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A Robust Video Compression Method Based On LZW Encoding in 2D-DCT Domain

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Abstract— **Video compression is crucial role for managing data in transaction process. The video resolution takes a large bandwidth thus it cannot be transmitted or sent. A compressed video reduces the minimum bandwidth used for its transmission. In this proposed work, video compression is efficiently handled by using 2D-DCT like DCT with Median filter and LZW encoding which gives the high CR than 1D-DCT algorithm. Video is divided into frames and noises are removed by median filter. The frames are expanded into 8x8 pixel blocks. 2D-DCT is working on these blocks followed by, quantization, zigzag model and LZW encoding is applied on transformed data. Finally, the worth of video is capable after compression of video using algorithms is swift with less density. Experimental results of the proposed work ensure the effectiveness and gives peak compression ratio without data loss and excellence of video.**

Keywords— **Video Compression, 2D-DCT, Quantization, ZigZag, LZW (Lempel– Ziv-Welch) Coding, Compression Ratio, Median Filter..**

I. INTRODUCTION

In multimedia applications, it is difficult to deal with transmission of the video due to large. In order to reduce the capacity of data and to reduce the bandwidth, compression technique is used which is employed to original data before its transmission. Video is divided in to frames and difference in the frames are stored, transmitted instead of sending frame one by one which is the idea behind video compression. Compression is classified in to two which are Lossy (original Data!= decompressed Data) and Lossless (original Data = decompressed Data). In lossless compression, data is compressed without loss of data (examples are, Run length Coding, Huffman Coding, LZW (Lempel Ziv- Welch) Coding) and in Lossy compression, data is compressed with loss of data (examples are Vector Quantization, Fractal Coding, Block Truncation Coding, etc.) [1]. Lossy compressors generally obtain much higher compression ratios than do lossless compressors. Among several techniques, DCT is a common method for video compression in which mapping the value from time to frequency domain. In general, DCT is used for being processing of 1D signal but for image and video, use 2D-DCT method. 2D DCT is similar to DCT but main difference is that takes 1D DCT individually to rows and columns [2]. In DCT process, image is split into small blocks and then on each block, DCT is applied. Quantization technique is used to compress each block and in this stage, less frequency is eliminated. Original image can be restored through decompression by applying Inverse DCT [3]. Transposition buffer is needed in between one DCT which is row wise transformation and another DCT which is column wise transformation.

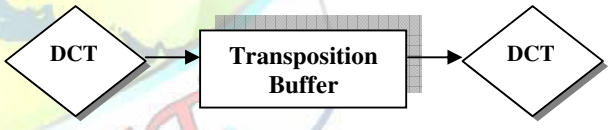

Fig.1 Basic DCT Transformation

Lossless compression is essential in applications such as text file compression. Lossy compression is acceptable in many imaging applications. In video transmission, a slight loss in the transmitted video is not noticed by the human eye. The purpose of Median filtering is remove the noises which is called as nonlinear method. This noise reduction is done at pre-processing step to get best results for the next level processing and also help to preserve edges while this noise reduction from an image. It is very useful to eliminate "Salt and Pepper Noise". Median Filter going through the image pixel by pixel and substitute one value with median of neighboring pixel. Neighbors pattern is known as "Windows" which slides, pixel by pixel, over the total image. For odd entries of windows, it is just the middle value after all the entries in the window are sorted numerically [4]. For an even number of entries, there is more than one possible median. LZW [Lempel – Ziv-Welch] is a "dictionary based coding" which uses dictionary to store the word patterns called as lossless compression algorithm. In LZW, Character sequences in the original text are replaced by codes that are dynamically determined. Both person the sender and receiver have dictionary, repeated patterns are encode by index to reduce the amount of information being transmitted. This dictionary based coding can be static which is fixed in encoding and decoding process. Otherwise it can be dynamic which is

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modifying on the time of fly. In LZW compression process, extracts sub string from uncompressed form of strings and then stored in dictionary as a new entry and assign index value to it [5]. If the code is already present in the dictionary, it adds the character to the current work string. The code table is not encoded into the compressed text, because it may be reconstructed from the compressed text during decompression. Decompression process is similar to compression process but inverse. Compression constraints are Quality, Complexity, Delay, and CR. Quality means compressed video doesn't lose its quality beyond acceptance level. A complexity indicates that is not too complex when run this algorithm. Delay means compression algorithm takes optimum time to execute and CR stands for Compression Ratio which is the ratio of original file size to compressed file size. If CR level is increase, then quality also good. Else, quality of video is lost.

II. Related Work

Harjeetpal singh *et al.* [6] use combination of DWT, DCT and Huffman Encoding Techniques for compressing image. In this method, image is partitioned into 16x16 blocks and transformed these blocks by using 2D-DWT. Higher frequencies are eliminated and Lower frequency LL is passed to next phase and decomposed by using second level 2D-DWT. Detailed coefficients are eliminated and applied 2D-DCT to LL. Then Huffman codes are used to obtain compressed image. To reconstruct the image, inverse procedure of encoding is applied. This method is used in many applications such as telemedicine, wireless Capsule endoscopies. Performance is evaluated by PSNR and get higher compression ratio when comparing to standalone DWT and DCT.

Vivek Arya *et al.* [7] have proposed DCT2 method with Huffman coding for compressing medical image. In this method, the image is split into 32 blocks of 8x8 size and DCT2 is employed on each block. The next step is to calculate mean for every block and this mean matrix is transposed. This transposed matrix is convert into vector form and then, arranging coefficients in order to select. Thereafter Zig-Zag coding and Huffman coding is applied to get compressed image. This method ensures that quality of the encoded, decoded image is improved as well as higher CR, PSNR values.

Er. Abhishek Kaushik *et al.* [8] have proposed image compression based DCT technique. In this proposed methodology, image is divided into 8x8 blocks then extracting non-zero coefficients on each and every block. While reconstructing an image, subtract non-zero coefficients from 64 to obtain zero coefficients. Performance of this method is evaluated by calculating parameter MSE. Experimental results of given image get MSE = 0 which is showing that favorable reconstruction is obtained at selection of highest coefficients. Further, it is concluded that successive frames in video transmission showing higher temporal correlation.

A new combination of LZW and BCH is proposed by A. Alarabeyyat *et al.* [9] for lossless image compression. LZW technique is used to reduce the value which is replicated and BCH code is used to detecting or correcting the error. In proposed method, BCH code is repeated till inflation is detected to improving CR. Data set of 20 images are tested by using this proposed method and results are evaluated with the help CR, Bits per pixel. Compression ratio of the proposed method is 1.636383 that means it is better than RLE, Huffman and LZW techniques.

Dalvir Kaur *et al.* [10] have proposed a new method naming Huffman Based LZW Lossless Image Compression using Retinex algorithm. In this method, three steps are involved. Compress image using Huffman coding, Then again compress Huffman coding words using LZW and Retinex algorithm is applied to enhance the contrast and improve the quality on compressed image. MSE, PSNR, CR is measured to evaluate the performance of this novel proposed method.

III. Proposed Method

This method is based on the 2D-Discrete Cosine Transform where video is the input of the proposed system. In this method, input video is divided into frames and the noises are removed from these frames by using Median filter technique. To achieve High CR ratio, Median Filter is applied to it before encoding process and these noise free frames are partitioned in to 8x8 pixel blocks. Each block is transformed using 2D DCT which performs two DCT on 8x8 blocks and transformed blocks are quantized through quantization table. Next these 8x8 blocks can be done for zigzag scanning to get 64 coefficients by convert 8x8 matrixes. Finally, LZW encoding technique is employed to the resultant video. After that Original data and compressed data are equal and therefore it has no loss of information. Simultaneously the process of video compression is similar to video decompression by applying reversely.

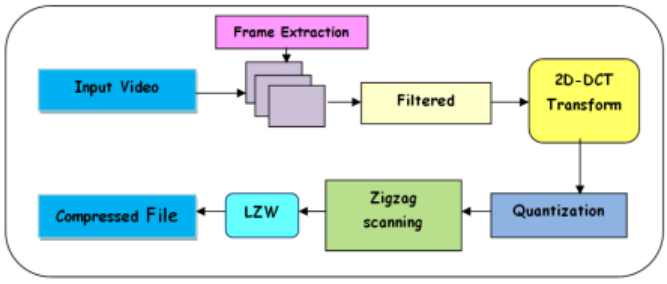

Fig.2 Block Diagram of Proposed method

A. Proposed Algorithm

Algorithm 1: Algorithm for Video Compression.
Step 1: Input- Video Clip

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Step 2: Divide the input video into frames.
Step 3: Remove noise from this frame by using Median filter.
Step 4: Now, this filtered frame is divided into 8x8 pixel blocks.
Step 5: Applying 2D-DCT on these frames.
Step 6: Transformed frames are quantized using quantization table.

Step 3: Apply Inverse Zig-Zag.
Step 4: Every block is de-quantized.
Step 5: Then apply inverse of 2D-DCT on each block.
Step 6: Output: Original Video.

IV. RESULTS AND DISCUSSION

A. *Experimental Results*

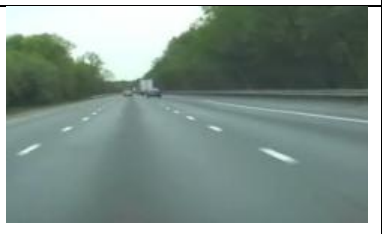
Step 7: Scan the block values in zigzag manner to exploit zero coefficients.
Step 8: Apply LZW lossless compression algorithm to compress video.
Step 9: Output: Compressed Video

Algorithm 2: Algorithm for Video Decompression .

Step 1: Input: Compressed video
Step 2: To decompress the video, apply LZW decoding technique.

We have conducted a series of experiments to evaluate the performance of the proposed depth compression techniques. We have tested with the various test sequences with different resolutions in the color video. In this work, the AVI file has been set as input video sequence on which compression is performed. Table 1 Shows results of video in sequences.

TABLE I
EXPERIMENTAL RESULTS OF THE PROPOSED METHOD IN VARIOUS SAMPLE VIDEOS

Video Name	Original Video	Compressed Video
barcodes		
vipbarcode		
vipunmarkedroad		
viplanedeparture		

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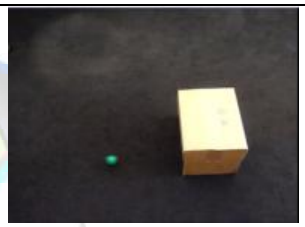
vipmen		
fil_cat		
singleball		

B. Performance analysis

Table 2 shows the proposed video compression techniques and its compression ratio. It shows the video resolution, frame/sec properties and its compression ratio for AVI videos compressed by proposed method. The minimum compression obtained is 3.56 and on average it is above 7, it is concluded that the proposed system is far better in terms of compression ratio obtained.

TABLE III
PERFORMANCE OF THE PROPOSED METHOD IN VARIOUS SAMPLE VIDEOS

Video Name	Resolution	Frame /Sec	Compression Ratio
barcodes	640×480	30	10.97
vipbarcode	320×240	30	8.46
vipunmarkedroad	320×240	1	11.28
viplanedeparture	360×240	30	3.56
vipmen	160×120	30	7.22

V. CONCLUSIONS

In this paper, the proposed work mainly focused on improving the compression quality of the video files. 2D-DCT and LZW encoding technique has been effectively used for providing video compression efficiently. It is concluded that the higher data redundancy helps to achieve more compression as well as original and compressed video is equal in quality enhanced to the video contrast. In the future work it is, suggested that the video can be compressed for storing and transmitting can be done by the other higher level transforms such as Wavelets, Neural networks etc, to improve the compression ratio.

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