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CHAOTIC ALGORITHMS USED FOR ENCRYPTION AND DECRYPTION ON MOVING IMAGES

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ABSTRACT

Chaotic algorithm is a well-used method in the real-time secure image transmission systems. Research's are using this algorithm in encryption and decryption process. Even though it is applicable in many areas there are some disadvantages of security means low security to the sending information (others can easily decrypt the code). Now almost all images are in color space and my project encrypt the color images by considering the each color (R, G and B). In this paper I am going to change the image pixels position by which we can get high security and more difference between the original image and cipher image. Currently this algorithm is only applicable to only still color images but in this paper I am going to develop encryption and decryption process for moving images such as videos by using chaotic algorithm. Finally I am going to compare the histograms also to demonstrate the encryption between the plain image and encrypted image. The main advantage of the paper is we can use longer key space and this process takes very less time.

By using this algorithm we are going to encrypt and decrypt the color image. After taking color image we separate the red, green and blue components and after that we are going to confuse the red, green and blue components and we encrypt the image with another gray scale image. In decryption process we are going to undiffused the red, green and blue components and by using histograms we are going to compare the image histograms before encryption and after decryption.

Key words: chaotic algorithm, Least significant bit, bigger key space , moving images , encryption and decryption, logistic map .

1. INTRODUCTION

Image encryption and decryption process have been increased to meet the demand for real-time secure image transmission over the Internet. Comparing with previous algorithms like DES, RSA traditional image encryption [5] algorithm has the weakness of low-level efficiency when the image is large. The chaos-based encryption and decryption algorithm [5,6] has suggested a new and efficient way to deal with the problem of fast and highly secure image transmission. Recently there have been many papers on chaotic encryption scheme.

Chaotic systems have many important properties, such as the sensitive dependence on initial conditions and system parameters, pseudorandom property, no periodicity and topological transitivity, etc. Most properties meet some requirements such as diffusion and mixing in the sense of cryptography. Therefore, chaotic cryptosystems have more useful and practical applications. One-dimensional chaotic system with the advantages of high-level efficiency and simplicity, such as Logistic map, has been widely used now.

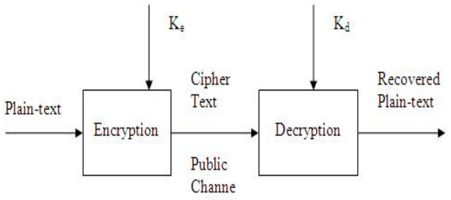


Figure 1. Encryption and Decryption procedure of a Cipher

But their weakness, such as small key space and weak security, is also disturbing Cryptography studies how to design good secure and fast encryption algorithms, and cryptanalysis tries to find security weaknesses of existing algorithms and studies whether or not they are vulnerable to some attacks. An encryption scheme is called a cipher (or a cryptosystem). The message for encryption is called plaintext, and the encrypted message is called cipher-text, which are denoted here by P and C, respectively. The encryption procedure of a cipher can be described as C=Eke(P), where Ke is the encryption key and E(.) is the encryption function. Similarly, the decryption procedure is P=Dkd (C), where Kd is the decryption key and D(.) is the decryption function. When Ke=Kd, the cipher is called a private-key cipher or a symmetric cipher For private key ciphers, the encryption-decryption key must be transmitted from the sender to the receiver via a separate secret channel. When Ke=!Kd, cipher is called a public-key cipher or an asymmetric cipher. . For public-key ciphers, the encryption key Ke is published, and the decryption key Kd is kept secret, for which no additional secret channel is needed for key transfer. The cryptosystems can be classified with respect to the structure of encryption algorithm as stream ciphers and block ciphers. Stream cipher is the method in which a key generator produces a bit stream (the Key stream) which enciphers the plain-text bit stream by simple modulo 2 additions. A stream cipher system thus hides the plain-text bit by changing the bits of it in a random way. An interceptor, who does not know the key, will not know which bits have been changed (corresponding to the occurrence of “1” in the key stream), or which ones remain unchanged (“0” in the key stream). An ideal stream cipher would use a physical (true) random number generator a Key generator. Since its output cannot be reproduced, however, decipherment would be impossible, unless the whole Key stream, with the same length as the plain-text, is transported to the legitimate receiver via a safe channel. This procedure is often impractical. Therefore mostly so-called pseudo-random number generators with special properties controlled by a relatively short Key have to be used instead as key generators.Unlike the stream ciphers, where only one bit at a time is ciphered, whole blocks of bits are treated simultaneously.

In this case the plain-text information is hidden by the fact that, depending on the key, a cipher-text block can be deciphered to any combination of plain-text bits or to as many combinations as the keys. If the keys are chosen with equal probability, then to the interceptor observing a ciphertext block, all the possible plain-text blocks are equally likely to have occurred.

Cryptography is a permanent field of interest at all time.At present secret communication plays an increasing role in many fields of common life, like banking, industry, commerce, telecommunication etc. Owing to the advance in network technology, information security is an increasingly important problem. Popular application of multimedia technology and increasing transmission ability of network gradually leads to us to acquire information directly and clearly through images. Hence, data security has become a critical and imperative issue. Encryption is such a way that its content can be reconstructed only by a legal recipient. The technology of encryption is called cryptology. Cryptology is the branch of science dealing with the theory of secure communication algorithms. Cryptography is the process of transforming information (plain-text) into unintelligible form (cipher-text) so that it may be sent over insecure channels or it may be stored in insecure files. Cryptographic procedures, can also be used for personal identification, digital signature, access control etc..

2. RELATED WORKS

The chaos-based image cryptosystem mainly consists of two stages [2]. The plain image is given at its input. There are two stages in the chaos- based image cryptosystem.[a]confusion and [b] diffusion. The confusion stage is the pixel permutation where the position of the pixels is scrambled over the entire image without disturbing the value of the pixels and the image becomes unrecognizable. The chaotic behavior is controlled by the initial conditions and control parameters which are derived from the 16-character key.In second stage of the encryption process we are going to change the value of each pixel in the whole image an important tool to protect image from attackers.

The basic idea of encryption[5,6] is to modify the message in diffusion stage, the pixel values are modified sequentially by the sequence generated from one of the three chaotic systems selected by external key. The whole confusion-diffusion round repeats for a number of times to achieve a satisfactory level of security.

In moving images we are going to divide the video into frames and then we are going to take one frame as input image and one key as secret key and the process repeats same as the normal images.

3. ARCHITECTURE OF AN CHAOS BASED IMAGE CRYPTOSYSTEM

The chaos-based image cryptosystem mainly consists of two stages. The plain image is given at its input. The typical architecture of the chaos-based image cryptosystems is depicted in Figure 2.

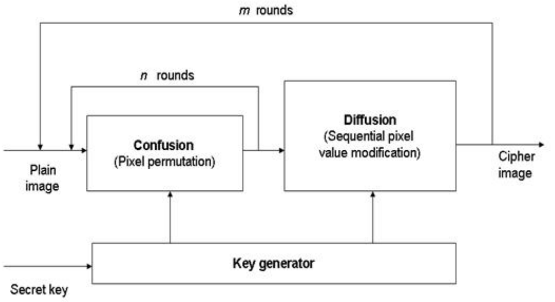


Figure 2. Architecture of proposed Chaos-based image cryptosystem.

There are two stages in the chaos based image cryptosystem The confusion stage is the pixel permutation where the position of the pixels is scrambled over the entire image for normal images, without disturbing the value of the pixels and the image becomes unrecognizable, whereas in videos we are going to divide into frames and then select one frame as input image and remaining process same as normal images process.

4. PROPOSED CRYPTOSYSTEM

A. Encryption System

The proposed scheme is shown in Figure 3. Different chaotic systems are employed in confusion and diffusion stages. Also complex chaotic maps are chosen rather than the simple ones to further enhance the complexity of the algorithm and there by improving the security. The input to the cryptosystem is the plain image which is to be encrypted. The cryptosystem consists of two stages.

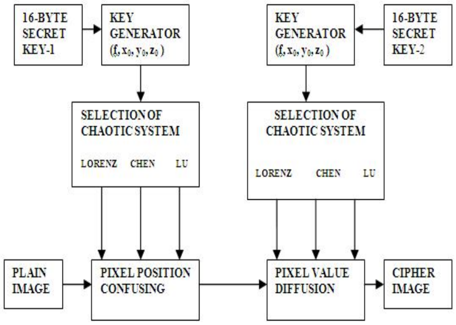


Figure 3. Architecture of proposed Chaos-based image cryptosystem

The first stage is the confusion stage and the second one is the diffusion stage. Among the three chaotic dynamic systems namely Lorenz, Chen and LU one is selected by the system parameter which is obtained from the key and it is applied to the digital color image encryption because of higher secrecy of high-dimension chaotic system.

The second step of the encryption process is to encrypt the shuffled image by changing its pixel values based on one of the three high-dimensional chaotic systems (Lorenz, Chen and LU) . This is referred to as the diffusion stage. The initial conditions and the control parameters used to generate the chaos sequence in both the stages serve as the secret key in the two stages. The resulting image is the Cipher image. Separate key is used for permutation and diffusion stages of the encryption process to improve security of the algorithm

For videos we are going to take one frame as input frame and another frame as key image and the process continues as we are going to confuse and diffuse the pixel positions and pixel values to maintain security.

B. Decryption System

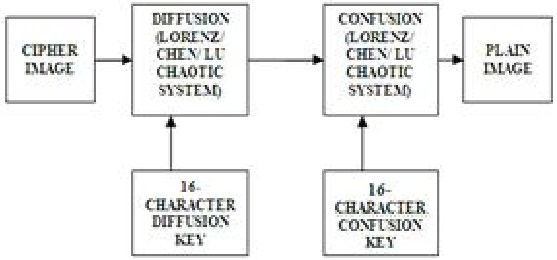

CIPHER IMAGE
DIFFUSION (LORENZ/ CHEN/ LU CHAOTIC SYSTEM)
CONFUSION (LORENZ/ CHEN/ LU CHAOTIC SYSTEM)
PLAIN IMAGE
16-CHARACTER DIFFUSION KEY
16-CHARACTER CONFUSION KEY

Figure 4. Chaos based Decryption system

The decryption system is illustrated in the Figure 4. The first stage in the decryption process is the diffused image decryption stage. In the encryption process, the pixel value diffusion was carried out with any one of the three chaotic systems. Therefore, in the decryption process to retrieve the original pixel values, again any one of the chaotic system (Lorenz, Chen, Lu) is employed in the first stage of decryption. The first stage of decryption process uses the three dimensional [8] sequence generated by any one of the chaotic system .It is a kind of high-dimensional maps and complex enough.

The initial conditions that were used in the encryption process should be used here and this serves as the decryption key for the first stage. Second, in the encryption process, the pixel position permutation was carried out with any one of the chaotic system. The initial conditions and control parameters for generating the chaos-sequence were used as the confusion key. Therefore in the decryption process, the same chaotic systems with same confusion key are used to get the original position of the image. The output of the decryption system gives the original image.

5. RESULTS

The proposed image encryption system uses any one of the chaotic system for pixel position permutation and one of the same chaotic system for pixel value modification. Color Lena image of size 256 × 256 was taken as the test image. In Pixel position permutation stage, the Lorenz, Chen and Lu chaotic systems are used. The original image taken for the work is given in Figure 5. The pixel position permuted image after applying one of chaotic systems such as Lorenz, Chen and Lu was obtained and shown in Figure 8. The diffused image was obtained and shown in Figure 10.

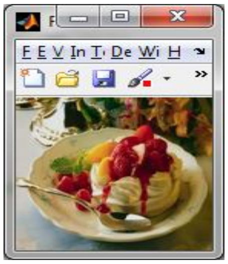


Figure 5. Original image

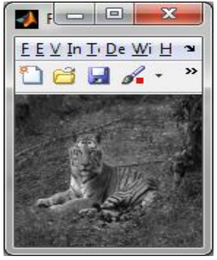


Figure .6. Encryption key

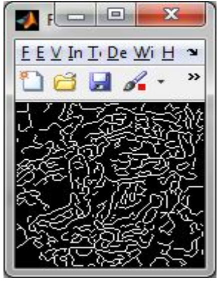
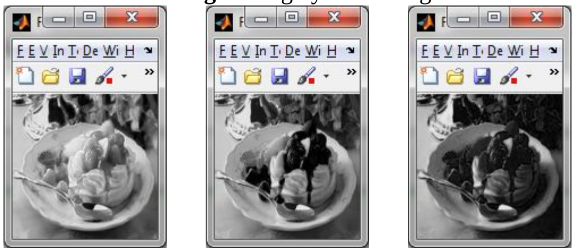


Figure.7. gray scale image



Red component Green component Blue component

Figure 8. Separation of Red,Green and Blue component

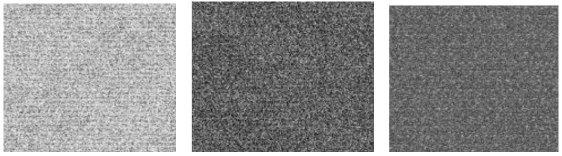


Figure 9. Confused Red,Green and Blue component

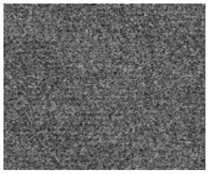


Figure 10 pixel permuted image

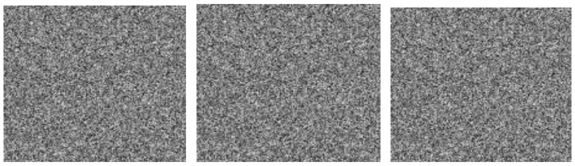


Figure 11 pixel values changed after diffusion

Figure 12 Encrypted image

And this will serve as the input image for the second stage of decryption. The decrypted image after applying Lorenz ,Chen and Lu chaotic systems was obtained

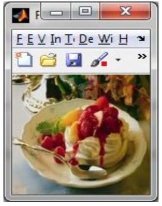


Figure 13 Decrypted image

The decrypted image after applying Lorenz ,Chen and Lu chaotic systems was obtained original image.

6. SECURITY ANALYSIS

To test the robustness of the proposed scheme, security analysis was performed. Key space analysis, statistical analysis and sensitivity analysis were carried out to demonstrate the satisfactory security of the new scheme. The image-histogram illustrates how pixels in an image are distributed by graphing the number of pixels at each color intensity level. It is observed that the histogram of the original image and after the confusion stage are thee same. Therefore, the diffusion function is carried out. The histogram of the final encrypted image is fairly uniform and is significantly different from that of the original image.

7. FUTURE ENHANCEMENT

Currently the chaos-based scheme was designed for still images and moving images. The prevalence of technology in the society has promoted digital images and videos to play a more significant role than the traditional texts, which demands a serious protection of users' privacy. To fulfill such security and privacy needs in various applications, encryption of images and videos is very important to frustrate malicious attacks from unauthorized parties. Hence in the second phase of the paper, it is purposed to design a chaos-based image encryption scheme for moving images (videos). We can improve security as well as execution time will be improved compared with the previous paper.

8. CONCLUSION

Based on the design rules discussed earlier, the new image encryption scheme was designed. A suitable chaotic map preserving the properties of chaos after discretization was chosen. By choosing a high dimensional chaotic system, the key space is increased. Complex non-linearity was preserved by choosing suitable chaotic maps. Repeated permutations are avoided but pixel values are changed by the diffusion function. By incorporating all these features, the proposed cryptosystem avoids all the crypto graphical weaknesses of earlier chaos-based encryption systems. Number of security analysis were carried out on the new algorithm and simulation results show that encryption and decryption are good and the algorithm has good security and robustness.

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