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Hybrid Approach for Image Compression Using SPIHT With Quadtree Decomposition

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***Abstract*—Low intricacy image compression algorithms are crucial for modern light-weight devices such as mobile phones, cellular sensor systems, and high constraint electricity consumption devices. In such applications, low tiny bit rate plus a reasonable image quality are essential requirements. This research proposes low and average complexness algorithms for cover above said the problem for image compression. Two algorithms will be used for this, the first one is level focused adaptive quantization coding, as the second reason is a combo of discrete wavelet transforms and the depth established adaptive quantization coding algorithm. Adaptive quantization coding produces a worthy peak signal to noise ratio (PSNR), but with high little rates weighed against other low complicated algorithms. The provided algorithms produce low tiny bit rate whilst guarding the PSNR and image quality at a reasonable range. The results obtained show a good reduction in rate with the same PSNR, or a simply a little less than PSNR of any standalone adaptive quantization coding algorithm. Further little rate lower has been achieved by decomposing the type image using different wavelet filtration and intensity focused adaptive quantization coding. The proposed the algorithm comprises a lot of parameters to modify the performance of the compressed images. To have the ability to obtain better compression on image benefits, across Set Partitioning In Hierarchical Trees (SPIHT) algorithm based on the past scanning the coefficients around which there were more significant coefficients was advised. The coefficients or items were sorted based on the level with significant coefficients before being coded, and the last significant coefficients were superior when the devices around which there been with us any significant coefficients have been scanned. The experimental results show that the strategy can improve PSNR and the subjective obvious experience weighed against SPIHT.**

Keywords—Image Compression; Wavelength Transform; SPIHT;DWT;JPEG

I. INTRODUCTION

Image compression is thought as an application of a proper copy function to a graphic signal to be able to limit strong range or program of bandwidth restricting or bit-rate decrease to a graphic signal to be able to take it within the limits of a lesser capacity channel. In general conditions, it could be defined as a method that involves solutions to decrease the size of the image documents while keeping necessary important info. A common attribute of images is usually that the neighboring pixels are correlated and for that reason contain redundant information. The main activity then is to find the less correlated representation of the image. Two important the different parts of compression are

(i) Redundancy

(ii) Irrelevancy lowering.

The necessity for image compression is principal because of the large storage devices required for most images. Virtually all commercial and private organizations are now moving towards 'paperless' office, which, create large size images, multimedia databases, intricate and expensive transmitting systems. Several transmitting devices and techniques like Standard Packet Radio Service (GPRS), Multimedia Messaging Services (MMS), ONLINE VIDEO transmission, HI-DEF Television (High definition TV), Video tutorial Conferencing, etc. are being employed by increasing numbers of people for faster and easy communication. The majorities of these communications require images and must be fast and effective, thus generating a market need for better compression algorithms [1].

A lot of the existing image compression techniques show good performance in conditions of compression rate and little bit rates. However, their performance degrades with special kind of images like doc images, normal substance images, facsimile image, etc. which needs special treatment during compression.

Image compression can be an area where research activities are occurring for more than 35 years. But due to increasing demand and technology of new devices for communication and storage area, there's always a dependence on the new improved version of compression algorithms. This work is one particular attempt at creating a few algorithms for compressing images.

Several experts have suggested lossy compression algorithms for the natural images that have large low consistency components, few components of the high rate of recurrence and higher derivatives. Various kinds' images are trusted in the region of media, entertainment, etc. They may be, natural or photographic images, collection arts, designs, maps, etc., which have special requirements for managing and compressing [2].

For this function, the principal goal was arranged as "to build up compression schemes that can compress color images quickly and which can decrease the compression rate for still color images, while keeping a good degree of visible quality". Four revised techniques using wavelets and wavelet packets are suggested and shown as below.

i) Wavelet-based mostly Improved Color Image Compression [12].
ii) Wavelet Packet Image Compression using Log Energy Entropy [12]
iii) Quadtree Decomposition [2]
iv) Set Partition in Hierarchical Tree (SPIHT) [11].

The proposed technique used in this research work is given in figure 1.

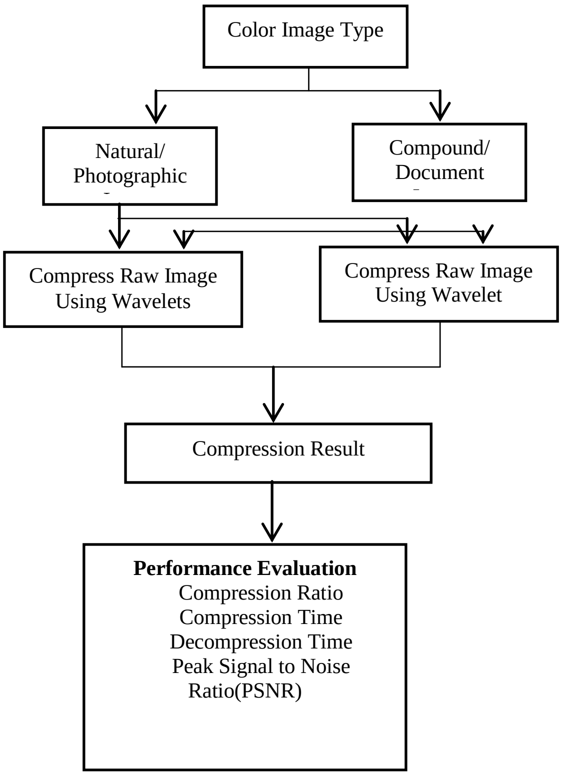


Fig. 1. Proposed Methodology

Generally, all the above-suggested schemes have the next two objectives.

i) Apply wavelets for compressing color images
ii) Measure the performance of the wavelet-based compression techniques using PSNR, compression percentage, acceleration of execution.

All the suggested techniques use color images as test images and in this dissertation, the word images hereafter identify color images only.

The underlying goal of the research work is to build up a few effective and successful color image compression strategies that can meet up with the demands of low space for storage with well visible quality and less time intricacy. The work is arranged as follows. In image compression, several research workers have addressed the condition of compression and the many available techniques related to this research work receive in Section 2, as the "High tech". Section 3 talks about the problem definition about the research and handles the next proposed approach specifically, the wavelet packet image compression using Set Partition in Hierarchical Tree (SPIHT). The detailed talk about the suggested ingredient image compression strategy is given in Section 4 with experiment and result discussions, the suggested mixture image compression using wavelet packet way is dealt at length. In section 5 the concluding remarks and future expansion work are detailed. The task of several researchers is quoted and used as information to aid the concepts described in this work.

II. RELATED WORK

A lot of research on image compression has been conducted by several researchers. A brief review of few important contributions from the existing literature is provided in this section. Recent research in the image compression community has explored and developed the power of the wavelet transform. The foundations of Discrete Wavelet Transform (DWT) make contact with 1976 when ways to decompose discrete time signals were devised. Similar work was done in discussion signal coding that was known as subband coding. In 1983, a way similar to subband coding originated that was called pyramidal coding. Later many improvements were made to these coding strategies which resulted in efficient multi-resolution analysis programs. Based on DCT and DWT various image coding programs have been developed. This section reviews couple of them related because of this study [3].

A. Compression algorithms built on DWT

The wavelet focused coding has more than doubled due to release of Baseline JPEG in 1992. In early stages, wavelet coders acquired performance that was at best much like change coding using DCT [3]. Also, these in early stages wavelet coders were designed using the same techniques placed on subband coding. An authentic breakthrough in wavelet transform founded coding was the release of Embedded Zero-tree Wavelet (EZW) coding [7].

The EZW algorithm could exploit the multi-resolution properties of the wavelet transform to provide the computationally simpler algorithm with very good performance. Improvement and enhancement to EZW have resulted in similar algorithms such as collection partitioning in hierarchical timber (SPIHT) and zero trees` entropy (ZTE) coding. Currently, a brand new algorithm used for constituting integer wavelet transform, known as lifting program (LS) has been advised. Biorthogonal wavelet filtration using the program have been established as very profitable for lossy image compression applications. This section reviews the working of another algorithm [12].

a) Embedded Zero-Tree Wavelet (EZW) Algorithm

This algorithm laid the inspiration of modem wavelet coders and excellent performance for the compression of still images in comparison to stopping founded DCT algorithm. Introduced by Shapiro in 1993, this algorithm uses the multi-resolution properties of the wavelet transform. As the name suggests, placed means the encoder can stop encoding of image data at any desired give attention to rate. Moreover, the decoder can stop decoding at any point resulting in image quality produced at the truncated tad stream of the image data, as the zero-tree platform is analogous to the zigzag scanning of the transform coefficients and End of Stop (EOB) icon within DCT organized algorithms[10].

b) Set Partition in Hierarchical Tree (SPIHT) Algorithm

In 1996, Pearlman and Said advanced the inlaid zero tree wavelet (EZW) algorithm and developed a faster and better image coding technology called established partitioning in hierarchical timber (SPIHT), SPIHT reveals a step toward spotting lower costs regarding compression intricacy and prediction, as advised in JPEG and JPEG 2000, to realize higher compression shows[4].

c) Zero-Tree Entropy (ZTE) Coding Algorithm

ZTE coding is a fresh efficient way of coding wavelet transform coefficients and is dependent on, but varies significantly from the EZW algorithm. Like EZW, this new ZTE algorithm exploits the self-similarity natural in the wavelet transform of images and video residuals to forecast the positioning of information across wavelet scales [13].

d) DWT Based Image Compression/Decompression in JPEG 2000

JPEG 2000 is the ISO/ITU-T standard for still image coding and is dependent on the discrete wavelet transform (DWT), scalar quantization, framework modeling, arithmetic coding and post-compression rate allocation. The DWT is dyadic and can be carried out with either the reversible filter systems, which give lossless coding or the non-reversible bi-orthogonal ones, which give higher compression, however, not lossless. The quantizer employs an inserted dead-zone scalar methodology and is the 3rd party for each and every subband. Each subband is split into rectangular blocks (called code-blocks in JPEG 2000), typically 64x64, and entropy coded using framework modeling and little bit aircraft arithmetic coding. The coded data is arranged in so-called levels, which can be quality levels, using the post-compression rate allocation and outcome to the code stream in packets.

The overview of the prevailing popular techniques uncovered the next facts. As the DCT-based image coders perform perfectly at moderate little rates, at higher compression ratios, image quality degrades due to artifacts caused by the block-based DCT structure. Wavelet-based coding, on the other side, provides the significant improvement in display quality at low bitrates (<l bpp) because of overlapping basis functions and better energy compaction property of wavelet transforms. Due to the natural multiresolution characteristics, wavelet-based coders assist in the progressive transmitting of images in so doing allowing changing bitrates. The JPEG-2000 standard comes with wavelet founded coders and addresses various cons of DCT. Wavelet packets generalize wavelets and offer a more adaptable tool for image examination. All the features of wavelets are maintained in wavelet packets and are believed as a typical tool in image control [10].

III. PROBLEM DEFINITION AND PROPOSED SOLUTION

Image compression can be categorized into lossy and lossless. The lossy type is designed to lessen the bits necessary for storing or transmitting a graphic without taking into consideration the image quality much. The lossless type targets preserving the grade of the compressed image such that it is exactly like the initial one. Image compression is vital for efficient transmitting and safe-keeping of images. Demand for communication of media data through the telecommunications network and being able to access the media data through Internet keeps growing explosively. By using digital camera models, requirements for storage space, manipulation, and the copy of digital images, explosively. These image data can be quite large and can take up a whole lot of recollection. Downloading of the files from the web could possibly be the very time-consuming job. Image data include a significant part of the multi-media data plus they take up the major part of the communication bandwidth for multimedia system communication. Which means the development of effective approaches for image compression is becoming quite necessary.

The current research introduces two strength structured adaptive quantization coding for color image compression. The first model will take into consideration the several intensity variances of image areas to lessen the bit cover the compressed image. The next computes the strength based mostly ASPIHT algorithm guidelines of the main one level decomposed image. The type image is decomposed using different wavelet filtration systems to further decrease the bit rate. Also, the suggested algorithms provide little bit rate and PSNR control for better performance. All of those other studies is planned the following. First, a conclusion of the SPIHT algorithm is given. Strength-based suggested algorithms are launched. Examples of the results obtained are also detailed. Finally, conclusions receive.

A. Proposed Solution

Many algorithms have been produced by research workers for both image compression types; many of these algorithms use Discrete Cosine Transform (DCT) or Discrete Wavelet Transform (DWT), while some avoid the difficulty of making use of such transformation [5, 6].

Different techniques have been suggested for image compression using DWT, including the adaptive algorithm for scalable wavelet image coding etc. The upsurge in the utilization of color images in the constant expansion of media applications has increased the demand for useful techniques that can store and transfer aesthetic information. This demand has made image compression an essential factor and has increased the necessity for effective algorithms that can cause high compression percentage with minimum reduction. This section proposes a progressive way of compressing color still images using wavelet compression structure. The wavelet transform has been efficiently found in image coding since it allows localization in both space and rate of recurrence domains. The suggested system uses DWT to boost compression approach in conditions of compression proportion and image quality. The machine is developed so that it will improve color still images. That is achieved by focusing on the utilization of predictors for subbands across different color components predicated on binary vector morphology. The primary objective of today's research work is to propose and create a system that is capable of doing compression on color image proficiently. To attain the above primary target, the following seeks were formulated.

i) To develop a competent and effective color image compression strategy using discrete wavelet change.

ii) The suggested system uses the next techniques:

   a. Subband coding to improve the procedure of image compression predicated on DWT,

   b. Quantization for Codebook design and storage area of the codebooks in the image and also use for Search Optimization through Quadtree decomposition

   c. Then apply customized Set Partitioning In Hierarchical Trees (ASPIHT) algorithm

   d. Use of Bit Plane Coding (BPC) and Binary Arithmetic Coding (BAC) to encode the coefficients produced.

iii) To compare the proposed system with a typical technique.

To attain the above aims, the proposed system uses wavelet change, tree-structured vector quantization and binary vector morphological prediction for compressing color images. Binary vector morphology can be used to predict the importance of coefficients in the subbands across different color components. The usage of tree-structured vector quantization reduces the search time for quantization and coding. This greatly increased the proposed algorithm in conditions of compression and decompression time.

B. *Techniques Used*

- Color Space Transformation

A color model can be an abstract numerical model describing just how colors can be displayed as tuples of amounts, typically as 3 or 4 prices or color components (e.g. RGB and CMYK are color models) and the mapping of colors from the color model is the color space. Both hottest color areas for holding digital images are RGB color space and B/W color space [14].

The RGB color space is described by the three chromaticities of the red, inexperienced, and blue additive primaries, and can produce any chromaticity. RGB stores a color value for each and every color levels, Red, Green, and Blue. It uses 8 parts to each color level, thus using 24 parts to store a pixel color information. The overall formula for the color space change is given in equation 1.

$$\begin{bmatrix} S_1' \\ S_2' \\ S_3' \end{bmatrix} = \begin{bmatrix} C_{12} & C_{12} & C_{13} \\ C_{21} & C_{22} & C_{23} \\ C_{31} & C_{32} & C_{33} \end{bmatrix} \begin{bmatrix} S_1 \\ S_2 \\ S_3 \end{bmatrix} \quad (1)$$

where $[S1\ S2\ S3]^T$ is the initial color space, $[S1'\ S2'\ S3']^T$ is the changed color space and [Cij] is the coefficient matrix of change.

Figure 2. shows a good example image in the RGB color space and each one of the three components. This illustrates the good thing about using the RGB color space, where almost all of the info is in the Red Part.

Fig. 2. Example image in RGB color space and its components

- Wavelet subband decomposition

Discrete Wavelet examination is computed using the idea of filter banks. Filter systems of different cut-off frequencies examine the indication at different scales. Image resolution is altered by the filtering and the range is improved by up sampling and down sampling. If a sign is subjected to two filters,

a) A higher pass filtration - high-frequency information is stored, low-frequency information is lost.

b) A minimal pass filtration system - low-frequency information is stored, high-frequency information is lost.

then the indication is effectively decomposed into two parts, an in-depth part (high occurrence), and an approximation part (low rate of recurrence).

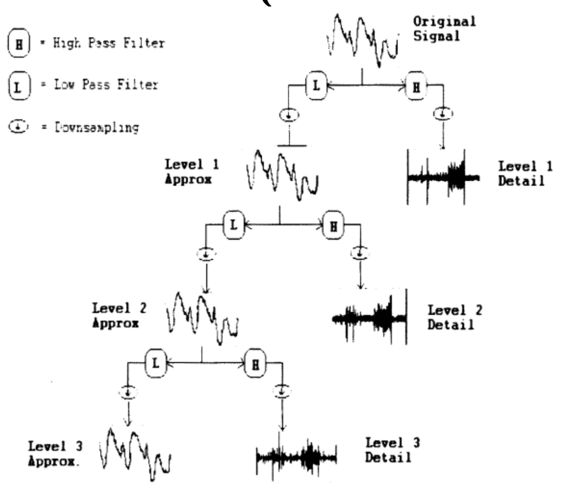


Fig. 3. Working of DWT

The ideas are shown in figure 3.The sub-transmission produced from the reduced filtration system will have the best frequency add up to 1 / 2 that of the initial. Matching to Nyquist sampling, this change in a rate of recurrence range means that only 1 / 2 of the original examples have to be kept to be able to correctly reconstruct the indication. More specifically which means that upsampling may be used to remove every second test. The approximation sub-signal may then be put by using a filter bank, which is repeated before required degree of decomposition has been come to. The DWT is obtained by collecting along the coefficients of the ultimate approximation sub-indication and everything the fine detail sub signals and it is given by equation 3.3.

$$W_t(a,b) = \int_{-\infty}^{\infty} X(t)\, \Psi_{a,b}(t) dt \tag{2}$$

Overall the filter systems have the result of separating out finer and finer depth and if each one of these details is 'added' along then our original indication is reproduced.

- Quantization

Quantization is a many-to-one mapping that replaces a couple of values with only 1 representative value. By meaning, this plan is lossy, because, after mapping, the initial value can't be recovered exactly. We will find two basic types of quantization,

(a) Scalar quantization and
(b) Vector quantization.

Scalar quantization (SQ) executes many-to-one mapping on each value, for example, it could store only the 6 most crucial pieces from 8-little bit ideals. Vector Quantization (VQ) is the simplest way of quantizing and compressing images. It replaces arrays of beliefs (i.e., blocks of pixels) with one value, which is the index from "codebook". Exactly the same index may be used to represents marginally different arrays of prices; therefore it results from a lossy many-to-one mapping. The primary execution issues in the look of VQ algorithm is the

- Codebook design and storage space of the codebooks in the image and
- Search Marketing - Computation intricacy and time through the search for most effective code vector

If the codebook size is large, the reconstructed image will be nearly the same as the initial image. On the other end, the image obtained using a tiny measured codebook will include a lot of obvious artifacts. How big the codebook is also important while determining the transmission over the head, which must be kept at the very least. The safe-keeping of codebooks in the image is another essential aspect, which improves with how big is a record. Smaller codebook size produces small transmitting and safe-keeping overheads but degrades the grade of the reconstructed image.

- Codebook Design and Search Optimization

A quadtree is decomposing a graphic into parts of homogeneous colors and can be handy in applications such as image compression or image segmentation, which results in obtaining a higher compression percentage. The traditional algorithms use a set number of parts to encode all image blocks independent with their information content. However, the quantity of information within typical images is not uniformly allocated among the several regions. This presents some type of inefficiency. A remedy to the problem is by using a hierarchical composition where the quantity of bits necessary to encode a graphic region is proportional to the info content of the spot. The quadtree data composition is one of the very most suitable structures for this function. Quadtrees are incredibly useful setups in image handling type applications since each stop can be decomposed in four equivalent quadrants, thus protecting the spatial characteristics of adjacent blocks [8].

- The SPIHT Algorithm

Probably one of the most useful algorithms in the region of image compression is the Set partition in Hierarchical Tree (SPIHT). Essentially, it runs on the sub-band coder, to make a pyramid framework where a graphic is decomposed sequentially through the use of electric power complementary low forward and high go filter systems and then decimating the ensuing images [11].

- Bit Plane Coding (BPC) and Binary Arithmetic Coding (BAC)

The entropy encoder used are Bit Plane Coding (BPC) and Binary Arithmetic Coding (BAC). The blend of BPC and BAC is known as Tier 1 coding. BPC has three moves in each tad plane: Value Propagation Forward, Magnitude Refinement Go away, and Cleanup Go. Each pass creates framework models and the equivalent binary data. The outcome of BPC and BAC produces the compressed tad stream. So each coding stop has an indie little stream. These self-employed bit streams of all code blocks are blended into an individual tad stream using Tier 2 coding, which is dependent on the consequence of rate-distortion search engine optimization. Tier 2 coding multiplexes the so unbiased bit streams which were made in Tier 1 coding to create the ultimate compressed output little bit stream. In addition, it effectively provides header information to point the buying of the causing coded blocks and related coding passes.

C. *The Proposed Algorithm*

The algorithm steps of the proposed hybrid method are as follows:

1) Read the Input image.
2) Initially, the image will be partitioned into no overlapping blocks. Then DWT will be employed to each and every block of the image.
3) Next, DWT coefficients of each block of the image will be quantized.
4) Divide the resultant image using quadtree decomposition with a threshold value of 0.2 minimum and maximum dimensions as 2 and 64 respectively.
5) Note x and y coordinate values, mean value and block size from quadtree decomposition.
6) Next, record also the fractal image compression value in order to complete the encoding phase of the image using ASPIHT and then calculate the compression ratio.
7) For the encoded image, apply ASPIHT decoding to reconstruct the original image.
8) Finally calculate the measuring parameters of the image such as PSNR, Compression ratio, encoding and decoding time.

This section provided a synopsis of the prevailing difficulties in image compression, the prevailing situation and the informed views for the analysis work. Various experts have placed into the improvement of image compression techniques with and without necessitating results on PSNR and the studies related for this reason work are examined in next section.

IV. IMPLEMENTATION & RESULT ANALYSIS

A. *Simulation Environment*

The ASPIHT algorithm was put in place using MATLAB. Our primary results are the following, figure 4. shows the Image Handling test out Lena image, it includes View Components, Equalizer and various quantization levels.

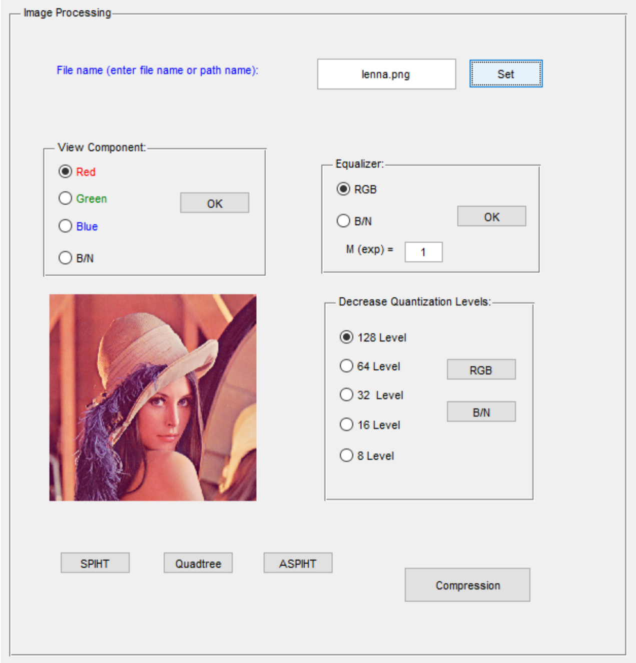


Fig. 4. Image Processing Simulation Environment

In such a simulation process we applied the SPIHT algorithm with DWT in MATLAB. Shape 2 shows the RGB image burning up to 5 degrees of bit plane (from the utmost of 128 bit-planes). Even though MATLAB version of the SPIHT works slow no look at was done to maximize the code for the case at Quadtree and ASPIHT execution. The desire to be with an execution ready for a test out images. When applying equalizer start to see the retrieved image is aesthetically very near the initial image. If all the little planes are being used then our original image is retrieved completely (up to rounding mistakes). Because of knowledge of MATLAB and accessible tools in it'll permit them to easily enhance the code and reduce development time. For example, one method has already been explored by changing the SPIHT algorithm using Lossy/Lossless region appealing (ROI) coding. In an identical fashion, our students can alter the algorithm to add different ways of ROI coding.

B. *Result Analysis*

The proposed system was vigorously examined with test images and was assessed using the results obtained. The first level, subband decomposition is performed through both dimensional wavelets transform on the image. The Daubechies category of basic functions for DWT, which is trusted in image compression, can be used for this function. Here we choose and review the RGB the different parts of the image of the check by making use of color space change. The RGB color space is identified by the three chromaticities of the red, renewable, and blue additive primaries, and we can produce any chromaticity among Red, Green, and Blue of the test image. RGB stores a color value for every single color levels, Red, Green, and Blue. It uses 8 parts to each color level, thus using 24 parts to store a pixel color information. Our bodies have both RGB as well as Black color and Wight view component analyzer.

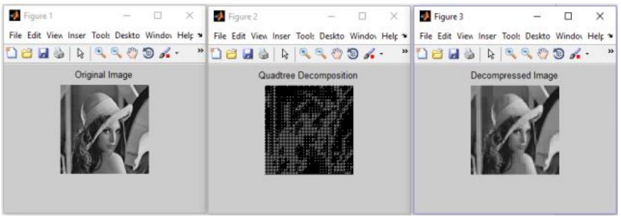


Fig. 5. Quadtree Decomposition of the Image

This is actually the result of the Quadtree Decomposition of the test image. The Quadtree Decomposition way for

- Low-Low (LL)
- High-Low (HL)
- Low-High (LH)
- High-High (HH).

As possible seen from the figure, minimal energy filled with the most redundant group is HH strap, therefore, is disregarded with the minimum lack of information. The LH (lower subband) and HL (higher subband) rings also show the characteristics of a higher frequency sign; but there is the correlation among the list of horizontal and vertical pixels for the past and latter rings, respectively.

Because of the reasons explained above, quantization should be performed before compressing these rings, unless they may be dismissed as noises. Usually, scalar quantization accompanied by entropy coding is put on these rings as the quantization-compression system.

The final level of the suggested system is encoding. The next level coefficients of the LL subbands are entropy encoded individually. All of those other coefficients are encoded from coarse to fine scales with each color aspect image treated individually. The low subbands are then encoded individually by using a DWT algorithm referred to previous. All coefficients not included in the prediction maps are encoded independently.

Fig. 6. Output of the 8 Level Modification of Image

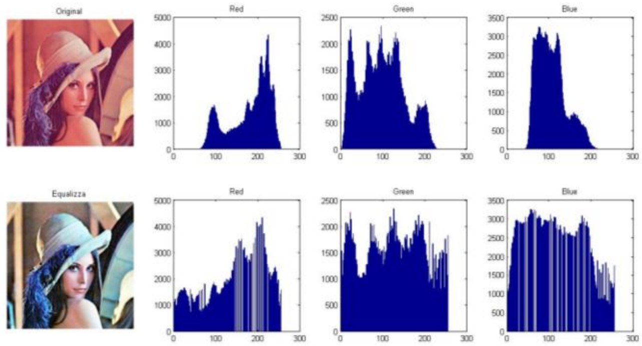


Fig. 7. Histogram Analysis of the RGB Image Compression

The proposed system was assessed in conditions of quality metrics like compression percentage, compression and decompression time and Peak Signal to Noise Ratio (PSNR). To authenticate the suggested system, the email address details are compared with the typical SPIHT image compression strategy. The email address details are discussed under the next headings.

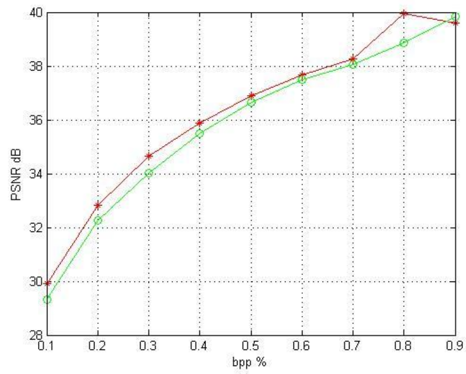
Compression Ratio (CR): Compression ratio is defined as the ratio between the uncompressed size (original) and compressed size of the image. It determines the efficiency of the compression algorithm. CR = size of original image / size of compressed image

Peak signal to noise ratio (PSNR): PSNR is a quality measurement ratio between an original and compressed image. Higher the value of PSNR, better is the compressed quality of the image. It is given by the following equation:

$$PSNR = 10 Log \frac{255^2}{MSE} dB \tag{3}$$

$$MSE = \frac{1}{MN} \sum_{i=1}^{M} \sum_{j=1}^{N} [I(i,j) - I'(i,j)]^2 \tag{4}$$

Encoding stores or transmits an image which is represented by a small memory.



bpp% / Technique	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
ASPIHT(dB)	**29.90**	**32.82**	**34.65**	**35.88**	**36.90**	**37.68**	**38.28**	**39.95**	**39.85**
SPIHT(dB)	**29.33**	**32.28**	**34.03**	**35.50**	**36.65**	**37.49**	**38.05**	**38.86**	**39.60**

Fig. 8. Analysis of PSNR vs bpp %

The comparative analysis is represented in Table I.

Along with the measuring quality parameters. The table shows the comparison of PSNR and bpp percentage from Proposed System and SPIHT. We observe that the proposed method has effectively reduced the encoding time and enhanced the compression ratio by maintaining a better PSNR.

V. CONCLUSION AND FUTURE WORK

This research work proposes four approaches for compressing color still images that are wonderful for both natural/photographic images and product images. The algorithms developed are complete below. Here, the suggested platform uses wavelet change, Quadtree Decomposition for binary vector morphological prediction for compressing color images. The usage of Quadtree Decomposition create vector quantization reduced the search time for quantization and coding. This greatly increased the performance of the informed algorithm in conditions of (i) increased compression ratio from 39.60% to 39.85%, (ii) decrease in compression time by 7.05% and (iii) decrease in decompression time by 5.4%. Additionally, it is found from the results that the suggested algorithm produced an elevated compression ratio with good quality of reproduced images having PSNR in the quantity of 23.90 to 39.85dB. The algorithm became useful in conditions of increased compression ratio (more than 8% upsurge in efficiency in comparison to SPIHT), reduced compression time (<0.9 events) and better image quality (PSNR in the number 29.33dB - 39.85dB).Future research methods can consider noisy images, images with different power and frequency.

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