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Performance Enhancement of image compression using SVD and Arithmetic Coding

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Abstract: ***Image compression finds its application in those systems which require considerable reduction in storage space and bandwidth required for transmission. In this paper, we summarize about the different research papers applicable to the topic of dissertation mentioned above.***

I. INTRODUCTION

Image compression is usually a data compression of digital images. The objective of image compression is to reduce redundancy of the image data in order to be able to store or transmit data in an efficient form. Even though compression is done, there is no harm done to quality of image, which is a factor taken in consideration while compression is done.

Uncompressed image requires considerable storage capacity and bandwidth. Storage capacity has a direct relation with speed of processors. With increase in storage capacity, processing time of processor increases which reduces the speed of operation of processors. Also, we know that, transmission bandwidth of any channel is always limited, hence with increase in data to be transmitted, bandwidth requirements increases. But there is always a trade-off between bandwidth available and data available for transmission. We all know that bandwidth is always limited and cannot be increased as per our wish, but data can be reduced to be transmitted. Hence, here the need for compression arises

II. LITERATURE REVIEW

In review paper [1], authors Rehna. V. J and Jeyakumar. M. K. have reached to a conclusion that while JPEG 2000 provides 20% higher Compression than JPEG, SVD provides 30% more compression than JPEG.

In review paper [2], authors Amhamed Saffor , Abdul Rahman Ramli , Kwan-Hoong Ng have found that compression ratio provided by Discrete Wavelet Transform(DWT) much better than JPEG compression which uses Discrete Cosine Transform(DCT).

In review paper [3], authors Sunil Kumar Pattanaik, K. K. Mahapatra have proposed the technique which is faster in terms of encoding and decoding procedure for images having less redundancy and more information content.

The authors of review paper [4] Prasantha H S, Shashidhara H L, Balasubramanya Murthy K N have shown that using SVD image quality can be enhanced by increasing the rank of matrix i.e. increasing the elements of matrix.

Review paper [5] authors Jianzhong Li, Junmin Zhang have demonstrated that the watermarking scheme provides durability against combined attacks.

In review paper [6], authors K. C. Chandra Sekaran, Dr. K. Kuppusamy has provided comparative analysis of various compression techniques like SVD,DCT,BTC and GP in terms of parameters like bpp, PSNR, MSE and compression ratio.

In review paper [7], authors R.Saranya, S.Raja Mohammad has presented the literature review on various compression techniques for compressing fingerprint image which is consistent and used for identification and whose compression algorithm requires preserving of minute details accurately

In review paper [8], authors Miss Samruddhi Kahu, Ms. Reena Rahate have shown that degree of compression can be varied by varying eigen values of matrix

The authors of review paper [9], authors Nivedita, Sonika Jindal have provided comparative analysis of two image compression techniques namely singular value decomposition (SVD) and set partition in hierarchical tree (SPIHT).While SVD helps in relaxing storage space requirements, SPIHT yields significant compression with little quality loss.

The authors of review paper [10], authors Maire D. Reavy, Charles G. Boncelet have established a new method for lossless compression of bilevel images called BACIC(Block Arithmetic Coding for Image Compression) having overall compression ratio 24.7% greater than JBIG's(Joint Bilevel Image Experts Group)

Review paper [11] authors Med Karim Abdmouleh, Atef Masmoudi, Med Salim Bouhlel presents a lossless image compression algorithm based on the combination of the Arithmetic Coding with the RLE.RLE has advantages of higher efficiency and arithmetic coding has advantage of good quality of image.

In review paper [12], authors Priyatosh Halder represents an image compression algorithm that adopts DCT-Biorthogonal wavelets transform with the arithmetic coding. This method helps in removing the redundancy from images and also significant reduction in the blocking artifacts and false contouring effects.

In review paper [13], authors Subarna Dutta, Aditya Abhinav, Partha Dutta, Purushottam Kumar, and Amiya Halder have proposed a new hybrid algorithm for image compression/decompression is applicable to a variety of image file types some of which cannot be compressed with that of JPEG and some other file types and also applicable to images having huge size which some of other algorithms failed to give proper results. Unlike JPEG, which gives 80% compression ratio, this algorithm gives compression ratio always greater than 95% with PSNR values for various images obtained are found to be comparable to that of JPEG standards.

Comparative Analysis based on certain parameters:

» Table 1 Shown below is for the JPEG Compressiontechnique which uses Discrete Cosine Transform(DCT)

» Table 2 Shown below is for the SVD Compression technique which uses Discrete Wavelet Transform(DWT)

Compression Ratio (CR)	Image Size(in bytes)	Root Mean Square Error (RMSE)	Mean Square Error (MSE)	Signal-to-Noise Ratio (SNR) in dB	Power Signal-to-Noise Ratio (PSNR) in dB	Bits Per Pixel (BPP)
7.8:1	400270	0.4378	0.224	51.75	54.62	8
29:1	104900	1.266	1.6	43.22	46.07	8
71:1	43181	2.183	4.772	38.48	41.34	8
100:1	29998	2.49	6.22	37.53	40.19	8
300:1	8375	5.75	33.11	30	32.90	8

Table: 1

Compression Ratio (CR)	Image Size(in bytes)	Root Mean Square Error (RMSE)	Mean Square Error (MSE)	Signal-to-Noise Ratio (SNR)	Power Signal-to-Noise Ratio (PSNR)	Bits Per Pixel (BPP)
7.5:1	137649	0.989	0.9795	45.35	48.22	8
20:1	46858	1.499	2.247	41.75	44.60	8
70:1	14651	2.654	7.04	36.79	39.65	8
100:1	10207	2.895	8.38	36.00	38.89	8
300:1	3418	3.462	11.985	34.40	37.34	8

Table: 2

Comparing both the tables we can see that for a same *compression ratio* Compression provided by SVD is higher than that by JPEG but while talking about *PSNR*, which represents quality of compressed image, it is vice versa i.e. PSNR for JPEG is higher than that of SVD.

Comparative Analysis based on output of compressed image:

Original Image

For K=4

For K=8

For K=16

For K=32

For K=128

Rank of image(K)	CR	MSE(dB)	PSNR(dB)
4	50.52	35.192	-32.32
8	31.577	38.8	-30.2716
16	15.788	35	-26.478
32	7.89	30.58	-22.05
128	1.973	29.047	-9.2022

From the above table, it is clearly seen that as we increase the rank of image, the PSNR increases but Compression ratio decreases. Hence, we can say that PSNR is directly proportional to rank of image while CR is inversely proportional to rank of image

III. Conclusion

A secure OB (Ordered Bucketization) was constructed with which any EOB that works on top of any IND-CPA-secure symmetric encryption scheme is secure on the IND-OCPA-P model. To analyze the security, this paper proposed a security model called IND-OCPA-P (INDistinguishability under ordered Chosen Plaintext Adversary with Polynomial querying distance) where no existing OPE and encryption with bucketization schemes have proven to be secure so far.

Thus, we conclude that alone SVD provides better performance than JPEG in terms of Compressing image but do not provide required PSNR for preserving quality of reconstructed image. So, along with SVD which is lossy compression technique, we will add features of lossless compression technique like arithmetic coding which increases PSNR of reconstructed image.

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