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Comparative Analysis on Medical Images using SPIHT, STW and EZW

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***Abstract*— Pathology labs are produces large amount of digital images. Digital images are required considerably large memory. However the only solution is a lossless compression technique. In this paper we compared the wavelet based algorithms such are Embedded Zero tree Wavelet (EZW), Set partitioning in Hierarchical Trees (SPIHT) and spatial orientation tree Wavelet (STW). These algorithms are compared in terms of Compression Ratio (CR), Peak Signal to Noise Ratio (PSNR), Bit per pixels and Mean Square Error (MSE). STW is the best algorithms as compared to others image compression method. It gives high CR and PSNR with better image quality.**

Keywords — Compression Ratio, EZW, Image Compression, MSE, SPIHT and STW.

I. INTRODUCTION

Image compression is combined with two words image and compression. Image is refers to a two dimensional array of finite size, finite number of bits represent the digital image.
Image are creating from digital camera requires large amount of storage capacity and bandwidth. To reduce the storage capacity and bandwidth we need an image compression. Compression is refers to reducing the quality of information used to represent a file, image or video without reducing the original information. Lossless and Lossy are the two parts of image compression. In lossless compression technique represents the original image but it gives low compression ratio. Lossless compression techniques are JPEGLS, Discrete Wavelet Transformed and Set Partitioning In Hierarchical Trees. In Lossy compression technique some amount of information is lost but it gives high compression ratio.LossycompressiontechniqueisDiscreteCosinetransforme dandDiscreteWaveletTransformed [1][2][4][5].Image Compression are used to reduce the redundancy present inside the image such as inter pixel , coding and psycho visual redundancy. Wavelet transformed is an important tool for image processing. It divides the image into number of segments each corresponding to a different frequency band. Discrete wavelet transform and Continuous wavelet transformed are the classification of wavelet transform. Discrete Wavelet transformed are Embedded Zero tree Wavelet (EZW), Set partitioning in Hierarchical Trees (SPIHT) and spatial orientation tree Wavelet (STW). DWT are widely used in image processing because it localize the signal in both Time and frequency domain. Application of Discrete wavelet transformed are compression, Transformation, De-noising and characterization [1][2]. In this paper we compared the wavelet based algorithms such as Embedded Zero tree Wavelet (EZW), Set partitioning in Hierarchical Trees (SPIHT) and Spatial orientation tree Wavelet (STW). These algorithms are compared in terms of Compression Ratio (CR), Peak Signal to Noise Ratio (PSNR), Bit per pixels and Mean Square Error (MSE).Our paper is divided into 7 sections such as Section II- SPIHT, section III-deal with STW, section IV -EZW ,section V-performance parameters section VI -deal result and analysis, section VII-conclusion followed by References.

II. SET PARTITIONING IN HIERARCHICAL TREES (SPIHT)

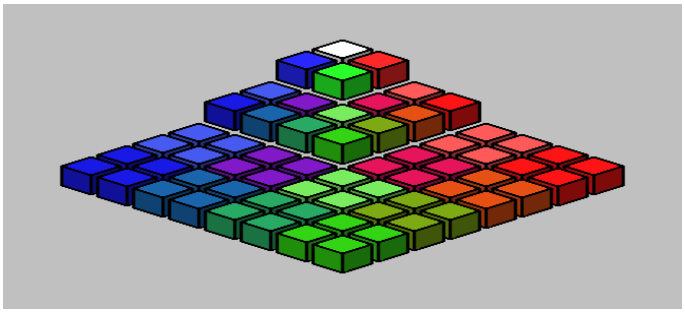

Fig.1 SPIHT

Set partitioning in Hierarchical Trees (SPIHT) is the most important algorithms based on wavelet coefficient. In SPIHT technique it converts the image coefficient into wavelet coefficient at the encoder side and the decoder performed the inverse operation i.e. it convert the wavelet coefficient into image coefficient [1][2].

Characteristics of SPIHT are as following:-

1) It performed fast encoding and decoding.
2) It is a lossless compression technique.
3) It gives high Peak signal to noise ratio and compression ratio.
4) It produce the image with better quality.

In SPIHT technique, it divide the wavelet into Spatial orientation trees. Each node in a tree has a individual pixels. In SPIHT method the information about the most significant bits of the wavelet element will be transmitted first on lower order significant bits. In each bit plane inforamtion is transmitted in three bits:-

1) List of Insignificant Sets (LIS)
2) List of Significant pixels(LIP)

International Journal of Engineering Research & Technology (IJERT)
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Vol. 5 Issue 02, February-2016

3) List of insignificant pixels(LSP)

The pixels values are compared to certain threshold level.If pixels values are greater then threshold is called LSP. If pixels values are lower then threshold is called LIP. If pixels values are approximatelyt equal to hreshold is called LIS[1][2].

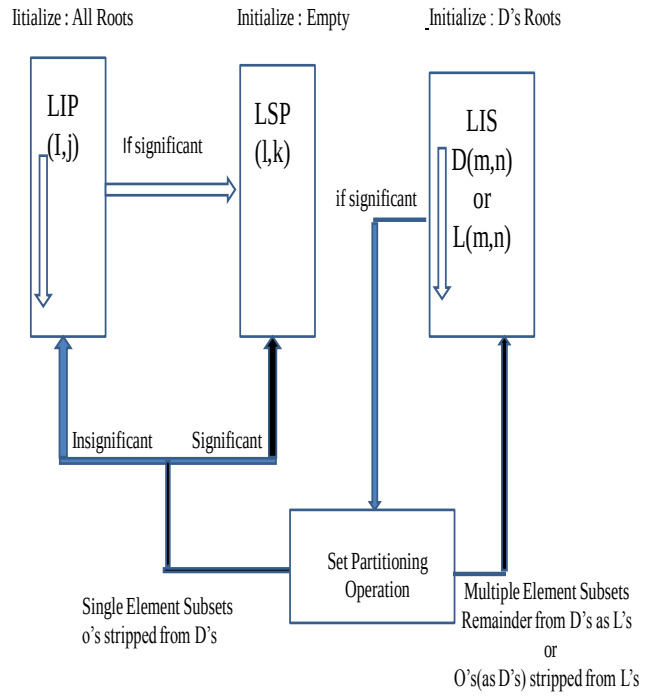

Fig2 SPIHT Shorting Pass

III. SPATIAL ORIENTATION TREE WAVELET (STW)

STW is based on state transition modal. From one threshold to the next the locations of transformed values undergo state transitions. State transitions modal allow the STW to reduce the number of bits needed for encoding. The difference between SPIHT and STW is that SPIHT is more careful in its organization of coding output. The difference between STW and EZW is that STW uses a different approach to encoding the zero tree information [11][12].

IV. EMBEDDED ZERO TREE WAVELET (EZW)

Embedded Zero Tree Wavelet is the simple algorithm used for image compression. The EZW is based on the following principles:-

1) Prediction of the absence of significancent information across scales.
2) Entropy coded successive approximation quantization and universal lossless information compression which is accomplised through arithmetic coding.Discrete wavelet transferred or hierarchical subband decomposition .

EZW is used adaptive arithmetic coding. It is used to achieve a fast and efficient method for entropy coding. The most important element of EZW algorithm is encoding process [11][12].

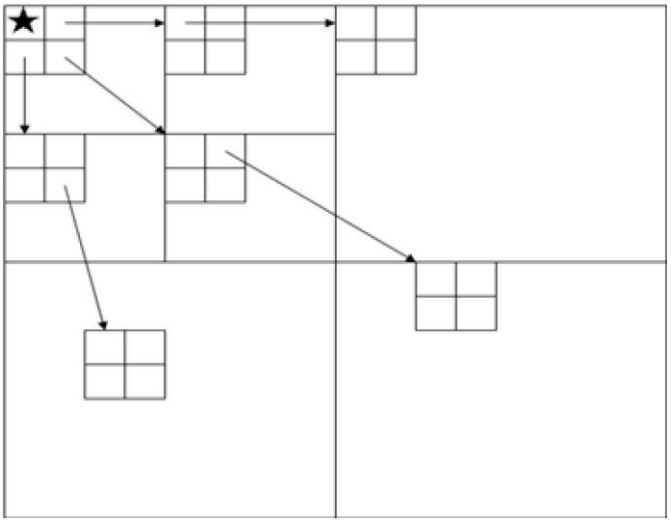

Fig 3 Spatial Orientation Trees

V. PERFORMANCE PARAMETERS

In all images following performance parameters are used:-

1) MEAN SQURE ERROR (MSE):-

$$MSE=\frac{1}{M*M}\sum_{x=1}^{M}\sum_{y=1}^{M}[I_o(x,y)-I_c(x,y)]^2 \text{--------- (1)}$$

Where $I_o(x,y)$= original image
$I_c(x,y)$= compressed image
M = dimensions of the images.

In the image error will be low when the value of MSE is low.

2) Mean Absolute Difference (MAD):-

$$MAD=\frac{1}{M*M}\sum_{x=1}^{M}\sum_{y=1}^{M}[I_o(x,y)-I_c(x,y)]\cdot \text{ ---------- (2)}$$

3) PEAK SIGNAL TO NOISE RATIO (PSNR):-

$$PSNR = 10\log_{10}(\frac{255*255}{MSE}) \quad \text{---------- (3)}$$

From equation (3) we observed that PEAK SIGNAL TO NOISE RATIO (PSNR) is inversely proportional to the MEAN SQURE ERROR (MSE) i.e. higher value of PSNR can be achieved by decreasing the value of MSE.

4) COMPRESSION RATIO (CR):-

$$CR = \frac{I_{os}}{I_{cs}} \quad \text{---------- (4)}$$

Where I_{os} = original image size
I_{cs} = compress image size.

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Vol. 5 Issue 02, February-2016

VI. RESULT AND ANALYSIS

Medical images has taken from the "Image diagnostic centre BHILAI" . This experiment is performed on medical images by using MATLAB (2012 a).The dimensional size of MRI images are 512 x 512. This experiment is performed on more than 300 medical images by using Embedded Zero tree Wavelet (EZW), Set partitioning in Hierarchical Trees (SPIHT) and Spatial orientation tree Wavelet (STW).

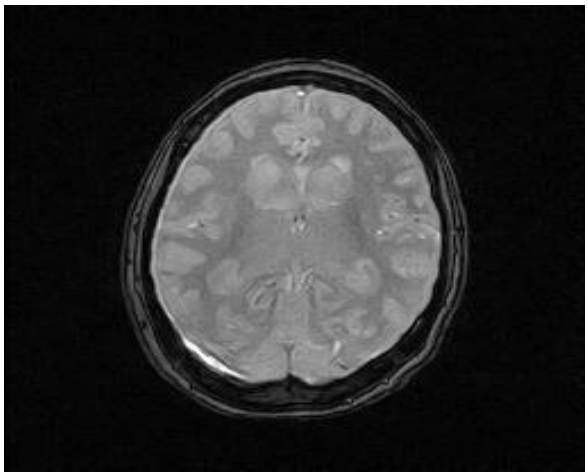

Fig 4 Image 1

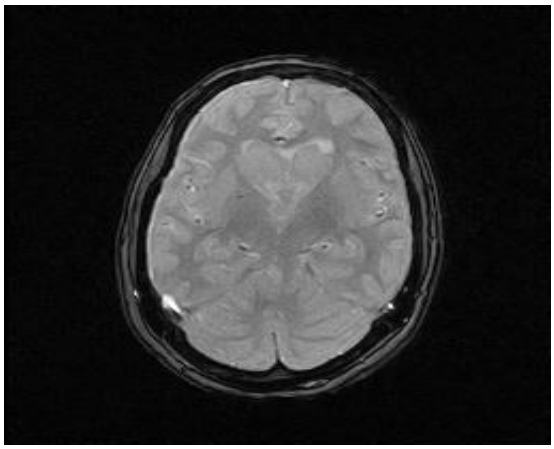

Fig 5 Image 2

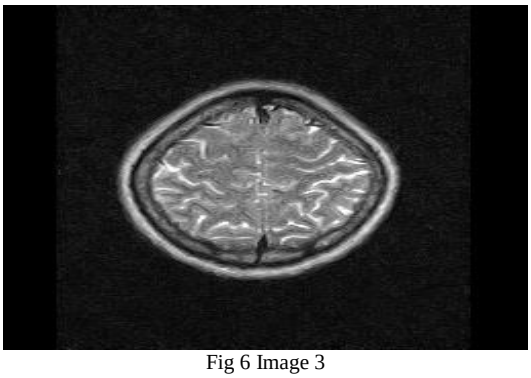

Fig 6 Image 3

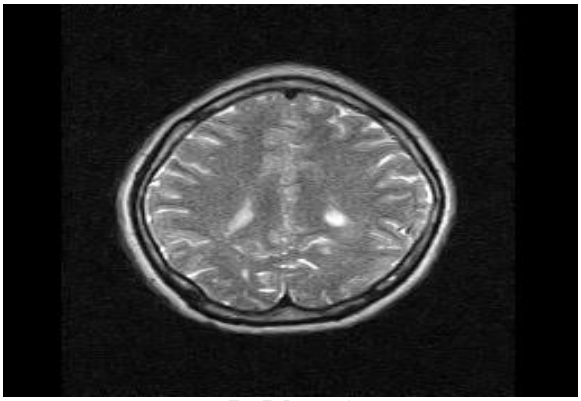

Fig 7 Image 4

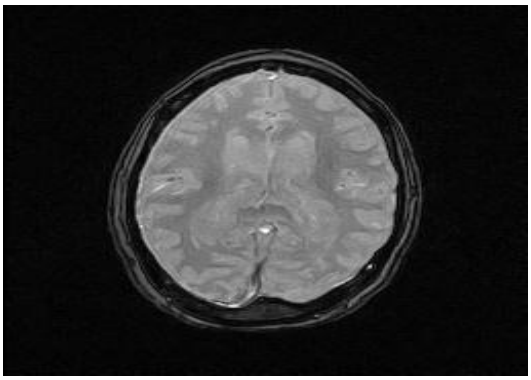

Fig 8 Image 5

TABLE I

Image Sequence	Compression Ratio		
	SPIHT	STW	EZW
1	7.29	10.98	11.15
2	7.21	10.85	10.09
3	4.76	7.18	7.17
4	4.66	7.03	7.13
5	4.72	7.07	7.09
AVERAGE	5.728	8.622	8.526

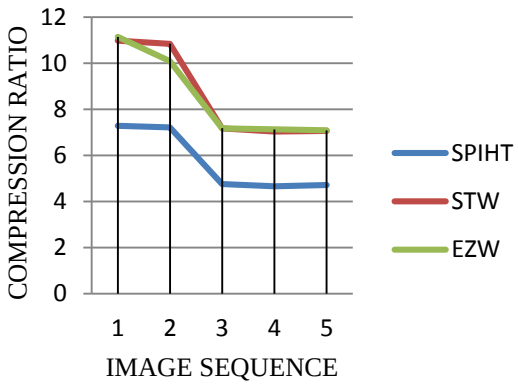

Fig 9 COMPRESSION RATIO OF MRI IMAGE

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TABLE II

Image Sequence	Peak Signal to Noise Ratio		
	SPIHT	STW	EZW
1	39.58	41.24	40.37
2	39.06	41.13	39.74
3	40.79	42.3	41.42
4	41.07	42.32	41.74
5	40.93	42.29	41.57
AVERAGE	40.286	41.856	40.968

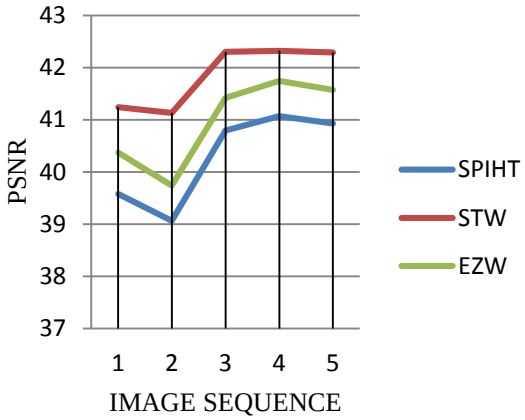

Fig 10 PSNR OF MRI IMAGE

TABLE III

Image Sequence	Mean Square Ratio		
	SPIHT	STW	EZW
1	7.14	4.87	5.95
2	8.06	5	6.9
3	5.41	3.82	4.67
4	5.07	3.81	4.34
5	5.24	3.83	4.52
AVERAGE	6.184	4.266	5.276

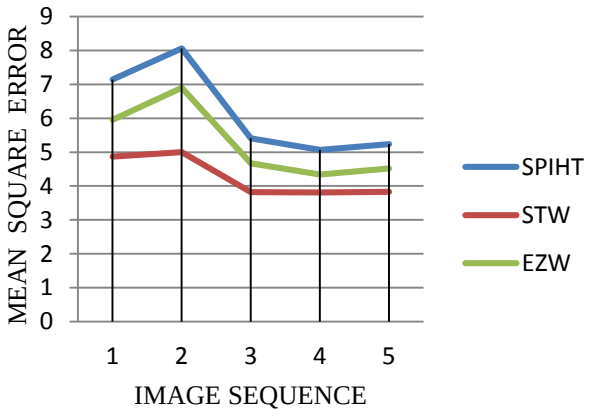

Fig 11MSE OF MRI IMAGE

TABLE IV

Image Sequence	Bit per Pixels		
	SPIHT	STW	EZW
1	0.584	0.879	0.892
2	0.872	0.868	0.577
3	0.38	0.575	0.574
4	0.37	0.563	0.571
5	0.388	0.566	0.567
AVERAGE	0.5188	0.6902	0.6362

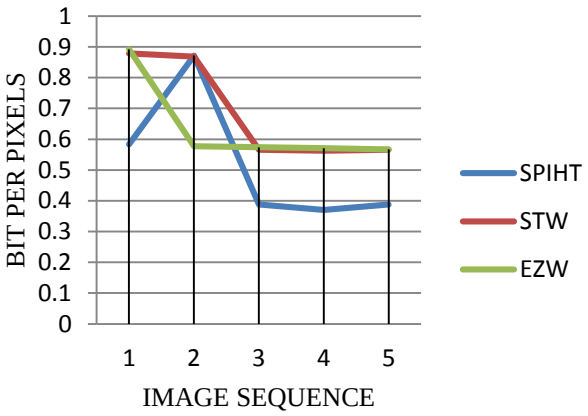

Fig 12 BPP OF MRI IMAGE

From Table I and Figure 9 it is easy identify that STW has better Compression ratio as compared to SPIHT and EZW. Average compression ratio of STW, SPIHT and EZW are 8.62, 5.72 and 8.52 respectively. From Table II and Figure 10 STW gives high PSNR as compared to SPIHT and EZW. Average PSNR of STW, SPIHT and EZW are 41.856, 6.184 and 40.968 respectively. From Table III and Figure 11 STW gives low MSE as compared to SPIHT and EZW. Average MSE of STW, SPIHT and EZW are 4.266, 40.286 and 5.276 respectively.

VII. CONCLUSION

In this paper, we compared the Embedded Zero tree Wavelet (EZW), Set partitioning in Hierarchical Trees (SPIHT) and spatial orientation tree Wavelet (STW). From Result and analysis we say that STW gives high CR and PSNR with better image quality.

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