Image Compression Using Hybrid Technique

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Abstract

The compression ratio of the study Hybrid approach may give better performance compared with the related methods. PSNR and SNR will be calculated to ensure the performance of the system. The PSNR value at the main subject area is equal for both the methods. The PSNR value at the background area is lower in Hybrid method which is acceptable, since the background area is not considered to be so important. The Hybrid method is appropriate for imagery with larger inconsequential background and certain level of loss is tolerable in the background of the image .

Keywords: Image Compression , Hybrid Technique .

1. Introduction

Image compression is an inevitable solution for image transmission since the channel bandwidth is limited and the demand is for faster transmission. Storage limitation is also forcing to go for image compression as the color resolution and spatial resolutions are increasing according to quality requirements. A huge amount of online information is used either graphical or pictorial in nature. The requirements for storage and communications are high. Compressing the data is one of the way out for this problem. Thus the methods of compressing the data prior to storage and/or transmission are of essential real-world and viable concern(Mohamed A. El-Sharkawy, 1997 IEEE).

Lossless and lossy Compression techniques are the two broad classes of image compression. The lossless compression is particularly beneficial in image archiving and permits the image to be compressed and decompressed without dropping any data. And the lossy compression, affords higher levels of compression ratio but result in a less than perfect replica of the original image(XiwenOwenZhao, ZhihaiHenryHe, vol. 17, no. 4, April 2010) .

Lossy compression is beneficial in applications such as television transmission, video conferencing, and facsimile transmission etc., in these circumstances certain amount of error is tolerable. The principal aim of image compression is to reduce the number of bits required to represent an image. In lossless image compression algorithms, the reconstructed image is identical to the original image. Lossless algorithms, however, are limited by the low compression ratios they can attain. Lossy compression algorithms, on the other hand, are capable of attaining high compression ratios. Though the reconstructed image is not identical to the original image, lossy compression algorithms attain high compression ratios by exploiting human visual properties(Nikolaos V. Boulgouris, DimitriosTzovaras, and Michael GerassimosStrintzis, vol. 10, No. 1, Jan 2001),(Jaemoon Kim, Jungsoo Kim and Chong-Min Kyung , 978-1-4244-4291 / 09 2009 IEEE. ICME 2009) .

Wavelet transformation(WT) approaches aregenerally used in addition to numerous other methodsin image compression. The problem in lossless compression method is that, the compression ratio is very less; where as in the lossy compression the compression ratio is very high but may lose vital information of the image. Hybrid image compression incorporates diverse compression systems like PVQ and DCTVQ in a single image compression. The study method uses lossy compression method with various quality levels based on the context to compress a single image by eluding the complications of using side information for image decompression in. (Marta Mrak, Sonja Grgic, and MislavGrgic ,EUROCON 2003 Ljubljana, Slovenia, 0-7803-7763-W03 2003 IEEE),(Hong, S. W. Bao, P., IEE Proceedings, Volume: 147, Issue: 1,16-22, Feb 2000) .

Discrete cosine transform (DCT) is widely used transform in image processing, especially for compression. Some of the applications of two-dimensional DCT involve still image compression and compression of individual video frames, while multidimensional DCT is mostly used for compression of video streams and volume spaces. Transform is also useful for transferring multidimensional data to DCT frequency domain, where different operations, like spread-spectrum data watermarking, can be performed in easier and more efficient manner. A countless number of search discussing DCT algorithms is strongly witnessing about its importance and applicability(Jundi Ding, Runing Ma, and Songcan Chen, IEEE Transactions on Image Processing, vol. 17, NO. 2, Feb 2008) .

2.Lossless and Lossy Image Compression

Usual methods of compression are called loss less coding techniques. With loss less coding, we restore every detail of the original data upon decoding. Obviously this is a necessity for numerical, financial documents.

Our tolerance of image approximation and need for high compression opens the opportunity to exploit a new form of coding: lossy coding. Lossy coding can only be applied to data such as images and audio for which humans will tolerate some loss of fidelity(faithfulness of our reproduction of an image after compression and decompression with the original image). Because we are no longer being held to the same requirements that underline the reproduction of financial or engineering data, we should be able to realize greater compression of the data as we increase the allowed loss of information.

lossy compression algorithms obtain greater compression by allowing distortion of the image that will be recovered on decompression. In effect, these systems simplify the image by removing information from them. The more the degree of simplification, the less the recovered image will look like the original.

Because the allowable distortion varies according to the purpose of the image, the amount of compression is typically set by the user of the compression system. Thus, little if any lossy compression is typically acceptable for spy satellite and medical images, while considerable compression is applied to the screen saver and icon images that are displayed on one's computer.

a. Lossless Methods for Image Compression

These methods include Run-length encoding – used as default method in PCX and as one of possible in BMP, TGA, TIFF, DPCM and Predictive Coding, Entropy encoding, Adaptive dictionary algorithms such as LZW – used in GIF and TIFF, Deflation – used in PNG, MNG, and TIFF and Chain codes.

b. Loss Methods for Image Compression

Reducing the color space to the most common colors in the image. The selected colors are specified in the color palette in the header of the compressed image. Each pixel just references the index of a color in the color palette. This method can be combined with dithering to avoid posterization.

Chroma sub sampling. This takes advantage of the fact that the human eye perceives spatial changes of brightness more sharply than those of color, by averaging or dropping some of the chrominance information in the image.

Transform coding. This is the most commonly used method. A Fourier-related transform such as DCT or the wavelet transform are applied, followed by quantization and entropy coding and Fractal compression.

3. Image Compression Using DCT

In the JPEG image compression algorithm, the input image is divided into 8-by-8 or 16-by-16 blocks, and the two-dimensional DCT is computed for each block. The DCT coefficients are then quantized, coded, and transmitted. The JPEG receiver (or JPEG file reader) decodes the quantized DCT coefficients, computes the

inverse two-dimensional DCT of each block, and then puts the blocks back together into a single image. For typical images, many of the DCT coefficients have values close to zero; these coefficients can be discarded without seriously affecting the quality of the reconstructed image.

The two-dimensional DCT of an M-by-N matrix A is defined as follows:

$$B_{pq} = \alpha_p \alpha_q \sum_{m=0}^{M-1} \sum_{n=0}^{N-1} A_{mn} \cos\frac{\pi(2m+1)p}{2M} \cos\frac{\pi(2n+1)q}{2N}, \quad \begin{array}{l} 0 \le p \le M-1 \\ 0 \le q \le N-1 \end{array}$$

$$\alpha_p = \begin{cases} 1/\sqrt{M}, & p = 0 \\ \sqrt{2/M}, & 1 \le p \le M-1 \end{cases} \quad \alpha_q = \begin{cases} 1/\sqrt{N}, & q = 0 \\ \sqrt{2/N}, & 1 \le q \le N-1 \end{cases}$$

The values Bpq are called the DCT coefficients of A. (Note that matrix indices in MATLAB always start at 1 rather than 0; therefore, the MATLAB matrix elements A(1,1) and B(1,1) correspond to the mathematical quantities A00 and B00, respectively).

The DCT is an invertible transform, and its inverse is given by:

$$A_{mn} = \sum_{p=0}^{M-1} \sum_{q=0}^{N-1} \alpha_p \alpha_q B_{pq} \cos\frac{\pi(2m+1)p}{2M} \cos\frac{\pi(2n+1)q}{2N}, \quad \begin{array}{l} 0 \le m \le M-1 \\ 0 \le n \le N-1 \end{array}$$

$$\alpha_p = \begin{cases} 1/\sqrt{M}, & p = 0 \\ \sqrt{2/M}, & 1 \le p \le M-1 \end{cases} \quad \alpha_q = \begin{cases} 1/\sqrt{N}, & q = 0 \\ \sqrt{2/N}, & 1 \le q \le N-1 \end{cases}$$

The inverse DCT equation can be interpreted as meaning that any M-by-N matrix A can be written as a sum of MN functions of the form:

$$\alpha_p \alpha_q \cos\frac{\pi(2m+1)p}{2M} \cos\frac{\pi(2n+1)q}{2N}, \quad \begin{array}{l} 0 \le p \le M-1 \\ 0 \le q \le N-1 \end{array}$$

These functions are called the basis functions of the DCT. The DCT coefficients Bpq, then, can be regarded as the weights applied to each basis function. For 8-by-8 matrices, the 64 basis functions are illustrated by this image.

4. Image Compression Using DWT

Wavelet Transform (WT) of an image represents image as a sum of wavelets on multi-resolution levels. Multire solution analysis is implemented via high-pass filters (wavelets) and low-pass filters (scaling functions). In wavelet transform any one-dimensional function is transformed into a two-dimensional space, where it is approximated by coefficients that depend on time(determined by the translation parameter) and on scale,(determined by the dilation parameter). The zoom phenomena of the WT offer high temporal localization for high frequencies while offering good frequency resolution for low frequencies. Hence, the wavelet transform is well suited to image compression.

The transform of a signal is just another form of representing the signal. It does not change the information content present in the signal. The Wavelet Transform provides a time-frequency representation of the signal. It was developed to overcome the short coming of the Short Time Fourier Transform (STFT), which can also be used to analyze non-stationary signals. While STFT gives a constant resolution at all frequencies, the Wavelet Transform uses multi-resolution technique by which different frequencies are analyzed with different resolutions.

A wave is an oscillating function of time or space and is periodic. In contrast, wavelets are localized waves. They have their energy concentrated in time or space and are suited to analysis of transient signals. While Fourier Transform and STFT use waves to analyze signals, the Wavelet Transform uses wavelets of finite energy.

5. The Proposed System

The hybrid image compression system is study to be implemented in order to get an efficient compression technique. The input image is initially segmented into background and foreground portions, then the image is subdivided into 8x8 blocks and DCT coefficients are computed for each block. The quantization is performed conferring to quantization table. The quantized values are then rearranged according to zig-zag arrangement. The lesser values are discarded from the list in the zig-zag arrangement by the selector as per the block's presences recognized by the classifier. If the block is being present in foreground area then the threshold level is set to high by the selector, otherwise a lower value for threshold is set by the selector. After discarding insignificant coefficients the remaining coefficients are compressed by the typical entropy encoder based.

The study image compression Algorithm is listed below:

Introduces the image to be compressed.

- Preprocessing the original image.
- Starts the DCT processor.
    - Segment the input image into background and foreground based on edges.
    - Subdivide the input image into 8x8 blocks.
    - Find the DCT coefficients for each block.
    - Quantize the DCT coefficients based on quantization table.
    - Discard lower quantized values depend on the threshold value selected by the selector.
    - Compress remaining quantized values by Entropy Encoder.
- Starts DWT processor.
    - Apply low pass filters on rows.
    - Apply low pass filter on columns of previous step, this generate LL-band.

The architecture of the study system is presented in figure (1), and then the results are illustrated in figure 2.

Figure (1) image compression approach

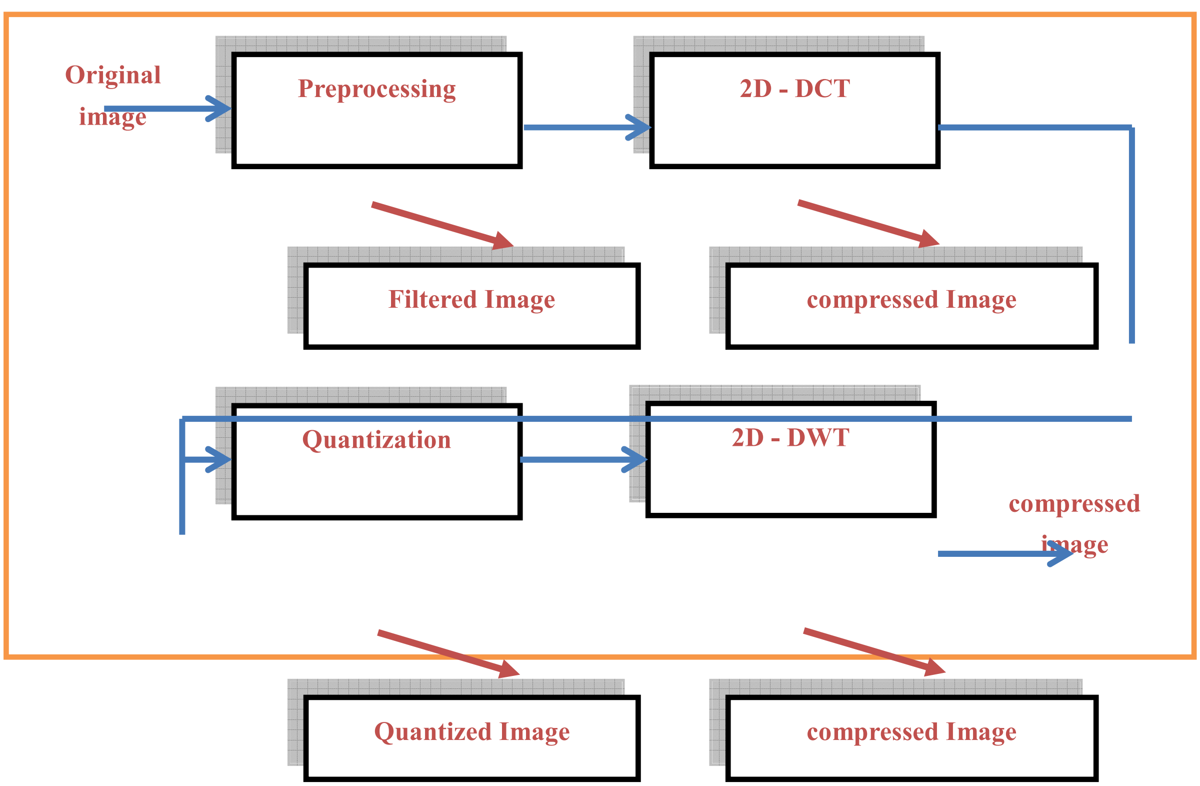
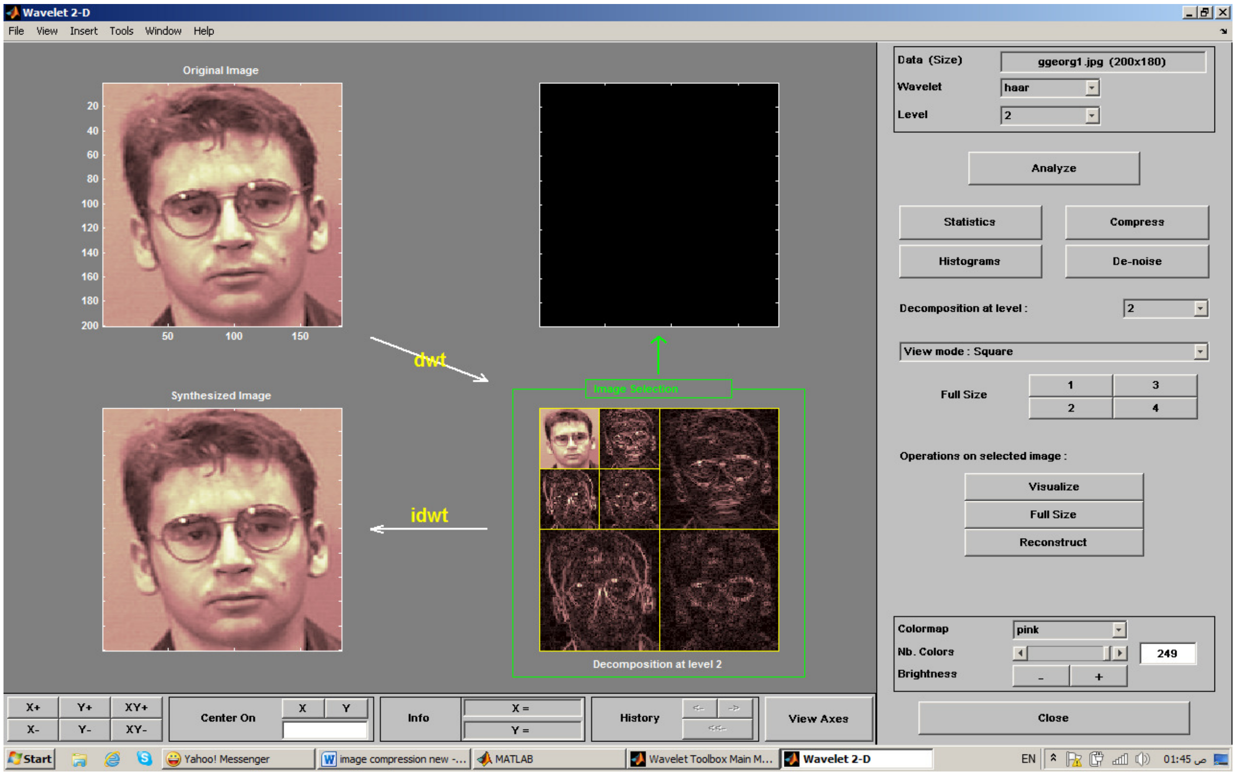


Figure (2) Image compression results



6. Conclusion

As well as a search study about this field of study to enrich the thesis, In this study, we propose an approach to enhance the tested image then apply a hybrid technique via discrete cosine transform (DCT) and discrete wavelet transform (DWT). In this study it is relevant to develop an effective compression technique. This system then will apply to different types of images that contents different levels of details. A performance measures then will apply to ensure that the system is accurate and will give a good performance.

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