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Video Compression Using Hybrid DCT-DWT Algorithm

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Abstract - *This paper provides a video compression using Hybrid (DCT-DWT) algorithm. There are two compression techniques for data compression, lossy and lossless. For video compression we will prefer lossy compression. The compression scheme has to achieve high compression ratio with maintain the reconstructed video quality. The hybrid compression technique use DCT transform as well as DWT transform. We used arithmetic coding for more compression. The performance of the system can be evaluated using criterion compression ratio, PSNR and mean square error.*

Key Words: Compression, Discrete cosine transform, Discrete wavelet transform, Hybrid DCT-DWT, Arithmetic coding, Performance parameters

1. INTRODUCTION

Now a days, videos entertainment and video communication are excessively used. But storage space required to the video is large amount of memory. If such videos has to send over transmission media then large requirement of transmission bandwidth. Therefore, Video compression is essential method for making video to transmittable size.

Video is series of the still image referred as frames. According to the persistence of vision property of the human eye, the scene formed on the retina will remain as it is for 60 ms. If the frame duration is kept below the 60 ms, then string of images formed on the eye will viewed as the video[6]. The frames contains the large amount of the Redundant data bits. Thus by discarding the redundant information compression can be achieved. As the information bits are discarded in this method ; it is the lossy compression method. The video compression using Hybrid DCT-DWT achieve greater compression with less losses[2].

There is inversely proportional relation between video quality and amount of compression achieved. If the compression ratio is more then quality of video decreases. Thus best algorithm is that which realize better compression with better video quality. The Discrete cosine transform and Discrete Wavelet transform are mostly used methods for video compression.

2. RELATED WORK

The DCT and DWT algorithms can be used for video compression. In fact the properties of DCT has become internal standards for transform coding system. The JPEG,MPEG1,MPEG4 standards designed using DCT algorithm. In DCT technique frame is broken into 8*8 blocks and then each block is subjected to DCT transform[8]. The two dimensional DCT is computed as the frame is two dimensional quantity.

Discrete Wavelet transform of frame is time frequency representation. The DWT represents frame as a sum of wavelet function, known as wavelet. Here the discrete information is passed through high pass and low pass filters. The output of low pass filter is approximate and output of the high pass filter is detailed coefficients. The approximate coefficients containing most important information of image. While detail coefficients are less important that can be ignored for compression[7]. As the frame is two dimensional quantity so two dimensional wavelet transform is required.

DCT and DWT algorithms has limitation that less compression ratio and the executing time is more. Also the reconstructed video has less quality than original.This drawbacks are overcome by using the combined properties of the DCT and DWT algorithms. The combined results named as Hybrid DCT-DWT algorithm.

3. PROPOSED METHOD

The hybrid DWT-DCT realize the properties of DWT and DCT transform and establishes better compression with better quality than the DWT and DCT individuals[10]. The input frame is transformed individually. The frame coefficients are subjected to one-level DWT. Which is two-dimensional. There are four types of coefficients at output of one level DWT. i.e. LL, LH, HL, HH. From that LL coefficients are details coefficients and LH, HL and HH are approximate coefficients. Detail coefficients are containing more important information. Approximate coefficients are less important and can be discarded. Then second level DWT is computed on the LL coefficients only. After that DCT transformation is applied on this information and then it is subjected to quantization. Quantization means approximation of coefficients to pre-fixed values.

The reconstruction can be performed by reverse coding. First inverse quantization is done then IDCT followed by IDWT. We proposed to achieve better compression with

better quality of video. The block diagrams of encoder and decoder are given figure1 and 2.

3.1 Video compression module

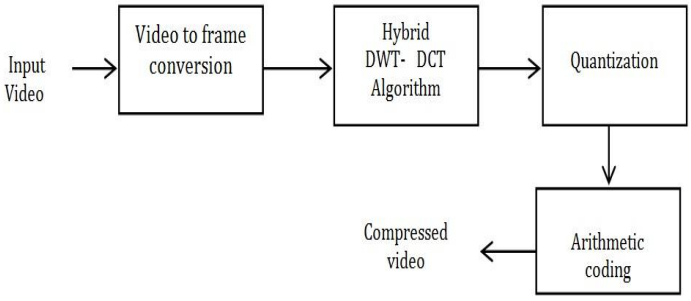

Fig. -1: Video compression module

The input video is first converted into frames and each frame is processed. The frame are hybrid DCT-DWT computed one by one[2]. After that quantization is performed on matrix. Quantization is approximation or rounding off information bits to nearest pre-defined levels. The arithmetic coding technique is used here which has better compression ability[3].

In arithmetic coding the number of bits used to encode each symbol varies according to probability assigned to that symbol. Low probability symbols use many bits, high probability use fewer bits. This is variable length coding. Arithmetic coding achieved more compression ratio. After that the output bit stream is stored to the storage space. This is compression version of video.

3.2 Video decompression module

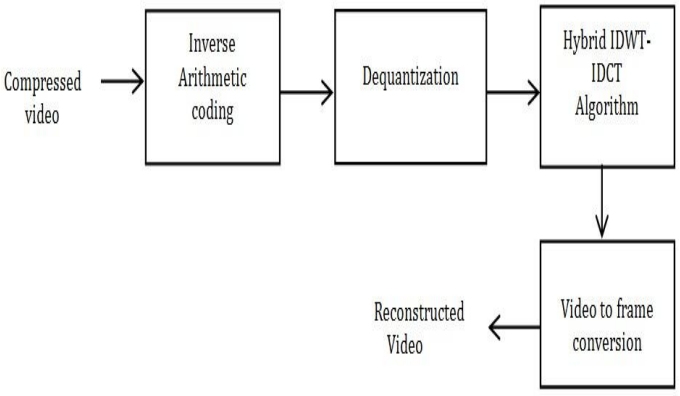

Fig.-2: Video decompression module

It is reverse procedure of compression. The coded bits are first inverse arithmetic coded[3]. After that de-quantization is performed. Output of dequtanizer is first inverse DCT transformed and then inverse DWT computed. The output of hybrid DCT-DWT is the reconstructed video frames. This frames are applied to the video to frame conversion block which satisfies the persistence of vision property for proper visualization of video[5]. The output video can be tested by comparing the size of it with original video. The output video will be similar to the input video.

4. PERFORMANCE PARAMETERS

4.1 Compression Ratio (CR)

The compression ratio is used to measure the ability of data compression by comparing the size of the compressed frame to original frame.

$$\text{Compression Ratio} = \frac{\text{Compressed Frame Size}}{\text{Original Frame Size}} \quad \ldots\ldots\ldots 1$$

4.2 Mean square error (MSE)

MSE is the mean of squared error in the decompressed frame . It compares the origin data and reconstructed data and results the level of distortion. The MSE between origin data and reconstructed data is

$$MSE=\frac{1}{m*n}\{\sum_{m=1}^{M}\cdot \sum_{n=1}^{N}(X1(m,n)-X2(m,n)\hat{}2\} \ldots\ldots 2$$

X1 is the original image and X2 is the reconstructed image.

4.3 Peak Signal to Noise Ratio(PSNR)

PSNR is one of the important parameter that used to check image quality .

PSNR is given by,

$$PSNR=10\log_{10}\left|\frac{255}{\sqrt{MSE}}\right| \quad \ldots\ldots\ldots\ldots\ldots\ldots 3$$

where MSE is Mean Square Error.

PSNR is one of the important parameter that used to check image quality .

5. EXPERIMENTAL RESULTS

5.1 Results

Frame 1 Frame 2

Frame 3 Frame 4

Fig.-3: Video to frame conversion

This frames are then compressed individually by hybrid DCT-DWT algorithm and then stored in the storage space. The stored frames are in .mat format and that are not viewable. This is the compressed version of the video.

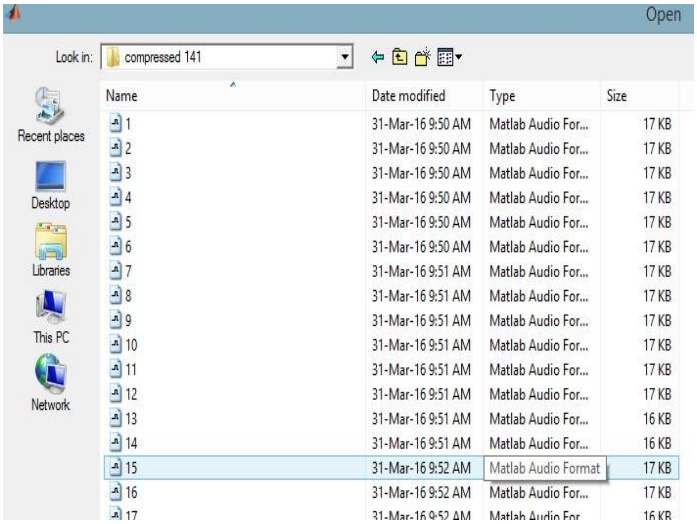

Fig.- 4: Compressed frames

To reconstruct the video reverse the procedure. It includes inverse arithmetic, inverse Quantization, inverse DCT-DWT.The output of the inverse DCT-DWT is in frame format as shown in figure 5.

Fig- 5: Decompressed frames

This frame are applied to frames to video converter. This frames are changed fast enough that it appear as video.

5.2 Result analysis

We calculated the analysis parameters for only four frames. The average compression ratio achieved is 11.50, average MSE is 14.10, average PSNR is 36.34

Table -1: Result analysis

Parameter	Frame 1	Frame 2	Frame 3	Frame 4
Original frame size (KB)	195	196	195	196
Compressed Frame Size(KB)	17	17	17	17
Compression Ratio (CR)	11.47	11.52	11.47	11.52
MSE	14.4354	14.4354	14.4354	13.9580
PSNR	36.5356	36.5356	36.5356	36.2826

6. CONCLUSION

video compression technique have important role in entertainment and the communication but it is limited by storage space and bandwidth of transmission medium. Hybrid method of video compression solves this problem to great extent. It reduces the size of the storage space and transmission bandwidth without affecting the quality of the video.

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