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IMAGE ENCRYPTION BY USING 3D LOGISTIC CHAOTIC MAP: A STATE OF THE ART REVIEW

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Abstract

This paper proposes a new method of digital colour picture lossless encryption and decryption using 2D discrete Haar wavelet transform (DHWT) and 3D chaotic logistic plot. The proposed cryptosystem provides digital image protection by means of a cryptographic algorithm in the image frequency domain. For the decomposition of the image, the proposed method uses two levels of 2D DHWT. 2D DHWT is applied to the various colour components of the colour image for encryption, and then the encryption method is applied to the different sub-bands of each decomposition step, and the reverse encryption procedure is used for decryption with the inverse of the functions used in encryption. In order to verify the feasibility and robustness of the system, experimental results and security analysis such as brute force analysis, statistical analysis, occlusion and differential attack of the proposed method are presented.

Keywords: *Communication, Chaotic Map, Encryption, Image, Picture, Wavelet transform, Cryptosystem.*

I. INTRODUCTION

In the process of communication, the present era of digitalization includes the security of digital images [1]. The smooth transformation of digital data into contact and the protection of digital data from unauthorized users is a demanding activity for different purposes in human life [2]. A lot of sensitive and confidential information could be found in such digital data. The main aim of the proposed cryptosystem is to establish a lossless method for digital image security [3].

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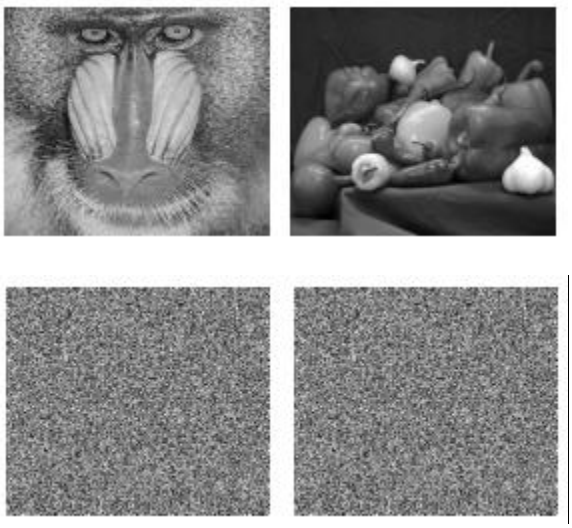

Fig 1: Illustrates the Real Images and Encrypted Image

IMAGE ENCRYPTION METHOD

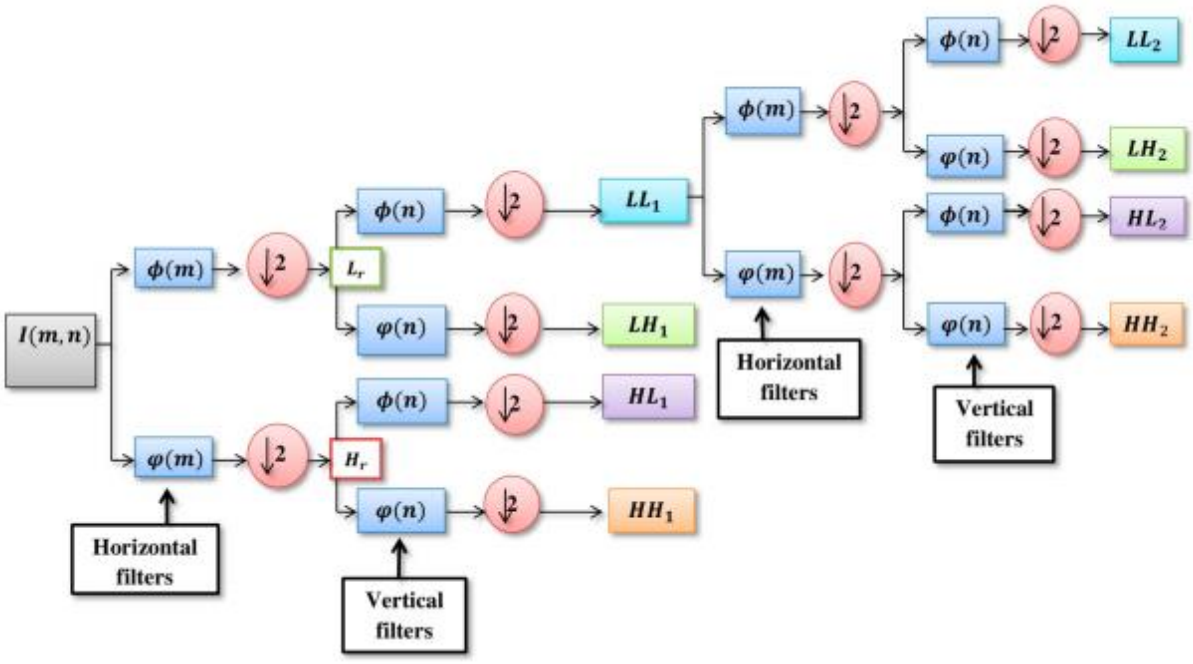

Fig 2: Illustrates the decomposition of 2D DWT

The Haar wavelet transform can be expressed by matrix form as I = HIHT, where I is an image matrix of order M × M, H is Haar transform matrix of order M × M and I is the resulting

transformed matrix of order M × M that contains the Haar basis function hn(x), which is defined in x ∈ [0, 1], where n = 0, 1, 2, ... , M − 1 can be decomposed uniquely as:

$$E(x) = \frac{1}{N}\sum_{i=1}^{N} x_i$$

$$D(x) = \frac{1}{N}\sum_{i=1}^{N}(x_i - E(x))^2$$

$$cov\,(x,y) = \frac{1}{N}\sum_{i=1}^{N}(x_i - E(x))\;(y_i - E(y))$$

$$r_{xy} = \frac{cov\,(x,y)}{\sqrt{D(x)}\sqrt{D(y)}}$$

$$\sqrt{D(x)}\; \neq 0, \sqrt{D(y)} \neq 0$$

$$NPCR = \frac{1}{M \times N}\sum_{i=1}^{M}\sum_{j=1}^{N} D(i,j) \times 100\ \%$$

$$UACI = \left[\sum_{i=1}^{M}\sum_{j=1}^{N}\frac{|C1(i,j) - C2(i,j)|}{255}\right] \times \frac{100\%}{M \times N}$$

$$D(y) = \frac{1}{K}\sum_{i=1}^{K}(y_i - E(y))^2$$

The correlation coefficient is another essential constraint to ensure that how much efficient is the encryption algorithm [4].

$$r_{x,y} = \frac{C(x,y)}{\sqrt{D(x)}.\sqrt{D(y)}}$$

Where $C(x,y), D(x)$ and $D(y)$ can be evaluated by using the following equations [5].

$$C(x,y) = \frac{\sum_{i=1}^{K}(x_i - E(x))(y_i - E(y))}{K}$$

$$D(x) = \frac{1}{K}\sum_{i=1}^{K}(x_i - E(x))^2$$

$$D(y) = \frac{1}{K}\sum_{i=1}^{K}(y_i - E(y))^2$$

II. LITERATURE REVIEW

A symmetric image encryption scheme based on 3D chaotic cat maps was suggested by Gao et al. Image encryption differs from that of texts because of certain inherent characteristics of images, such as bulk data capacity and high redundancy, which are typically difficult to handle by traditional methods. Chaos-based encryption has proposed a new and powerful way to deal with the intractable issue of easy and highly secure image encryption due to the extremely desirable properties of mixing and sensitivity to initial conditions and parameters of chaotic maps. In this paper, the two-dimensional chaotic cat map is generalized to 3D for designing a real-time secure symmetric encryption scheme [6].

III. DISCUSSION AND CONCLUSION

In this paper, we have proposed a new lossless method of digital colour-image encryption using a cryptographic algorithm in the frequency domain of the image. In this method, 2D DHWT and 3D logistic chaotic map are used for the encryption and decryption of the image. In the proposed method, encryption is done by changing the pixels in the frequency domain by using 2D DHWT and then scrambling the data using a 3D logistic chaotic map. The decryption method reverses the encryption process. Standard images with various details are used to test the efficiency of the proposed method. A lossless analysis of the proposed method is also given in this paper. Further, we have done various security and statistical analyses to test the robustness of the proposed method.

IV. REFERENCES

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