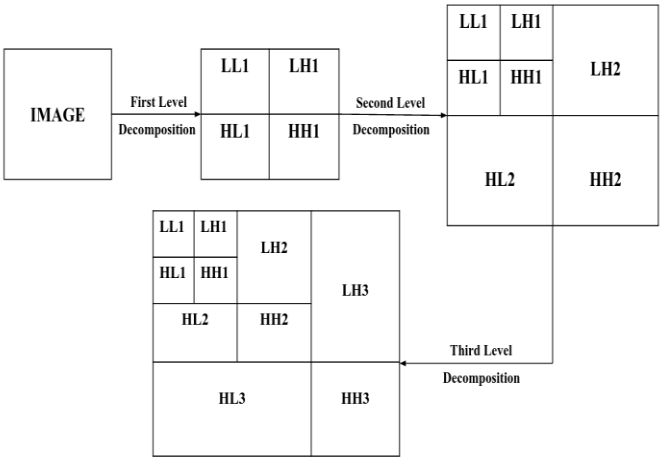


figure 3: Haar DWT Decomposition

ILH output is passed through a high pass filter.So it will give the horizontal features of the image. if we repeat the same operation by making an approximation output as the input, then the resulting image is the second level of the original image. By repeating the same procedure, a third level of the decomposed image is obtained.

IV. LIFTING SCHEME

The lifting scheme is the effective perpetration of a wavelet transform algorithm. It was primarily developed as a system to improve wavelet transformation, and also it was extended to a general system to produce so-called alternate-generation ripples(i.e.Ripples which don't inescapably use the same function prototype in different situations). The lifting scheme perpetrates the filtering operations at each position.

The lifting scheme consists of three steps:

1. Split: In this step, the data is split into even and odd elements.
2. Predict: It deploys a function that has the potential to approximate the taken dataset. The variations are existing intermediaries to the real-time data and approximated data replace the already existing constituents of the dataset. The constituents that are of the "even" type are kept unattended and they serve as the input for the subsequent stage in the transformation. In predict step, where the odd sample is "predicted" from the even sample is described by the equation

$$\text{odd } y+1,\, x = \text{odd } y,\, x - P(\text{ even } y,\, x\,) \qquad (1)$$

3. Update: The update step substitutes the even samples with the average of the samples. This results in input for the next step of the wavelet transform. The odd samples also point to a source dataset approximation. Thus, it permits the filters to get built. The stage of the update takes place right after the stage of prediction. The source magnitudes of the samples of the type "odd" get altered with the dissimilarity that's the existing intermediary to the odd samples and its even "predictor". While calculating an average the update phase must operate on the differences that are stored in the odd elements

$$\text{even } y+1,\, x = \text{even } y,x + U(\text{ odd } y+1,\, x\,) \qquad (2)$$

A simple lifting scheme forward transform is shown in the figure.

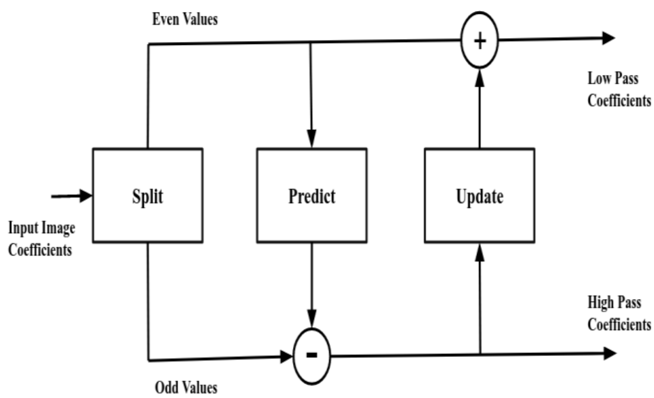


Figure 4: Lifting scheme forward wavelet transform

The split phase initiates each forward transform step that moves the odd samples to the alternate half of the array, leaving the even samples in the lower half. At the end of the transform step, the odd samples are replaced by the differences of the elements, and the even samples are replaced by the average of the elements. The even samples act as the input for the coming step, which again starts with the split phase.

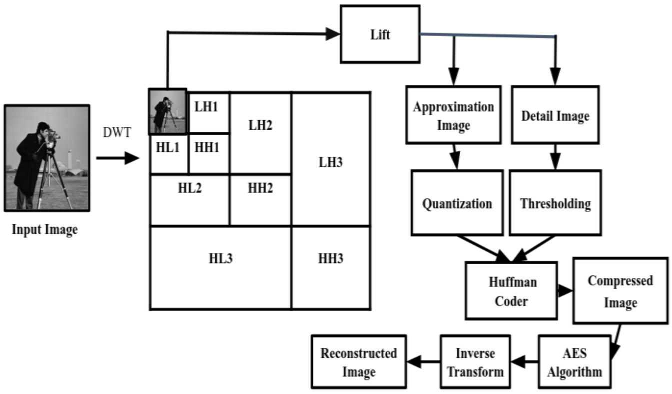


Figure 5: DWT lift compression Model Block diagram

One of the elegant features of the lifting scheme is the inverse transform is the opposite of the forward transform. The inverse Lifting Scheme block schematic is shown in fig. 5. In the case of the Haar transfigure, additions are substituted for deductions and deductions for additions. The merge step restores the split step.

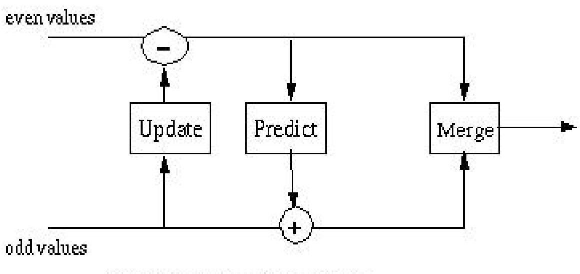


Figure 6: Lifting scheme inverse wavelet transform

V. AES ALGORITHM

The AES algorithm comprises a 128-bit containing LFSR-Linear Feedback Shift Register and the core of AES that's got masked for generating the encryption of the masks. The core of AES has masked processes encryption of the type "128-bit". The operation gets carried out in ten rounds depending upon the size of the key, estimating one revolution every round. Also, the equipment of every revolution gets reutilized for cutting down the area. Our devised methodology of masked AES has been indicated in the following Figure:

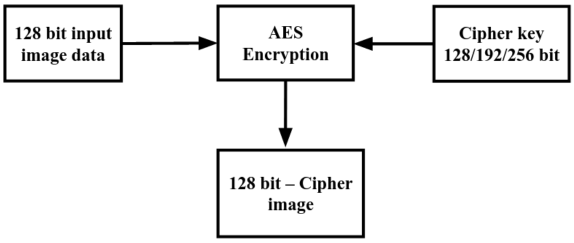


Figure 7 : AES Encryption Block Diagram

Here, the text that's plain (source information) gets initially masked by an arbitrary mask. The plain text that got masked along with the mask itself is next given via the core of AES that's got masked, which is responsible for the encryption of the masked information by containing a confidential key. The cipher-text that's masked is obtained as an outcome, which is then input into those that remain unmasked to arrive upon cipher-text.

1. AES is a block cipher.
2. The key size can be 128/192/256 bits.
3. It encrypts data in terms of blocks with128 bits each.

ROUNDS	KEY SIZE
10	128
12	192
14	256

Table 1: Number of rounds based on key size

Each round comprises 4 steps:

1. SubBytes
2. ShiftRows
3. MixColumns
4. Add Round Key

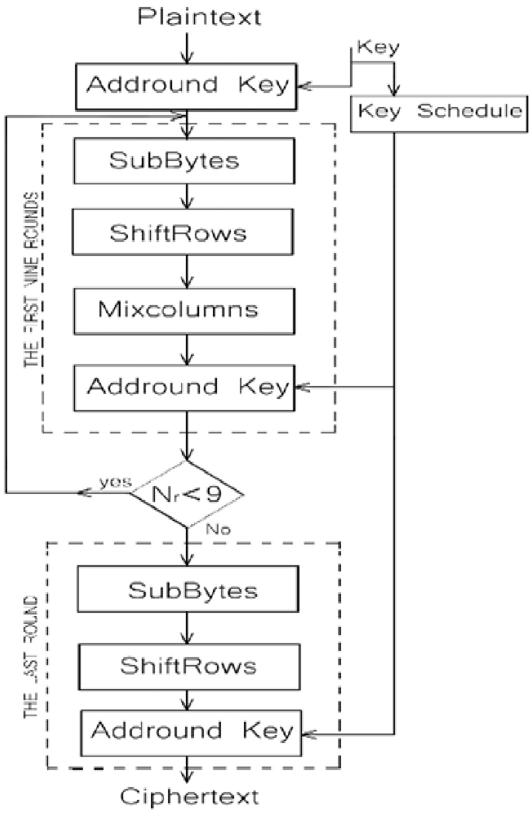


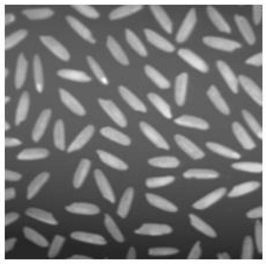
Figure 8: steps in AES Algorithm

The last round doesn't have the Mix Columns round. The SubBytes perform the substitution and Shift rows and Mix columns execute the permutation in the algorithm.

VI. RESULTS AND DISCUSSION

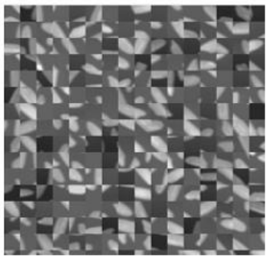
The proposed work deals with the implementation of DWT-LIFT. This work aims at obtaining better PSNR and MSE values and obtaining highly compressed images for the purpose of data storage and image data transmission more easily, compared with existing work, image reconstruction without degrading the original image quality. Implementation of DWT-LIFT for image compression and image security using AES algorithm results are obtained below.

(1) Simulation Results of an 256 x 256 image 'rice'

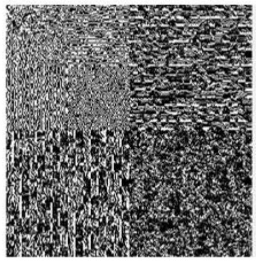


(a) Original Image

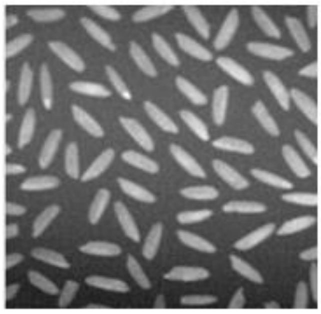
(b) Compressed Image



(c) Image Encoding



(d) Image Decoding



(e) Reconstructed Image

Comparison of Haar and Lift for an image 'rice'

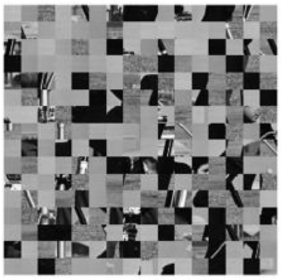
Wavelets	**PSNR**	**MSE**
Haar	12.94 dB	66.26
Lift	34.38 dB	24.71

Table 2 : Performance Analysis of an image 'rice'

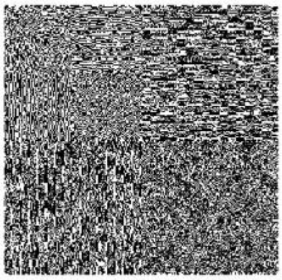
(2) Simulation Results of a 256 x 256 image 'photographer'

(a) Original Image

(b) Compressed Image



(c) Image Encoding



(d) Image Decoding

(e) Reconstructed Image

Comparison of Haar and Lift for simple image 'Photographer'

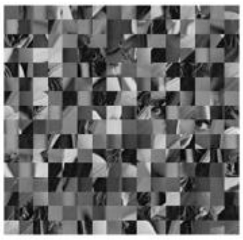
Wavelets	**PSNR**	**MSE**
Haar	10.28 dB	122.08
Lift	28.92 dB	84.47

Table 3: Performance Analysis of an image 'photographer'

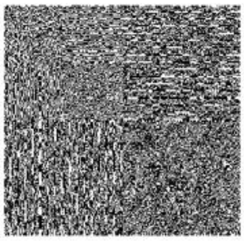
(3) Simulation Results of a 256 x 256 image 'lena'

(a) Original Image

(b) Compressed Image



(c) Image Encoding



(d) Image Decoding

(e) Reconstructed Image

Comparison of Haar and Lift for simple image 'lena'

Wavelets	**PSNR**	**MSE**
Haar	12.48 dB	72.28
Lift	30.16 dB	63.61

Table 4: Performance Analysis of an image 'lena'

From the above observations we came to know that the MSE got by Lift is less than that of Haar. Less MSE value indicates less error in the image.

The PSNR earned by Lift is more than Haar. More PSNR indicates better picture quality.

VII. CONCLUSION

In this paper, we have proposed a new approach to image compression using hybrid wavelet transforms. It increases the time performance of the system computationally. The compressed image is formed using DWT and Lifting Scheme. To add security to the image, the AES algorithm is used. This proposed system was developed for fast image compression. The proposed method is compared with the existing method by using its image quality assessment parameters such as peak - signal - to - noise - ratio (PSNR), Mean Square Error (MSE). The results obtained related to reconstructed image quality as well as maintenance of significant image details, while on the other hand parallel achieving good compression rates.

VIII. REFERENCES

[1]. L. Yi-bo, X. Hong, and Z. Sen-Yue, “The wrinkle generation method for facial reconstruction based on extraction of partition wrinkle line features and fractal interpolation,” in Proc. 4th Int. Conf. Image Graph., Aug. 22–24, 2007, pp. 933–937.

[2]. Y. Renner, J. Wei, and C. Ken, “Down sample-based multiple description coding and post-processing of decoding,” in Proc. 27th Chinese Control Conf., Jul. 16–18, 2008, pp. 253–256.

[3]. H. Demirel, G. Anbarjafari, and S. Izadpanahi, “Improved motion based localized super-resolution technique using discrete wavelet transform for low-resolution video enhancement,” in Proc. 17th Eur. Signal Process. Conf., Glasgow, Scotland, Aug. 2009, pp. 1097–1101.

[4]. Y. Piao, I. Shin, and H. W. Park, “Image resolution enhancement using inter-subband correlation in the wavelet domain,” in Proc. Int. Conf. Image Process., 2007, vol. 1, pp. I-445–448.

[5]. H. Demirel and G. Anbarjafari, “Satellite image resolution enhancement using complex wavelet transform,” IEEE Geoscience and Remote Sensing Letter, vol. 7, no. 1, pp. 123–126, Jan. 2010.

[6]. C. B. Atkins, C. A. Bouman, and J. P. Allebach, “Optimal image scaling using pixel classification,” in Proc. Int. Conf. Image Process., Oct. 7–10, 2001, vol. 3, pp. 864–867.

[7]. W. K. Carey, D. B. Chuang, and S. S. Hemami, “Regularity-preserving image interpolation,” IEEE Trans. Image Process., vol. 8, no. 9, pp. 1295–1297, Sep. 1999.

[8]. S. Mallat, A Wavelet Tour of Signal Processing, 2nd ed. New York: Academic, 1999.

[9]. J. E. Fowler, “The redundant discrete wavelet transforms and additive noise,” Mississippi State ERC, Mississippi State University, Tech. Rep. MSSU-COE-ERC-04-04, Mar. 2004.

[10]. X. Li and M. T. Orchard, “New edge-directed interpolation,” IEEE Trans. Image Process., vol. 10, no. 10, pp. 1521–1527, Oct. 2001.

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