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Effect of Channel Consideration on Auto Encoders for Color Image Compression using Deep Learning

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***Abstract:** In this paper, we have studied the effect of channels consideration on autoencoders for color image compression. The study is made in relation to RGB patch in an image and individual channel patches to know the effectiveness of what criteria is to be used while processing the image for compression. The study reveals that the RGB patch consideration in a color image is better than considering the channels individually. The chaotic (or scramble) image is given as input to autoencoder for compression and this helps to overcome the threat by the intruder and as well protection to data transmitted.*

***Keywords:** Autoencoder-Decoder, Chaotic, Image Compression*

I. INTRODUCTION

The threat by the intruder to data and also for effective utilization of bandwidth of communication channel has led to this study on color image compression using deep learning. The deep neural network consists of multiple hidden layers, one input layer and one output layer. The autoencoder is used for image compression. The autoencoders are a kind of unsupervised learning structure. The autoencoders consists of 1. Encoder 2. Decoder. The encoder is used to map input to hidden representation and the decoder is used to reconstruct the image from hidden representation. The output of an autoencoder is a lossy compression because of latent distribution. The autoencoders are specific type of feed forward neural network in which the input and output are identical. Autoencoders are used to solve unsupervised learning problems. The chaotic (or scrambled) input is given to the autoencoder. The chaotic input will make intruders intrusion to access data of no use and that's how the image protection is achieved. The color image has three channels Red, Green, Blue. The study is made on compressing the color image. Compression is the process of minimizing the file size without degrading the quality of image and thereby we achieve the benefit of less transmission time.

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The study here is conducted to know the effect of channels consideration on compression and decompression using autoencoders. The remainder of this paper is organized as follows. In Section 2, a review of related works is provided. Section 3 deals with the study conducted for Channel Consideration for Compression using autoencoders. Section 4 describes the implementation results and conclusion is provided in Section 5.

II. RELATED WORK

Research works carried out related to compression and encryption using complete source image as well using tiling of the source image. Tile refers to the partition of the source image into rectangular non overlapping blocks [1]. Studies related to chaotic Input for compression were also carried out[2]. Initially, Compression and encryption were largely carried out on gray images.

But in recent time a lot of work on color images were carried out. Some works include transforming color to gray image and then followed by compression and encryption. The related works include compression using principal component analysis (k-PCA) followed by encryption using secret key. To achieve lossless compression, quadtrees were used. Studies were conducted using discrete transformation of the source image followed by Quantization and entropy encoding to get compressed image.

Then the compressed image is entropy decoded, Dequantization and inverse transformed to get the source image. Non uniform quantization schemes of compression were also carried out [3]. Pixel based compression schemes, and compression using code book were also carried out. The effect of compression and encryption with chaotic input were also studied [4][5]. Some studies were conducted on compression using variational autoencoders and sparse autoencoders. The variational autoencoders assumes that the source image data has some sort of underlying probability distribution and then attempts to find parameters of the distribution. In Sparse autoencoders the loss function consists of two terms 1. Reconstruction loss and 2. a Regularizer (KL divergence). The divergence measures how much information is lost. Recently, many deep learning-based methods have been proposed for image compression. These methods utilized deep convolutional neural network (CNN) to construct the encoder and decoder but used different ways to approximate [9][10].

III. CHANNEL CONSIDERATION FOR COMPRESSION USING AUTOENCODERS

Auto encoders are used for dimensionality reduction or feature learning. They learn automatically. It is an unsupervised learning method. The study carried out here considered first the scrambled RGB patches of an image for compression and the other case is scrambled R, G, B, channels for compression.

The scrambled input is given to encoder which encodes and its output is given to decoder to decode. The output of the decoder is quantized. Quantization is a process of mapping of broad range of input values to the limited number of output values. Mapping is an irreversible process and hence there is a loss of information and us we have lossy compression. The output of decoder is reshuffled to reconstruct the image.

The input to autoencoders is made chaotic (or scrambled) by random shuffling based on key generation.

The study reveals that, in a color image RGB patch consideration will be better choice for information processing of an image than individually considering the color channels. The block diagram of the chaotic (or scrambled) compression process is shown below.

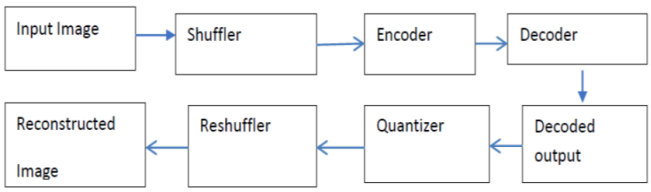

Fig. 1. Block Diagram of Scrambled Image Compression using Auto Encoder.

IV. IMPLEMENTATION RESULTS

Autoencoders learn automatically from input data. Training an auto encoder is image specific. The experiment was conducted on GPU and the images considered are Lena image, Peppers image, Baboon images. Multilayer autoencoders perform better in compressing the image than the sparse autoencoders.

The sparse autoencoders is an regularized autoencoder because the input is mapped to distribution at the bottleneck layer from which the image is reconstructed.

The sparse autoencoders are better suited for generating morphed images Table 1 shows the accuracy of Encoding-Decoding of an autoencoder with complete image as input to autoencoder, shuffled RGB Patches of an image as input to autoencoder , and Shuffled Individual channel patches of image to an autoencoder.

Table- 1: Decoded Image Accuracy

Image	Encoding-Decoding Accuracy percentage		
	Complete Image	Shuffled RGB patch	Shuffled Individual Channel patches
Lena	98.67%	98.67%	80.28%
Peppers	51.58%	51.58%	45.67%
Babbon	39.47%	39.46%	37.66%

Table 2 shows the Structural Similarity Measure. It is a method for predicting the perceived quality of image based on initial uncompressed or distortion free image as reference.

Table -2: Structural Similarity Measure

Image	SSIM		
	Complete Image	Shuffled RGB patch	Shuffled Individual Channel patches
Lena	0.4802	0.3420	0.0035
Peppers	0.3640	0.3105	0.0029
Babbon	0.5041	0.1086	0.0021

The output images generated by autoencoder-decoder are shown below Fig 1: Row 1 when complete image is given as input to autoencoder

Row 2 when Shuffled RGB patches are considered as input to autoencoders

FIG. 1: DECODED IMAGES

Fig. 2: when shuffled individual channels are considered as input to autoencoders

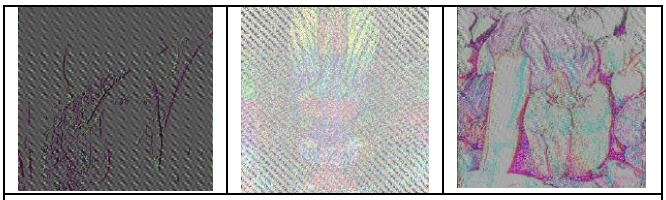

Fig. 2: Decoded Images when Shuffled Individual Channels are given as Input

V. CONCLUSION

The effect of channels consideration on autoencoders for color image compression is studied in this paper. The accuracy of reconstruction of image after decoding is more when we consider complete image as input to autoencoder. The study also reveals that the RGB patch is a better piece of image processing element rather then each individual channel patches. The future study can be made on removing the dependency of the autoencoder on input data using Deep learning which is a challenge of Today.

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REFERENCES

1. Nehal Markandeya, Sonali patil, "Digital Image compression Hybrid Technique Based on Block Truncation coding and Discrete Cosine Transform," IEEE Trans,2017.
2. K.M.Ameen Suhail, Syam Sankar, "Image Compression and Encryption combining Autoencoders and Chaotic Logistic Map" Springer 2020.
3. David Minnen Goerge Toderici et.al, "Image-Dependent Local Entropy Models for Learned image compression,. IEEE Trans 2018.
4. Fei Hu, Changjiu Pu et.al, "An Image Compression and Encryption Scheme Based on Deep Learning," *IEEE Trans.*
5. Sohrab Ferdowsi, Slava Voloshynovsky, Dimche Kostadinov, "A Multi -Layer Image representation using Regularized Residual Quantization: Application to Compression and Denoising," *IEEE Trans 2017*.
6. Jianrui Cai, Lei Zhang," Deep Image Compression With Iterative Non Uniform Quantization", *IEEE Trans 2018*.
7. Ryan Rey M. Daga, "Improved k-d Tree- Segmented Block Truncation Coding for Color Image Compression", *IEEE Trans 2017*.
8. Fei Hu, Changjiu Pu, Haowel Gao, Mengzi Tang and Li Li" An Image compression and encryption Scheme Based on Deep LearningJ. "arXiv:1608.05001
9. Z.Cheng, H.sun, M.Takeuchi and J.Katto, "Deep Convolutional autoencoder-Based Lossy Image compression", arXiv:1804.09535
10. Ching-Chun Huang, Thanh-Phat Nguyen and Chen-Tug Lai, "Multi-Channel, Multi-Loss Deep learning based Compression Model For Color Images", IEEE Trans 2019.

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