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Enhanced Image Wavelet Lossy Compression Algorithm

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Abstract: *In the proposed technique, an attempt was made more on lossless compression due to the data substance of the critical segment as in we won't dispose of any wavelet coefficients. Be that as it may, because of the intrinsic idea of wavelet encoding and consequent round off blunders there was in every case some misfortune related with the encoding plan. It comprises of the Transformation, Quantization, and compression. The outcome demonstrates that the method utilized here would be of the precise method of compression in the required range. What's more, the method utilizes the lossy compression with the two frequencies like high-frequency energy dispersion and low-frequency spatial area. The high compression rate was of 97.1%.*

Keywords- *Wavelet coefficient, transformation, quantization, compression and lossy compression.*

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I. Introduction

Image compression was an application of data compression on digital image. In initial stage of research data compression includes in 1838 for use in telegraphy, it was 'Morse code' a first method for data compression. Contemporary work of data compression was begun in the late 1940 with the growth of information theory. In this field, the first efficient way for allocating codeword based on probability of data block was presented by Shannon and Fano in 1949. Later on, Huffman has technologically advanced an optimal method for conveying codeword in 1951 [1].

Initially image compression was begun in 1970, fundamentally it was attained by mathematical transformations and quantization with encoding procedures. In 1980, a number of compression schemes were developed and then these schemes were divided according to two different properties namely lossless compression and lossy compression [2]. Lossless compression deals with the rebuilt image after compression was numerically matching to the original image. Whereas in lossy compression, the rebuilt image was not numerically matching to the original image [3].

Image compression is the application of Data compression on digital images. The objective of image compression is to reduce redundancy of the image data in order to be able to store or transmit data in an efficient form. Image compression can be lossy or lossless. Lossless compression is sometimes preferred for artificial images such as technical drawings, icons or comics. This is because lossy compression methods, especially when used at low bit rates, introduce compression artifacts. Lossless compression methods may also be preferred for high value content, such as medical imagery or image scans made for archival purposes. Lossy methods are especially suitable for natural images such as photos in applications where minor 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. Run-length encoding and entropy encoding are the methods for lossless image compression. Transform coding, where a Fourier-related transform such as DCT or the wavelet transform are applied, followed by quantization and entropy coding can be cited as a method for lossy image compression. With the increasing use of multimedia technologies, image compression requires higher performance. To address needs and requirements of multimedia and internet applications, many efficient image compression techniques, with considerably different features, have been developed. Traditionally, image compression adopts Discrete Cosine Transform (DCT) in most situations which possess the characteristics of simpleness and practicality.

In recent years, many studies have been made on wavelets. An excellent overview of what wavelets have brought to the fields as diverse as biomedical applications, wireless communications, computer graphics or turbulence. Image compression is one of the most visible applications of wavelets. The rapid increase in the range and use of electronic imaging justifies attention for systematic design of an image compression system and for providing the image quality needed in different applications [4].

In the earlier time analog signals were more common, here using sampling approach possible to convert analog to digital signal. A digital encoded data was suitable to further encoding schemes like Run Length Encoding (RLE) or entropy coding [5]. Image compression basically started with quantization (scalar and vector), which has rejected spatial redundancy of digital image data. Further introduces several algorithms based on prediction encoding, block segmentation of image for data compression.

Here, prediction encoding schemes adopt different method like LMS algorithms, which were uses adaptive prediction filter for image source encoding. There were optimal and spatial prophecy compression schemes were utilized, when apply prophecy compression on image data there was implicit theory that the image was scanned in particular order of image blocks 9. Where block size segmentation provide high quality variable-rate image was attained by segmenting an image into various block size, this was perform as a lossless compression [6]. Recently in area of image data compression DWT and DCT based compression area more popular, both were gave good compression utilizing various encoding schemes.

II. Research Methodology

It was generally known that, the course of classifying image compression could be established in different ways. But, a widely acceptable classification procedure puts the various compression techniques into two major groups as Lossless compression and Lossy compression.

2.1: Lossless Compression: In this compression scheme, no bits of information were permanently lost during compression or decompression of an image. This means that, an image would look exactly the same before compression and after decompression. The most common image format on the WWW that uses a lossless compression scheme was the GIF format. Although it was lossless, it has the capability of showing a maximum of only 256 colours at a time. The GIF format was used mainly when there were distinct lines and colours in the image, as was the case in logos and illustration work. Cartoons were an excellent example of the type of work that was best suited for the GIF format. At this time, all web browsers support the GIF format. When converting an image in to GIF format, we have the option to have the image display any number of colours up to 256 (the maximum number of colours for this format). A lot of images appropriate for the GIF format could be saved with as little as 8 to 16 colours, which would greatly decrease the required file size compared to the same image saved with 256 colours. These settings could be specified when using Photoshop; Lossless data compression was used in software compression tools like the highly popular Zip format, used by PKZIP, WinZip, and the UNIX programs bzip2 and gzip.

2.2: Lossy Compression: Lossy methods were frequently employed for compressing sound or images. In such circumstances, the recovered file might be quite dissimilar to its original source at bit level. A compression scheme in which some bits of information were permanently lost during compression and decompression of an image. This means that, an image would permanently lose some of the information that it originally contained. Fortunately, the loss was usually only minimal and hardly detectable. The most typical image format on the WWW that utilizes a lossy compression technique was the JPEG format. JPEG was a maximum efficient, true-color, compressed image format. Although it belongs to lossy type, it possess the capacity of showing more colours than GIF (more than 256 colours). The JPEG setup was utilized mostly when image comprises of gradients, blends, and varying color disparities, as the same with photographic images. Since it was lossy, JPEG possess the capability in compressing every image enormously, with minimum loss in quality of image. It was generally able to compress more resourcefully than other lossless GIF setups, achieving maximum achievable compression. The most popular browsers like Netscape do support JPEG, and it was expected that very shortly all browsers would have built-in support for it. Both GIF and JPEG have their distinct advantages, contingent on sorts of images.

2.3: Data Compression: Data was denoted as an integration of redundancy and information. Data was the segment of data that must be conserved enduringly in its original form to suitably understand the data for its meaning or purpose of. Redundancy was the data segment that could be eliminated when it was not required or could be implanted to know the data when necessary. Mostly, the redundancy was implanted to create the data in its unique form. Data compression was a method to lessen the redundancies in representation of data and minimize data storage needs and bring down communication costs. Data compression was the method to reduce the redundancies in data representation with the intention of decreasing data storage necessities and therefore communication costs. Decreasing the storage necessity was corresponding to growing the competence of the storage medium and the band width communication. As a consequence, the development of effective compression methods would endure to be a design challenge for upcoming communication systems and progressive multimedia applications. Data was represented as a blend of redundancy and information.

2.4: Lossless vs Lossy Compression: In these compression systems, the rebuilt image, later compression, was numerically equal to the input image. But, lossless compression could only attain a modest amount of compression. An image reconstructed behind lossy compression encompasses degradation comparative to the original. Often this was due to the compression scheme entirely rejects redundant information. But, lossy schemes were accomplished of attaining much advanced compression. Under normal viewing circumstances, no visible loss was observed (visually lossless). Image compression was the application of Data compression on digital images. The objective of image compression was to condense image data redundancy with the intention to be capable to store or communicate information in an effective manner. Image compression might be losslessor lossy. Lossless compression was sometimes desired for imitation images, for example, comics oricons, technical drawings,. This was due to LCT, particularly once utilized at lower bit rates, present compression artifacts. Lossless compression techniques could also be desired for great value content, like medical scans image prepared for reporting purposes. Lossy techniques were particularly appropriate for natural images like photos in submissions where minor fidelity loss was satisfactory to attain a considerable reduction in bit rate. The lossy compression that produces unnoticeable variances could be known as visually lossless. Run-length encoding and entropy encoding were the approaches for lossless image compression. Transform coding, where the wavelet transforms or Fourier-related transforms like DCT were applied, followed by entropy coding and quantization with technique for lossy image compression could be mentioned.

2.5: Image Compression: An image was a processed 2-D signal by the human visual system. The signals designating the images were usually in analog form. The images were converted to digital form to analog form to process, store and transmit for computer applications. An image forms the major part of data, predominantly in remote sensing, biomedical and video conferencing applications. In the contemporary scenario, efficient techniques were much needed for transmitting and storing the huge quantities of data due to the incredible development and growth in data storage. Image compression techniques minimalize the bits quantity necessary to denote an image by considering the above stated redundancies. An opposite procedure known as decompression was applied to the compressed data to acquire the rebuilt image. Image compression schemes were collected of two dissimilar structural blocks specifically a decoder and an encoder.

2.6: Basic Image Compression Model: It contains two parts i.e., source encoder and source decoder.

2.6.1: Source Encoder: It contains mapper, quantizer and encoder. Mapper: It transforms the original image into a layout which eliminates the redundancies of inter-pixel from the image. The transforms were used as mapper for many image compression schemes. This process was reversible.

2.6.2: Quantizer: This procedure eliminates the PVR from the image. It was a process which signifies the uninterrupted image data set with finite values set. There were two forms of quantization, namely, vector quantization and scalar quantization. In case of scalar quantization each input symbol was processed independently and corresponding output was produced. In case of vector quantization, a set of input symbols were grouped together to form vectors and its corresponding output was being produced. A quantizer was called as uniform quantizer only when the input partitions were equally divided.

2.6.3: Encoder: The encoder represents the finite set of values with minimum number of bits and hence helps in achieving additional compression. The output produced by the encoder block was the compressed image.

2.6.4: Source Decoder: It contains two blocks, namely, decoder and inverse mapper.

2.6.5: Decoder: The compressed image was decoded using suitable decoder.

2.6.6: Inverse Mapper: It was process which maps the decoded data into format which was necessary for rebuilding the image. The output produced by this block was the rebuilt image.

2.7: Source Coding Algorithm: Source coding could mean both lossless and lossy compression. Contingent on the features of the data, each algorithm might give different compression performance. So selection of the particular algorithm would rest on the data characteristics themselves. In a lossy compression mode, the source coding algorithms were usually applied in the entropy encoding step after transformation and quantization.

2.8: Wavelet Based Image Compression: The aim behind wavelet transform was to convert the image from spatial domain to frequency domain. The wavelet based image compression was comprised of the same steps as transform coding. The main difference lies in the transformation part where an invertible wavelet transform was used. The wavelet transform refers to image analysis at different scales and different resolutions. The image scale refers to the image size. As the image scale increases, the image shrivels (tightens). As the image scale decreases, the image expands. The image resolution refers to the frequency of the image. As the resolution increases, more amount of high intensity image information becomes visible.

III. Results And Discussions

In the present scenario, analysis and study of the performance of the compression technique on an image based on the principle of compression by scaling with HWT was attempted. The work process was specially referred to the two-dimensional compression of medical image using scaling technique with HWT to minimize total degradation and to protect a compression ratio limited. Scaling technique with HWT established image compression includes, scaling and hard thresholding applied for the detailed coefficients, entropy coding. Reconstructed image was acquired by employing the original approximation co-efficient and the altered detailed coefficients.

The compressed image was assessed for the perceptual and quantitative quality, the measures of objective used were CR, Peak-Signal-Noise-Ratio (PSNR) and the Mean Square Error (MSE). The result improves the decompressed image quality by applying de-noising technique to bring in the image that was reconstructed very much analogous to the actual one as much as possible to confirm the obtaining retained energy at maximum percentage in the compressed image. Tests were conducted on the images to get this result on grayscale size of 256×256. Noise was not taken into consideration to the unique image in the lossless compression.

Lossy image compression using EWZ algorithm: The following figure 1 shows the blurred image that could be converted into grey scale to acquire the color image and its noise could be reduced by employing the Weiner filter. Image could be acquired with less quantity of data loss. The gaps established in the image could be filled with Hilbert curve method.
The figure 2 shows the grey image by reducing some noises without any loss of original image data. The grey scale image could be converted into color image. This provides the image quality from the blurred image. Here, the ratio of lossy compression could be accomplished as higher as 97.1%.

Fig: 1 Blurred Input image

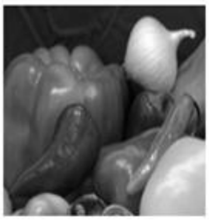
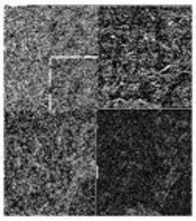
Fig: 2 Converted grey image

Fig: 3 Decompressed output image with EZW algorithm

For Baboon image:
The bitrate was 0.25 bpp (with threshold 50 in the encoding)
The performance of psnr was 24.89 Db

For Cameraman image:
The bitrate was 0.36 bpp (with threshold 50 in the encoding)
The performance on psnr was 24.84 Db

For Onion image:
The bitrate was 0.15 bpp (with threshold 50 in the encoding)
The performance on psnr was 30.63 Db


IV. Conclusion

The present work proposes the Lossy Image compression utilizing improved EZW algorithm. Lossy image compression was a class encoding method. Utilize this method for data size reduction, data handling. Lossy compression was used to compress multimedia data, for example, sound, video, and images.

In this work, the improved EZW algorithm finishes lossy image compression by Hilbert modification and singular esteem truncation. By joining these techniques, it tends to repetition in low-frequency spatial appropriation and high-frequency energy dissemination. The high compression rate was accomplished by this method. By utilizing staggered wavelet decomposition, a functioning color transformation was achieved. At the point when contrasted with different algorithms, this upgraded EZW algorithm gives high compression ratio as 97.1 %. Apply the Lossy compression algorithm to TIFF, GIF, and PDF.

The fundamental point of compression was to reduce the prerequisite of bandwidth for memory and transmission for a capacity of a wide range of data. The principal objective was to actualize the operations used in a lossy compression two-dimensional image. This thesis focuses on developing the efficient and successful algorithm for compressing a lossy image utilizing an improved Embedded Zerotree Wavelet (EZW) algorithm.

In the proposed method, an attempt was made more on lossless compression in light of the data substance of the noteworthy segment as in we would not dispose of any wavelet coefficients. Be that as it may, because of the intrinsic idea of wavelet encoding and resulting round off mistakes there was in every case some misfortune related with the encoding plan. The EZW image encoder and it comprises of the following three fundamental advances such as Transformation, Quantization and Compression.

The algorithm has been tried on different images, each having particular highlights. It was seen that, while utilizing Ads lets for compression, the outcomes got were reliably great on all images regardless of the fluctuating highlights. Henceforth, the algorithm was image-autonomous and could be utilized adequately on any image.

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