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VLSI ARCHITECTURE FOR 3-D DWT BASED VIDEO CODING USING BITPLANE ENTROPY ENCODING

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ABSTRACT

The paper explains high-speed video encoding based on 3-D discrete wavelet transform using bitplane entropy encoder. Novel low-complexity bit-plane entropy coding of wavelet sub bands is explained here. Subsequently entropy encoding based on parent-child sub band tree was realized. The proposed entropy encoding can be as well adopted for spatial-domain motion-compensated temporal filtering based video coding and, pooled with complexity scalable motion compensation, be able to attain better rate-distortion-complexity performance for highly complex encoding modes. The aim of the project is that the effective memory utilization, low complex computations, reduced power consumption and the reduced amount of data transferring.

Keywords: entropy coding, parent child relation, 3-D DWT.

INTRODUCTION

Video coding and transmission are core technologies used in numerous applications such as methods like streaming, conferencing, surveillance, broadcasting etc and so on. Taking into account high bit error rates, packet losses and time-varying bandwidth, the scalable video coding (SVC) is the preferable compression method for video transmission. A scalable extension of the H.264/SVC standard, which is currently the most received video coding approach, includes temporal, spatial and excellence scalability and provides high compression effectiveness due to motion compensation and inter-layer prediction exploiting the video source temporal idleness and redundancy among unlike layers [11].

Compression fundamentally means reducing image data. A digitized analog video sequence can consist of up to 165 Mbps of data. To reduce the media overheads for distributing these sequences, the following techniques are commonly employed to achieve popular reductions in image data: Decrease color nuances within the image, reduce the color resolution with respect to the prevailing light intensity, take away tiny invisible parts of the image and evaluate neighboring images and take out details that are unmoved between two images. The first three are image based compression techniques, where only one frame is evaluated and compressed at a time. The final one is video compression technique where dissimilar adjacent frames are compared as a way to additional condense the image data. All of these techniques are based on a precise understanding of how the human brain and eyes work jointly to form a complex visual system. As a result of these reductions, a significant reduction in the resultant file size for the image sequences is realizable with little or no critical effect in their visual quality. The extent, to which these image modifications are humanly able to be seen, is typically needy upon the degree to which the elected compression technique is used. Frequently 50% to 90% compression can be achieved with no visible difference, and in a number of scenarios even beyond 95%.3-D DWT based video encoding method as an alternative for DCT in H.264 using efficient bitplane entropy coder is mentioned here.

EXISTING COMPRESSION FORMATS

There are two basic categories of compression; lossless and lossy. Lossless compression is a class of algorithms that will allow for the accurate original information to be reconstructed from the dense data. In the case of Lossy compression, data is condensed to a degree. There are two vital organizations that develop image and video compression standards: International Telecommunications Union (ITU) and International Organization for Standardization (ISO).

Motion JPE offers flexibility both in terms of brilliance and compression ratio.JPEG 2000 was bent as the follow-up to the successful JPEG compression, with better compression ratios. Motion JPEG 2000 is generally calculated not as high-quality as a Motion JPEG stream, and Motion JPEG 2000 has not at all been any achievement as a video compression technique. The H.261 and H.263 are not International Standards but only recommendations of the ITU. There are different compression techniques like MPEG-1, MPEG-2, MPEG-3, MPEG-4, MPEG-7 & MPEG-21.H.264 is the newest generation standard for video encoding. It offers high-quality video at substantially minor bit rates than preceding standards and with enhanced error robustness – or superior video quality at an unchanged bit rate.

VIDEO COMPRESSION

The wavelet transform (WT) has attained widespread acceptance in signal processing and image compression. Because of their inherent multi-resolution nature, wavelet-coding schemes are especially appropriate for applications where scalability and tolerable degradation are important. Recently the JPEG committee has freed its new image coding standard, JPEG-2000, which has been based upon DWT. Wavelet transform, decomposes a signal into a set of basic functions. These basis functions are called wavelets. Wavelets are got from

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a single prototype wavelet y (t) called mother wavelet by dilations and shifting.

The wavelet transform is estimated independently for different pieces of the time-domain signal at various frequencies. Multi-resolution analysis gives analyzes the signal at different frequencies giving different resolutions.MRA is intended to give good time resolution and poor frequency resolution at high frequencies and good frequency resolution and poor time resolution at low frequencies. Good for signal having high frequency components for short durations and low frequency components for long duration. E.g. Images and video frames. To use the wavelet transform for volume and video processing we should implement a 3D version of the analysis and synthesis filter banks. In the 3D case, the 1D analysis filter bank is useful in turn to each of the three dimensions. If the data is of size N1 by N2 by N3, after implementing the 1D analysis filter bank to the first dimension we have two sub-band data sets, each of size N1/2 by N2 by N3. After applying the 1D analysis filter bank to the second dimension we have four sub band data sets, each of size N1/2 by N2/2 by N3. Applying the 1D analysis filter bank to the third dimension provides eight sub-band data sets, each of size N1/2 by N2/2 by N3/2.

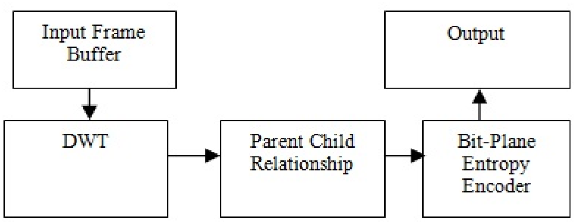

Figure-1. Block diagram of video compression.

In the case of DWT, no need to divide the input coding into non-overlapping 2-D blocks, it has higher compression ratios avoid blocking artifacts. It allows good localization both in time and spatial frequency domain. Transformation of the entire image bring in inherent scaling and Better identification of which data is relevant to human perception to higher compression ratio. It has higher flexibility. Wavelet function can be generously chosen and rejection needs to divide the input coding into non-overlapping 2-D blocks, it has higher compression ratios avoid blocking artifacts. The Transformation of the whole image introduces inherent scaling.

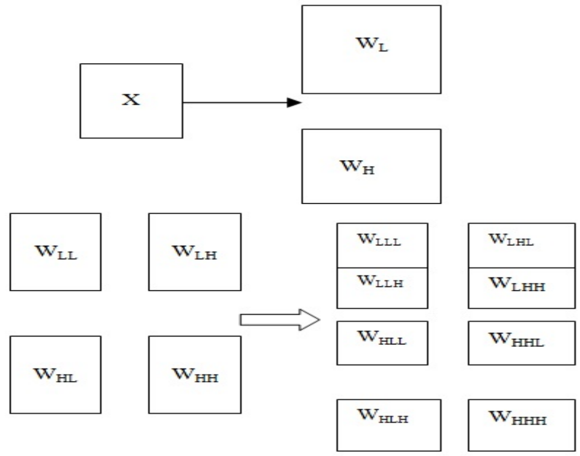

Figure-2. DWT.

After applying the DWT part it is given to the entropy encoder using parent child relationship. For a 8*8 block image there will be 1 dc component, 3 parent, 12 children's & 48 grandchildren's.

The encoding is taking place in the bit plane entropy encoder. For gray scale images the maximum pixel value will be in the limit of 2^8.so that 8 biplanes has been used for the process. Data is transmitting parallel using 8 bitplanes. Here it is setting flag for each bitplanes and whenever the flag set for a data, it is transferring only from the maximum binary representation of pixel value. One more channel is used to indicate the MSB bit. Both data and sign bit transferred separately for effective memory utilization. The hardware in this project was Spartan-6 FPGA. The entire simulation result for video transmitter is shown below.

Figure-3. Video transmitter using Bitplane entropy encoder.

FUTURE VIDEO/IMAGE COMPRESSION

- Improved low bit-rate compression performance
- Improved lossless and lossy compression
- Improved continuous-tone and bi-level compression
- Be able to compress big images
- Use single decompression architecture
- Transmission in noisy environments
- Robustness to bit-errors
- Progressive transmission by pixel accuracy and resolution
- Protective image security

CONCLUSIONS

A study has been conducted based on 3-D DWT real time codec based system. The main advantageous is that it has got a low complexity bit plane entropy coding with the rate control has been discussed. The proposed codec shows a lower computational difficulty compared to the most well-organized software implementation of H.264/AVC with similar rate-distortion performance [11]. It shows effective memory utilization when compared to the other systems. The simulation results show that area is reduced and the power consumption is reduced.

The proposed codec is not compared with a scalable extension of the H.264/AVC standard, since the authors have not created any open source real-time software implementation of it. But, taking into account that H.264/SVC has lesser rate-distortion performance and more computation complexity (due to additional inter-layer prediction, input frame down sampling, etc.) than H.264/AVC single-layer coding, our scalable video compression method can be extra preferable than H.264/SVC in numerous applications where computational complexity and scalability plays a significant role.

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