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HEVC VIDEO COMPRESSION USING DWT AND BLOCK MATCHING ALGORITHM

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ABSTRACT

Uncompressed videos fetched from video cameras generally takes huge disk space approx 18MB per second. When these uncompressed videos are required to be shared over internet it would take huge time to upload or download. To overcome these situation videos need to be compressed so that it can be digitally distributed. This process is also known as transcoding. In the event of transcoding it is essential to ensure the quality of the video is not compromised and overall size of the video is reduced. Transcoding or compression is the process of segregating the video in to digital tracks, decoding the individual tracks to eliminate the high RGB and redundant pixels. In the existing paper video compression was tested using DCT (discrete cosine transformation), However there are few know issues on DCT such as artifacts blocking. In this paper testing is performed using DWT (discrete wavelet transformation) and there by the input coding is not overlapped by another 2-D blocks. In the proposed work PSNR value is improved when compared to the existing work.

Keywords: discrete wavelet trasformation (DWT), discrete cosine transformaion (DCT), HEVC, Block Matching algorithm.

1. INTRODUCTION

Compression is a process of reducing the size of audio files or video files. To achieve high compression ration the audio files or video files needs to be encoded and decoded from one form to another form. While doing so some details get lost and it is generally called as lossy process. However the video can be losslessly compressed if the frames are individually encoded, the input and output video is also losslessly compressed.

In general compression is a two step process where the original video is initially encoded to an intermediate form and later it is decoded to the same target format or any other different format.

Multiple layers of encoding can be applied on the coding units to perform various activities like noise reduction, depth correction, mode mapping etc., It is essential to ensure the quality of the video is not compromised after the compression process.

High Efficiency video coding (HEVC) [1] [2] is the latest video standard that is developed on top of previous video coding standard H.264/MPEG. When compared to H.264 the latest standard is said that it would provide double compression to that. In the proposed work transcoding of the digital video [3] liaise on the latest HEVC coding standard [4].

DWT (Discrete Wavelet transformation) is one of a most famous transformation method, here we try to indentify the moving/changing and non-moving pixels between frames and try to eliminate the stagnant pixels [5] and thereby reducing the video size.

DWT method can be found efficient or more useful for compressing high definition slow motion videos as the motion between frame to frame is very minimal and also high definition slow motion videos has higher bit rate compared to the fast motion videos [6].

Usage of DWT method is not much recommended or seen beneficial in case of Wyner-Ziv [7] where the focus is more on low end or low cost videos. In most of the Wyner-Ziv based transcoder a low complexity MPEG-2 to H.264 [8].

Usage of Discrete wavelet Transformation (DWT) can also be said more beneficial when compared to Discrete cosine transformation (DCT) where the focus is more on the content modeling[9, 10] due to the known drawback that surface with the usage of DCT.

2. PROPOSED TRANSCODER

For Compression methods involving discrete wavelet transformation two types of redundancies are to be considered. They are

(a) Spatial redundancy and
(b) Temporarily redundancy.

Spatial redundancy is also called as inter-frame redundancy and it is said when there is a redundancy indentified between pixel (i.e., found mostly on gray scale images or black and white videos).

Temporarily redundancy is also called as intra-frame redundancy and it is said when there is a redundancy identified between frames to frame. (i.e., found mostly on slow motion videos where the moving pixels are less over the frames).

Any video is a combination of the set of frames which is a set of digital images that are timed to run approx 55 digital images per second and 55x60 frames that runs for a minute and forms 1 minute of video.

When any two consecutive frames in a video are seen the difference between the two would be very minimal/negligible and it could not be seen/identified for human eye. Video transcoding plays a crucial role in identifying such changes and convert the video from one format to another format occupying low disk space.

Figure-1 shown below is the end to end flow chart of the raw video processed into a compressed video.

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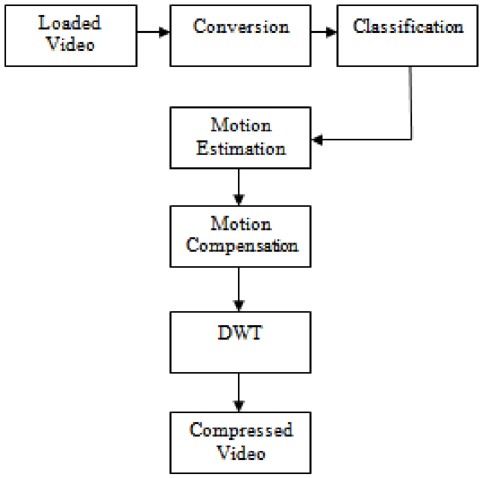

Figure-1. Flowchart for video compression.

A raw video or the uncompressed original video has to pass through multiple layers of internal processing in the coding before it comes out as compressed video with less disk space. Once the videos are compressed they are easily transported/shared over the internet and also they can be easily uploaded or downloaded.

As shown in Figure-1 the input source video is loaded to coding which is then passed to discrete wavelet transformation (DWT) based transcoder/compression process and then the decompressed readable form of output video with less size is produced.

Each of the processes involved in the proposed transcoder is explained more in are detail in the below sections.

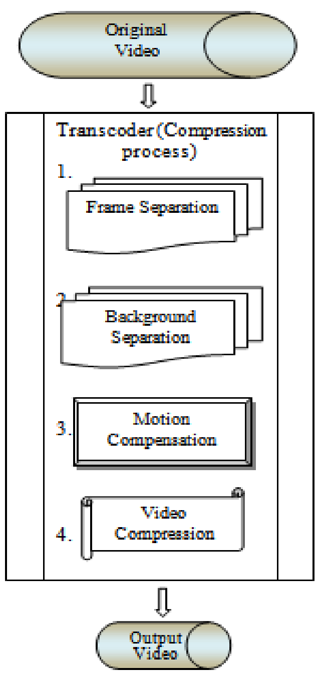

Figure-2. Shows the process of original video compressed to output video.

With the use of DWT process high compression, high resolution and efficiency of the video is increased, same is also shown with the calculation of PSNR value which is much improved compared to DCT based transponders.

Figure-2 shows the individual processes that are involved inside a compression utility.

A. Frame seperation process

Frame separation is a process in which the input video is separated in to individual frames (i.e., approx 1 second of video is separated in to 55 frames). Each frame looks like a digital still image. At this stage the frames are separated as i-frames, p-frames and b-frames.

I-frame is also known as intra frames and these are most common frames that are independently decoded to any other frames.

P-frames are known as predictive frames in forward direction and b-frames are known as backward predictive or bi-directional frames.

Once the frames are separated that are loaded in to coding and kept on buffer for further processing to eliminate the redundant pixels.

B. Background separation process

This is typically called as foreground detection technique. This is the key component of the compression mechanism where it essentially identifies the redundant pixels. This technique is based on the static pixels which do not get to change between frames to frame. A motion is detected only when the foreground is moving and segmented from the background.

Once the non-moving units are successfully separated to those that have the motion next process of motion compensation is applied.

C. Motion compensation process

Coding units at this stage have already passed through frame separation and background separation process. In motion compensation process only those frames and those macro blocks that are identified with the motion are taken in buffer.

Initially before processing for motion compensation, motion estimation is carried which would give a tentative estimation on how many frames or macro blocks that can be compensated using block matching algorithm.

In motion estimation the movements of macro blocks are identified by using p-frame (predictive frames). Those frames that have minimal movement of macro blocks are compensated with the p-frame and b-frame.

Motion compensation is only possible on p-frames where the motion could be predicted, however it cannot be applied on I-frame which is a completed independent frame.

D. Video compression process

Once the motion compensation process is completed the video now need to be built from the buffers that are constructed out from background separation and

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motion compensation process. All the redundant frames are eliminated at this stage and resultant video is in compressed form lesser in size compared to the original video.

Efficiency of the compression ratio and bit stream is calculated with the new PSNR value. The resultant video is not necessary to be of separate format, it can be of the same format of the input video also.

3. EXPERIMENTAL RESULTS

In the proposed work PSNR value is observed and measured. By using discrete wavelet transformation (DWT) we get more efficient PSNR value.

A sample video of 2.5 MB is loaded to the process using load input video as shown in Figure-3. This sample video is divided in to individual frames via frame separation process as shown in the Figure-4, there by the original video of 2.5 MB (3seconds) is separated in to 55 frames.

Once the frames are separated successfully the unwanted clusters from identical frames are identified and eliminated. In motion compensation the 55 frames are now compensated to new set of 55 frames as shown in Figure-5.

These new frames are now passed to video compression and in video compression process the individual 55 frames are rejoined to form the video using 10 frames and they by the video size reduced significantly. In the proposed work we observed the PSNR value as 45.85 as shown in fig6 and this is much improved when compared to the previous paper which had the PSNR value around 26.

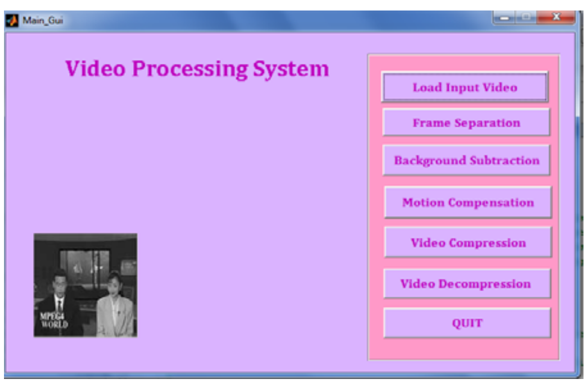

Figure-3. Sample video is loaded.

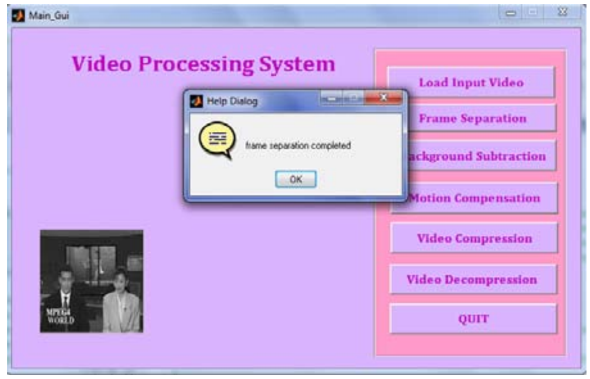

Figure-4. A loaded input video is separated into frames.

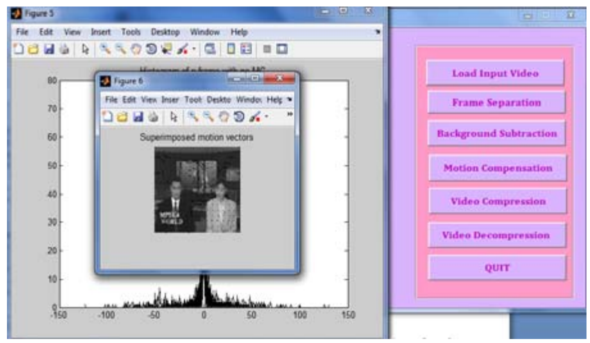

Figure-5. Super imposed motion vector frames formed after motion compensation process.

Figure-6. Above image shows the calculated PSNR value after video compression process.

4. CONCLUSIONS

We proposed a video transcoder based on Intra-frame redundancy and it is achieved using techniques of DWT, Quantization and Entropy coding. Temporal redundancy, also known as Inter-frame redundancy is achieved using this technique. It is observed that when the motion is compensated using frame based block matching method and also there by reducing the matched blocks the resultant video is reduced significantly. However, these blocks resemble constant over the frames until any motion is detected in following frames. When the blocks size is further increased to achieve greater compression ratio it is observed the video quality is compromised and seen blurred.

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For future use the DWT based transcoding can be explored further using any of the hybrid combinations to study compression ration without compromising the video quality.

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