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DWT Based Hybrid Image Compression For Smooth Internet Transfers

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ABSTRACT — The image compression is very necessary and popular technique in course of saving the memory on the local disc or to speed up the internet transfers. The discrete wavelet transform (DWT) has already been proved as the best image compression algorithm. The DWT technique decomposes the image matrix into various sub-matrices to create a compressed image. The new compression technique will be developed by combining the most effective and fast wavelets of DWT technique for image compression. The quality of the new image compression technique will be evaluated using the peak signal to noise ratio (PSNR), mean squared error (MSE), compression ratio (CR) and elapsed time (ET). Also, the new techniques would be compared with the existing image compression techniques on the basis of the latter mentioned parameters.

Keywords – Image compression, DWT compression, decomposed matrix, wavelet transform

INTRODUCTION

Compression is the process of reducing the size of a file or of a media such as high-tech graphical images etc, by encoding its data information more efficiently. By doing this, there is a reduction in the number of bits and bytes used to store the information. Therefore, a smaller file or image size is generated in order to achieve a faster transmission of electronic files or digital images and a smaller space required for downloading. Compression basically employs four types of redundancy in the data:

Temporal: This is present in 1D data, 1D signal, Audio etc.

Spatial: It occurs due to correlation between neighboring pixels or data items.

Spectral: This is present due to correlation between colour or luminescence components. This uses the frequency domain to exploit relationships between frequencies of change in data.

Psycho-visual: This redundancy exploits perceptual properties of the human visual system.

Compression is done by using compression algorithms that rearrange and reorganize data information so that it can be stored economically. By encoding information, data can be stored using fewer bits. This is done by using a compression/decompression program that alters the structure of the data temporarily for transporting, reformatting, archiving, saving, etc.

Compression reduces information by using different and more efficient ways of representing the information. Methods may include simply removing space characters, using a single character to identify a string of repeated characters or substituting smaller bit sequences for recurring characters. Some compression algorithms delete information altogether to achieve a smaller file size. Depending on the algorithm used, files can be greatly reduced from its original size. Compression is achieved by applying linear transform, quantizing the resulting transform coefficients and entropy coding the quantized values.

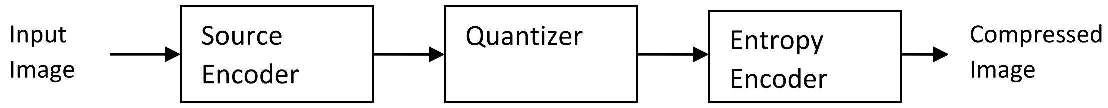

Figure 1.1: Image Compression Model

Image Compression Model as shown in figure 1.1 consists of three components namely Source Encoder, Quantizer and Entropy Encoder.

Source Encoder: In the first step, signal is processed with a reversible linear mathematical transform to map the pixel values onto a set of coefficients which are then quantized and encoded. This step is intended to decorrelate the input signal by transforming its representation in which the set of data values is sparser which compact the information content of the signal into smaller number of coefficients.

The choice of transform to be used depends on a number of factors such as computational complexity, coding gain etc. For compression purpose, higher the capabilities of compressing information in fewer coefficients better the transform. Most widely used transform coding techniques are DCT (Discrete Cosine Transform), DWT (Discrete Wavelet Transform), etc.

Quantizier: It is an irreversible step. It represents the lossy stage in the process. A good quantizer tries to assign more bits for coefficients with more information content and fewer bits for coefficients with less information content, based on the given fixed bit rate. The choice of the quantizer depends on the transform that is selected. Some quantization methods perform better with particular transform methods. Quantzation can be performed on each individual coefficient is called Scalar Quantization (SQ). Quantization can also be applied on a group of coefficients together known as Vector Quantization (VQ).

Entropy Encoder: It removes redundancy from the output of the quantizer. This redundancy is in the form of repeated bit patterns in the output of the quantizer. The frequently occurring symbols are replaced with shorter bit patterns while infrequently occurring symbols are replaced with longer bit patterns, resulting in a smaller bit stream overall. It uses a model to perfectly determine the probabilities for each quantized value and produces an appropriate code based on these probabilities so that the resultant output code stream is smaller than the input stream. Most commonly used entropy coding techniques are RLE (Run Length Encoding), Huffman Coding, Arithmetic Coding, Lempel-Ziv (LZ) algorithms, etc. The properly designed quantizer and entropy encoder are absolutely necessary along with optimum signal transformation to get the best possible compression.

The compression algorithms are based on the loss of information or detail present in the reconstructed image. Depending on the detail present, compression can be categorized in two broad ways:

Lossless Compression: In this data is compressed and can be reconstituted without loss of detail or information. This is referred to as bit- preserving or reversible compression systems. To achieve this, algorithms create reference points for things such as textual patterns, store them in a catalogue and send the along the smaller encoded file. When uncompressed, the file is regenerated by using those documented reference points to re-substitute the original information. Lossless compression is a form of compression in which data files are split up into different chunks and reorganized to optimize them. This sort of compression very rarely saves much space, but it is ideal for transporting enormous files by breaking them into easier-to-handle pieces. Lossless compression is used when every bit of data is needed in the end product, often when transmitting a file to a designer. In the case of images, a lossless compression allows the designer to be sure that any data they may want to alter will be there, letting them create a final product before compressing the file further using a lossy compression. This is also true of sound files, where a sound mixer may need additional information, such as separate channels, that an end user will not require. Lossless compression is ideal for documents containing text and numerical data where any loss of textual information can not be tolerated. ZIP compression, for example, is a lossless compression that detects patterns and replaces them with a single character. Another example is LZW compression which works best for files containing lots of repetitive data.

Lossy Compression: Its aim is to obtain the best possible fidelity for a given bit rate or minimizing the bit rate to achieve a given fidelity measure. It reduces a file by permanently eliminating certain information especially redundant information. When the file is uncompressed, only a part of the original information is only present, although the user may not notice it. It is generally used for images, video or sound where a certain amount of information loss will not be detected by most users and the loss of quality is affordable. For instance, in an image containing a green landscape with a blue sky, all the different and slight shades of blue and green are eliminated with compression. The essential nature of the data isn't lost as the essential colors are still there. The JPEG image file, commonly used for photographers and other complex still images on the web, is an image that has lossy compression. Using JPEG compression, the creator can decide how much loss to introduce and make a trade-off between file size and image quality. The advantage of lossy methods over lossless methods is that in some cases a lossy method can produce a much smaller compressed file than any lossless method, while still meeting the requirements of the application. If an image is compressed, it needs to be uncompressed before it can be viewed. Some processing of data may be possible in encoded form. Lossless compression involves some form of entropy encoding and are based in information theoretic techniques whereas lossy compression use source encoding techniques that may involve transform encoding, differential encoding or vector quantization.

LITERATURE REVIEW

Many researchers have worked for the analysis of image compression application but there is still some room for improvement in cases where data compression is necessary due to huge requirements of storage and time, especially in problems of information transmission. Preeti Aggarwal et.al. (2010) have performed Comparison of Image Compression Using Wavelets. They proposed an improved fractal image algorithm based on the wavelet sub-tree. This algorithm proposed improved fractal image compression technique in wavelet domain with thresholding value, which reduces the encoding time effectively. S.M.Ramesh et.al. have proposed Medical Image Compression Decomposition for Prediction Method. The technique offers a simple and lossless compression method for compression of medical images.

Method is based on the wavelet decomposition of the medical images followed by correlation analysis of coefficients. K. Veeraswamy et.al. have made the improvements in Wavelet based Image Compression Scheme and Oblivious Watermarking. The proposed procedure is being improved on the basis of the performance of a wavelet based image compression in terms of entropy as all the subbands of wavelet decomposed image are quantized based on the energy of the subband. Veeraswamy et.al. have designed Quantization Table for Hadamard Transform based on Human Visual System for Image Compression. By incorporating the human visual system with the uniform quantizer, a perceptual quantization table is derived. This quantization table is easy to adapt to the specified resolution for viewing. The result of the proposed method shows improved PSNR, NCC and reduced blocking artefacts.

PROBLEM STATEMENT

Compression is the process of reducing the size of a file by encoding its data information more efficiently. By doing this, the result is a reduction in the number of bits and bytes used to store the information. A smaller file size is generated in order to achieve a faster transmission of electronic files and a smaller space for its downloading. With the increasing demand of manipulations, storage and transmission of the images, great effort has been made to develop the compression algorithms that can provide better compression ratio. Many new schemes such as curvelets, ridgelets, wavelets etc have been used for image compression but most of them suffered from the problems of computational complexity, choice of the filters involved and so forth. Still it is a challenge for researchers to improve the compression ratio of compression algorithms, smaller size of the encoding file, and improved quality of the decompressed images. This work focuses on developing a new algorithm based on fractal image compression.

METHODOLOGY

A key component to implement the compression or decompression algorithm and understanding of the factors that influence of the specific Wavelet transform technique (DWT) for which the algorithm is intended. The target is to achieve the goals of the proposed algorithm mentioned in the next section, the research is divided into three distinct phases. The First phase involved a through literature review where the related work was studied to investigate the factors that quality metrics like PSNR, encoding time, size of encoded file and compression ratio. The literature study also includes an investigation into the available compression and decompression algorithms which are related to the Discret wavlet transform using Haar wavelet, Daubechies wavelet, Coif let wavelet in order to identify the common problems faced by these algorithms. The second phase involved the implementation of the proposed algorithm in MATLAB platform.

CONCLUSION AND FUTURE WORK

The aim of the proposed project is to design and implement a new compression algorithm using wavelet filters in unique and effective combination. The proposed compression technique will decompose the image matrix and will reproduce the compressed image. It has already been proved in number of researches that the wavelet transform techniques are very effective for image compression. The new technique will be the unique combination of the various wavelets used under the DWT in MATLAB simulator. In the future, the project will be implemented using the MATLAB. The algorithm will designed and the design will be revived and reviewed to build stronger, effective and lossless compression technique by keeping an eye over the image quality matrix.

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