



Study of Simulation of SPIHT Algorithm for Lossy Image Compression

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Abstract— *At the evaluation of Images for calculating the Peak Signal to Noise Ratio values of the color images as well as grey scale images different types of wavelet based image compression algorithms are available. PSNR won't be calculated. With an easy rearrangement of a transmit bit stream, the SPIHT algorithm can be created temporarily without any loss in performance. We have a tendency to show the experimental results comparing the original SPIHT and the simulated SPIHT image compression algorithm for the calculation of PSNR values for the reconstructed images. Simulated SPIHT images have small in size because this images have lost the redundant bits in the simulation process. Out of these, we try to simulate the original SPIHT image compression algorithm. The simulated SPIHT has better compression ratio as well as better perceptual quality compared to the other image compression algorithm*

Keywords— *Image Compression, SPIHT and Simulated SPIHT, Wavelet Transform*

I. INTRODUCTION

The size of a graphics file may be reduced in bytes while not degrading the standard of the image to associate unacceptable level mistreatment compression. so additional pictures may be hold on within the given memory house. This additionally minimizes the causing and receiving time of the photographs, say for associate example: through the net many strategies area unit there for press the photographs. the foremost fashionable graphic image formats used for compression area unit JPEG format and GIF format. JPEG methodology is employed notably for the pictures whereas the GIF methodology is employed once the photographs embrace line arts and easy geometric shapes [1].

Generally, a text file can be compressed without the introduction of errors up to a certain extent. This is called lossless compression. But after that extent errors are unavoidable. In text and program files it is important to use lossless compression because a single error in text or program file will change the meaning of the text or cause the program not to run. A small loss in Image Compression is always not noticeable. The compression factor can be high if there is less tolerance or else it must be less. So, graphic images can be with higher compression ratio than that of the text files or program files [1]. Wavelet-based coding provides substantial improvements in image quality at higher compression ratios. Over the past few years, several competitive wavelet based Image Compression algorithms with an embedded bit stream have been developed, such as Shapiro's Embedded Zero tree Wavelet compression (EZW) algorithm [2], Said and Pearlman's Set Partitioning In Hierarchical Trees (SPIHT) algorithm [3], and Tubman's Embedded Block Coding with Optimized Truncation (EBCOT) algorithm [4]. The purpose of compression is to code the image data into a compact representation, and the distortion caused by the compression. Here developed a fast and a low memory image coding algorithm based on SPIHT. This algorithm uses two state mark bitmaps to replace three lists of SPIHT, so the coordinates of the coefficients are not stored in the high, variable and date dependant lists. The MSPIHT becomes a low-memory solution to other algorithm's [9].

II. BASIC OF IMAGE COMPRESSION

Compressing an image is significantly different than compressing raw binary data. Of course, general purpose compression programs can be used to compress images, but the result is less than optimal. This is because images have certain statistical properties which can be exploited by encoders specifically designed for them. Also, some of the finer details in the image can be sacrificed for the sake of saving a little more bandwidth or storage space. This also means that lossy compression techniques can be used in this area [7].

A. Image Compression Principle

It's a general fact that most images have their neighbouring pixels correlated to each other. This correlation contains less information and to remove this less correlated representation of the image [4]. Image Compression addresses the problem lying behind the reduction of the amount of data that is required for representing a digital image. Removal of redundant data is the key basis of Image Compression. In mathematical point, the 2-D pixel array is transformed into a statistically uncorrelated dataset. This is done before transmitting or storing the image. Later, the original image can be reproduced or an approximation is set in the decompression process. The key concepts of the compression are irrelevancy and redundancy reduction. Removing duplication from the original image is carried by redundancy reduction whereas the irrelevancy reduction omits the part of the signal which cannot be noticed by the signal receivers like Human Visual System [8]. The three kinds of redundancy are as follows) a) Spatial Redundancy or correlation between neighbouring pixel values, b) Spectral Redundancy or correlation between different colour planes or spectral bands, c) Temporal Redundancy or correlation between adjacent frames in a sequence of images (in video applications). The image

compression research aims at reducing the number of bits needed to represent an image by removing the spatial and spectral redundancies as much as possible [5].

B. Types of Image Compression

In Lossless Compression schemes, the reconstructed image, after compression, is numerically identical to the original image. However Lossless Compression can achieve a modest amount of compression Lossless coding guarantees that the decompressed image is absolutely identical to the image before compression. This is an important requirement for some application domains, e.g. Medical Imaging, where not only high quality is in the demand, but unaltered archiving is a legal requirement. Lossless techniques can also be used for the compression of other data types where loss of information is not acceptable, e.g. text documents and program executables. Lossless compression algorithms can be used to squeeze down images and then restore them again for viewing completely unchanged. [7]

Lossy techniques cause image quality degradation in each Compression/decompression step. Careful consideration of the human visual perception ensures that the degradation is often unrecognizable, though this depends on the selected compression ratio. An image reconstructed following lossy compression contains degradation relative to the original. Often this is because the compression schemes are capable of achieving much higher compression. Under normal viewing conditions, no visible loss is perceived (visually Lossless)[7].

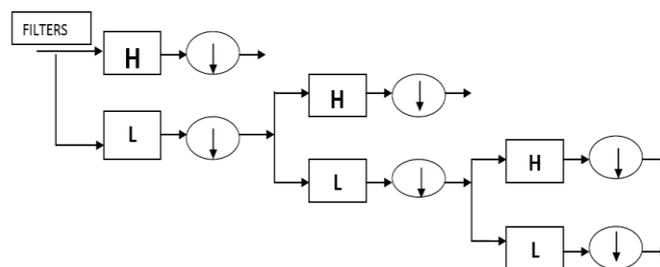


Fig. 1 2-D Discrete Wavelet Transform

C. Various Techniques in Image Compression.

Image Compression done on image may be lossless or lossy. In the lossless type Images can recreate exactly without any change in the power values this limits the amount of compression that can be reached in images encoded using this technique. There are number of purpose such as satellite image processing, medical and document imaging, do not bear any losses in their data and are often compressed using this type on the another hand lossy encoding is based on adding off the reach comp or bit rate with the twist of the reconstructed image. By the use of transform encoding methods ,lossy encoding can be obtained with LZW, JPEG etc and EZW,WDR,ASWDR,SPIHT etc are the examples of lossless image comp technique.

III. SET PARTITIONED INTO HIERARCHICAL TREES (SPIHT)

The SPIHT algorithm was introduced by said and Pearlman [6]-[9]. It is a controlling, well organized and yet computationally easy image compression algorithm. By using this algorithm we can get the highest PSNR values for a different types of gray-scale images for a given compression ratio. It provides good differentiation standards for all ensuring algorithm. It stands for set partitioned into hierarchical trees. It was developed for best developed transmission, as well as for compression. During the decoding of an image, the quality of a displayed image is the superior that can be reaching for the number of bits input by the decoder up that time. In The progressive transmission method, decoder starts by setting the reconstructed image to zero. Then transform coefficients are inputted decodes them ,&uses them to generate an improved rebuild images to transmit most important information first is the main aim of this type of transmission SPIHT uses. The Mean squared error(MSE)twist measure EZW algorithm is the base version for SPIHT coder[11] [12].and it is a powerful image compression algorithm that generates an embedded bit stream fro9m which the best recreated images in the MSE sense can be extracted at different bit rates. Some of the best results-highest PSNR values and compression ratios for a different types of gray scale images have been gained but this algorithm we can't compress the images dynamically we have to change the image manually every time.

A. SPIHT Algorithm

It is important to have the encoder and decoder test sets for significance in the same way, so the coding algorithm uses three lists called list of significant pixels (LSP), list of insignificant pixels (LIP), and list of insignificant sets (LIS).

The following sets can represent the corresponding representation:

$O(i, j)$ is the set of coordinates of all offsprings of node(i, j)

$D(i, j)$ is the set of all coordinates that descendants of the node(i, j)

$L(i, j)$ is the set of all coordinates that descendants but not offspring of node (i, j)

The following are the lists that will be used to keep track of important pixels:

LIS: List of Insignificant Sets, this list is one that shows us that we are having work by not accounting for all coordinates but just the relative once.

LIP: List of Insignificant Pixel, this list keeps track of the pixel to be evaluated.

LSP: List of Insignificant Pixels, this list keeps track of pixels already evaluated and need not be evaluated again.

Step1: Initialization: Output n, n can be chosen by the user or predefined for maximum efficiency, LSP is empty, add starting root coordinates to LIP and LIS. The sorting of in the LIP and LIS is same with that of EZW zero tree structure.

Step 2: Sorting pass: (new n value)

a. For entries in LIP: (stop if the rest are all going to be insignificant)

- Decide if it is significant and output the decision result.

- If it is significant, move the coordinate to LSP and output sign of the coordinate

b. For entries in LIS: (stop if the rest are all going to be insignificant)

IF THE ENTRY IN LIS REPRESENTS D(i, j) (everything below a node on the tree)

- Decide if there will be any more significant pixels further down the tree and output the decision result *If significant, add it to LSP, and output sign.

*If insignificant, add it to LIP

IF THE ENTRY IN LIS REPRESENTS L(i, j)(not children but all others)

- Decide if there will be any more significant pixels in L(i, j) further down the tree and output the decision result.

- If there will be one, add each child to LIS of type D(i,j) and remove it from LIS

Step 3: Refinement Pass: (all values in LSP are now $2n \leq |C_{i,j}|$) a. For all pixels in LSP, output the n^{th} most significant bit

Step 4: Quantization-step Update: decrement n by 1 and do another pass at step 2 [12].

IV. DESCRIPTION OF BLOCK DIAGRAM:

Input image and its pre-processing: This block is directly out there within the simulated atmosphere that fetches the image from the required location, the image is of size $m \times n$ wherever m represents rows and n represents columns. Within the pre-processing block if the input image is 3-colour domain i.e. RGB image is pre-processed to pass more, it's born-again into the intensity image with the required category and double knowledge kind for compatibility.

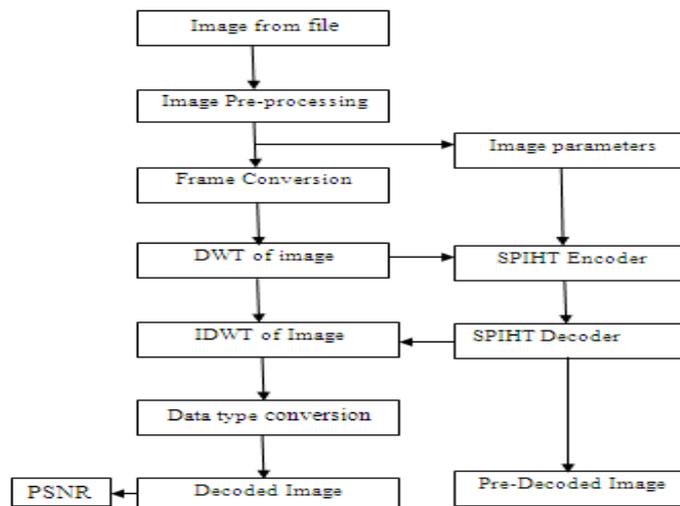


Fig.2 Flow of Simulation

Image Parameters and Frame conversion: In image parameter block, extracting the row and column vector parameters of a picture and also the most bits to represent the image used for the any process. The Frame Conversion block passes the input through to the output and sets the output sampling mode to the worth of the sampling mode of signal parameters, which might be either Frame-based or Sample-based. The Frame Conversion block doesn't create any changes to the signalling aside from the sampling mode. Above all, the block doesn't re buffer or size 2-D inputs. As a result of 1-D vectors cannot be framed based mostly, once the input may be a long M 1-D vector and also the block is in Frame-based mode, the output may be a frame-based M-by-1 matrix i.e. one channel.

DWT of an Image: DWT of a picture is nothing however the passing the image from the filter bank that filters the image in high pass and low pass domain on filtering. Wherever because the low pass domain contains the highest info, therefore by applying the DWT on the lower region once more and once more the higher the image is obtained. Within the wave rework of the image it's rotten within the pyramids means with multi decomposition with the No.of significant and insignificant bits, here in our experiment on mistreatment the nine/7 filtering method during which out of each 9 coefficients seven square measure vital. Once more playacting the 6-level decomposition of a picture for higher results.

SPIHT Encoder: In this block the image parameters within the kind of block size, most bits and therefore the input from the DWT block that's the wavelet coefficients and therefore the decomposition level area unit combined to line up the SPIHT encryption descriptor within the SPIHT algorithmic rule data formatting of coefficients, sorting and refinement is finished supported these input parameters.

SPIHT Decoder: In this block the compressed image is fed as associate degree input to the decoder to urge the first image. The encoded image obtained from the encoder block is decoded victimisation the SPIHT coding rule and also the decoded wave elements ar generated for any process.

IDWT of Image: Decoded wavelet components and the input from DWT are recovered. By performing the inverse function on DWT. The IDWT parameters are passed through the data type conversion block to convert the output in double for compatibility

Output Image: On obtaining the 2 consecutive pictures in output the decoded image and pre-decoded image. The pre-decoded image is that the riffle rotten image once filtering wherever the decoded image is obtained once riffle recovery.

Experimental PSNR Calculation and Display: The quality of the decoded image is judged on the basis of the PSNR (Peak Signal to Noise Ratio) value. Peak Signal to Noise Ratio of images mainly based on the 8 bit per picture element is defined as:

$$PSNR (dB) = 10 \log_{10} (255^2 / MSE)$$

Where, MSE (mean square error) is the image reconstruction error.

The PSNR block displays the PSNR value for the image under experiment

Compression ratio: An Image Compression system consists of two distinct structural blocks: An encoder and decoder. Image $f(x,y)$ is fed into the encoder which creates the set of symbols from the input data and uses them to represent the image. Let's assume n_1 & n_2 be the no. of information carrying bits in the original and the encoded image respectively, then the compression ratio is given as: $CR = (n_1/n_2)$

V. RESULTS

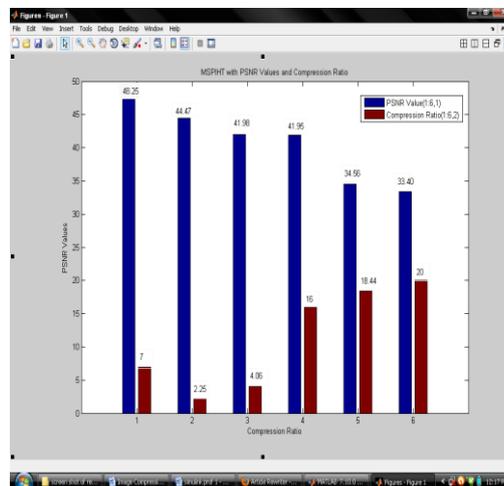


Fig 3. Results of Simulation

Experimental results ar performed on differing kinds of pictures that ar having totally different sizes it's going to vary from thirty KB to two MB. victimization 7-level decomposition supported 9/7 filter. we have a tendency to compare our MSPIHT with the SPIHT algorithmic program in 2 ways:

1) PSNR values of the reconstructed image oppression while not mathematics burial to writing.

2) The central processing unit time for committal to writing riffle decomposition lists the experimental results of encryption the image by the MSPIHT programmer that compared with the fundamental SPIHT. As shown in Figure three the MSPIHT coder's PSNR and committal to writing speed ar accumulated aside. The reconstructed pictures of MSPIHT in varied decoded level as shown in Figure five, Figure 6, Figure 7. The Figure 7 shows that good visual quality for "Shree image"

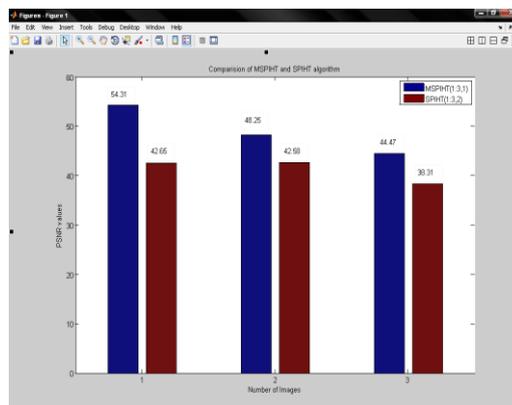


Fig 4. Graphical representation of an original SPIHT algorithm and Simulated SPIHT algorithm with Peak Signal to noise ratio



Fig.5 Original Image

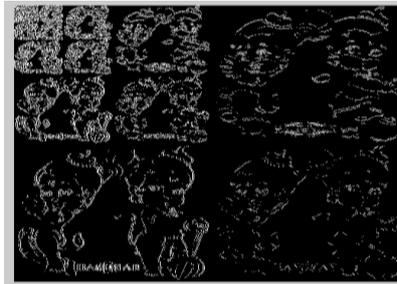


Fig 6. Pre-Decoded Image



Fig 7. Decoded Image

V. PERFORMANCE ANALYSIS

The higher than converse algorithmic program has been performed in MATLAB during this compression algorithmic program we tend to take Hanuman Image. first we tend to compressed with existing SPIHT algorithmic program and in the end compressed with planned algorithmic program then following outcome area unit returning. though Simulated SIPHT is easy, aggressive with SPIHT in PSNR value's and infrequently provides higher sensory activity ends up in Table. we tend to show the amount of serious Value's cipherd By each for three completely different pictures in virtually each case Simulated SIPHT was able to encode additional values then SPIHT.

VI. CONCLUSION

The main problem of Image Compression is to compress the very massive size image for transmission through the net within the market information measure. Except for compression this algorithms is economical that compress the image with size varying from KB to MB. In this paper most of the Image Compression techniques carried out up till now all are having some sort of redundancy. The proposed technique i.e Simulated SPIHT algorithm is beneficial in order to achieve the high PSNR value and better compression ratio. This proposed SPIHT Technique is not only well suited for greyscale images but also colour image. Simulated SPIHT is very fast in execution as compared to the other techniques on the basis of the amount of time required to execute that algorithm. In this paper Simulated SPIHT proven to be better for Image Compression is used. Using this technique an accurate Image Compression Algorithm is developed and tested and the performance found is efficient.

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