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A Comparative Analysis between DCT and JPEG2000 Modules Algorithms

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***Abstract*:** Analysis and comparison Discrete Cosine Transform (DCT), and JPEG2000. Both modules were experimented in a bitmap figure in a software called VCDemo, with changing the properties of each module for every experiment. This paper focuses on noting down the comparative analysis with JPEG2000 and DCT. As well as, to make a brief literature review of the latest research works on JPEG2000 and DCT worldwide.

Keywords: JPEG2000, DCT, VCDemo, Encoder, Decoder, Entropy.

I. INTRODUCTION

The research on digital image and video coding algorithms is one of the prime research in the 21st century. As the development of storage and communication schemes have rapid growth to fulfil customers, and companies need in various areas. The research is still going on to improve compression efficiency, error robustness, and extended functionalities between encoder and decoder in various communication patterns [1]. This paper discusses two transform modules, Joint Photographic Experts Group (JPEG) 2000 transform module, and Discrete Cosine Transform (DCT) Module. JPEG 2000 and DCT transform will be analyzed and applied to a bitmap type image as shown in (Figure 1). DCT is one of the most common transform techniques, it encodes images without losing its data, by splitting images into disjoint blocks matrix of pixels, and doing matrix operation on each block matrix [1], [2]. JPEG2000 is an improved standard of still image coding that takes place in various industries [1], [3]. (Figure 2) shows integrated DCT module with JPEG module.

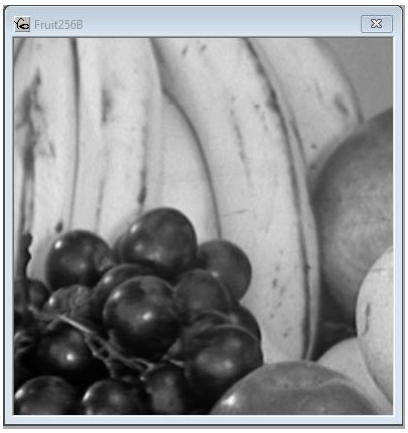

Figure 1: sample Image to study

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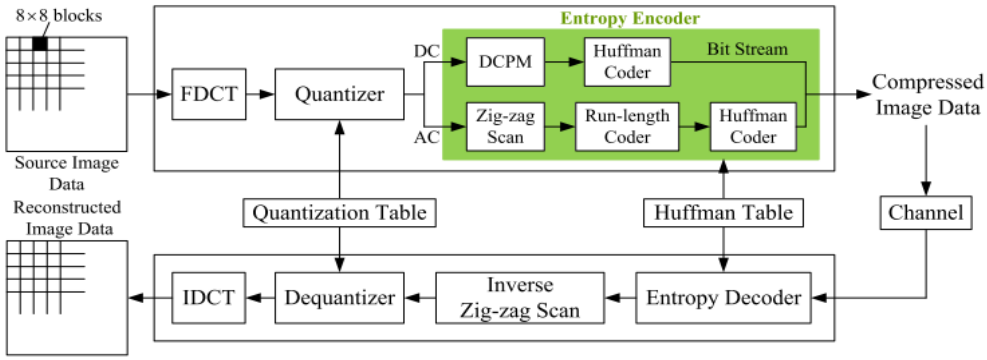

Figure 2: The scheme of DCT-JPEG (baseline JPEG) image codec.

II. Litreature Review

A.Chouhan et. al. examined double compression of JPEG image using DCT with estimated quality factor. It is noted that double compression of JPEG images showed a significant compression ratio, MSE, and PSNR values [2]. A.Wu et. al. applied semi-supervised learning algorithm in solving unbalanced JPEG images steganalysis. The results of experiments show that the proposed method can effectively detect MBs and nsF5 steganographic methods and outperform existing steganalysis approaches. [5]. V. Holub et.al. introduced a novel feature set for stgaanalysis of JPEG images [3].

III. Objectives

The main goal of this research is note down the comparative analysis with JPEG2000 and DCT. As well as, to make a brief literature review of the latest research works on JPEG2000 and DCT worldwide.

IV. Research Methodology

VcDemo created by Delft university of technology will be utilized to experiment the JPEG2000 and DCT modules on (Figure 1). VcDemo provides various tools to configure the parameters of each module. Which is, threrfore, very helpful tool for our comparative analysis. After the figure is opened, one of the modules will be applied to it, and do the various encoding, and decoding with a certain bitmap.In addition, in JPEG2000 we can do configuring Quantization (lossless quant., SNR layers, with setting up codeblock), Resolution levels with/without perfect reconstruction filterbank, setting visual weighing with exponential value, and setting image tiling size. And in DCT we can set the transform size matrix with and without encoding DCT Coefficients (setting DPCM and PCM in different C-Value and Prediction Model Selection), setting bitrate with and without entropy coding. As well as, display DCT coefficients (Collections, DCT Blocks).

V. Results And Discussion

A. Dct With And Without Entropy

In this experiment, I have observed the various data change before and after applying entropy encoder. Entropy encoders functionality make data compressed [6]. Table 1 and 2 shows the values obtained from (Figure 1) after applying DCT to it, with and without entropy encoding. The values noted are the coded bitrate, mean square error, signal to noise ratio, and PSNR. (Figure 3 , 4) shows the variation of the stated values by the increment of bitrate. It is noticed that in both cases, mean square error drops down drastically by the increment of bitrate. Whereby, signal to noise ratio and PSNR, shows an increment. It is noticed that, entropy encoding shows higher values of SNR and PSNR than in the non-entropy encoding. (Figure 5 , 6) show DCT collection and block with one bitrate.

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Table 1: DCT with entropy encoding

DCT-Entropy encoding										
	0.25	0.5	0.75	1	1.5	2	2.5	3	3.5	4
Coded Bitrate	0.26	0.52	0.79	1.06	1.64	2.22	2.83	3.43	3.97	4.45
Mean Square Error	64.5	26.5	14.9	9.9	5.2	3	1.8	1.2	1	0.9
Signal To Noise Ratio	18.1	22	24.5	26.3	29.1	31.4	33.8	35.4	36.2	36.7
PSNR	30	33.9	36.4	38.2	40.9	43.3	45.7	47.3	48.1	48.6

Table 2: DCT without entropy encoding

DCT-Non Entropy encoding										
	0.25	0.5	0.75	1	1.5	2	2.5	3	3.5	4
Coded Bitrate	0.25	0.5	0.75	1	1.5	2	2.5	3	3.5	4
Mean Square Error	96.4	45	27.2	17.7	10.2	6.6	4.7	3.3	2.3	1.6
Signal To Noise Ratio	16.4	19.7	21.9	23.8	26.1	28.1	29.5	31.1	32.7	34.2
PSNR	28.3	31.6	33.8	35.6	38	40	41.4	43	44.6	46.1

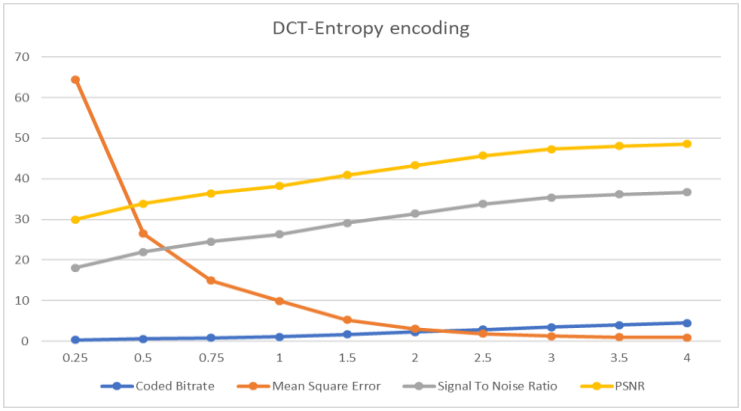

Figure 3: DCT with entropy encoding chart

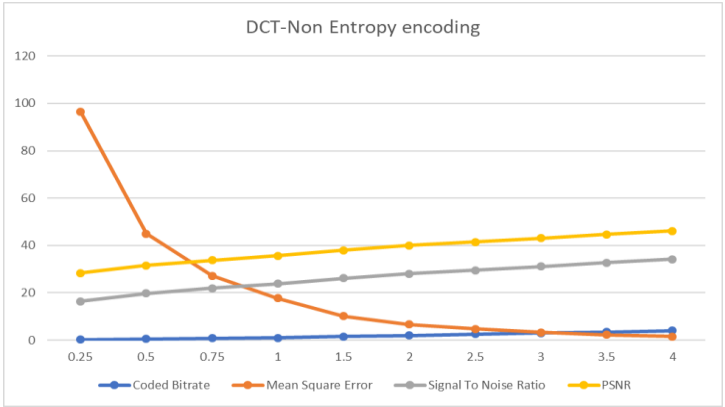

Figure 4: DCT without entropy encoding chart

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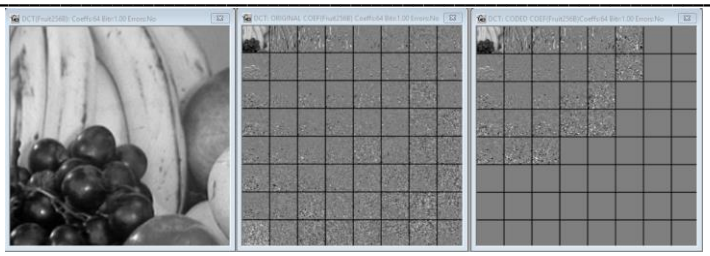

Figure 5: DCT collections

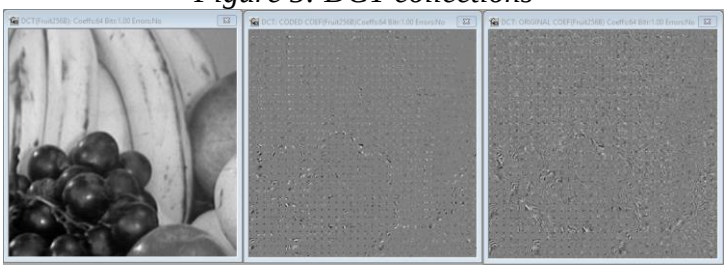

Figure 6: DCT BLOCKS

B. Jpeg2000

Table 3 shows data from (Figure 1), with encoded bitrate, MSE, SNR, and PSNR. As shown in (Figure 7), MSE shows a decrement by the increment of bitrate values. Whereby, in PSNR and SNR show increment. (Figure 8) shows different encoders and decoders values of JPEG2000 pictures.

Table 3: JPEG2000 Encoder Values

JPEG2000						
	0.05	0.1	0.2	0.3	0.4	0.5
Encoded Bitrate	0.05	0.1	0.2	0.3	0.4	0.49
Mean Square Error	229.2	95.6	42.4	25.2	18	14.3
Signal To Noise Ratio	12.6	16.4	20	22.2	23.7	24.7
PSNR	24.5	28.3	31.9	34.1	35.6	36.6

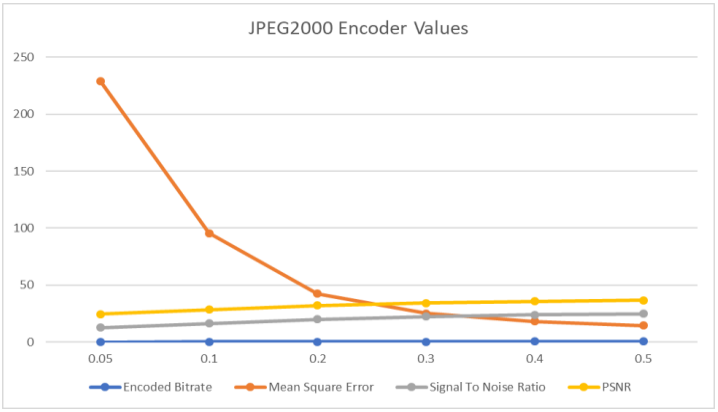

Figure 7: JPEG2000 Encoder Chart

Figure 8: Different Encoders and Decoders values of JPEG2000 pictures

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VI. CONCLUSION

DCT and JPEG 2000 are two modules that can be applied to images and videos. In this paper, we have examined the encoding and decoding data generated after applying DCT and JPEG 2000 modules. The data examined are the SNR, PSNR, and MSE. And it is noticed that entropy encoding shows higher values of SNR and PSNR than in the non-entropy encoding in DCT module. Furthermore, in both modules, MSE shows a decrement by the increment of bitrate values. Whereby, in PSNR and SNR show increment.

REFERENCES

1. T. Sikora, "Trends and Perspectives in Image and Video Coding," *Proc. IEEE*, vol. 93, no. 1, pp. 6–17, 2005.
2. A. Chouhan and M. J. Nigam, "Double compression of JPEG image using DCT with estimated quality factor," *1st IEEE Int. Conf. Power Electron. Intell. Control Energy Syst. ICPEICES 2016*, pp. 31–33, 2017.
3. V. Holub and J. Fridrich, "Low-complexity features for JPEG steganalysis using undecimated DCT," *IEEE Trans. Inf. Forensics Secur.*, vol. 10, no. 2, pp. 219–228, 2015.
4. Q. Fu, X. Zhou, C. Wang, and B. Jiang, "Mathematical Relation between APBT-Based and DCT-Based JPEG Image Compression Schemes," *J. Commun.*, vol. 11, no. 1, 2016.
5. A. Wu, G. Feng, X. Zhang, and Y. Ren, "Unbalanced JPEG image steganalysis via multiview data match," *J. Vis. Commun. Image Represent.*, vol. 34, pp. 103–107, 2016.
6. [V. K. Padmaja, "Literature Review of Image Compression Algorithm," vol. 3, no. 6, pp. 1–6, 2012.