An Extensive Efficient Technology To Improve The Image Compression Technique in Transform Domain

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Abstract:The Discrete Cosine Transform is one of the most widely transform techniques in digital signal processing. In addition, this is also most computationally intensive transforms which require many multiplications and additions. Real time data processing necessitates the use of special purpose hardware which involves hardware efficiency as well as high throughput. Many DCT algorithms were proposed in order to achieve high speed DCT. Those architectures which involves multipliers ,for example Chen's algorithm has less regular architecture due to complex routing and requires large silicon area. On the other hand, the DCT architecture based on distributed arithmetic (DA) which is also a multiplier less architecture has the inherent disadvantage of less throughputs because of the ROM access time and the need of accumulator. Also this DA algorithm requires large silicon area if it requires large ROM size. Systolic array architecture for the real-time DCT computation may have the large number of gates and clock skew problem. The other ways of implementation of DCT which involves in multiplier less, thus power efficient and which results in regular architecture and less complicated routing, consequently less area, simultaneously lead to high throughput.

Keywords:Image Compression, DWT, IWT, DCT,PSNR.

I. INTRODUCTION

Image compression is very important for efficient transmission and storage of images. Demand for communication of multimedia data through the telecommunications network and accessing the multimedia data through Internet is growing explosively[14].With the use of digital cameras, requirements for storage, manipulation, and transfer of digital images,has grown explosively . These image files can be very large and can occupy a lot of memory.A gray scale image that is 256 x 256 pixels has 65, 536 elements to store, and aa typical 640 x 480 color image has nearly a million. Downloading of these files from internet can be very time consuming task. Image data comprise of a significant portion of the multimedia data and they occupy the major portion of the communication bandwidth for multimedia communication. Therefore development of efficient techniques for image compression has become quite necessary. A common characteristic of most images is that the neighboringpixels are highly correlated and therefore contain highly redundant information. The basic objective of image compression is to find an image representation in which pixels are less correlated. The two fundamental principles used in image compression are redundancy and irrelevancy. Redundancy removes redundancy from the signal source and irrelevancy omits pixel values which are not noticeable by human eye. JPEG and JPEG 2000 are two important techniques used for image compression.

Work on international standards for image compression started in the late 1970s with the CCITT (currently ITU-T) need to standardize binary image compression algorithms for Group 3 facsimile communications. Since then, many other committees and standards have been formed to produce de jure standards (such as JPEG), while several commercially successful initiatives have effectively become de facto standards (such as GIF). Image compression standards bring about many benefits, such as: (1) easier exchange of image files between different devices and applications; (2) reuse of existing hardware and software for a wider array of products; (3) existence of benchmarks and reference data sets for new and alternative developments.

Types Of Compression

Lossless versus Lossy compression: In lossless compression schemes, the reconstructed image, after compression, is numerically identical to the original image. However lossless compression can only a achieve a modest amount of compression. Lossless compression is preferred for archival purposes and often medical imaging, technical drawings, clip art or comics. This is because lossy compression methods, especially when used at low bit rates, introduce compression artifacts. An image reconstructed following lossy compression contains degradation relative to the original. Often this is because the compression scheme completely discards redundant information. However, lossy schemes are capable of achieving much higher compression. Lossy methods are especially suitable for natural images such as photos in applications where minor (sometimes imperceptible) loss of fidelity is acceptable to achieve a substantial reduction in bit rate. The lossy compression that produces imperceptible differences can be called visually lossless.

Predictive versus Transform coding: In predictive coding, information already sent or available is used to predict future values, and the difference is coded. Since this is done in the image or spatial domain, it is relatively simple to implement and is readily adapted to local image characteristics. Differential Pulse Code Modulation (DPCM) is one particular example of predictive coding. Transform coding, on the other hand, first transforms the image from its spatial domain representation to a different type of representation using some well-known transform and then codes the transformed values (coefficients). This method provides greater data compression compared to predictive methods, although at the expense of greater computational requirements.

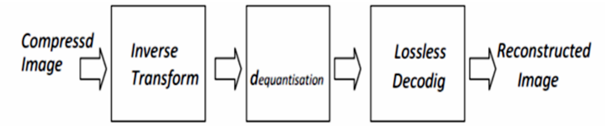

Fig.1.1 Image Compression Model

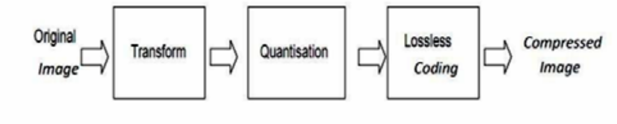

Fig.1.2 Image Decompression Model

Image compression model shown here consists of a Transformer, quantizer and encoder.

Transformer**:** It transforms the input data into a format to reduce interpixel redundancies in the input image. Transform coding techniques use a reversible, linear mathematical transform to map the pixel values onto a set of coefficients, which are then quantized and encoded. The key factor behind the success of transform-based coding schemes is that many of the resulting coefficients for most natural images have small magnitudes and can be quantized without causing significant distortion in the decoded image. For compression purpose, the higher the capability.of compressing information in fewer coefficients, the better the transform; for that reason, the Discrete Cosine Transform (DCT) and Discrete Wavelet Transform(DWT) have become the most widely used transform coding techniques.

Quantizer: It reduces the accuracy of the transformer's output in accordance with some pre- established fidelity criterion. Reduces the psychovisual redundancies of the input image. This operation is not reversible and must be omitted if lossless compression is desired.

Symbol (entropy) encoder: It creates a fixed or variable-length code to represent the quantizer's output and maps the output in accordance with thecode. In most cases, a variable-length code is used. An entropy encoder compresses the compressed values obtained by the quantizer to provide more efficient compression. Most important types of entropy encoders used in lossy image compression techniques are arithmetic encoder, huffman encoder and run-length encoder.

II. METHODOLOGIES USED FOR IMAGE COMPRESSION

THE DISCRETE COSINE TRANSFORM: DCT Attempts to decorrelated the image data after decorrelation each transform coefficient can be encoded without dropping off compression efficiency. The DCT and some of its important properties. The DCT for an N×N input sequence can be defined as where x=0,1, ….., n-1, is the list of length n given by:

$$D_{DCT}(i,j)=\frac{1}{\sqrt{2N}}B(i)B(j)\sum_{x=0}^{N-1}\sum_{y=0}^{N-1}M(x,y)$$
$$.\cos\left[\frac{(2x+1)}{2N}i\pi\right]\cos\left[\frac{(2y+1)}{2N}j\pi\right]$$

Where

$$B(u)=\begin{cases}\frac{1}{\sqrt{2}} & if \quad u=0\\ 1 & if \quad u>0\end{cases}$$

For u= 0, 1, 2, … N-1.

N is the size of the block that the DCT is applied on. The equation calculates one entry (i, jth) of the transformed image from the pixel values of the original image matrix. M(x,y) is the original data of size x* y.

DISCRETE WAVELET TRANSFORM (DWT): The DWT represents an image as a sum of wavelet functions, known as wavelets, with different location and scale. The DWT represents the image data into a set of high pass (detail) and low pass (approximate) coefficients. The image is first divided into blocks of 32×32. Each block is then passed through the two filters: the first level decomposition is performed to decompose the input data into an approximation and detail coefficients. After obtaining the transformed matrix, the detail and approximate coefficients are separated as LL,HL, LH, and HH coefficients. All the coefficients are discarded except the LL coefficients that are transformed into the second level. The coefficients are then passed through a constant scaling factor to achieve the desired compression ratio. An illustration is shown in Fig. 2. Here, x[n] is the input signal, d[n] is the high frequency component, and a[n] is the low frequency component. For data reconstruction, the coefficients are rescaled and padded with zeros, and passed through the wavelet filters.

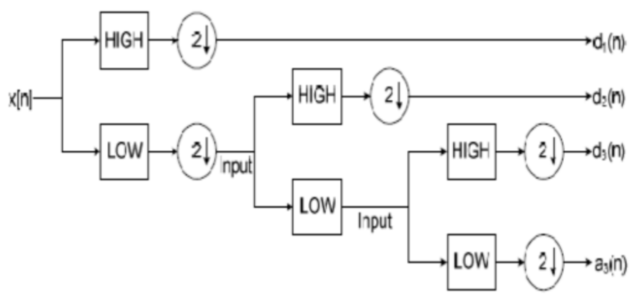

Fig. 2 Block diagram of the 2-level DWT scheme

PROPOSED HYBRID DWT- DCT ALGORITHM: The main objective of the presented hybrid DWT-DCT algorithm is to exploit the properties of both the DWT and the DCT. Giving consideration of the type of application, original image/frame of size 256×256 (or any resolution, provided divisible by 32) is first divided into blocks of N×N. Each block is then decomposed using the 2-D DWT. (9)Low-frequency coefficients (LL) are passed to the next stage where the high frequency coefficients (HL, LH, and HH) are discarded. The passed LL components are further decomposed using another 2-D DWT. The 8-point DCT is applied to these DWT coefficients. By discarding the majority of the high coefficients, researchers can achieve a high compression. To achieve further compression, a JPEG-like quantization is performed. In this stage, many of the higher frequency components are rounded to zero. The quantized coefficients are further scaled using scalar quantity known as scaling factor (SF). Finally, the image is reconstructed following the inverse procedure.

III. LITERATURE REVIEW

T. K. Poolakkachalil, S. Chandran, R. Muralidharan and K. Vijayalakshmi [1],gives the "Comparative analysis of lossless compression techniques in efficient DCT-based image compression system based on Laplacian Transparent Composite Model and An Innovative Lossless Compression Method for Discrete-Color Images," The main objective of image compression is to diminish the number of bits required to represent an image by eliminating the spatial and spectral redundancies. Image compression is classified as lossy and lossless compression. Lossy compression reduces the size of a file by removing redundant information. Whereas, in the lossless compression there won't be any loss of information upon the extraction of original image from the compressed image. The aim of this study is to do a comparison between two latest works in the image compression namely, An Efficient DCT-Based Image Compression System Based on Laplacian Transparent Composite Model and An Innovative Lossless Compression Method for Discrete-Color Images. From the analysis, it is observed that on average, An Efficient DCT-Based Image Compression System Based on Laplacian Transparent Composite Model reduces the compression rate by 25% in the case of images, compared to JBIG2. It is also observed that this approach is better suited for traditional images like Lena and Goldhill while An Innovative Lossless Compression Method for Discrete-Color Images is better suited for charts and maps.

S. Shrestha and K. Wahid[2]" was researched on Hybrid DWT-DCT algorithm for biomedical image and video compression applications," Abstract: Digital image and video in their raw form require an enormous amount of storage capacity. Considering the important role played by digital imaging and video in medical and health science, it is necessary to develop a system that produces high degree of compression while preserving critical image/video information. In this study , authors present a hybrid algorithm that performs the discrete cosine transform on the discrete wavelet transform coefficients. Simulation has been carried out on several medical and endoscopic images and videos. The results show that the proposed hybrid algorithm performs much better in term of peak-signal-to-noise-ratio with a higher compression ratio compared to standalone DCT and DWT algorithms. The scheme is intended to be used as the image/video compressor engine in medical imaging and video applications, such as, telemedicine and wireless capsule endoscopy.

E. Magli and D. Taubman[3],discovered that the "Image compression practices and standards for geospatial informationsystems," Compression technology is becoming increasingly important in geospatial information systems. In this study authors address some of the most relevant compression issues for remote sensing applications, and highlight the potential benefits of the JPEG set of standards. In particular, authors review the JPEG, JPEG 2000, and JPEG-LS compression standards, and the JPIP protocol for interactive image retrieval. Finally, authors discuss the use of compressed-domain processing, along with the use of flexible file formats for efficient storage and access to metadata.

B. V. Reddy, P. B. Reddy, P. S. Kumar and A. S. Reddy[4], "Lossless Compression of Medical Images for Better Diagnosis," Region of interest (ROI) based image compression is an intelligent technique in medical image storage and classification applications. A combination of both lossless and lossy compression methods are used for such application. Many wavelet transform derived techniques are proposed in this regard. Embedded zero-tree wavelet (EZW) is among them which is simple and efficient. In this study , MRI medical images are considered for compression and ROI based image compression is reported. The results reported good image quality in terms of several metrics. Also the comparison of lossless compression using two different wavelets is made possible to analysed the performance of each techniques.

IV. PROBLEM DESCRIPTION

From theaboveresults it is derived that proposed technique achieved not higher PSNR value compared to DWT+DCT method for all quality factors. The results show that PSNR decreases whenever quality factor decreases So PSNR is proportional to quality factor. PSNR signify visual quality against loss due to embedding for compression. So proposed technique have better visual decompressed image or less loss of compressing embedding compared to DWT+DCT based compression. The reason behind better decompressed image quality of proposed technique is that Integer wavelet transformation avoids fraction loss which is occurred during in dwt based technique.

V. CONCLUSION

In the research work the image compression techniques using DCT and DWT were implemented. DCT is used for transformation in JPEG standard. DCT performs efficiently at medium bit rates. Disadvantage with DCT is that only spatial correlation of the pixels inside the single 2-D block is considered and the correlation from the pixels of the neighboring blocks is neglected. Blocks cannot be decorrelated at their boundaries using DCT. DWT is used as basis for transformation in JPEG 2000 standard. DWT provides high quality compression at low bit rates. The use of larger DWT basis functions or wavelet filters produces blurring near edges in images. DWT performs better than DCT in the context that it avoids blocking artifacts which degrade reconstructed images. However DWT provides lower quality than JPEG at low compression rates. DWT requires longer compression time.

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