HUFFMAN CODING ALGORITHM AND DCT IMPLEMENTATION FOR HYBRID IMAGE COMPRESSION ON MATLAB PLATFORM

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ABSTRACT

Every single day world is evolving very fast. Rapid development of the computer technology has affected all the scientific areas. Medicine, automation, data analysis, finances, biology, chemistry, economics and many, many more have benefited from the technology expansion. People got interested in the possibilities of information technology and they have noticed that computer can help them in daily tasks. In this paper MATLAB Simulator has been used to evaluate the performance of DCT (Discrete cosine transform) followed by RLE (Run length encoding) and Huffman coding (lossless techniques) in the field of image compression.

This paper presents a hybrid compression technique using DCT with RLE, Huffman coding. In this technique the compression ratio is compared with varied PSNR (peak signal to noise ratio). Discrete Cosine Transform with Huffman codes has been used in the proposed algorithm and better quality of compressed image with reduced MSE, increased PSNR,has been achieved with high compression rate.

KEYWORDS: Discrete Cosine Transform; peak signal noise ratio(PSNR); statistical redundancy; Mean square error(MSE); Compression Ratio(CR); RLE(Run length encoding); Huffman coding.

1. INTRODUCATION

1.1 Image Processing

Image transmission through internet discourage due to lack of security. The secured image transmission can be integrated with imagecompression which provides dual benefits in both security andcompression [1].

The process of converting an image into digitized format is known as Image processing. It

extracts the needed information from the image, processes it and presents it in an enhanced format. It uses a technique called signal dispensation, which accepts the input as an image. It can be a video frame or a photograph and produces an output that representstheimage and itsassociatedcharacteristics [2].

The steps in image processinginclude:

- Capturing the image by using digital camera orscanners
- Analyzing and manipulating the image which includes compression, enhancement and spottingpatterns

1.2 IMAGE PROCESSING TECHNIQUES INCLUDE

- **Image Preprocessing**
- **Image Enhancement**
- **Image Segmentation**
- **Feature Extraction**
- **Image Classification**

2 IMAGE COMPRESSION FUNDAMENTALS

2.1 DATA AND INFORMATION

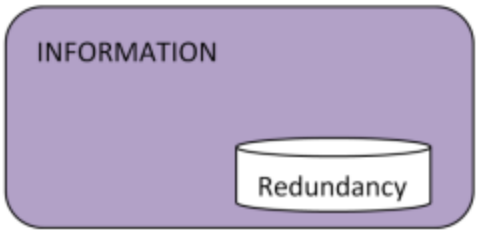


Figure1: Information and Redundancy

Figure 1 represents the Image as an information and redundancy. Data compression is defined as “the method of decreasing the number of bit necessary to represent digital information”.information that is complementary and Redundancy which carries no meaningful information and therefore can be deserted. Reduction of redundancy is to remove duplicated data

from the image. Reduction of Irrelevancy is to omit some portions of the image which is not detected by the HVS (Human visual system).

2.2 IMAGE COMPRESSION TECHNIQUES

There are two types of image compression methods; (1) Lossless, (2) Lossy. In lossless compression, image can be reproduced same as the original image but in lossy, reconstructed image may lose some meaningful image information. In many applications loss of information within image may be unacceptable [3].

(1) LOSSLESS COMPRESSION METHODS

- Run Length Encoding (RLE)
- Huffman Encoding
- Arithmetic Coding
- LZW Coding
- Linear Predictive Coding

(2) LOSSY COMPRESSION METHODS

- . Predictive coding
- Transform coding (FT/DCT/Wavelets)

2.3 COMPRESSIONAND DE-COMPRESSION

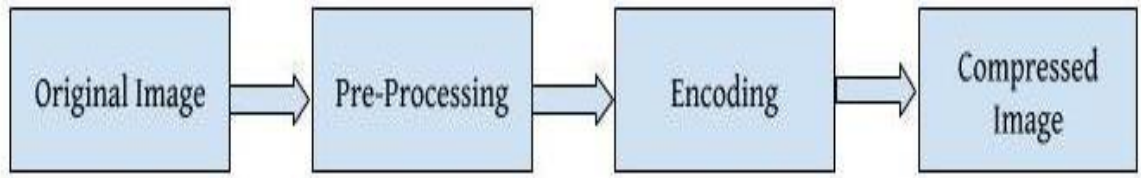


Figure 2: General block diagram of Compression

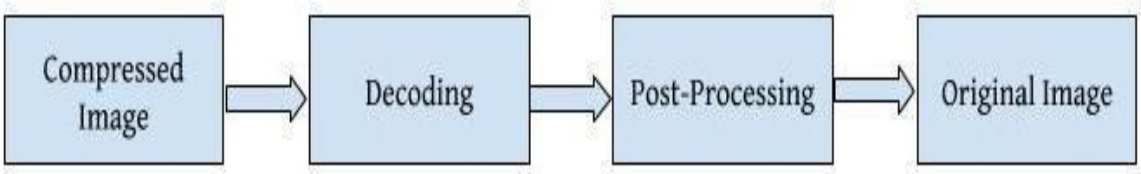


Figure 3: General block diagram of De-compression Technique

The compressor shown in Figure 2 consists of a pre-processing stage that performs data diminution (reduction) and mapping. The encoding stage performs quantization and coding, whereas, the de-compression consists of a decoding stage that performs decoding and inverse mapping followed by a post- processing stage, as shown in Figure 3. In compression, prior to encoding process, pre-processing is accomplished to prepare the image for the encoding process and consists of many operations that are application specific. Post-processing can be

accomplished to remove some of the potentially unwanted artifacts brought about by the compression process, after the completion of compressed file has been decoded [3, 4].

3 PROPOSED WORK

Discrete cosine transforms (DCT), vector quantization (VQ), Short time Fourier transforms (STFT) and discrete wavelet transforms (DWT) are widely used methods for the image compression. DCT is an image compression algorithm that samples an image at regular intervals, analyzes the frequency components present in the sample, and discards those frequencies which do not affect the image as the human eye perceives it. DCT presents blocky artifacts in the reconstructed image, which are not necessary and pleasing to the eyes [6].

3.1DESCRIPTION OF PROPOSED WORK

In this paper, we propose hybrid method which combines lossy and lossless compression to reduce redundancy of the images the hybrid method combines DCT followed by RLE and Huffman coding (lossless techniques) [8].

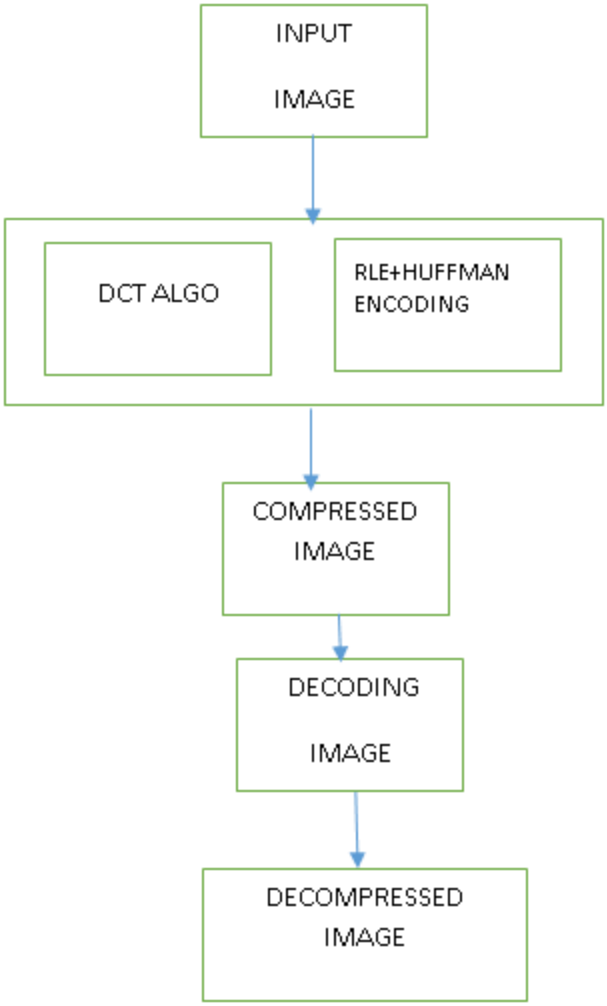


Figure 4:Block Diagram of Proposed Algorithm

3.2 PERFORMANCE PARAMETER

Finally, the performance of this proposed work is evaluated by these parameters given below:

- Compression ratio (CR): It is calculated based on number of bit required to represent original image and the compressed image.

  Compression Ratio = Original Image Size / Compressed Image Size

- Mean Square Error (MSE): It is calculated based on the difference between original and reconstructed image.

- Peak Signal to Noise Ratio (PSNR): It is extensively used to check quality of reconstructed image in the area of image compression. A higher PSNR value would generally indicate better reconstructed image quality.

$$PSNR = 10log_{10}\left(\frac{MAX_I^2}{MSE}\right)$$

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - K(i,j)]^2$$

MAX_I = Maximum value of pixel in Original image
MSE=Mean Square error
m = No. of Row in Original image
n = No. of Column in Original image

4 RESULT

This paper presents the result of different approaches towards the image compression like DCT and various lossless coding techniques namely RLE, Huffman Coding for the evaluation of the test images like Lena (200x200). The results are discussed based on parameter under consideration like PSNR (Peak Signal to Noise Ratio), CR (Compression Ratio) .

Image Size = 200x200

Compression Quality (Q) = 10

Block Size = 8x8

Number of Blocks = 625

Compression ratio = 0.089 or 8.9%

PSNR = 37.9dB

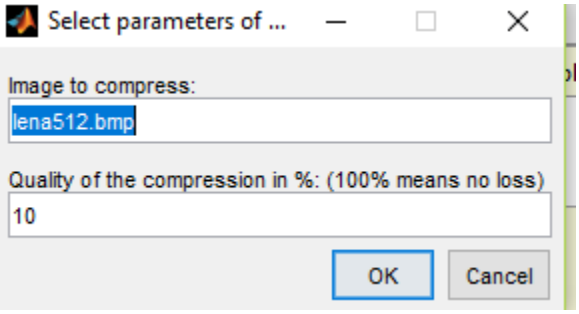


Figure 5:Selectionparameter (Q= 10%)

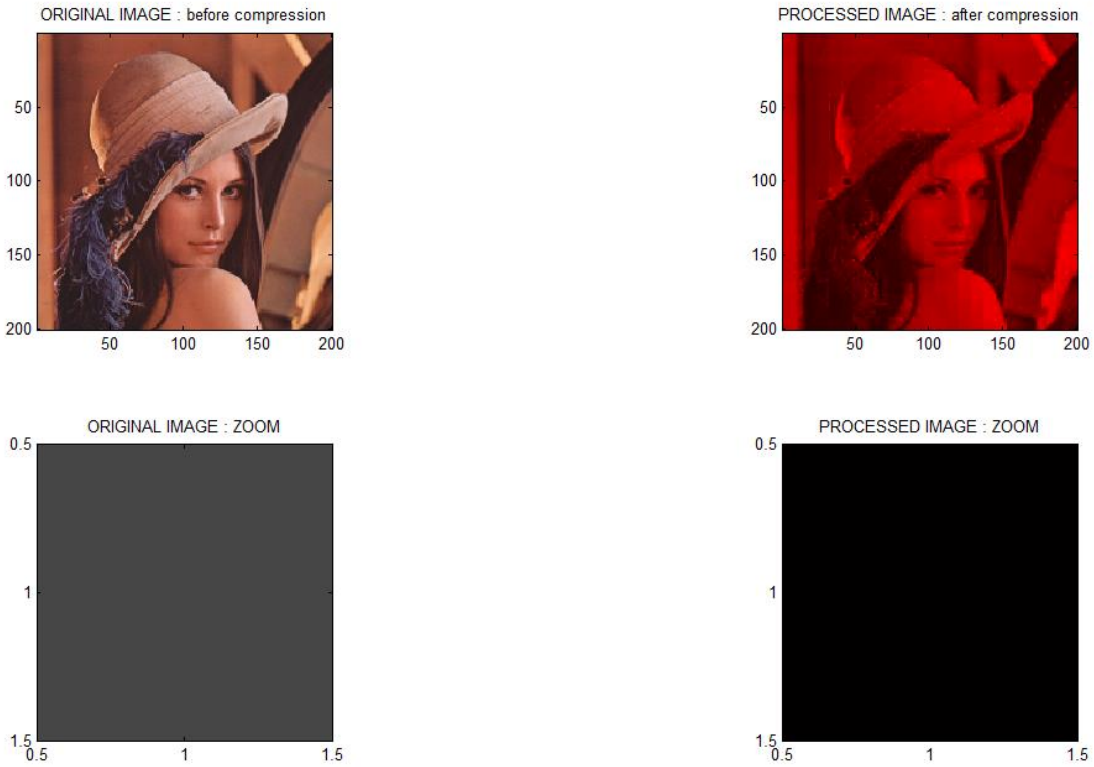


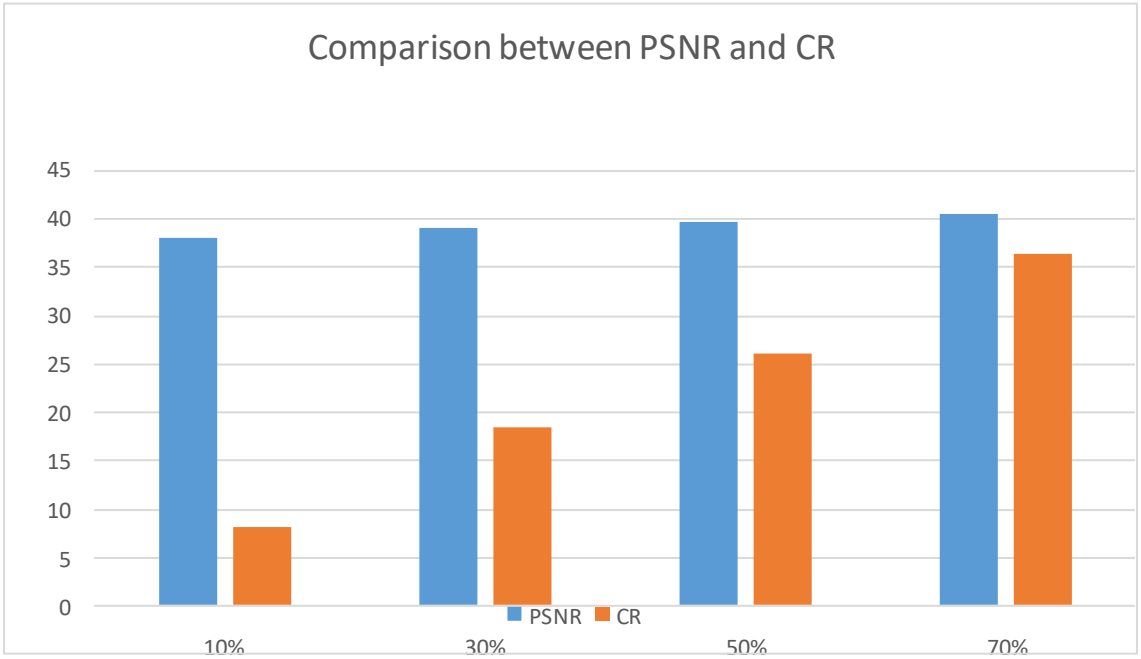
Figure 6: Before and after compressed image

In this simulation, Table 1 lists the results obtained after compression of test images (Lena). The values are calculated after reconstruction of the compressed image and then solving for the PSNR and CR parameters.

Table 1: Comparison of PSNR and CR

Image Size	Compression Quality	Compression ratio	PSNR(dB)
200x200	10%	0.089 or 8.9%	37.9dB
200x200	30%	0.184 or 18.4%	39.1dB
200x200	50%	0.26 or 26%	39.7dB
200x200	70%	0.363 or 36.3%	40.5dB

As an indication of comparison performance, we compare the result with previous work This hybrid technique will result in reduced MSE, increased PSNR, CR values for various test Images. The PSNR, CR gets better with the increase in compressed image. As shown in the graph 1 for test images. The results show increasing in PSNR with CR values on the other hand MSE decreases gradually with the improvement in compressed image.



Graph 1 Comparisons between PSNR and CR

5 CONCLUSION AND FUTURE WORK

In the present paper work we have presented an analysis and comparisons of DCT and RLE, Huffman coding (lossless techniques) for Hybrid image compression considering PSNR, CR, and visual quality of image on variety of test images like woman (Lena) has been implemented. This work put emphasis to develop the algorithm, which is used for the hybrid compression of the two dimensional images. In Huffman, the coding redundancy can be eliminated by assigning the codes in better way. Discrete Cosine Transform with RLE and Huffman codes has been used in the proposed algorithm and better quality of compressed image with high PSNR value and MSE has been achieved with high compression rate.

This Hybrid Image Compression field may include the upcoming standard which incorporate many of the research works in vector quantization and will address many important aspects in image compression for the coming years. Future work determines to enhance the wavelet based vector quantization algorithm that performs well for any format of the image. By implementing an effective code book and the wavelet based tree structure the computation complexity can be

reduced. Also compression algorithm can be improved by analysis of wavelet based vector quantization.

6 REFERENCES

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