Indian Journal of Science and Technology, *Vol 9(29), DOI: 10.17485/ijst/2016/v9i29/91008, August 2016*
ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645

Lossless DWT Image Compression using Parallel Processing

Ruby Patel*

School of Computing, SASTRA University, Thanjavur - 613401, Tamil Nadu, India; ruby.patna@gmail.com

Abstract

Discrete Wavelet Transform (DWT) provides more improvements in the quality of the image without losing quality and information of images. Parallel processing reduces power and area and it gives high throughput and nice performance and very useful in VLSI. It is used in a number of DSP applications like HD video compression; biomedical imaging and we get the image data in redundancy format without reducing image data. Here two parallel Discrete Wavelet Transform is passed through original image using two filter high pass and low pass.

Keywords: Discrete Wavelet Transform (DWT), Image Compression

1. Introduction

Image compression is used for extremely large data storage, video conferencing and medical imaging purpose. Nowadays the use of telecommunications, multimedia sources like cameras, mobile phones, transfer of data is increasing very fastly. Uncompressed images always capture more area and also bandwidth. Our main target to compress image to save our memory space for other purpose. If we are reducing the memory spaces that will be very useful in many applications like hospitals, shop, museums, security cameras etc. with the decrease of data storage the communication costs is also will decrease. When the data is no longer in use then it can be removed, and again it can inserted when we are going to use.

LOCO-I[1] attains compression ratios similar or superior to those obtained with state-of-the-art schemes based on arithmetic coding. Moreover, it is within a few percentage points of the best available compression ratios, at a much lower complexity level. We discuss the principles underlying the design of LOCO-I, and its standardization into JPEC-LS. Image enhancement technique is among the simplest and most appealing area of digital image processing[2]. Wavelet[3] and curve let transformations are widely used transformations techniques to carry out compression. The best wavelet packet bases[4] exhibit SFFT (Short-time Fast Fourier Transform) sub-band decomposition at one source instance, intermediate wavelet packet decomposition at yet other instances to best match the signal's characteristics. To factories WFB, self-lifting takes one part of a filter as the factor to decompose the other part of the same filter and obtains two factorized filters in one pass, whereas cross-lifting based one takes one part of a filter as the factor to decompose the corresponding part of the other filter and obtains one factorized filter in one pass[5]. Image compression is used to reduce the size of the bitmap without compromising on the quality of an image[6]. This enables to store large number of images in the same given amount of storage space.

In image compression the images or data are coded in bits. The multimedia data will be in video, audio, web formats. If we are downloading images from the net then that time it will reduces time. So, time performance also nice. By compression methods we can reduce the storage cost and speed and performance will be increase. Image compression is used to minimize the file without changing any state or quality of images. Suppose an image has size 100 kb and by compressing we get 70 kb sizes, so we save 30 kb memory for other multimedia operations. Thus, by this compression techniques it will be very good in future telecommunication systems and many multi-

Author for correspondence

media applications .the image is represented in pixel and each pixel is represented in bits. There are 4 maximum level of grey scale.

The compression systems have two types:

- **Lossy compression techniques:** In this the unnecessary content is discarded. When we have to save little more storage then some data we may discard.
- **Lossless compression:** In Lossless compression we are computing the data without losing any information. Here; we get the exact same image of our original image.

In a lossless compression algorithm, we are getting the same image in exact format without losing the informations.in this every even single bit of data also will be remains same after compressing the images. All the information and data will be restored. It don't have high compression ratio and is very useful in losing words and financial problems where it will create problems. It is widely used in medical reports x rays or any legal reports. Entropy coding, Huffman coding are the methods for lossless image compression Methods.

In Lossy image compressions it reduces the file by permanently eliminating some information especially the redundant data. Lossy compression is used in video signal or audio signal where if we remove some data also, it can't be detected by the most users. Encryption, however, also adds some overhead in both the time and space domains[7]. To be scalable, a system that relies heavily on encryption should use as efficient algorithms as possible.

2. Discrete Wavelet Transform (DWT)

The Figure 1 shows the 1-D DWT. DWT is the sum of all wavelets functions, they are known as wavelets, having different location .in numerical and functional, dwt wavelets are discretely sampled. It covers both frequency and time related information. In which the first process to pass the samples through low pass filter and again it has to be passed through the high pass filter and next we are getting the convolutions of that both. The two filters are similar to each other. After getting the filter outputs that has to be down sampled by 2, and through low pass filter we are getting approximate coefficient and by high pass filter we are getting detail coefficients.

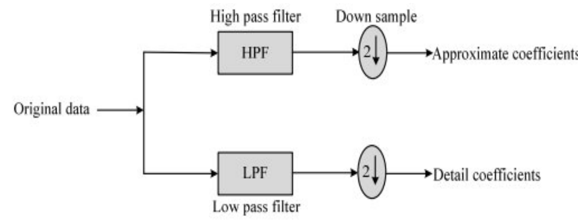

Figure 1. 1 D-DWT.

Nowadays dwt is a very perfect method in image-compression tool by the knowledge of research activities because of data reduction. Wavelets are wave like oscillation with amplitude which starts with zero, again increases and again decrease and again come to zero. Wavelets are signals that are frequency and time related so it has irregular shape. It has a zero average value. The wavelet integrates to zero that is wave up signals and also wave down across the axis. From different images the wavelets extracts the different sub bands by the use of different sub band coding. And through different quantizes it will be quantized that will give better compression. Through shifting and scaling methods the mother wavelet is represented to decompose the signals. After decomposing a signal into component wavelets, the wavelets coefficient has to remove some of the decimated details.

Wavelet transform describe signals in time as well as in frequency domain. There are two parts of signal decomposition. High frequency contains the detailed part and low frequency contains approximated parts. The output came from high-pass-filter, low-pass-filter, the image is again decomposed in 4 parts and these are LL, HH, LH, HL.LL is the sum of vertical low-pass-filter and horizontal high-pass-filter. HL is sum of horizontal high-pass-filter and vertical low-pass-filter. LH is sum of horizontal low-pass-filter and vertical high-pass-filter. HH is sum of horizontal high-pass-filter and vertical high-pass-filter. The 4 sub bands, the first half block is vertical details and second half is the horizontal details. Second lower is diagonal blocks.

The Figure 2 shows the Discrete Wavelet Transform (DWT) image processing by filtering process is passed through encoding and decoding schemes. First in encoding scheme the input image has to be passed by high-pass-filter and low-pass-filter on first by row basis and next by column basis respectively. Both of the outputs of high-pass-filter and low-pass-filter are combined then that output has to down sampled by 2. We completed by row filtering, now same thing we have to do with column basis. Now that row output has to passed through the high-pass-filter and low-pass-filter by column filtering. And output of both is combined. And that output is again has to down sampled by two. And finally we will get our compressed image.

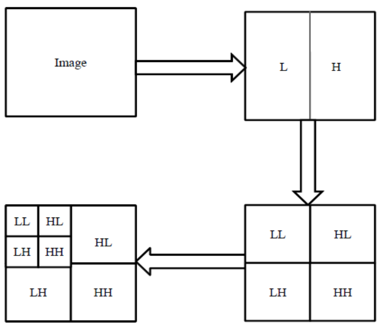

Figure 2. Two level wavelet decomposition applied on an image.

The decoding scheme is not the just reverse of encoding process. Now we have to take the low-pass-filter-image and high-pass-filter-image, after extracting the images has to be up sampled by 2 units. We have to sum both of images into single image. Now in next section again we have to extract we have to through low-pass-filter image and high-pass-filter image by vertically. The summand of both images is the reconstructed image. By filtering techniques the images splits into four bands splits, LL, HL, LH and HH respectively as shown in Figure 3.

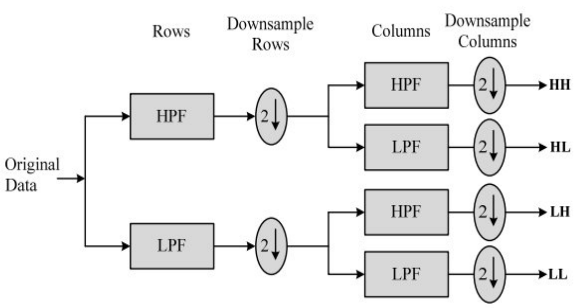

Figure 3. 2-D DWT by filtering method.

There is two type of filter in above operation:

- High-pass-filter: high frequency related overall information is given more prior than low frequency information.
- Low-pass-filter: low frequency related overall information is given more prior than high frequency information.

3. D-DWT Parallel Processing

DWT works on whole image by folding an image to the maximum level to compress a gray scale image. DWT has less time complexity than other techniques. Using parallel processing we can split into two rows and it will give less area and gives low power and then the high throughput will be there and nice performance and very useful in VLSI.

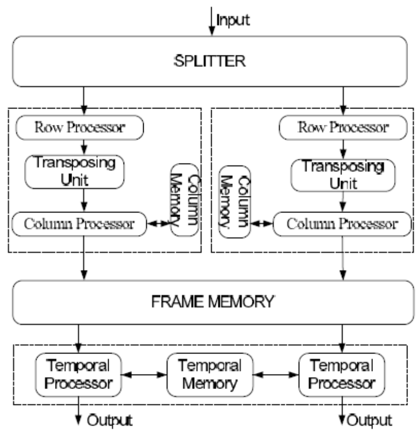

Figure 4. 2-D DWT using parallel processing.

Figure 4 shows the two dimensional DWT using parallel processing. Proposed algorithm is useful in memory reduction, throughput, the power using parallel 2-D DWT processors and temporal DWT processors. The input splits into two row processors, and it is fed to the transposing unit and followed by column processors. For parallel DWT processors requires memory of N*N+8N and for temporary processors is 3N*N. The proposed parallel processing consumes less power because it has less memory addressing, read and write memory and hence very suitable for and multimedia devices.

Figure 5 shows the hardware architecture of an image processing. First the image is send to MATLAB coding and we will get the images in into pixel value. And each pixel will be in the text format. And it read by file reading. And it is forwarded to DWT as an input. Then the DWT splits into two dimensional DWT using parallel processing.

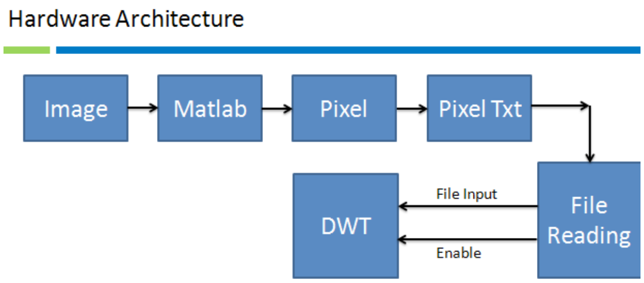

Figure 5. Hardware architecture of an image processing.

4. Conclusion

In this paper two dimensional Discrete Wavelet Transform using parallel processing is presented. By this way our computation works has been performed and it reduces the complexities and the 5.5 filter is used. From the satisfactory simulation results till first level decomposition we can conclude that computation works properly. Table 1 shows the device utilization summary. It reduces the number of slices and hence the area and power and gives high throughput. The performance is very useful in VLSI.

Table 1. Device utilization summary

Device utilization summary (estimated values)			
Logic utilization	**Existing Architecture**	**Proposed Architecture**	**% of reduction**
Number of slices	632	319	50%
Number of slice flip-flops	1130	270	76%
Number of 4 input LUTS	850	516	39%
Number of bonded IOBS	66	10	85%
Number of GCLKs	1	1	0%
Maximum frequency, MHz	353.107	75.240	79%

5. References

1. Weinberger MJ, Seroussi G, Sapiro G. The LOCO-I lossless image compression algorithm: Principles and standardization into JPEG-LS. IEEE Trans on Image Processing. 2000; 9(8): 1309-24.
2. Singh M, Goswami AD. Image compression technique using hybrid Discreet Cosine Transform (DCT) and Discreet Wavelet Transform (DWT) method. International Journal of Advanced Research in Computer Science and Software Engineering. 2012; 2(10):13-7.
3. Grgic S, Grgic M, Zovko-Cihlar B. Performance analysis of image compression using wavelets. IEEE Transactions on Industrial Electronics. 2001; 48(3):682-95.
4. Kharate GK, Pati VH. Colour image compression based on wavelet packet best tree. International Journal of Computer Science. 2010 Mar; 7(2):31-5.
5. Daubechies I, Sweden's W. Factoring Wavelet Transforms into Lifting Schemes. The Journal of Fourier Analysis and Applications. 1998; 4(3):247-69.
6. Singh M, Goswami AD. Image compression technique using hybrid Discreet Cosine Transform (DCT) and Discreet Wavelet Transform (DWT) method. International Journal of Advanced Research in Computer Science and Software Engineering. 2012; 2(10):217-23.
7. Verma OP, Agarwal R, Dafouti D. Performance analysis of data encryption algorithms. IEEE 3rd International Conference on Electronics Computer Technology (ICECT); 2011. p. 399-403.