Performance analysis of lossless Compression for High Frame Rate Videos

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Abstract

Lossless compression of high frame rate video is very critical task due to high resolution of video content. The high resolution of video content occupied more storage and bandwidth space for transmission of video. The motion of video destines the frame rate of video. The high rate of frame creates a image of that video. The process of compression compromised with loss of frame. The loss of frame distorted the quality of video. Now a day's various authors used video compression technique based on transform function and HV.2.64 model for encoding technique. in this paper evaluate the performance of video compression technique using different compression technique. The DCT is employed in a multitude of compression standards due to its remarkable energy compaction properties. Multiplier-free approximate DCT transforms have been proposed that offer superior compression performance at very low circuit complexity. Such approximations can be realized in digital VLSI hardware using additions and subtractions only, leading to significant reductions in chip area and power consumption compared to conventional DCTs and integer transforms.

Keyword: - Video compression, High frame rate video, transform function.

INTRODUCTION

Mobile equipment in the current generation is not only used for speech transfer but also for watching a video, video telephony, video streaming and live streaming. Video streaming requires a lot of complex circuits, bit rate etc. Implementing these complex circuits requires a lot of space which may not be provided by the mobile telephone manufacturers [2]. The development in the chip technology has helped the mobile telephony manufacturers and researchers working on the video streaming to easily implement complex circuits on integrated chips which can be easily deployed in the mobile phones. Video telephony can be done through some software's such as for example Skype where the video is compressed to a major extent; the compressed data is transmitted and is displayed to the end user. Video streaming is watching a video sequence from the websites where the videos are uploaded and saved in the website servers. Some of the frequently used video streaming sites are youtube.com, kycrickethighlights.com etc [10]. Live streaming can be used to watch live telecasts happening at any part of the world in our computer. Some of the websites providing live streaming are you tube, NDTV etc. All the above mentioned video streaming applications require lots of space and bandwidth to be transmitted. But the mobile manufacturers are provided with limited bandwidth and space. Hence video compression is required where the video sequence is compressed to major extent and is transmitted using less bandwidth than what is required for transmitting the uncompressed video sequence [6]. The video researchers are facing a real challenge in fulfilling the requirements of the end user whose ultimate aim is to watch a high quality video sequence. The end users are not interested in knowing about the compression rate, bit rate etc., of the video sequence. Providing a good quality video at lower bit rate, higher compression ratio is a challenging task to the researchers working in video domain. A combination of technology advances, market expansion and increased user expectation is driving more demand for better quality video. H.264/ MPEG-4 Part 10/ Advanced Video Coding is an open video compression standard which is currently the most commonly used codec for compression, storage and transmission of high definition video [1]. H.264 provides a set of tools that can be used in different ways to compress and transmit visual information. H.264 is a block based motion compensated codec standard, which is developed as a combined effort from ITU-T (International Telecommunication Union) and ISO (International Organization for Standardization). H.264 is the name used by the ITU-T and MPEG-4 part 10 is the name used by the ISO. Flickering occurs mainly due to the coarse quantization from frame to frame and is mainly observed in static regions of the frame [4]. Flickering also occurs due to different prediction techniques from frame to frame and is most annoying when intra only coding is used compared to periodically inserted intra frames. Section-I gives the introduction of the video compression and high fame rate. Section-II gives the information of encoder technique. In section III discuss the method of video compression. In section IV discuss comparative result finally, in section-V conclusion and future scope.

II VIDEO ENCODER

In this section discuss the video encoder technique. Now a day's used various video encoder techniques such as MPEG-4 decoder and HV264. Here discuss the HV264 encoder and predictor. A video codec encodes the video sequence into a compressed bit stream and decodes this to reproduce an exact or approximated copy of the original video sequence. If the decoded sequence is identical to the original sequence, it is a lossless compression technique else it is a lossy compression technique. H.264 is a lossy compression technique [5]. A video encoder performs three functions: Prediction, Transformation and Quantization and Encoding. A video decoder performs the complementary process of the encoder i.e. decoding, inverse transformation and reconstruction. A typical video codec is as shown below:

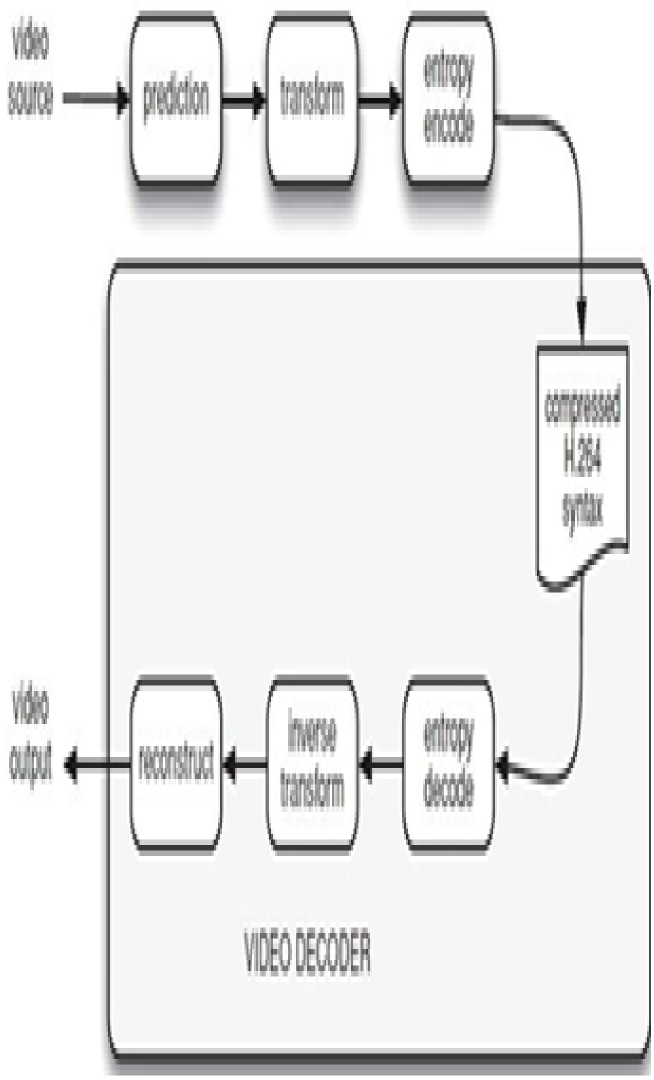

Figure 1: The H.264 video coding and decoding process.

The ultimate goal of video codec is to represent a compressed video sequence with less number of bits and with high fidelity. In general, lower bit rate gives a lower video quality at the decoder [11]. Hence the goal of the video codec manufacturers is to provide a codec which gives a better video quality at the decoder at lower bit rates. A H.264 encoder takes raw video sequence as input data and gives an encoded bit stream as output. In H.264, data is processed in units of blocks known as macro blocks (MB). In the encoder, a prediction macro block is subtracted from the original macro block to form a residual macro block which is transformed and quantized and encoded to bit stream which is stored or transmitted [1]. The quantized data are rescaled and inverse transformed and added to Prediction macro block and the reconstructed macro block is stored for future predictions.

III VIDEO COMPRESSION TECHNIQUE

In this section discuss the video compression technique. The video compression technique divide into two types one is lossy video compression and another is lossless video compression [9]. The lossy video compression technique is very efficient and compressed the video at very high compression rate. Instead of that the lossless video compression, the compression rate is very low. How to improve the compression ratio is major issue. For the improvement of compression ratio of video various encoders are used. Here we discuss three encoding technique MPEG, DCT and HV.264

MPEG VIDEO ENCODER

MPEG video is broken up into a hierarchy of layers to help with error handling, random search and editing, and synchronization, for example with an audio bit stream. From the top level, the first layer is known as the video sequence layer, and is any self-contained bit stream, for example a coded movie or advertisement. The second layer down is the group of pictures, which is composed of 1 or more groups of intra (I) frames and/or non-intra (P and/or B) pictures that will be defined later. Of course the third layer down is the picture layer itself, and the next layer beneath it is called the slice layer [3]. Each slice is a contiguous sequence of raster ordered macro blocks, most often on a row basis in typical video applications, but not limited to this by the specification. Each slice consists of macro blocks, which are 16x16 arrays of luminance pixels, or picture data elements, with 2 8x8 arrays of associated chrominance pixels. The macro blocks can be further divided into distinct 8x8 blocks, for further processing such as transform coding. Each of these layers has its own unique 32 bit start code defined in the syntax to consist of 23 zero bits followed by a one, then followed by 8 bits for the actual start code. These start codes may have as many zero bits as desired preceding them.

DCT VIDEO ENCODER

In general, neighboring pixels within an image tend to be highly correlated. As such, it is desired to use an invertible transform to concentrate randomness into fewer, de-correlated parameters. The Discrete Cosine Transform (DCT) has been shown to be near optimal for a large class of images in energy concentration and de-correlating. The DCT decomposes the signal into underlying spatial frequencies, which then allow further processing techniques to reduce the precision of the DCT coefficients consistent with the Human Visual System (HVS) model. The DCT/IDCT transform operations are described with Equations 1 & 2 respectively.

$$F(\mu,\nu) = \frac{1}{4} C(\mu)C(\nu)\sum_{x=0}^{7}\sum_{y=0}^{7} f(x,y)\cos\left[\frac{(2x+1)\mu\pi}{16}\right]\cos\left[\frac{(2y+1)\nu\pi}{16}\right] \quad ..1$$

$$C(\mu) = \frac{1}{\sqrt{2}} \ for \ \mu = 0$$

$$C(\mu) = 1 \ for \ \mu = 1,2,\ldots,7$$

$$f(x,y) = \frac{1}{4}\sum_{\mu=0}^{7}\sum_{\nu=0}^{7} C(\mu)C(\nu)F(\mu,\nu)\cos\left[\frac{(2x+1)\mu\pi}{16}\right]\cos\left[\frac{(2y+1)\nu\pi}{16}\right] \quad ..2$$

HV2.64 VIDEO ENCODER

H.264/MPEG4-AVC is the video coding standard of ITU-T Video Coding Experts Group (VCEG) and the ISO/IEC Moving Picture Experts Group (MPEG). H.264 has been adopted by the Motion Picture Experts Group (MPEG) to be a key video compression scheme in the MPEG-4 format for digital media exchange. It is also known as MPEG-4 Part 10 and MPEG-4 AVC (Advanced Video Coding). H.264 delivers the same quality as MPEG-2 at a third to half the data rate, and when compared to MPEG-4 Part 2, H.264 provides up to four times the frame size at a given data rate [13]. A profile defines specific encoding techniques that you can or can not utilize when encoding the files (such as B frames), while the level defines details such as the maximum resolutions and data rates. For each profile, 16 levels can be applied, each specifying a typical frame size, frame rate, and maximum data rate. The same 16 levels are used for each profile. In other words, levels are used to limit performance, bandwidth and memory requirements. Each level defines the bit rate and the encoding rate in macro block per second for resolutions ranging from QCIF to HDTV and beyond.

IV PERFORMANCE EVALUATION

For the comparative performance evaluation here we are using Matlab software for the implementation with using different number of methods, we find that the value of CR and PSNR for the different number of videos. Here we using videos from the you tube and some other resources available easily for the implementation. The value of CR and PSNR we get the maximum value for the MPEG video converter than the some other methods such as DCT video converter and HV 2.64 VI encoder.

	MPEG VIDEO ENCODER		DCT VIDEO ENCODER		HV 2.64 VIDEO ENCODER	
D	**CR**	**PSNR**	**CR**	**PSNR**	**CR**	**PSNR**
0	**4.54**	**35.24**	**3.45**	**31.78**	**3.13**	**26.38**
1	**5.64**	**38.29**	**4.58**	**34.26**	**4.53**	**31.24**
2	**6.48**	**42.13**	**5.68**	**36.28**	**4.35**	**31.26**
3	**5.68**	**39.64**	**4.87**	**34.61**	**4.32**	**29.38**
4	**6.32**	**38.74**	**5.69**	**34.56**	**4.37**	**28.37**
5	**6.24**	**36.49**	**5.48**	**31.26**	**4.21**	**27.64**

Table 1: Shows that the comparative performance evaluation for the different number of video converter method.

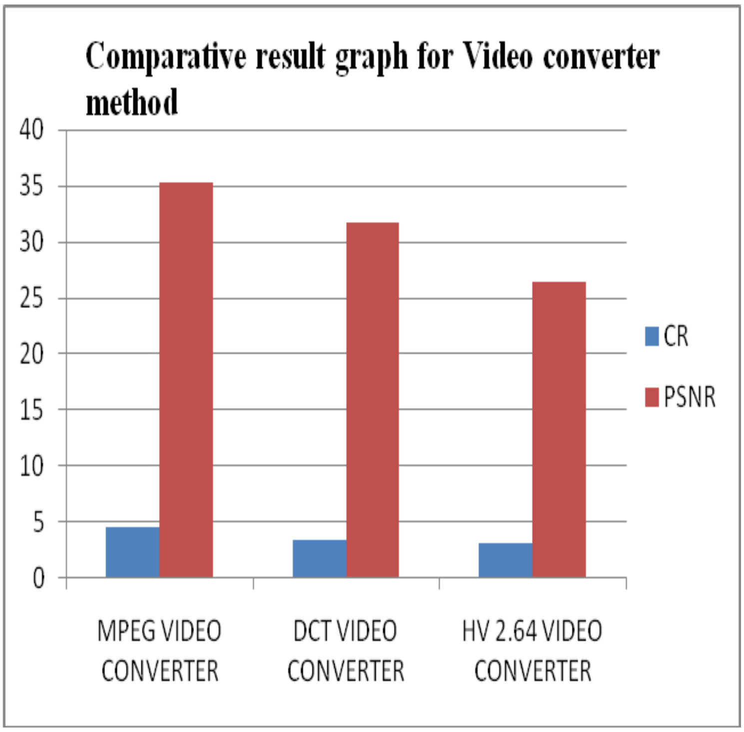

Figure 2: Comparative result graph for the value is 0 using different number of comparative method.

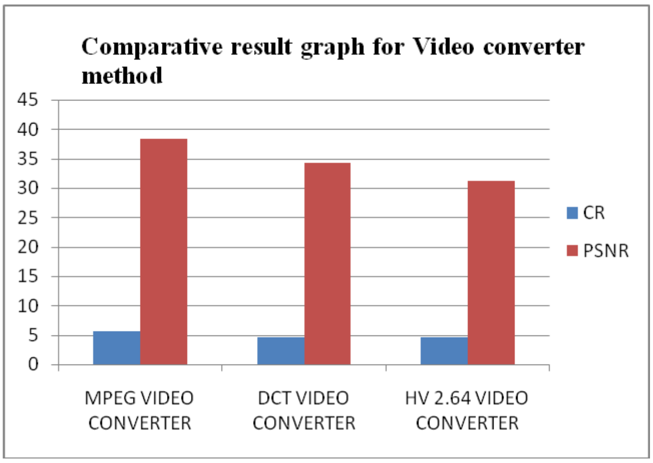

Figure 3: Comparative result graph for the value is 1 using different number of comparative method.

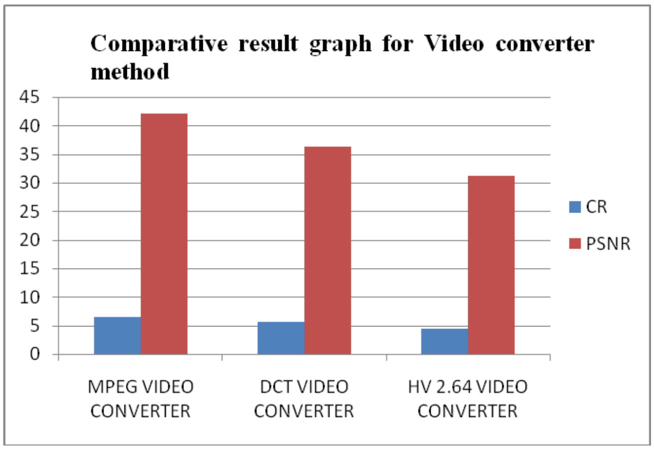

Figure 4: Comparative result graph for the value is 2 using different number of comparative method.

V CONCLUSION AND FUTURE WORK

In this paper present the experimental review of video compression technique. Here used three video compression techniques one is MPEG, DCT and HV2.64. The performance of MPEG video encoder is good in compression of DCT and HV2.64. The ratio of compression in all these cases is very low. It is observed that MPEG performs better than DCT at lower values of the metrics. However DCT surpasses the performance high values of the metrics. This observation is based on the variance in rate corresponding to a particular value of the metric. Use of multiple interleaves helps in decreasing the variance of the rate corresponding to a metric value. Simulation results confirm the argument. Decision tree performs better than Bayesian estimation for rate estimation at the encoder. Decision tree constructed using the attributes DCT and HV2.64 predicts the rate with high accuracy. It has also been observed that the decision trees built from a sequence which covers both high motion and low motion frames can be used for any video sequence.

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