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LOSSY IMAGE COMPRESSION BY USING DISCRETE COSINE TRANSFORM AND IMPROVE JPEG ALGORITHM

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Abstract: - Image and video storage and fast data transfer for different purposes increased demand to compress video and images. Compression is divided into two, lossy compression and lossless compression, In this article we aim to implement a compression method for this purpose, at first we used discrete cosine transform to obtain Fundamental frequency components after that we design a Binary quantizer and your image will then be quantized binary digital signal that is greatly compressed then with LZW method that is a method of lossless compression will be compressed more efficiently.

Keywords*:* Image Compression, Lossy source coding, LDGM, JPEG.

1. Introduction

Recently applications such as ecommerce, astronomy, and medicine deal with massive amounts of digital images (T.Glatard *et al.*, 2013), (H.Gu *et al.*, 2011), (F.Garca-Vlchez *et al.*, 2011), (Ping Li *et al.*, 2011), (M.Naixia *et al.*, 2011),. This has led to the transmission and storing of huge amounts of digital images. This digital images has massive data so makes transmission slow and storage expensive. We need compressed this amount of data used to represent these images. Image compression deals with reducing the number of bits needed to represent an image by removing redundant data. Psychovisual redundancy takes advantage of the fact that the human eye is less sensitive to rapid variations (R.C.Gonzalez *et al.*, 2008) (A.zabala *et al.*, 2013), in lossy techniques; the original image cannot be recovered from the compressed image as some quantization losses some data during the encoding of the image (X.Zhang, 2011), (H.Singh *et al.*, 2012).

2. JPEG algorithm

Joint Photographic Experts Group (JPEG) is currently a worldwide standard for compression of digital images. The standard is named after the committee that created it and continues to guide its evolution.
In JPEG image compression, each component array in the input image is first partitioned into 8 8 rectangular blocks of data. A signal transformation unit computes the DCT of each 8 8 block in order to map the signal reversibly into a representation that is better suited for compression. The object of the transformation is to reconfigure the information in the signal to capture the redundancies and to present the information
in a "machine-friendly" form that is convenient for disregarding the perceptually least relevant content. The DCT captures the spatial redundancy and packs the signal energy into a few DCT coefficients. The coefficient with zero frequency in both dimensions is called the direct current (DC) coefficient, and the remaining 63 coefficients are called alternating current (AC) coefficients (N.N.Ponomarenko *et al.*, 2013), (H.Singh *et al.*, 2012).

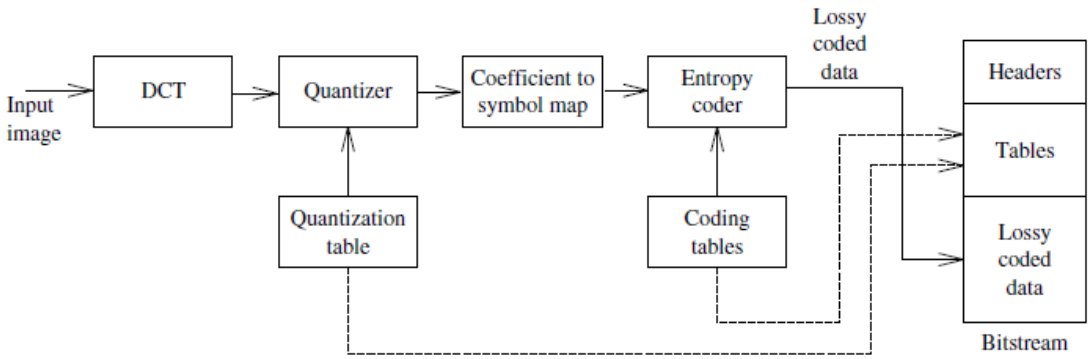

Figure 1: JPEG algorithm encoder diagram

In lossy compression, the DCT coefficients are mapped into a relatively small set of possible values that are represented compactly by defining and coding suitable symbols. The quantization unit performs this task of a many-to-one mapping of the DCT coefficients so that the possible outputs are limited in number. Quantization is done by dividing each element of the DCT coefficient array by a corresponding element in an 8*8 quantization matrix and rounding the result (N.N.Ponomarenko *et al.*, 2013).

$$Q = \begin{bmatrix} 16 & 11 & 10 & 16 & 24 & 40 & 51 & 61 \\ 12 & 12 & 14 & 19 & 26 & 58 & 60 & 55 \\ 14 & 13 & 16 & 24 & 40 & 57 & 69 & 56 \\ 14 & 17 & 22 & 29 & 51 & 87 & 80 & 62 \\ 18 & 22 & 37 & 56 & 68 & 109 & 103 & 77 \\ 24 & 35 & 55 & 64 & 81 & 104 & 113 & 92 \\ 49 & 64 & 78 & 87 & 103 & 121 & 120 & 101 \\ 72 & 92 & 95 & 98 & 112 & 100 & 103 & 99 \end{bmatrix}$$

Figure 2: Quantization matrix of JPEG algorithm

A key feature of the quantized DCT coefficients is that many of them are zero, making them suitable for efficient coding. Entropy coding unit assigns a code word to the symbols that appear at its input and generates

the bit stream that is to be transmitted or stored. Huffman coding is usually employed for variable-length coding (VLC) of the symbols, with arithmetic coding allowed as an option (N.N.Ponomarenko *et al.*, 2013).
In a decoder the inverse operations are performed in an order that is the reverse of that in the encoder

3. *The proposed lossy grayscale image compression technique*

In this section, we describe our algorithm, as mentioned, this algorithm is designed based on the JPEG algorithm and improved it. First, the input image is divided into an 8 x 8 matrix and then uses the DCT transform converted to a frequency-domain representation. The human eye is good at seeing small differences in brightness over a relatively large area, but not so good at distinguishing the exact strength of a high frequency brightness variation. This allows one to greatly reduce the amount of information in the high frequency components, in this method we use a quantization matrix that we call it Qmask matrix and it is different from jpeg algorithm.

$$Q_{mask} = \begin{pmatrix} 8 & 8 & 8 & 8 & 16 & 16 & 16 & 16 \\ 8 & 8 & 8 & 8 & 16 & 16 & 16 & 16 \\ 8 & 8 & 8 & 8 & 16 & 16 & 16 & 16 \\ 8 & 8 & 8 & 8 & 16 & 16 & 16 & 16 \\ 16 & 16 & 16 & 16 & 16 & 16 & 16 & 16 \\ 16 & 16 & 16 & 16 & 16 & 16 & 16 & 16 \\ 16 & 16 & 16 & 16 & 16 & 16 & 16 & 16 \\ 16 & 16 & 16 & 16 & 16 & 16 & 16 & 16 \end{pmatrix}$$

Figure 3: Qmask matrix of proposed algorithm

According to Qmask Matrix shows that the remaining information after divided is small number and many of the higher frequency components are rounded to zero the remaining amount saved. The remain of zero quotient are deleted and the remain of non- zero quotient are saved, The main thing is that to improve the quality of image stored, The final step in the JPEG algorithm used Zigzag method But because the most number of values in our approach quotient is zero, it is better to be saved only non-zero numbers And for each non-zero number in the matrix 8 x 8 must be store the place of them in Num_Map matrix This means that wherever there is a non-zero number we store 1, otherwise stored zero Then we use run-length encoding, For example, the string 111000001 would be stored 315011 to more data compression. Finally, entropy coding implemented in lossless LZW compression method instead Huffman Coding to increase the amount of compression without loss of quality.

Table 1: PSNR values in dB for 20:1 compression

Image/method	JPEG	Proposed
Goldhill	31.82	32.06
Airfield	26.89	27.15
Boats	31.60	32.92
Bridge	27.96	28.50
Lena	35.14	35.81
Peppers	33.53	34.59

In order to decompress an image, the above steps are reversed, First decompressed with LZW method after that obtain Num_Map matrix by run-length decoding and then reconstruct the Matrix of 8 x 8 by Num_Map matrix and data stored. The matrix of 8 x 8 matrix containing bits were quotient is multiplied Qmask and the remaining bits are reconstructed. The product of the matrix 8 * 8 and Qmask gather to regain fundamental components and transformed by inverse of DCT to obtain the matrix 8 x 8 pixel values and the final image reconstructed with a merging of the matrixes 8 * 8.

(a)

(b)

(c)

Figure 4: (a) Original Goldhill image and compressed image by using (b) JPEG (c) the proposed algorithm at 40:1 compression ratio.

4. Conclusion

In this paper, we have proposed a new lossy image compression technique by using new quantizer. The proposed algorithm was using remains of divide to improve quality easily and fast, and after that use lossless LZW then reconstruct a compressed image by reverse the algorithm steps. The compression ratio was obtained by multiplication of the proposed quantizer based compression ratio with the LZW based compression ratio. The results of proposed method compared with modern image compression technique. The quantitative and visual results showed the advantage of proposed compression technique over the latest techniques.

REFERENCES

[1] Shaw M., 2003, Writing good software engineering research papers, In Proceedings of 25th International Conference on Software Engineering, pp.726-736
[2] T. Glatard, C. Lartizien, B. Gibaud, R.F. da Silva, G. Forestier, F. Cervenansky, M. Alessandrini, H. Benoit-Cattin, O. Bernard,S. Camarasu-Pop, N. Cerezo, P. Clarysse, A. Gaignard, P. Hugonnard, H. Liebgott, S. Marache, A. Marion, J. Mon- tagnat, J. Tabary, D. Friboulet, A virtual imaging platform for multi-modality medical image simulation, IEEE Trans. Med. Imag. 32 (2013) 110118.
[3] H. Gu, G. Zhao, J. Qiu, Online metric learning for relevance feedback in e- commerce image retrieval applications, Tsinghua Sci.Technol. (2011).
[4] F. Garca-Vlchez, J. Muoz-Mar, M. Zortea, I. Blanes, V. Gonzlez-Ruiz, G. Camps-Valls, A. Plaza, J. Serra-Sagrist, On the impact of lossy compression on hyperspectral image classication and unmixing, IEEE Geosci. Remote Sens. Lett. 8 (2011) 253257.
[5] Ping Li, Xia-xin Tao, Jin-quan Zhang, Xin-zheng Wang, Retrieval module to choose satellite images by considering the demand of disaster mitigation, in: International Conference on Remote Sensing, Environment and Transportation Engineering, 2011, pp. 685688.
[6] M. Naixia, L. Bing, L. Xiushan, Z. Lingxian, L. WenBao, Semantic-based remote sensing images intelligent service on grid environment, in: First International Workshop on Database Technology and Applications, 2009, pp. 291294.
[7] R.C. Gonzalez, R.E. Woods, Digital Image Processing, 3rd edition, PrenticeHall, 2008.
[8] A. Zabala, X. Pons, Impact of lossy compression on mapping crop areas from remote sensing, Int. J. Remote Sens. 34 (2013) 27962813.
[9] N.N. Ponomarenko, V.V. Lukin, K.O. Egiazarian, L. Lepisto, Adaptive visually lossless JPEG-based color image compression, J. Signal Image Video Process. 7 (2013) 437445.
[10] X. Zhang, Lossy compression and iterative reconstruction for encrypted image, IEEE Trans. Inf. Forensics Secur. 6 (2011) 5358.
[11] H. Singh, S. Sharma, Hybrid image compression using DWT, DCT & Human encoding techniques, Int. J. Emerging Technol. Adv. Eng. 2 (2012) 300306.

A Brief Author Biography

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