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Implementatıon of JPEG-XR/HD System Archıtecture for Image Compressıon

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ABSTRACT: This paper presents the importance of JPEG-XR/HD in the area of high dynamic range images (HDR). JPEG-XR/HD is based on integer based coding technology. It can support compression of different HDR formats. The main advantage of JPEG-XR/HD is high compression efficiency and low computational complexity. Image compression plays a vital role in various applications like Big Data, Internet, Telemedicine etc.In this paper a lossless JPEG-XR/HD design has been proposed with well timing concept and high dynamic range.This paper shows how effectively an entropy encoder has been designed which is an important component in JPEG-XR/HD.

KEYWORDS: Image compression, JPEG-XR/HD ,Pulse core transform, Interger coding, HDR, Entropy encoder.

I.INTRODUCTION

Image compression plays a vital role in several important applications, including telemedicine, remote sensing, medical imaging etc. Still image compression standard nowadays an active area of research.Eventhough JPEG2000 is an improvement over the traditional JPEG.But JPEG is the most widely used compression method.Data compression is playing a significant role in saving storage space efficiently [1]. Currently a new image coding standard JPEG-XR/HD has been introduced by JPEG Committee. Lapped Biorthogonal Transform (LBT) and advanced huffman coding is used in the JPEG-XR/HD. JPEG XR delivers a better perceptual quality than JPEG at the same bit rate, and implements both lossy and lossless compression. Many advanced multimedia applications require image compression technology with higher compression ratios and better visual quality[2]. The JPEG-XR/HD design has been verified in [3][4] using different architectures.For High defnition(HD) photo and High dynamic range(HDR) JPEG-XR/HD is very much useful.Compared to JPEG2000,less computaional cost is possible with JPEG-XR.

II.RELATED WORK

The experimental results shows that JPEG-XR/HD proved to be better when compared to JPEG and JPEG2000 results. The JPEG-XR/HD capable of encoding millions of samples at a high throughput [5], [6]. The existing compression techniques may handle pixel values at low dynamic range typically 8 bits per pixel whereas JPEG-XR/HD can handle pixel values with high HDR typically 16 or 32 bits. The unique feature of JPEG-XR/HD is it supports different HDR formats. JPEG XR aims to be the compressed format of choice in the HDR space.JPEG XR is a draft international standard underwent standardized by the JPEG committee, based on a Microsoft technology known as HD Photo. One of the key developments in the draft JPEG XR standard is its integer-reversible hierarchical lapped transform. The remaining part of the paper is organized as follows: Section II describes the proposed architecture of the JPEG-XR/HD and covers the details about the implementation of the algorithm. Section III explores the comparison of the simulation results using MATLAB and VLSI to input images on applying the JPEG-XR/HD codec. Finally, section IV states the work conclusion.

III.PROPOSED ALGORITHM

A. *Design Considerations:*

The VLSI architecture for JPEG XR system for high defnition photo has been proposed in this paper.Therefore, JPEG XR can save data format with more detailed data format than JPEG.Discrete wavelet transform (DWT), transforms a discrete time signal into a representation of a small wave having varying frequency on limited duration. DWT decomposes given signal frequency into low frequency and high frequency components as shown fig 1.

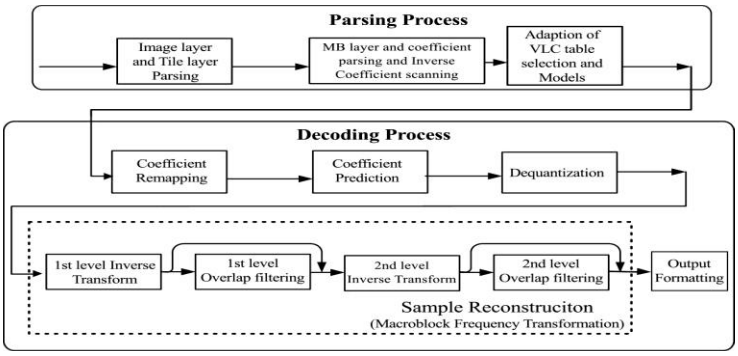

Fig 1.Block Diagram of Proposed JPEG XR/HD System

B.Description of the Proposed Algorithm:

In JPEG XR lapped bi-orthogonal transform has been used. This transform is based on two operations namely photo core transform and photo overlap transform. The lapped transform can be obtained by the concatenation of PCT and POT.PCT can be applied at each stage of transformation where as POT can be applied based on some controlling factors like disabling and enabling of stages. In order to improve the visual quality by JPEG XR, there is a need to express PCT into a polynomial expansion. In some cases, POT is optional where as PCT must be applied for every block of a macro block. The color conversion is necessary in order to match to the characteristics of human eyes. The color conversion equations are

$$V = B - R \qquad (1)$$

$$U=-[R-G+[V/2]] \qquad (2)$$

$$Y=G+[U/2]-offset \qquad (3)$$

For digital cinema (DC) compression JPEG XR is much more suitable than JPEG2000. Like DCT,A 4x4 PCT is applied to each block in order to obtain 1 DC coefficient and 15 AC coefficients. The DC coefficients of all the blocks are collected forming a DC block.JPEG XR is considered as a block transform in spatial domain, where the transform operates on the spatial hierarchy of the image.

The proposed VLSI architecture provides less hardware in the design, find out the critical path and achieves less power consumption. The systolic array VLSI architecture uses pipelining to compute the operations. The architecture mainly consists of adders and multiplexers. This is an efficient VLSI architecture for the implementation of PCT.The advanced very-long instruction words (VLIW) having 256 bits wide consisting of four floating point ALUs, two fixed point ALUs and two multiplexers. The VLIW is fetched by CPU in order to supply eight, 32-bit instructions to 8 functional units such as ALUs and multipliers during every clock cycle.

IV.PSEUDO CODE

Step 1: Read the image from the input source
Step 2: The original image is converted into YUV space
Step 3: Dividing the YUV space into macro blocks
Step 4: Apply photo core transform on macro blocks
Step 5: Perform incrementation for every macro block of the vector M_1 do
    I=I+1
    Read M_1 (I)
    M_2 (I) = Shift Right M_1 (I) by 4 bits
    M_2 (I) = Shift Left M_2 (I) by 4 bits
    M_3 [color, freq] = check consecutive pixels (M_2)
    Decimal values of M_2.

Step 6: For each element of M_3 do
    k=k+2
    F=F+1
    If F <= 15 then
        M_4 (F) =M_3 (k) + M_3 (k-1)
    Else

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$Q = M_3 (k) / 15$

Step 7: Reminder = M_3 (k) MOD 15
Step 8: Repeat
F=F+1
M_4 (F) =M_3 (k) + 15
Q =Q -1

Step 9: Until (Q <= 0)
Step 10: F=F+1
Step 11:M4 (f) =M3 (k) + Reminder
Step 12: End
Step 13: Apply quantization for coefficients
Step 14: The coefficients are encoded

V.SIMULATION RESULTS

A) MATLAB Results

The previous results have been carried out by comparing with JPEG and JPEG2000.Nowadays JPEG XR compression technique has been compared with the JPEG and JPEG2000.The performance measures PSNR,MSE and CR obtained using JPEG XR are also compared with JPEG and JPEG2000.The various images have been implemented using MATLAB and also using Cadence EDA. To evaluate the performance of the proposed unified architecture, different PCT architectures are compared in terms of hardware complexity, hardware utilization, computing complexity, critical path and system power consumption
The proposed JPEG XR/HD architecture can be implemented using MATLAB. The results have been compared with jpeg and jpeg2000.

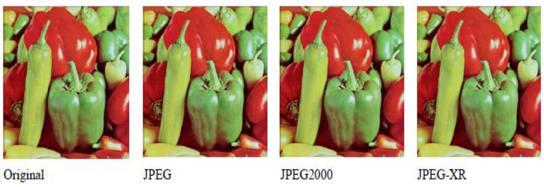

Fig 2. Comparison of results between jpeg,jpeg2000 and jpeg xr

(a) (b)

Fig 3. a) JPEG XR b) JPEG

The color image is 512x512 Lena is used for testing with JPEG and JPEGXR While comparing with JPEG, JPEG XR compression performance is very high. And it also has the feature of flexibility of the code stream.

Table 1:Comparison between the parameters

Method	Compressed File Size	CR	MSE	PSNR
JPEG	135278	1.4538	122.61	27.2455
JPEG 2000	128163	1.5344	126.56	27.1078
JPEG-XR	122325	1.6077	130.02	26.9907

B) CADENCE EDA RESULTS

The proposed architecture has been implemented using cadence EDA under 180nm technology. The results show that there is a drastic decrease in the area and power consumption compared to the existing architectures.

Table 4. Comparison of delay and power of the proposed Architecture

Parameter	Architecture[1]	Proposed
Critical path delay(ns)	23.25	19.23
Power(mW)	19.45	11.39

VI.CONCLUSION AND FUTURE WORK

In this paper, a three-stage pipelining of lossless JPEG XR encoder was proposed to process the capacity and hardware utilization All the transform operators are implemented as lifting steps using only integer operations. The paper shows how lossless and lossy compression of multiple HDR formats can be achieved using JPEG XR codec with better compression efficiency and less computational complexity due to the arithmetic calculations on integers. The proposed design can be suitable for HDR formats effectively. For future research the high performance hardware implementations of PCT is necessary.

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BIOGRAPHY

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