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Implemented of Supervised Table Spiht Algorithm in Vlsi Processor for Image Transmission

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***Abstract*- Image coding is to represent an image with as few bits as possible while preserving the level of quality and intelligibility required for the given application. In this project we use the Supervised Table Set-Partitioning In Hierarchical Trees (STSPIHT) algorithm. In which the lookup table is supervised for the transmission of images to preserve the brightness and contrast. Approach supports progressive transmission which makes maximum use of all previously transmitted data. With progressive transmission, one can have a rough picture of the image transmitted and access it before the end of the transmission. When this algorithm is implemented in the VLSI processor the number of gate levels is reduced. The processing speed for the transmission is increased by 85% when compared to the existing methods.**

I. INTRODUCTION

A digital image is an array of real or complex numbers represented by a finite number of bits. Any image in the form of photograph, transparency or char is digitized and stored as a matrix of binary digit in computer memory. This binary digit in the computer memory is displayed on a high resolution television, monitor or displays. The basic classes of problems and application in image processing is a) image representation and modelling b)Image enhancement c)image restoration d)Image analysis e)Image reconstruction f) Image data compression.

Image data compression is concerned with minimizing the number of bits required to represent an image. Perhaps the simplest and most dramatic form of data compression is the sampling of band limited images, where an infinite number of pixels per unit area is reduced to one sample without any loss of information. Consequently, the number of samples per unit area is infinitely reduced.

Applications of data compression are primarily in transmission and storage of information. Image transmission applications are mainly applicable in broadcast television, remote sensing, and computer communication. Image storage is required for educational purpose applications and business documents applications, and medical images that arises in digital radiology, and computer tomography, motion pictures and so on. Application of data compression is also possible in the developments of fast algorithms where the number of operations required to implement an algorithm is reduced by working with the compressed data.

II. DATA AND BANDWIDTH COMPRESSION

The process of converting an analog video signal into a digital signal results in increased bandwidth requirements for transmission. Data compression techniques minimize this cost and sometimes try to reduce the bandwidth for the digital signal below its analog bandwidth requirements. Although digitized information has advantages over its analog form in terms of processing flexibility, random access in storage, higher signal to noise ratio for transmission with the possibility of errorless communication, and so on, and one has to pay the price in terms of this increase in bandwidth.

The applications of multimedia technologies increases day by day, by this image compression techniques needed high performance with new features. To achieve this specific area in image encoding, a new standard developed i.e.., JPEG 2000. This developed standard not only provides rate distortion and image quality performance to existing methods, but also it provides functionalities and features of existing standards, here are some representative features of provided method i.e.., lossy compression and lossless compression, progressive transmission by resolution and by pixel accuracy, embedded lossy coding and lossless coding, and robustness to the region-of-interest coding and the presence of bit-errors.

The JPEG2000 is mainly designed fulfil the requirements of a diversity of application like internet, printing, digital scanning, colour facsimile, digital photography, mobile applications, medical image applications, E-commerce, digital library applications and remote sensing applications etc..,

A joint adaptive power allocation and channel coding optimization scheme is proposed. This scheme exploits the difference in importance among bits used to represent a video signal or an image. To find optimum combination of coding and power to use for the transmission of individual bits this offline iterative algorithm is developed. Optimality here is in the sense of minimizing the mean square error (MSE) which results in a better quality of the reconstructed image. The bits of significant importance should always be coded and allocated most of the transmitted power while bits of less significance may be sent without coding and with less allocated power in simulation results. This is done by maintaining at the same level of average per-bit energy level. When compared to the case of coding alone Simulation results also shows that the proposed combined approach achieves a gain of about 3 dB. In addition to the proposed scheme outperforms the case of power allocation alone while reducing the peak-to-average power ratio (Mohamed El-Tarhuni, 2010).

A novel image coding scheme using M-channel linear phase perfect reconstruction filter banks (LPPRFB's) in the embedded zero tree wavelet (EZW) framework introduced by Shapiro. The innovation here is to replace the EZW's dyadic wavelet transform by M-channel uniform band maximally decimated LPPRFB's, which offer finer frequency spectrum partitioning and higher energy compaction. The implementation of transform stage can be done as a block transform which supports parallel processing mode and facilitates region of-interest coding/decoding. To employ a minimal number of delay elements and are robust under the quantization of lattice coefficients, the transform boasts efficient lattice structures to implement in hardware. All attractive properties of the EZW coder and its variations such as idempotency, progressive image transmission, exact bit rate control ,embedded quantization, will retained by The resulted compression algorithm. Despite its simplicity, our new coder outperforms some of the best image coders published recently in literature for almost all test images (especially natural, hard-to-code ones) at almost all bit rates (Trac D. Tran, 1999)**.**

A study of the performance difference for both image and video coding of the discrete cosine transform (DCT) and the wavelet transform, while comparing all aspects of the coding system on an equal footing based on the state-of-the art coding techniques. By our studies to make known that, for still images, the wavelet transform outperforms the discrete cosine transform typically by the order of about 1 dB in peak signal-to-noise ratio. The advantage of wavelet schemes is less obvious for video coding. From this we believe that the image compression algorithm and video compression algorithm should be addressed from the overall system viewpoint: Instead of spending all the efforts on optimizing the transform (ZixiangXiong, 1999), we can give more importance on the complex interplay among elements of the coding system, quantization, and entropy coding.

A method to realize the joint application layer coding for image transmission over deep space channels has been presented. In more technical detail, both image compressions, based on algorithms such as JPEG2000 and CCSDS, and encoding techniques, such as LDPC codes, to protect the sent images are simultaneously applied by the proposed mechanism. It is based on the Multi-Attribute Decision Making theory and in terms of Bit Error rate, it acts on the bases of the deep space channel conditions. In practice, this proposal targets to protecting the essential informative contents of images sent through a deep space network and, at the same time, allows minimizing the load offered (the total amount of data to transmit) by the overall application layer coding process to the deep space network. The presented mechanism has been tested through simulations. The obtained results show the effectiveness of the proposal and open the door to further developments of the method in real systems (Igor Bisio, 2011).

Progressive image transmission (PIT) technique provides the capability that it allows to interrupt the transmission when the quality of the received image has reached a desired accuracy. When the receiver recognizes that the image is not interesting or only a specific portion of the complete image is needed, PIT can also terminate transmission at any point of bit-stream. Newer coding techniques, such as JPEG2000, and MPEG4 standards, have supported the progressive transmission feature.

A progressive image transmission system over wireless channels by combining joint source-channel coding (JSCC), space-time coding, and orthogonal frequency division multiplexing (OFDM). The BER performance of the space-time coded OFDM-based MIMO system based on a newly built broadband MIMO fading model is first evaluated by assuming perfect channel state information at the receiver for coherent detection. Then, for a given average Signal to Noise Ratio SNR (hence, BER), a fast local search algorithm is applied to optimize the unequal error protection design in joint source-channel coding JSCC, subjected to fixed total transmitted energy for various constellation sizes. The expected reconstructed image quality will be measured by this design .The adaptive modulation scheme is proposed for system performance evaluation end-to-end, to pick the constellation size that offers the best reconstructed image quality for each average Signal to Noise Ratio (SNR). By these Simulation results of practical image transmissions confirms the effectiveness of our proposed adaptive modulation scheme (Srikanth.N, 2012).

This paper deals with two interesting application areas of Physics: Signal Processing and Electronics. For the first area; particularly image signal coding for efficient transmission or low memory consumed storage and the signal's information identifying techniques were focused. The low cost, LED display panel was used to display final results. Paper is based on the first stage results of the project for designing of an automated electronic system for coding, transmitting, decoding, data extraction and result displaying of remotely sensed large size image/video still frame signals. The law bit-rate information preserving coding of passive sensor acquired such image signals is one of the major problem for updating the GIS (Geographical Information System), for useful Hiperspectral or Multispectral imaging signal processing and object identification tasks. Here, a modified codec based on the Quadtree Subband Coding Method [1] was implemented. For the 3-D Hiperspectral signal used for surveillance applications, band wise coding approach was introduced and acceptable PSNR values (above 29.14 dB) for very-Low to higher bit rate coding were observed with acceptable quality HVS perception. For the 2-D "Gold hill" test image signal used for urban planning, fairly better window observation results were obtained at larger Compression Rate (CR=80); the coded/decoded image at 0.1bpp. For the next step, Morphological and enhancing techniques were innovatively implemented for identifying faces in the 2-D image signal; "People-gathering"(Ajith.Kumarayapa,2010).

The latency of the critical path and the gate count of the proposed PIE core and other encoders. The gate count of EZT encoder in (Hsiao, 2000) is reported about 5 *K* gates, it is almost twice as proposed PIE core. The gate count of EZW encoder in (Vanhoof, 1999) in about 3889 gates, and the latency of the critical path is 16.53 *ns*. Although, the handling image size of proposed PIE is less than others. While considering larger image size implementation, PIE core only increases the memory size but few the gate count of the circuit. Moreover, the latency of the PIE core is less than EZT in (Hsiao, 2000) and EZW encoder in (OMAKI, 1999). Thus, PIE core is a faster and simpler architecture than others.

An energy efficient JPEG 2000 image transmission system over point-to-point wireless networks. The main objective is to reduce the overall transmission energy consumption with the expected end-to end QoS guarantee and the overall processing, which is achieved by jointly adjusting, transmitter power levels in an optimal way, channel coding rates, and the source coding schemes. Based on the characteristics of the image content, the distortion constraint , and the estimated channel conditions, the proposed power control algorithm, and low-complexity joint source channel coding adjusts the coding and transmission strategies adaptively that which can approximate the solution optimally with a tight bound. This reveals the advantages of the proposed system exists in three aspects i.e.., low complexity, adaptivity, and optimality (Wei Yu, 2003).

A new progressive image coding algorithm called Tag Setting In Hierarchical Tree (TSIHT) had developed, that can save the memory requirement while keeping the low-bit-rate quality high. The Tag Setting In Hierarchical Tree TSIHT algorithm has been implemented onto a chip with 0.35µ 1P4M CMOS technology, in this the chip can handle 256×256 gray-scale images and the gate count is as low as about 2560 gates within 247500 µm2 area. The maximum working frequency can be as high as 158 MHz, and the latency of the critical path is 6.32 ns. (Tsung-Hsi Chiang, 2007). Methodology we have presented an algorithm that operates through set partitioning in hierarchical trees SPIHT and accomplishes completely embedded coding.

In SPIHT algorithm the input image is first decomposed into a number of subbands by means of hierarchical wavelet decomposition. For example, the subbands obtained for two-level decomposition. The special orientation trees are nothing other than the subband coefficients are grouped into sets, which efficiently exploit the correlation between the frequency bands. In each spatial orientation tree the coefficients are then progressively coded from the most significant bit-planes (MSB) to the least significant bit-planes (LSB), starting with the coefficients with the highest magnitude and at the lowest pyramid levels. The block diagram of the encoding and decoding is shown as in the Figure 1.sub bands obtained.

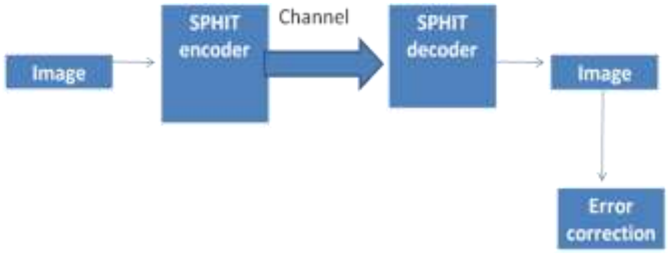

Figure 1.Block diagram of SPHIT Algorithms for image encoding and decoding

The SPIHT multistage encoding process is explained through an image. In an image initially the highest value of pixel is identified. For example consider a part of 8*8 matrix in an image as shown below

10	18	11	32	44	48	55	27
31	17	42	27	28	22	44	56
44	11	11	11	32	19	49	52
56	34	41	42	10	3	10	20
22	43	10	43	10	10	43	17
11	10	11	30	43	49	57	39
18	30	20	43	52	47	34	32
32	12	44	24	39	41	20	19

Now in the matrix the highest value of the pixel value is 57.Now let we assume 32 be the x value. Since the highest pixel values is 57 and its near value of 2^n is 32 when n=5 and when n=6 the value is 64 and it exceeds the highest value of the pixel value in the matrix and so the x value is fixed to 32.After the initializing the next process it the sorting process. In the sorting process a lookup table of size 8 by 8.Compare each pixel with x and if the value is greater than or equal to x put that position in the look up table as 1 and if the pixel is less than the value put that position as 0.In the similar pattern the table will be updated for each pixel. For each 1 value in the lookup table it will subtract the pixel value with x. Now fix the x value as 16 because the next two to the power of n is 4 and repeat the same up above and lookup tables are formed. In the paper we formed the lookup table for n values of 5,4, 3. For each 1 value in the table compare with x value if the value greater than or equal to the x value refinement register will have a 1 else it will be 0.For remaining pixels in the table it will compare with the modified x value and table will be updated with corresponding results. Then for each new pixel value will be subtracted from x value .The x will be reduced 8 and same procedure will be continued until the required level. These lookup will be transmitted .These transmitted lookup tables will be received at the receiver end and then these values will be merged with the empty lookup tables in the receiver end. Now the process is reversed as in the receiving end with respect to transmitting end.

The above encoding and decoding is done by using the FPGA-ALTERA DE2-cyclone board-II. Altera DE2 board become one of the most widely development FPGA board which is used to development of FPGA design and implementations. The purpose of the Altera DE2 Development and Education board is to provide the ideal vehicle for learning about FPGAs, computer organization, and digital logic. ALTERA DE2 uses the state-of the-art technology in both hardware and CAD tools to expose students and professionals to a wide range of topics.

The FPGA-ALTERA DE2 board offers a rich set of features that make it suitable for use in a laboratory environment for university and college courses, for a variety of design and research projects, as well as for the development of sophisticated digital systems. Altera provides a suite of supporting tutorials and supporting materials for the FPGA-ALTERA DE2 board, which are “ready-to-teach” for laboratory exercises, and illustrative demonstrations Figure.2 gives the picture of the DE2 board. All connections are made through the Cyclone II FPGA device to provide maximum flexibility for the user. Thus, the user can be provided to configure the FPGA to implement in any system design. The Nios II Embedded Processor and its Software provided with the DE2 board features the Quartus II Web Edition CAD system. Also board includes several features to help designers and professionals experiment such as tutorials and example applications. Traditionally, manufacturers have provided a variety of hardware features and software CAD tools needed to implement designs on these boards to educational FPGA boards, but very little material has been offered which used directly for teaching purposes. Altera's DE2 board is a significant departure from this trend. For simulation purpose the board is interfaced with monitor through VGA card for the display of the image as shown in figure 2.

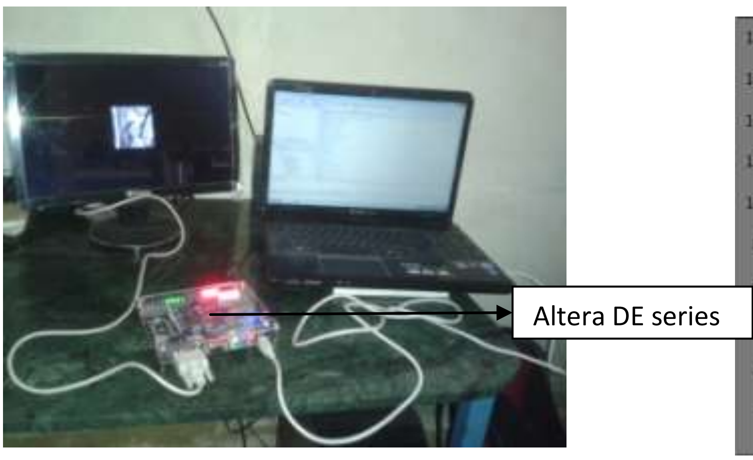

Figure 2.Experimental Setup of Altera for image display in monitor

III. RESULT AND DISCUSSIONS

From the above experimental setup the lena image, figure 4 a is processed for the encoding and decoding and the output image is statistically analysed for the brightness and contrast of the image. The brightness and contrast is measured by using the mean and standard deviation of the image. The table with these values are shown below. The Brightness of the output image compared to the input image is reduced during the transmission and where as the contrast has been increased.

Image	Mean value (Brightness)	Standard Deviation (Contrast)
Input Image	109	44
Output Image	106	46

In the figure 4b the comparison of pixel statics calculated over the image as straight line for the input and output image is shown. From the plot it proves that the pixel values are very close to the input image. Still the image error can improved when the n values 2 and 1 of lookup tables is also transmitted.

Figure 4. A) Input image

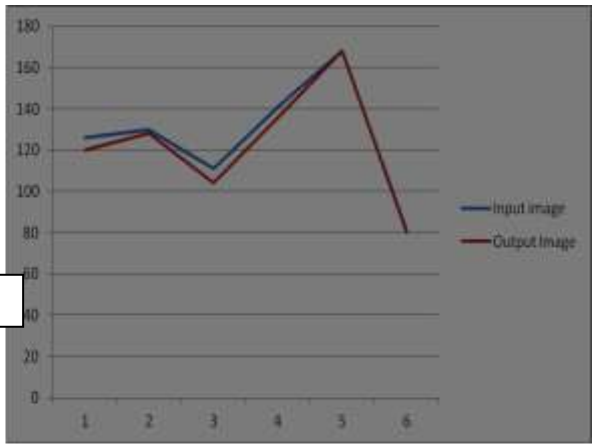

Figure 5. B) The pixels statistics for the line drawn over the image

For a typical 256×256 grayscale image, each entry requires at least 8+8=16 bits of the lists to store the row and column coordinate values. Thus, SPIHT coding needs 2×16×256×256 bits = 256 *K* bytes memory to store both LIP and LSP lists. For a typical 256×256 gray-scale image, both of each TSP and TIP lists need 256×256 bits, and TST list needs 128×128 bits. Thus, TSIHT coding totally needs 2×256×256+128×128 (bits) = 18 *K* bytes memory. For a typical 256×256 gray-scale image,Lut for both tsp and tip need 256×256 bits, and due to parallel processing no need of TST table. Thus, proposed coding totally needs 256×256 (bits) = 6 *K* bytes memory.

Dr. Debmalya Bhattacharya received Doctor of Engineering (Eng.,) Ph.D from Lancaster University, UK from 2003 to 2007 as a full time International Student, currently working as Associate Professor & Dean of Technology in University of Technology & Management, Shillong, India.

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