Comparative Analysis of WDR-ROI and ASWDR-ROI Image Compression Algorithm for a Grayscale Image

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Abstract--- In t**his paper we have compared WDR-ROI (Wavelet Difference Reduction- region of interest) concept and ASWDR-ROI (Adaptively Scanned Wavelet Difference Reduction-region of interest) algorithm. The term difference reduction refers to the way in which WDR encodes the locations of significant wavelet transform values. The WDR algorithm combines run-length coding of the significance map with an efficient representation of the run length symbols to produce an embedded image coder. Here we have analyzed WDR-ROI algorithm for the greyscale image. ASWDR algorithm aims to improve the subjective perceptual qualities of compressed images and improve the results of objective distortion measures, especially at low bit rates, than WDR and SPIHT compressed images. ASWDR retains all of the important features of WDR: low complexity, region of interest capability, embeddedness, and progressive SNR. We have analyzed that adaptively Scanned Wavelet Difference Reduction using Region of interest concept given good results compare to Wavelet Difference Reduction algorithm. Using MATLAB Toolbox we have calculated CR, PSNR and BPP and compared their results and found that ASWDR-ROI concept provides improved PSNR value as shown in our results. ASWDR-ROI and WDR-ROI algorithms are best suited algorithm for medical images and satellite images which requires increase resolution area.**

Keywords: Image Compression, ASWDR, WDR, WDR-ROI, CR, PSNR, BPP.

I. INTRODUCTION

Now a day's Medical science is growing very fast and hence each hospital needs to store high volume of information or data about the patients. And medical images are one of the most important data about patients. As a result hospitals have a high volume of images with them and require a huge hard disk space and transmission bandwidth to store these images. Most of the time transmission bandwidth has not sufficient into storing all the image data. Image compression is the process of encoding the information using fewer bits (or other information-bearing units) than an un-encoded representation which would use of specific encoding schemes. Image compression is the application of data compression on digital images. Image compression is minimizing the size in bytes of a graphics file without degrading the quality of the image to an unacceptable level. The reduction in file size allows more images to be stored in a given amount of disk or memory space. It also reduces the time required for images to be sent over the Internet or downloaded from Web pages.

WDR (Wavelet Difference Reduction) algorithm analyzed by J.Tian and R.O.Wells [IEEE, 1996 & 1998]. It provides the highest image quality, progressive image transmission, fully embedded coded file, simple quantization algorithm, fast coding/decoding, completely adaptive, lossless compression, exact bit rate coding and Error protection. In both SPIHT and WDR techniques, the zero tree data structure is precluded, but the embedding principles of lossless bit plane coding and set partitioning are preserved. The only difference between WDR and bit-plane encoding is the significant pass. In WDR, the output from the significance pass consists of the signs of significant values along with sequences of bits which concisely describe the precise locations of significant values.

The improved quality of ASWDR compressed images has applications to image database search/retrieval, to remote medical image transmission/ diagnosis, and to multi-resolution methods for reconnaissance and feature extraction. The term adaptively scanned says that this algorithm modifies the scanning order used in WDR to achieve improved performance. ASWDR adapts the scanning order so as to forecast locations of new significant values. If a prediction is true, then the output specifying that location will just be the sign of the new significant value and the reduced binary expansion of the number of steps will be empty. So a good prediction scheme will considerably reduce the coding output of WDR.

In this paper a new ASWDR algorithm and WDR along with the CTM (Coefficients Thresholding Method) with ROI concept have been developed on natural image named Rice (256x256) using series of various available filters. This new approach improves the results and enhances the quality of the image in terms of Compression ratio (CR), Mean Square Error (MSE), Peak Signal to Noise Ratio (PSNR).

II. Process Flow

In the ASWDR algorithm, instead of employing the zero trees, each coefficient in a decomposed wavelet pyramid is assigned a linear position index. The output of the ASWDR encoding can be arithmetically compressed [1, 2]. Figure 1 show the Block diagram process flow of finding and analysing ROI and other than ROI.

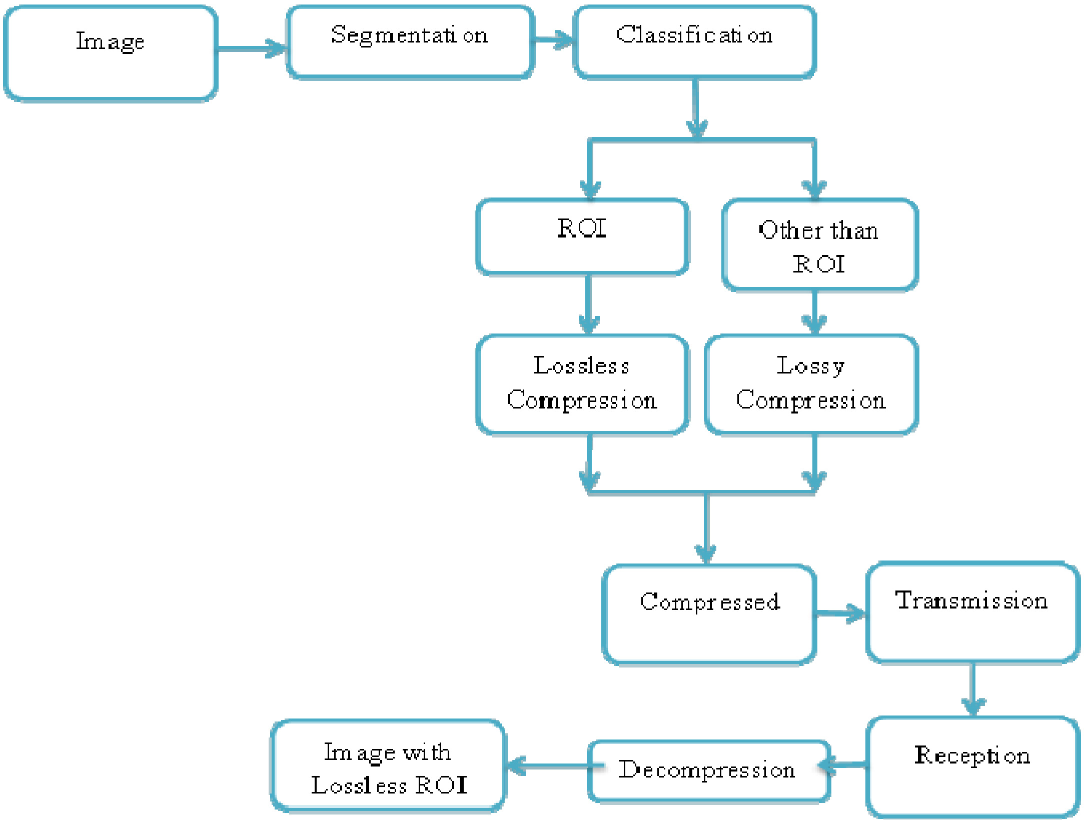


Fig. 1 Block diagram process flow of finding and analyzing ROI and other than ROI

III. WDR Algorithm

A. Initialization

During this step an assignment of a scan order should first be made. For an image with P pixels, a scan order is a one-to-one and onto mapping = Xk, for k =1, 2... P between the wavelet coefficient and a linear ordering (Xk). The scan order is a zigzag through sub bands from higher to lower levels. As the scanning order is made, an initial threshold T0 is chosen so that all the transform values satisfy |Xk|< T0 and at least one transform value satisfies |Xk|>= T0 / 2.

B.Significance pass

In this part, transform values are deemed significant if they are greater than or equal to the threshold value. Then their index values are encoded using the difference reduction method of Tian and Wells [4]. The difference reduction method essentially consists of a binary encoding of the number of steps to go from the index of the last significant value to the index of the current significant value.

C. Refinement pass

The refinement pass is to generate the refined bits via the standard bit-plane quantization procedure [3]. Each refined value is a better approximation of an exact transform value.

IV. Coefficients Thresholding Method

A.Global Thresholding:

After the quantization steps we have applied the global thresholding for each level from 1 to N, a threshold is selected and hard thresholding is applied to the detail coefficients. It involves taking the wavelet expansion of the signal and keeping the largest absolute value coefficients.

B. Huffman Coding:

Next process is to apply Huffman coding algorithm on the decomposed ROI image. Repeat steps until the bit budget is reached

V. ASWDR ALGORITHM

Choose an initial threshold, T, such that at least one transform value has magnitude less than or equal to T and all transform values have magnitudes less than 2T.

A. Significant Pass

Record positions for new significant values: new indices m for which x[m] is greater than or equal to the present threshold. Encode these new significant indices using difference reduction ([1], [5]).

B. Refinement pass

Record refinement bits for significant transform values determined using larger threshold values. This generation of refinement bits is the standard bit- plane encoding used in embedded codecs ([6], [2]).

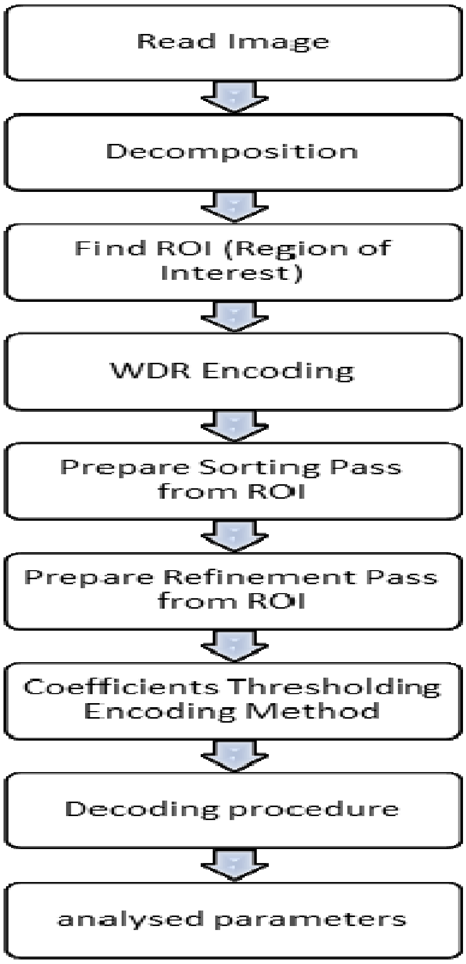
C. New scan order

Run through the significant values at level j in the wavelet transform. Each significant value, called a parent value, induces a set of child values-four child values for all levels except the last, and three child values for the last described in the quad-tree definition in [2]. The first part of the scan order at level j - 1 contains the insignificant values lying among these child values. Run through the insignificant values at level j in the wavelet transform. The second part of the scan order at level j - 1 contains the insignificant values, at least one of whose siblings is significant, lying among the child values induced by these insignificant parent values. The third part of the scan order at level j - 1 contains the insignificant values, none of whose siblings are significant, lying among the child values induced by these insignificant parent values. Although this description is phrased as a three-pass process through the level j sub band, it can be performed in one pass by linking together three separate chains at the end of the one pass.)

Divide the present threshold by 2. Repeat above Steps until either a bit budget is exhausted or a distortion metric is satisfied. After that CTM method is applied using global thresholding and Huffman coding as discussed in WDR algorithm.

VI. METHODOLOGY

This section describes the methodology behind the WDR-ROI method and ASWDR-ROI method. In this process first we take an image and then apply decomposition also find the region of interest and then on that decomposed image we have applied WDR coding and CTM method and then analyzed its various parameters. Similarly we have found the ROI for ASWDR algorithm because using this algorithm the PSNR is improved than SPIHT and WDR algorithm.



VII. RESULTS

We have implemented improved WDR Algorithm with Region of interest concept on rice image to calculate CR, MSE, BPP, and PSNR. Figure 2 shows an original Natural image compressed by WDR Algorithm by cropping the region Figure 3 shows an original Natural image and compressed image using our proposed (WDR-ROI) Algorithm. Figure 4 shows the original and compressed image using ASWDR-ROI algorithm.

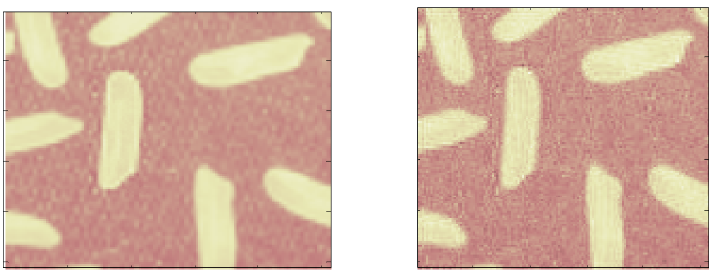


Fig 2: Original Cropped image and compressed cropped image

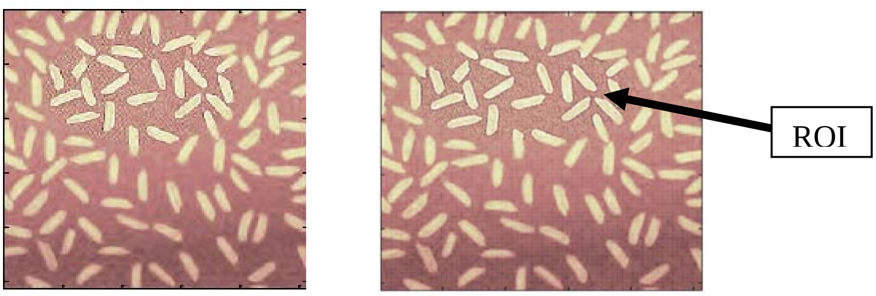


Fig.3 Compressed image using WDR algorithm and WDR-ROI concept

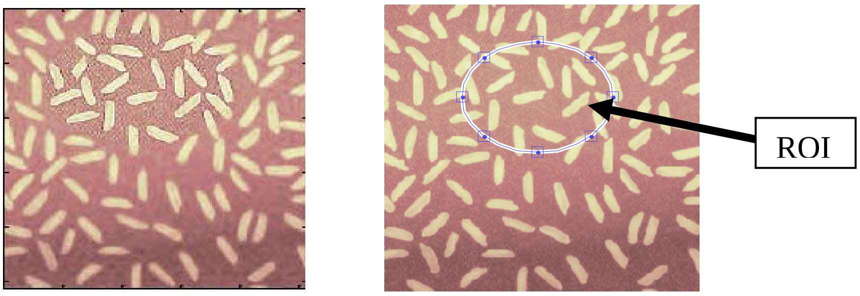


Fig.4 Compressed image using ASWDR algorithm and ASWDR-ROI concept

TABLE 1. Various calculated parameters for rice image using WDR-ROI concept and cropped image.

Wavelet	CR		BPP		PSNR	
	CROP-AREA	WDR-ROI	CROP-AREA	WDR-ROI	CROP-AREA	WDR-ROI
Bior3.1	9.35	14.17	0.75	1.13	29.35	30.44
Coif5	9.26	14.27	0.74	1.14	30.31	31.05
Db16	9.02	13.98	0.72	1.12	30.55	30.8
Sym5	9.77	13.79	0.78	1.1	30.12	30.83
Rbio4.4	9.39	14.08	0.75	1.13	29.99	30.98

TABLE 2. Various calculated parameters for rice image using ASWDR-ROI concept and cropped image.

Wavelet	CR		BPP		PSNR	
	ASWDR-ROI	CROP-AREA	ASWDR-ROI	CROP-AREA	ASWDR-ROI	CROP-AREA
Bior3.1	14.13	9.35	1.13	0.75	29.44	30.44
Coif5	14	9.26	1.12	0.74	30.92	30.31
Db16	14.09	9.02	1.13	0.72	30.62	30.55
Sym5	13.83	9.77	1.11	0.78	30.92	30.12
Rbio4.4	13.84	9.98	1.11	0.8	31.08	29.99

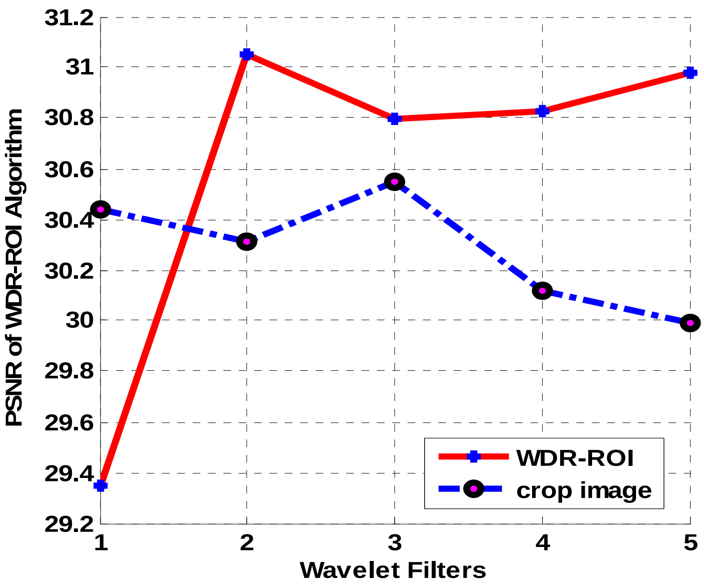


Fig. 5: Comparison Chart of PSNR of an image using WDR-ROI Algorithm

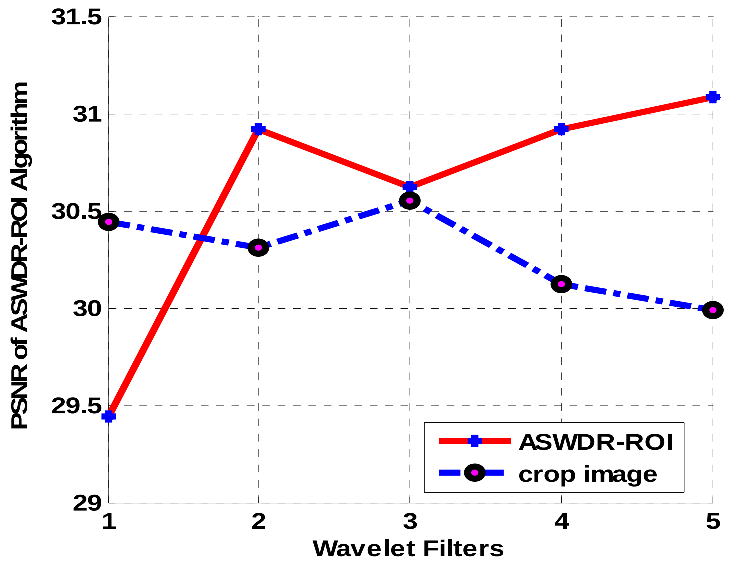


Fig. 6: Comparison Chart of PSNR of an image using ASWDR-ROI Algorithm

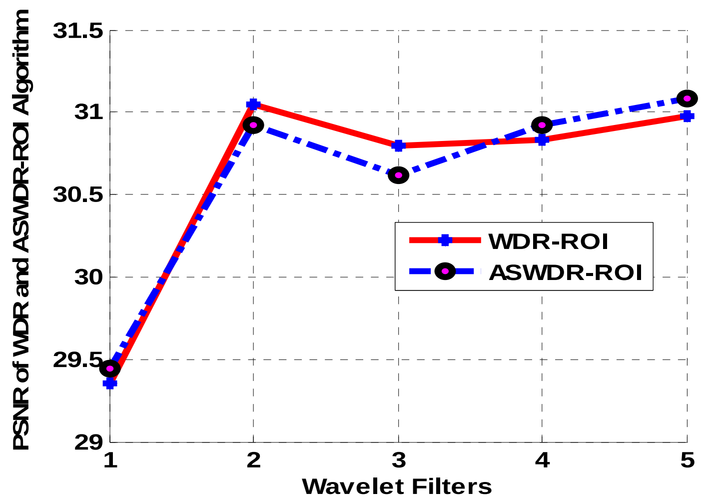


Fig. 7: Comparative Chart of PSNR of an image using WDR-ROI and ASWDR-ROI Algorithm

VIII. Conclusion

In this paper we have implemented our algorithm on a greyscale image firstly we have cropped the required area and compressed it and then applied our WDR-ROI algorithm after that we have applied ASWDR-ROI algorithm and found that the proposed algorithm provides highest PSNR as compared to cropped area image. Tables show the various statistical calculated parameters of Natural Image. From the table we can see for the natural image coif5 filter is applied and PSNR is increased by 31.05db.For the ASWDR algorithm rbio4.4 provides the highest PSNR 31.08. Similarly we can see from the table using various applied filter such as db16, coif2 and sym5 PSNR is increased.so from all results we can say that coif5 provides best PSNR value. Its main application is now a day in telemedicine and in teleconsultation where a lot of medical images are sent on-line in India or out of India for the super specialist doctors to proper digonisis.so at the receiving end picture should be very clear. It is expected that the volume of uncompressed data produced by hospitals will exceed capacity and drive up costs even as the capacity of storage media continues to increase. However, unlike many other compression applications, medical imaging application demands lossless or high-fidelity image compression. It is clear that lossless compression is a legal technical approach by ensuring perfect reconstruction of the original. But after decades of active research on lossless compression, the achievable compression ratio remains low. As in telemedicine, videos and the medical images are transmitted through advanced telecommunication links, so the help of medical image compression to compress the data without any loss of useful information is immense importance.

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