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A SURVEY ON IMAGE COMPRESSION TECHNIQUES

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Abstract

Due to the Advancements of multimedia and digital imaging has led to high quantity of data required to represent modern imagery. This requires large disk space for storage, and long time for transmission over computer networks, and these two are relatively expensive. These factors prove the need for images compression. Image compression addresses the problem of reducing the amount of space required to represent a digital image yielding a compact representation of an image, and thereby reducing the image storage/transmission time requirements. The key idea here is to remove redundancy of data presented within an image to reduce its size without affecting the essential information of it. In order to reduce the redundant information, there were a lot algorithms are developed and utilized, this paper describes the general applied mechanisms and schemes for image compression without losing information. Various lossless schemes are described in this paper and a combination of the lossless scheme is proposed for a better compression and a reduced reconstruction.

I. Introduction

Image applications are widely used, driven by recent advances in the technology and breakthroughs in the vision technologies have led to acquisition of the large quality images with higher pixel ratios. The quality of the images rely on the pixel ratio as it increases the image quality increases on , contrarily the storage requirements and the processing time for the images have also increased while having a larger quality over images. Acquisition and processing of large quality images is mandatory for medical image processing, where a loss of information may lead to a false diagnosis. In that case the recording of high defined images would lead in larger storage require needs , To optimize

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the size it image size reduction is mandatory .Generally to image size reduction involves in the removal of redundant information which leads to image compression . Image compression is achieved by removal of unwanted desired information or reducing number of bits for representing a pixel. Based on the requirements the compression can be classified as Lossless and lossy schemes. Images without much importance to quality would approach lossy schemes and if analysis is made on the images lossless schemes are preferred , as they reproduce the near original image even the compression is done .

II. Image Compression Techniques

Image compression is broadly divided into two types which are as follows:

2.1 Lossy Compression Techniques:

In lossy compression, as the name states that there is the loss of data in some manner. The decompressed image is not same as the actual image [4]. Lossy compression is most frequently used to compress multimedia data. Lossless compression is typically required for text and data files, such as bank records and text articles. Mostly it is beneficial to make a master lossless file that can then be used to produce compressed files for different purposes [3].

a) Predictive Coding
b) Transform Coding
c) Fractal
d) Chroma Sampling

2.2 Lossless Compression Techniques:

Lossless compression is a compression in which after decompression the image remains same as the original image. Lossless data compression most probably exploits statistical redundancy to express data more precisely without any loss in information [2]. It compresses the image by encoding all the information from the original file, so when the image is decompressed, it will be exactly matching the original image [5].

a) Run Length Encoding
b) Entropy Encoding
c) Huffman Encoding
d) Arithmetic Coding
e) Lempel–Ziv–Welch Coding
f) Deflation
g) Chain Codes

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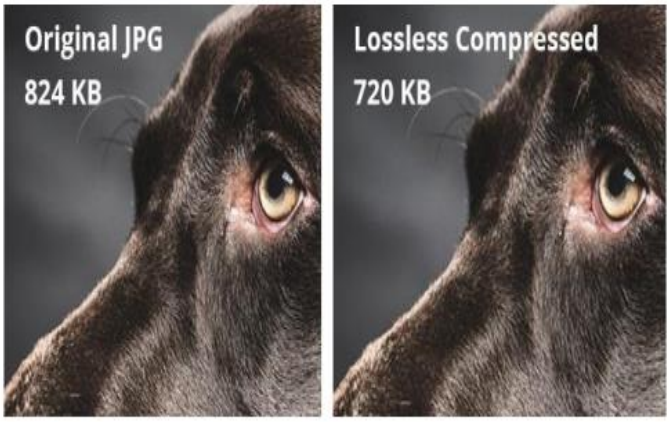

Fig 1: Compressed and non-compressed image through lossless mechanism

III. Literature Survey:

With the advancements in the coding techniques image compression techniques have been widely deployed in various fields of imaging applications. Medical and remote sensing are two major areas of image processing where the fidelity of the data is more important. Generally lossless compression schemes are based on the run length coding, arithmetic, LZW coding, these techniques rely on data variance for content reduction [1]. Lossless compression techniques compute data redundancy for compressions which is not sufficient for size reduction, which these techniques are to be combined with data reduction techniques for efficient image compressions [2].

Lossless compression methods eliminates the redundant data from the original image for compression , later can retrieve original data without errors or distortions with compression ratios 2:1 or 5:1 , due to the limitations on size reductions ,these techniques alone cannot handle much higher compression ratio[3].

A dual prediction compression scheme based on the combination of the Linear prediction code and Huffman coding is presented in [4] ,based on the linear prediction and Huffman combination a new mechanism for image compression is efficiently deployed , based on the linear predictions of the contents the redundancies are removed which makes a effective compression without larger calculations.

Fourier transform schemes such as DCT and DFT can be applied for image compression where a 2D DCT is applied to quantize data between the blocks of neighbouring pixels, these methods produce an effective compression, however their basis functions are lengthy results in high computation [5] alternatively multiresolution image analysis with the base compression schemes would reduce the size of the compressions further.

Wavelts have been a keen interest for image compressions due to their frequency domain analysis where a details of images are being processed simply and effectively .Wavelets apply the hierarchal frequency

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multi resolution analysis to remove the information redundancy effectively [6-7].

The Embedded Zerotree Wavelet (EZW) algorithm, is proposed in [7-8] implements a coding method Based on the quantization scheme with the combination of the DWT schemes apply a higher frequency coding with a multi-resolution analysis with the higher frequency coding improves the compression ratio further.

Various image compression schemes with lossless scheme that includes DWT analysis were presented in [9-17], combines the effectiveness of the high frequency quantization with the wavelet multiresolution analysis, identifying redundancies are being done through wavelet frequency transformations, with the coders the storage requirements are being reduced, multiple coding schemes were discussed among them the hierarchy of the data sequences are being prominent for image size reduction.

Table 1: Medical Image Based Compression

Author	Core Work	Methodology	Research gap
M. Rajasekhar Reddy,et. Al	The space occupied can be reduced.	SPIHT PSNR DCT SVD.	Only take medical images.
M. Rajasekhar Reddy,et. Al	In the bio-medical research, compression becomes necessary due to transfer of patients images from one group of experts to other experts group.	SPIHT PSNR DCT PCA.	Parameters are missing.
Rong-Choi Lee,et. Al	Which is used to generate absolute data values, and to convert decimal numbers into binary as a bit-plane.	MSPIHT 1D RRO-NRDPWT	Only take ECG signal images.
Khalid M. Hosny,et. Al	The optimum feature selection using ABC significantly improve the quality of the reconstructed bio-signals.	ABC	Limited metrics
Tahar Brahimi,et. Al	The aim of compressing jointly an image and a signal via a single codec.	SPIHT PSNR DCT	Only takes medical image compression and Limited metrics.

IV. Proposed Method:

SPIHT is the wavelet based image compression method. It provides the Highest Image Quality, Progressive image transmission, fully embedded coded file, Simple quantization algorithm, fast coding/decoding, completely adaptive, Lossless compression, Exact bit rate coding and Error protection[6][11]. SPIHT makes use of three lists – the List of Significant Pixels (LSP), List of Insignificant Pixels (LIP) and List of Insignificant Sets (LIS). These are coefficient location lists that contain their coordinates. After the initialization, the algorithm takes two stages for each level of threshold – the sorting pass (in which lists are organized) and the refinement pass (which does the actual progressive coding transmission). The result is in the form of a bit stream. It is capable of recovering the image perfectly (every single bit of it) by coding all bits of the transform.

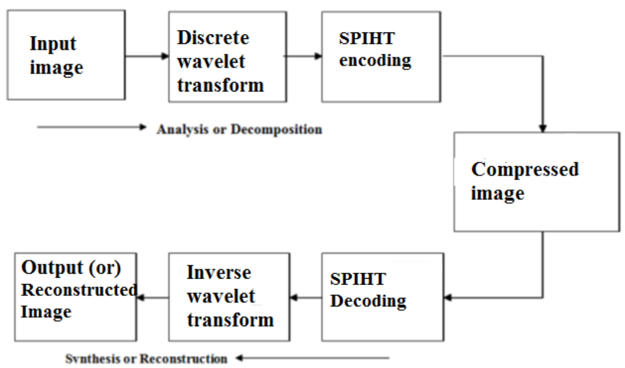

Fig 2: Proposed Method Architecture

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Metrics

1. $PSNR = 10 * log_{10}((MAX_1^2)^2/MSE) = 20 * log_{10}\left(\frac{MAX_1}{\sqrt{MSE}}\right)$

2. $MSE = \frac{1}{MK}\sum_{i=0}^{K-1}\sum_{j=0}^{M-1}|f(i,j) - f_1(i,j)|^2$

V. RESULT

Comparison over existing lossless image compression: In order to verify the effectiveness of the proposed compressor scheme, the proposed scheme is compared with the existing schemes, the proposed DWT, SHPHIT and Huffman coding utilizes lesser memory compared to other compression such as LZW, SPHIT and DWT. The combination of the wavelet and the SPHIT with the arithmetic coding has reduced size of the storage, with the reduced reconstruction errors. The proposed method is being verified with various input sizes of images with exhibits lower computation size and storage size makes suitable for lossless compression schemes. To validate the effectiveness of the compression a 512 * 512 image is been taken as input for all the schemes and results are tabulated below

			Storage size in KB		Time performance in sec			
Method	Compression Ratio	Bits per pixel (bpp)	Before Compression	After Compression	Encoding	Decoding	MSE	PSNR db
SPHT+DWT Huffman	11.47:1	0.77	767	37	132	102	30.67	30.11
SPHT	8:01	1.28	767	66	100	87.2	44.52	39.43
DWT	5.2:1	2.01	767	89	89.2	60.4	47.25	51.55

Table 2: Comparisions of the image compression mechanism over the proposed method

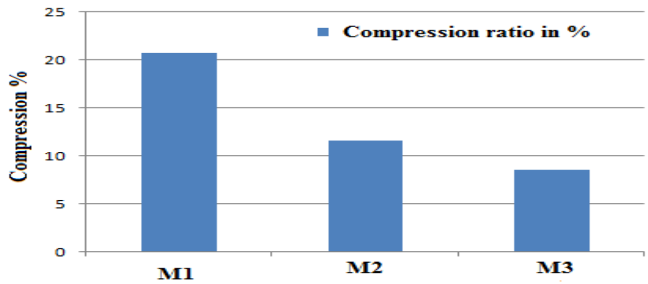

Fig 3: Compression percentage of the images with various mechanism

It can be clearly stated from the above figure that the compression ratio of the image is drastically reduced with the mechanisms included, the combination of the wavelet and SPIHT with the arithmetic coding has reduced the size requirements compared to the traditional lossless compressors. The time for the compression and decompression might be higher than the traditional compressors but the size requirements has reduced much higher with the reduced reconstruction error.

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VI. Conclusion

Data size reduction has been considered as one of the major requirements for imaging applications on various fileds, reduction of the size and the ability of reconstruction with a minimal error has been one of the major requirements. To meet the size and reconstruction error requirements is a multimodal image compressor scheme based on the combination of the wavelet , SPHT and arithmetic coding has been demonstrated in this thesis .The proposed mechanism has been validated with the traditional mechanisms that poses a lesser size, and reduced reconstruction error. The proposed mechanism has been validated against various image sizes with large and less information's. The combination of the wavelet and the SPIHT arithmetic coder exhibits a less error rate compared to the existing mechanisms, which makes the compressor suitable for the lossless compression. Due to its simplicity and high compression factor this compression can be adopted to various lossless compression applications over medical and engineering analysis where information is mostly required. Compared to the traditional compressors the proposed scheme exhinits a size reduction over 20% with the minimal error of MSE around 0.7 for high information image and this size reduces further if the information are lesser.

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