IFERP
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ISSN (Online) 2394-6849

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)
Vol 4, Issue 5, May 2017

Video Compression for Video Codec Using Hybrid Transform along with Huffman coding

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***Abstract* - The hybrid transform has emerged as a greatest advancement, in the field of video compression. Video coding pattern established on hybrid of SWT-DCT which provides considerable enhancement in video quality at higher compression ratios. Wavelet transform is an effective strategy that can be utilized to perform a productive compression technique. This work manages the creating of a proficient video compression approach based on hybrid algorithm. The hybrid of SWT-DCT algorithm exhibits the effects of both the DCT and SWT methods which give a superior compression of video. This paper presents improvements in video compression scheme to enhance the ratio of compression without compromising enough quality of the video. In this technique, we have suggested is very simple to execute in the efficient usage that little measure of adaptation in the existing codec can give better performance results.**

***Keywords:* Stationary wavelet transform, DCT, Hybrid SWT-DCT, Huffman coding, Compression, Performance factors.**

I. INTRODUCTION

The compression of video performs a significant aspect in relative time video conferencing operation. The primitive goal of compression of video is to obtain better achievable quality, for a given storage or communication capacity. Compression techniques are used to minimize redundancy in video. Video compression is an essential technology in digital communication and multimedia fields. Uncompressed video data could be extremely large storage and requirement of bandwidth of this input video is very high. Compression is achievable in video frames because of pixel redundancy in these images.

A video consists of a stream of images called frames which are taken at regular intervals of time. The frames are represented as visual information at each temporal and spatial location. At every sample point visual information can be reproduced as three essential color components called RGB color space. A video signal can be examined in either frames (dynamic) or fields (interweaved). In dynamic video, a frame is totally sampled at an instant of time though an interlaced video only 50% of the frame is under taken at a particular instant of time they are called fields. In video compression there is a compact among the video quality and the compression amount accomplished. If the ratio of compression is more, then quality of video will be decreased. Compression of video using hybrid SWT-DCT achieves greater compression with less loss. This best method is what acknowledges better compression with better quality of video.

In video compression, video is featured as a progression of frames. All frames are compacted over dividing that as no less than one slice where all slice comprises of arrangement of large segments. Obtained large segments were moved to quantization and encoding. The conversion module converts the information of frame from time slot to frequency slot that expects to decorrelate the energy (i.e., information rate being in still image) are in the spatial slot. It also follows the energy segments of the frame into little quantity of coefficients of transform, in which they are very much efficient for encoding instead of their root frame. As the transformation module is variation in behavior so this process will not revise the content of information being in the source input signal in the meanwhile of encoding and decoding operation. By theory of information and coding, coefficients of transformed data are varying in behavior.

II. TRANSFORM METHODS

A. Stationary Wavelet Transform (SWT)

The stationary wavelet transform is a wavelet method of transform in which is modeled through affect the defect of translation invariance in Discrete Wavelet Transform. The translation invariance can be accomplished through discarding the up samplers and down samplers in the Discrete Wavelet Transform. The SWT can be an implicitly unwanted pattern because it

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may yield of every stage of SWT which encompasses an equivalent number of patterns as an input. The disintegration of N stages there should be a redundancy of N in the coefficients of wavelet transform.

Effective fundamental scheme of the stationary wavelet transform should be 'fill in the gap' which is caused through decimation step in basic wavelet transform. The primary concept can be employ the convenient high and low pass filters to the information at every stage to generate two strings at the next stage and two strings of all have the equal length in the process of the original string. Instead of modifying the filters at each stage, by padding them out with zeroes. The actual Fourier transform, based on the assumptions of stationary stochastic process, which is harder to follow time-reliant nature of unstable data. Among one is the greater appeal in wavelet transform, which is nonexistent in Fourier transform, so that the coefficients of wavelet are deduced from time-sequential information represent the factors of energy input in time and frequency slots.

B. Discrete Cosine Transform (DCT)

A Discrete Cosine Transform is the procedure for changing over a signal into rudimentary components of frequency. It communicates a grouping of limitedly various information points as far as an entirety of cosine function fluctuating at various frequencies which is broadly utilized as a part of compression of frame. DCT is firmly identified with Discrete Fourier Transform with some uniqueness. The DCT is highly dynamic in examining vitality into lower arrange coefficients than what the DFT accomplishes for frame information. DCT is simply genuine while the DFT is unpredictable. Coefficients delivered through DCT operation on a section of pixels are like the frequency slot coefficients created through a DFT operation. In the process of an N point DCT is firmly related towards a 2N-point DFT, it has the same frequency pattern resolution. The N frequencies of a 2N point DFT compare toward N points on the upper portion of the unit however in the convoluted frequency plane.

Distinct DCT, the consequence of coefficients of DFT is spatially stable by assuming a periodic value. Whereas transforming 1-D signals for example speech wave signals 1-D DCT is utilized. DCT can store most of information in fewest coefficients.

C. Hybrid SWT-DCT Algorithm

The Hybrid SWT-DCT algorithm accomplishes the effects of both the SWT and DCT performances which give a best compression. The frame input acquired against the video is initially changed over to a 32×32 segments. Every block has to be then applied independently. The 32×32 segment is transformed towards 16×16 after first stage of SWT and hence removing the entire coefficients aside from the LL sub band. The next stage of the 2-D SWT will enforce on the remained LL coefficient. What's more, It returns a 8×8 segment after removing the complete components of sub bands and saving only LL sub band coefficient. The DCT shall be transformed on the obtained block. Once succeeding the transformation through DCT the lossy compression exist.

If the quantization has employed over the DCT coefficients that cancelled the high frequency elements into zero. In the inverse procedure, initially the inverse quantization has to be done and later effective inverse DCT will implemented by 8×8 segments. Soon after the first stage of ISWT provides a 16×16 segments and the later stage of ISWT provides the 32×32 segments. Mentioned procedure is tested for the integrated frames.

Hybrid SWT-DCT transformation gives more compression ratio compared to JPEG and JPEG 2000. Hybrid SWT-DCT transform reduces blocking artefacts of the frames and retaining maximum information of frame thus provide better aspect of regenerated frames. After the hybrid transform the obtained video is move to quantization, in this process converting range of lesson values into a smaller set of output values that nearly relative to the original information.

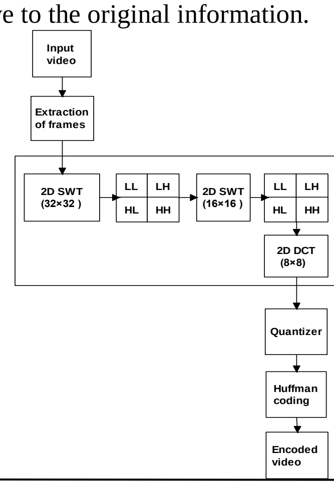

Figure. 1. Hybrid Transform

III.PROPOSED METHOD.

A.Video Encoder

The designed video codec components are Hybrid transform technique, quantization, Huffman coding. Initially the input sample video source is taken then the extraction of frames from the given input video is to be done and each frame is refined. The frames are computed one by one through hybrid SWT-DCT. After that it should be fed to quantization process here rounding off or approximation of information to nearest pre-defined levels. The Huffman coding technique is used here which has better compression ability and bit stream is generated from the Huffman coding.

B.Video Decoder

It is inverse procedure of video compression. The encoded bit streams are first inverse Huffman coded. Then de-quantization is performed. The de-quantizer output is first inverse DCT transformed and later inverse SWT transform. The outcome of hybrid SWT-DCT is the reconstructed video frames. These frames are applied to the video to frame extraction block which satisfies the persistence of visualization of video. The output video will be similar to the input video.

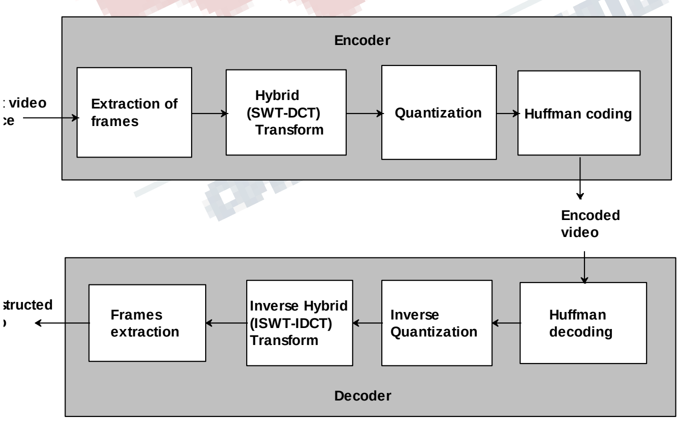

Figure.2 .Video Encoder & Decoder

IV. QUANTIZATION

Quantization is a several-to-one scaling that replaces arrangements of values with only one representative esteem. The quantity of quantitation layers should be commonly high for human recognition of fine shading subtle elements in the frame. The event of false contours is the main issue in image which has been quantized with deficient brightness levels. Visual data is available only in coefficients that are least transformed. Hence, reducing the number of bits for transform is necessary this is known as coefficient quantization which is applied to a particular scales and sub bands. Quantization is of two types: Scalar quantization in which information values are scaled to a precise number of output values and Vector quantization obstructs a vector at a given rate with less exaggeration.

V.HUFFMAN CODE

In this project, compression is achieved by using Huffman encoding, which is easy to implement. It is a lossless compression method which assigns a prefix code to the two consecutive information bits. In this method, depending upon the quantity of information contained in the source symbols a constant number of bits are assigned to each source symbol irrespective of symbol length.

Huffman coding utilizes a precise approach whereas taking the determination on every symbol, bringing a without prefix code that communicates the most widely characters utilizing less bits strings than are utilized for less basic source symbols.

VI. PERFORMANCE PARAMETERS

A. Ratio of Compression (CR)

The ratio of compression is utilized to measure the ability in compression of data by analyzing the range of the uncompressed frame to compressed frame.

$$\text{Compression Ratio} = \frac{\text{Original size of the video}}{\text{Compressed size of the video}} \quad (1)$$

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International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)
Vol 4, Issue 5, May 2017

B. Mean Square Error (MSE)

The MSE in the decompressed frame, it analyzes the initial data and reconstructed data and result the level of distortion.

$$MSE = \frac{1}{N^2}\sum_{i=0}^{N-1}\sum_{j=0}^{N-1}(C_{ij} - R_{ij})^2 \qquad (2)$$

C. Peak Signal to Noise Ratio (PSNR)

PSNR can be specified as effective significant parameter that used to check image quality.

$$PSNR = 10\log_{10}\frac{255^2}{MSE} \qquad (3)$$

VII. OUTCOME

A succeeding still image of a recorded video is comparative means its limited redundancy occurs. If the rate of compression is high then it can be accomplished through applying limited redundancy.

Figure. 3. Extraction of frames (video of 6 seconds, having 173 still images)

The input source video size = 13258kb

These frames are then compressed individually by applying hybrid SWT-DCT transform and then stored in storage space. The stored frames are in .mat format. This is the compressed variant of the video.

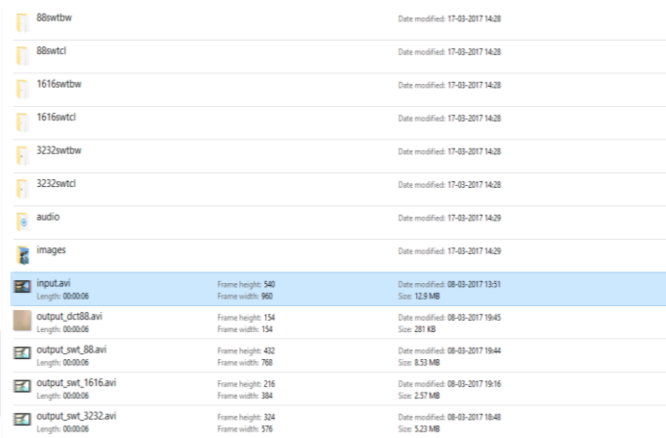

Figure .4.Compressed video size

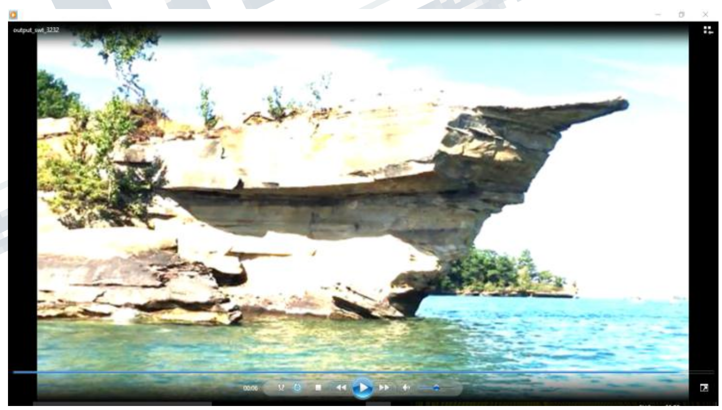

Figure.5. Hybrid SWT-DCT Compressed frame

TABLE I. RESULT ANALYSIS

Video	DWT-DCT		SWT-DCT	
	CR	***PSNR***	***CR***	***PSNR***
Sample1	80.4%	36.5dB	96.9%	75.2dB
Sample2	88.3%	42.3 dB	96.2%	72.1dB
Sample3	83.2%	38.4 dB	90.0%	65.6dB

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Video	DWT-DCT		SWT-DCT	
	CR	***PSNR***	***CR***	***PSNR***
Sample4	89.3%	43.1 dB	97.6%	76.6dB
Sample5	74.5%	33.8 dB	97.8%	76.4dB

VIII. CONCLUSION

We have designed a innovative method of video compression which is a mixture of two transform so called hybrid scheme of SWT-DCT transform techniques. Here in our work SWT and DCT is very good to cope up for compression ratio and quality measurement which we are concluded with the help of PSNR, further to enhance the compression ratio we are using Huffman coding as of its lossless compression nature and it will provides better PSNR and higher compression ratio which helps to achieve good reconstruction. This concludes that after applying lossy technique it's better to use lossless also to enhance compression at same PSNR.

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