COMPRESSION ALGORITHM FOR BIOMEDICAL INFORMATION

S.Zhagaramozhi[1], Prof.S.Saritha[2]

[1]PG Scholar, Dept. of ECE, Nandha College Technology, Tamilnadu,India[2]Assistant Professor, Department of ECE, Nandha College Technology, Tamilnadu,India

ABSTRACT

Video compression plays an important role in many digital video processing applications such as for digital video transmission, also thousands of website like Youtube ,NetFlix that requires large storage space. Video compression technologies are about reducing and removingredundant video data so that a digital video file can be effectively sent over a network or can be stored on computer disks with the reduction of data size. In this project we proposed video compression using motion compensation technique that reduces video data based on motion estimation from one frame to another. Motion compensation is an algorithmic technique employed for the encoding of video data for video compression.Motion compensation describes a frame in terms of the transformation of a reference frame with respect to the current frame. The reference frame may be previous in time or even from the future. The proposed method reduces the candidate of the prediction modes based on the Sum of Absolute Hadamard-Transformed Difference (SATD) between the original block and the intra predicted block. Motion of each block is obtained based on the SATD value. The current frames are further reduced by using the combination of motion and most probable displacement. The proposed method reduces the number of motion in frames to either one or two. When imagescan be accurately synthesised from previously stored images, the compression efficiency can be improved. Temporal redundancy is exploited so that not every frame of the video needs to be coded independently as a new image.

Keyword:- *Fixed size block motion estimation[1],Block-based motion estimation[2], Peak-Signal-to-Noise-Ratio(PSNR)[3], Block matching algorithm[4].*

1.INTRODUCTION

Now a days there are videos in high definition or high quality qualities, So it requires a large transmission bandwidth and amount of storage space. To reduce the redundant data in video,here are various strategies to employ that compress the information without negatively affecting the quality of the frames. There are some methods which lossless and lossy, but in lossless in which there is no data is lost, but most are lossy, meaning that information is thrown away that can't be retrieved. So far our discussion on compression has been on still images. In the lossy techniques try to exploit the spatial correlation that exists in a still image. When we want to compress video or sequence images we have an added dimension to exploit, namely, the temporal dimension. Generally, there is little or very little change in the spatial arrangement of objects between two or more consecutive frames in a video. Therefore, it is advantageous to send over the network or store the differences between consecutive frames rather than sending or storing each frame.The difference frame is called the residual or differential frame and may contain far less details than the actual frame itself. Due to this reduction in the details in the differential frames, compression is achieved. To illustrate the above idea, let us consider compressing two consecutive frames of a video sequence . When objects move between successive frames, simple differencing will introduce large residual values especially when the motion is large. Due to relative motion of objects, simple differencing is not efficient from the point of view of achievable compression. It is more advantageous to determine or estimate the relative motions of objects between successive frames and compensate for the motion and then do the differencing to achieve a much higher compression. This type of prediction is known as motion compensated prediction. Because we perform motion estimation and compensation at the encoder, we need to inform the decoder about this motion compensation. This isdone by sending motion vectors as side information, which conveys the object motion in the horizontal and vertical directions. The decoder then uses the motion vectors to align the blocks and reconstruct the image [1,10].Video compression techniques are used to reduce redundancy in video data without affecting visual quality.

Itmostly used in video conference and real time application. In reality, motion compensation based coding are used in video compression techniques. Such encoders make use of inter-frame correlation to provide well-organized compression. For video compression we are using motion compensation method. In this Motion compensation technique, created In the 1960s, to exploit inter-frame redundancy contained in the temporal dimension of video sequence, is implemented in three stages. The first stage estimates object motion (motion estimation -ME) between the previously reconstructed frame and the current frame. The second stage creates the current frame prediction (motion compensation - MC), using the motion estimates and the previously reconstructed frame. The final stage differentially encodes the prediction and the actual current frame as the prediction error. Block transforms used in video encoders are unitary, which means that the transform operation has an inverse operation that uniquely reconstructs the original input. The DCT successively operates on 8 x 8 image blocks. Then, the quantization stage creates a lossy representation of the DCT Coefficients. The quantizer should be well matched to the characteristics of the input in order to meet or exceed the rate-distortion performance requirements. Motion compensation technique engaged for video compression in the encoding of video data. Motion compensation describes the transformation of a reference frame to the current frame. The reference frame may be previous or even taken the later frames. When current frames can be accurately synthesized from previously transmitted or stored frames, the compression efficiency can be improved.

2.OBJECTIVES

- Firstly we have to use algorithm for conversion of video into number of frames.
- To calculate difference in frames with the help of these delay to find block matching in current frame fromprevious frame to develop a algorithm.
- To develop algorithm for Motion Compensation for calculating the difference in between frames with help of block matching.
- In motion estimation there is a requirement to make a Algorithm for searching a motion vector in frame, For compression of video for this develop algorithm in motion compensation to reduce video size.
- To develop the transform coding in which DCT and quantization algorithm for image compression.
- For compression of video frames is made Run length coding is done for Data compression.
- Technique to be implemented reconstruction of compressed frames are done by developing the algorithm in Motion compensation Decoder.

3. MOTIVATION

Video compression is the field in Electronics engineering and computer science that works with representation of video data, for transmission and storage, for digital video. Video coding is often related with only for all type of natural video, and also applied to synthetic video, i.e. graphics. Many demonstrations take benefit of primitive features of the Human Visual System to accomplish an efficient demonstration. Using video compression, the biggest challenge is to retard the size of the video data. Due to this reason “video compression” and “video coding” are often used interchangeably by those who don’t know the difference. The finding for efficient video compression techniques dominated much of the research activity for video coding ought to 1980s, the first major milestone was H.261, from which JPEG gave the idea of using the DCT; since then another development have been made to algorithms such as motion compensation. Since ultimately 2000 the concentration has been more on Meta data and video search, resulting in MPEG-21andMPEG-7.

4. IMPLEMENTATION

4.1.ENCODER BLOCK

The basic function of the proposed system is to Convert a biomedical video into many frames of standard size or fixed size. The fixed size frames are sent to the pre-processing unit for filtering process. The pre-processing unit uses four pre-processing techniques for image filtering; they are Histogram Equalization, image filtering using Gaussian filter, Sobel Operator and Susan or Gabor filter andcertain parameters such as Peak Signal to Noise Ratio, Mean Square Error

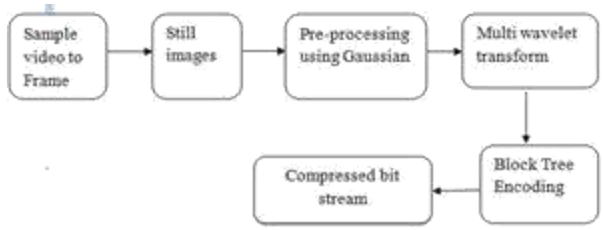


Figure 3.1 Block Diagram of Video Encoder

4.1.1 PREPROCESSING USING GAUSSIAN FILTERS

Key functions of pre-processing are to improve the quality of image in various ways that increase the chances for success of other process. Generally filters are used to filter unwanted things or object in a spatial domain or surface. In digital image processing, mostly the images are affected by various noises. The main objectives of the filters are to improve the quality of image by enhancing. Low- pass filter is a type of filter used for the image enhancement. It preserves the smooth region in the image and removes the sharp variation leading to blurring effect.

The frequency domain technique is based on the convolution theorem. It decomposes an image from its spatial domain form of brightness into frequency domain components and is represented as the following equation

$$g(x,y) = h(x,y) * f(x,y)$$

Where f(x,y) is the input image ,h (x,y) is a position invariant operator and g(x,y)is the resultant image from the convolution theorem.

$$G(u,v) = H(u,v)\ F(u,v)$$

Where G, H, F is the Fourier transform of g, h, f respectively. The transform H (u, v) is called transfer function of the process.

Gaussian filters are used to remove the noise and smoothing of images. The Gaussian filters works by using the 2D distribution as a point-spread function. This is achieved by convolving the 2D Gaussian distribution function with the image. The Gaussian smoothing filter is very good in noise removal in normal distribution function. This filter is rotationally symmetric the amount of smoothening in all direction.

A Gaussian filter is a filter whose impulse response is a Gaussian function (or an approximation to it). Gaussian filters have the properties of having no overshoot to a step function input while minimizing the rise and fall time. This behaviour is closely connected to the fact that the Gaussian filter has the minimum possible group delay. It is considered the ideal time domain filter, just as the since is the ideal frequency domain filter. Mathematically, a Gaussian filter modifies the input signal by convolution with a Gaussian function.It is not particularly effective at removing salt and pepper noise. The Gaussian filter is a non-uniform low pass filter. Central pixels have a higher weighting than those on the periphery. Larger values of σ produce a wider peak (greater blurring). Kernel size must increase with increasing σ (standard deviation) to maintain the Gaussian nature of the filter. Gaussian kernel coefficients depend on the value of σ. At the edge of the mask, coefficients must be close to 0. The kernel is rotationally symmetric with no directional bias. Gaussian kernel is separable which allows fast computation separable. Gaussian filters might not preserve image brightness. Figure 3.4 shows the image which is pre- processed by Gaussian filter.

4.1.2.MULTI-WAVELET TRANSFORM

Multi-wavelets are very similar to wavelets but have some important differences; they have two or more scaling and wavelet functions. Consider N compactly supported scaling functions (x),=1,2,….N and their corresponding N mother wavelet functions $\Psi l(x)$,l=1,2,….N where all translates are mutually orthogonal

$$\Psi l,, \triangleq 2j2\Psi l(2jx-k), j, k \in Z=1,2,\ldots.N$$

Forms an orthogonal basis for L2 (ℝ)

Let H[k] and G [K] be their nxn impulse response constant matrices.

Let

$$\phi(x)=[\phi 1(x),\phi 2(x),\ldots\ldots\ldots,\phi N(x)]T$$
$$\Psi(x)=[\Psi 1(x),\Psi 2(x),\ldots\ldots\ldots,\Psi N(x)]T$$

be the multi-scaling and multi-wavelet function respectively.

The jth space is given by

$$Vj=Spanj\in\{\phi 0(2jx-k),\phi 1(2jx-k)\}$$

And jth wavelet space is given by

$$Wj=Spank\in\{\Psi 0(2jx-k),\Psi 1(2jx-k)\}$$

The multi-scaling and multi-wavelet function is respectively given by the matrix dilation and wavelet equation as given in equation (8) and

$$(x)=\sqrt{2}\Sigma H[k]\infty k=-\infty\phi(2x-k)$$

k=-α

$$(x)=\sqrt{2}\Sigma G[k]\infty k=-\infty\phi(2x-k)$$

Where the matrix filter H[k] has l 2x2 matrix coefficients, the kth matrix co-efficient

$$H[k]=[h0(2k)h0(2k+1)h1(2k)h1(2k+1)]$$

The corresponding multi-wavelet function satisfies the following equation where the matrix filter G[k] has l 2x2 matrix coefficients, the k_{th} matrix co-efficient is given by

$$G[k]=[g0(2k)g0(2k+1)g1(2k)g1(2k+1)]$$
$$G[k]=[g0(2k)g0(2k+1)g1(2k)g1(2k+1)]$$

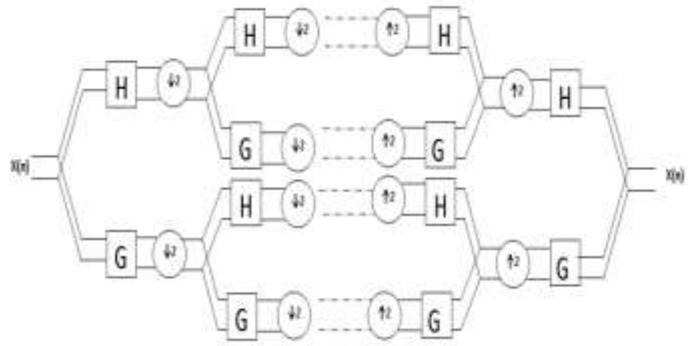


Figure 3.2 Multi wavelet Filter Bank: Analysis and Synthesis Stage

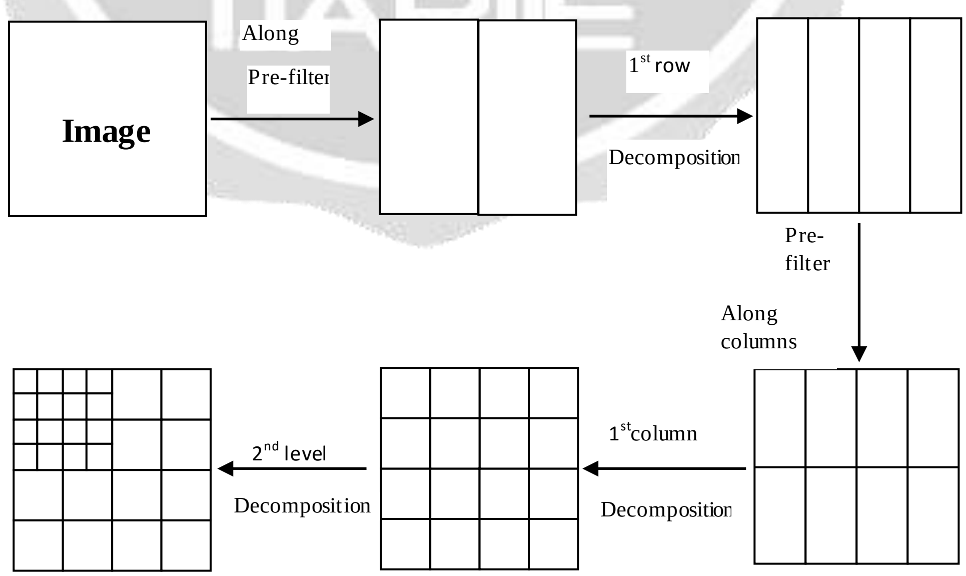
4.1.2.1.MULTI WAVELET DECOMPOSITION

The decomposition procedure and structure for multi-wavelet decomposition differs from scalar wavelet decomposition since they possesses two low pass sub bands corresponding to two scaling functions and two high pass sub bands corresponding to two wavelet functions in each dimension.

This is the discrete multi-wavelet decomposition

$$\bar{s}_{-1}[n]=\Sigma H[k-2n]\bar{s}_0[k]$$

This means that multi-filter banks need r input rows. In frequency domain, the matrix frequency responses for the H and G be denoted by H(ω) and G(ω) respectively.



4.1.2.2 ITERATION OF MULTIWAVELET DECOMPOSITION

This sub-section details the iteration of discrete multi-wavelet decomposition using the decomposition algorithm. The sub band structure obtained by multi wavelet decomposition will be different from a scalar wavelet due to its multichannel nature. The multi-wavelets used here have two channels, so there will be two sets of scaling.

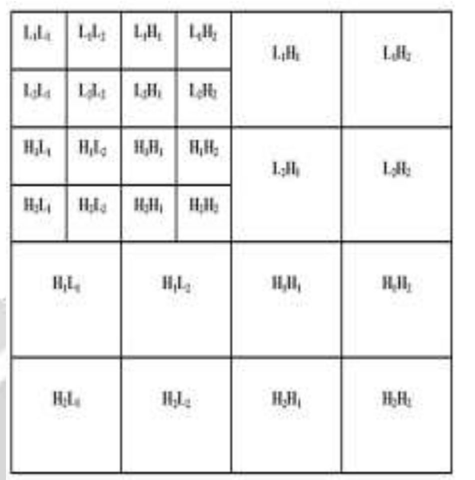


Figure3.3Two Level Multi-wavelet Decomposition- Sub band Structure

The important is note that the quarter image of the multi-wavelet decomposed image structure is actually a 2x2 block of LiLj sub band. One low pass and three band pass function associated with second channel possesses different statistical characteristics.Therefore mixing them together using the standard multi-wavelet decomposition results in subsequent sub band with mixed data characteristics.

The low pass coefficients contain most of the original signal energy, this iteration process yields better energy compaction, but this standard inter mixing of the multi-wavelet low pass sub bands leads to suboptimal results. This implies that to preserve the statistical characteristics of the image by gaining the benefit both in energy compaction and reducing computational complexity, a suitable improved co-efficient inter mixing scheme must be analysed and designed

4.1.2.3 MULTIWAVELET BLOCK TREE CODING

WBTC for scalar wavelet decomposed images, which combines the features of both zero tree coding algorithm like SPIHT and zero block coding algorithm like Set Partitioning . Embedded block (SPECK) to provide inter and intra Sub band correlation .

WBTC overhands the SPIHT in three aspects: first it creates zero trees with more elements Second it strengthens the intra sub band correlation and thirdly it reduces the encoding time. However its efficiency can be fully signified only when applied to multi-wavelet transformed data.

This motivates to apply block tree coding to multi-wavelet transformed image and for the first time applied this to Multi-wavelet transformed image. The proposed MBTC algorithm partitions the image transformed coefficients into coefficient blocks and then block trees are formed with the roots in the topmost sub band in a zero tree fashion. In a block tree, significant blocks are found using the tree partitioning concept of SPIHT, whereas significant coefficients within each block are found using the quad-tree partitioning of SPECK.

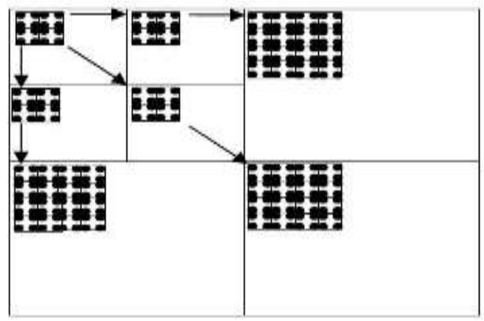


Figure 3.4 Multi- wavelet Block Tree Coding

If the descendent blocks of a set is insignificant it remains in LIBS whereas the significant blocks are partitioned into subsets by quad tree partitioning. In the significant block sets the four off springs are added to LIB and they are examined for significance as if they were in LIB. The scanning proceeds in the same manner for the same threshold until all the blocks are examined.

4.1.3 SPIHT CONVENTIONAL ALGORITHM

The SPIHT algorithm is a highly refined version of EZW algorithm. It was designed and introduced by Said and Pearlman for still image compression. SPIHT represents a small "revolution" in image compression because it broke the trend to more complex (in both the theoretical and the computational senses) compression schemes. While researchers had been trying to improve previous schemes for image coding using very sophisticated vector quantization, SPIHT achieved superior results using the simplest method: uniform scalar quantization. Thus, it is much easier to design fast SPIHT codec. The SPIHT algorithm is nearly symmetric, i.e., the time to encode is nearly equal to the time to decode.

The SPIHT method is not a simple extension of traditional methods for image compression, and represents an important advance in the field. The method deserves special attention because it provides good image quality, high PSNR, It is optimized for progressive image transmission, Produces a fully embedded coded file, Simple quantization algorithm, Fast coding/decoding, Has wide applications, completely adaptive, Can code to exact bit rate or distortion. The SPIHT algorithm taking the advantage of the properties of the wavelet coefficients. In wavelet coefficients, most of the energies are in the low frequency sub bands and there are coefficients .

Different sub bands that correspond to the same spatial locations. These coefficients can form a tree link between them and they have parent – child relationship, with the root in the lowest sub band.

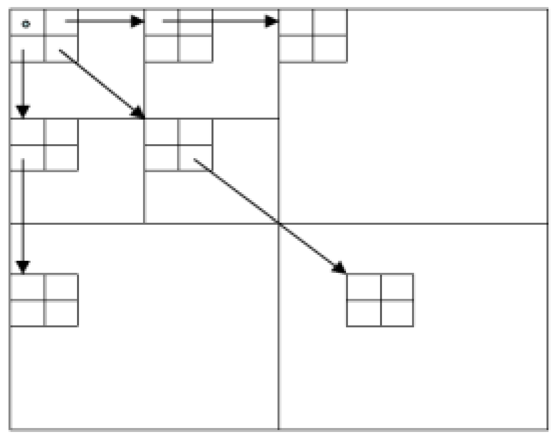


Figure3.5 SPIHT-Parent–child relationships

There are three lists maintained in SPIHT encoding. List of significant pixels (LSP), List of insignificant pixels (LIP), and List of insignificant sets (LIS). The descendants of a node include children and grand-children. Set of coordinates of all descendants of node (i, j) is denoted as D (i, j). Set of coordinates of four direct offspring of node (i, j) is denoted as O (i, j). Set of coordinates of all grandchildren of node (i, j) isdenoted as L(i, j). Hence the relationship is D(i,j)= O(i, j)+ L(i, j).

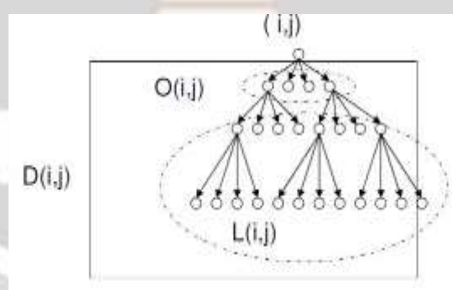


Figure 3.6 Descendant's structure

4.2 DECODING TECHNIQUE

Here an overview of the basic operations in a proposed video decoder is shown in Figure 3.14. There are three main components in the proposed video decoder: block tree decoder, Inverse multi-wavelet transformation and Post-processing using Gaussian filter.

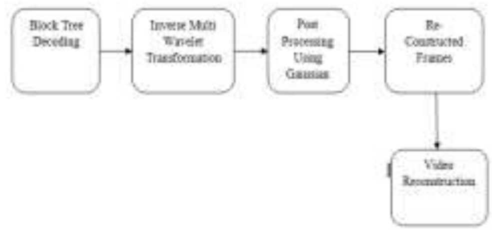


Figure 3.7 Proposed Video decoder

In the receiver side, the block tree encoded value is decoded using MWBT decoding. The decoded value is then inverse transformed using various level inverse multi-wavelet transformations. The components can be assembled back into the original signal without loss of information. This process is called reconstruction, or synthesis. After various level transformation of MWBT decoded value, the reconstruction is performed to reconstruct the frames.

4.2.1 INVERSE MULTI-WAVELET DECOMPOSITION

The two levels of inverse decomposition for multi-wavelet transformed values is the opposite to the process illustrated in fig. 3.7. This section illustrates process of integration of the proposed pre- and post-filtering into vector valued multi-wavelet inverse decomposition and reconstruction algorithms, with special focus on the discrete biorthogonal multi-wavelet transforms of images.

4.2.2 PERFORMANCE EVALUATION PARAMETERS

The peak error between the original and the compressed image is shown by PSNR

PSNR=10*log 10(255^2/m sec)

Compression Ratio is define as the ratio of original file size to that of compressed file size.

CR = (Total encoding bits of SPIHT – Total encoding bits of MBTC)

*100 Total encoding bits of MBTC

The effectiveness of compression schemes described by following parameters: The image reconstruction quality has been analysed by calculating PSNR and CR for the Multi-wavelets. The PSNR and the CR values are calculated. The cumulative squared error between the original and the compressed image is shown by MSE.

5. RESULT

The section 5.1 deals with screen shots which consist of frames conversion using video to JPG converter software, pre-processing using Histogram equalization, Gaussian filter and SOBEL filter. Then the pre-processed image is decomposed using Multi-wavelet Transform and encoded using wavelet block code tree. The encoded image is decoded using Block Tree Decoding, Inverse Multi-Wavelet Transform, Post-Processing using Gaussian, the frames are reconstructed, and finally video is reconstructed. The sub division 5.1 has table representation of energy and PSNR values of various processes.

Figure 5.1 Original image & Reconstructed SPIHT image

The Figure 5.1 shows original image and pre –processed Gaussian filter image, by using Gaussian filter removes salt and pepper noise, rotationally symmetric & smoothing in all directions.

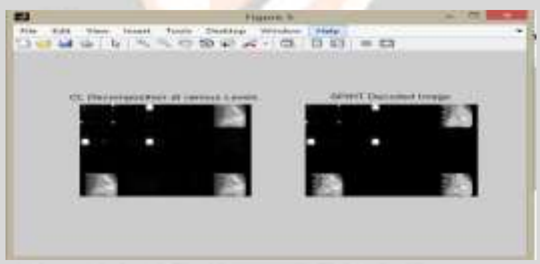


Figure 5.2CL decomposed image & SPIHT decoded image

The above Figure 5.6 shows CL decomposed image & SPIHT decoded image for the Gaussian pre-processed filter image.

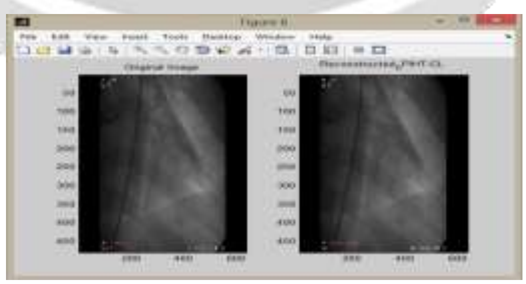


Figure 5.3 Original image and SPIHT Reconstructed Image

The above Figure 5.3 shows the reconstruction of Original image by post processing technique, Inverse multi-wavelet transform & Block tree decoder.

TABLE 5.1 COMPARISONS BETWEEN PRE-PROCESSING TECHNIQUES WITH PSNR VALUES AND CL-ENERGY FOR FRAME-410

PRE-PROCESSING	ELLAPSED TIME	CL-decomposition	PSNR	CL ENERGY
HISTOGRAM	Encoding	456	65.201	2.10E+04
	6.354064 s	2388		
	Decoding	21042		
	4.952919 s	249567		
GAUSSIAN	Encoding	411	76.6071	4.42E+03
	5.379947 s	2580		
		23436		
	Decoding	230685		
	3.964301 s			
SOBEL	Encoding	6210	85.3246	623.0259
	5.422380 s	30096		
		81969		
	Decoding	161646		
	3.010384 s	284370		

6. CONCLUSION

The proposed method of using multi-wavelet block tree encoding (MWBTC) algorithm provides encoding and the Sobel pre-processing technique provides high PSNR value and Energy. Here experimental result shows the comparison between various pre-processing techniques and provides Energy and Peak Signal to Noise Ratio for overall operations. The Inverse multi-wavelet, Inverse block tree coding is used with inverse Gaussian to reconstruct the frames and provides reconstructed bio-medical Coronary Angiography video. Based on the various pre-processing technique and using MWT gives better image quality and lossless image in bio-medical video compression.

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