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An Efficient Image Encryption Technique Based on Optimized Key Generation Using Chicken Swarm Optimization

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ABSTRACT

Today's world, image encryption is used to send interactive image data with the highest level of security and accuracy. There are a variety of picture encryption methods that can be used to transfer hidden pictures. Of these methods, Elliptic Curve Cryptography (ECC) is one of the most intriguing for keeping image data safe and private. The ECC approach generates the public and private key pair that is used to encrypt and decrypt a picture during the key generation phase. The public key is created randomly during the encryption phase. The private key (H) is developed using a Chicken Swarm Optimization (CSO) based optimization technique in the proposed method decryption procedure. The PSNR value is used to measure the image's performance and is used as a health value for optimization. In comparison to current approaches, the proposed approach has the best PSNR performance.

1. INTRODUCTION

Nowadays, mobile gadgets are an integral part of our everyday lives. They may be used for a range of activities such as making phone calls, listening to music, and browsing the Internet. They are suitable for both video conferencing and online transactions [1]. As a result, security has become a serious concern while accessing wireless networks via mobile devices. A mobile user normally connects to a wireless network by finding the nearest network access point with a good signal [2][3].

To prevent unauthorized access, these wireless connections must be permitted. Mobile users can gain free access to the wifi network. Mobile devices in power saving mode may switch off while connecting to different access points due to unreliable radio signals [4][5]. The necessity to restart upon reconnecting causes severe slowness. This header grows when the mobile user approaches the remote network, which increases line time since the remote network requires authentication from the home network's authentication server [6].

Elliptic Curve Cryptography (ECC) computing is well recognized for its better encryption and labeling capabilities, and the National Security Agency (NSA) warmly recommends it [7]. The ECC hypothesis is based on the mathematics of elliptical loops, making it difficult to program the new logarithm of elliptical loops in an abelian bundle with plausible methods. ECCs are often more safe, restricted, and quicker than their exemplary counterparts, which include Ron Reeves, Adi Shamir Leonard Adleman (RSA), and the Digital Signature Algorithm (DSA) [8][9]. As a result, ECC accomplishes zones such as confirmation, extended signature, secure correspondence, and signature processing. The testing permitted in remote sensing companies are a significant consideration. Some WSNs are ineffective in terms of bargaining leverage due to their secrecy [10][11].

The WSN's security style requires strict standards for verifying diverse assets, organizations, and assaults. The remote sensor network's design for this overriding security or validation program must be robust against assaults that result in sensor transactions and other security problems [12]. However, it is sometimes difficult to discover an efficient remote security enhancement strategy, which is often dependent on the keys and encryption / encryption mechanisms employed. Similarly, longer cryptographic keys necessitate greater baud rates, more memory, and processing power.

Ergonomics, vulnerability to input circumstances, and competency during long-term operation are all excellent opportunities for creating cryptographic keys that may be utilized for a variety of reasons [13]. There are several cryptographic computations. The numerical postulate is crucial to all cryptography techniques. Each has a distinct use case and addresses a specific issue. This problem evolves over time, and as it does, the present structure must be altered to accommodate this development. Portable data processing will be the standard against which all cryptographic improvements will be assessed during the next decade [14].

Thanks to the approach of Apple Bay, Google Wallet and many other portable exchanges, they are common in most currency exchanges [15][16]. This requires strong cryptographic calculations for the assets, not benefits, but is an important precondition for the security of more beautiful structures. Legacy conditions, with their limited assets, fuzzy selection standards, and elliptical curvature cryptography, are the most predictable crypto strategies.

In this study, we show how to preserve IoT intermediate information security utilizing the ACECC method. We presently create series information bases mostly based on use. To pick the best hub, we do an ACECC computation using organizational information. We have previously specified the collection of information for all data in order to distinguish between personal and non-confidential data. At this stage, we encrypt sensitive data with ECC and save it with the cloud provider.

2. LITERATURE REVIEW

To deal with security issues in the IoT climate, experts have introduced different and different security arrangements using cryptography programs. This section depicts past and related works in the IoT security region.

Sethuraman et al. [17] Diffie Hellmann has introduced a fuzzy genetic elliptical curve to ensure correspondence between companies. The uniqueness of elliptical curve cryptography (ECC) lies in the ability to produce information using efficient limited keys to provide the RSA's long-standing key prerequisite. Intelligent guidelines are used for stabilization during key determination measurements, and many characteristic dynamic models with fuzzy reasoning to obtain keys and hereditary calculations to compulsorily improve computation in the ECC get the proposed FGECDH calculation.

Dharminder et al. [18]have provided a secure letter based on learning error on cell phones using fluffy extraction. The security verification of the proposed method ensures provable-security by learning the problem of errors at some point in the irregular prophecy. Besides, a simple security conversation and execution test shows that our LWESM conference is effective and can be used in many different applications. Joshi et al.[16]have implemented a lightweight verification conference for body territory networks based on elliptical-curve cryptography. This conference empowers the customer to refuse by immediately updating the time key. The proposed conference meets different security requirements, for example, non-connectivity, secrecy, forward security, shared confirmation and meeting key security. Experimental testing at AVISPA proved that the cost of verification conference calculation and efficiency on the part of the client was completely reduced compared to the existing arrangements, which are more suitable for property restricted remote body regional systems.

Sowjanya et al. [19]presented a guaranteed framework for WBAN using Ciphertext and Attribute-Based Elliptic Curve Elliptic Curve Encryption (CPABE) without implementing linear coordination. The proposed CPABE is provided under Diffie-Hellman's assumption of elliptical curve determination and in addition has a customer / brand disclaimer segment. We investigated the light portion of the proposed CPABE, differentiating it from other ABE plans for WBAN.

Kumar et al.[20]have introduced a protected elliptic bend cryptography based common confirmation convention for cloud-helped TMIS. The proposed convention secure against man-in-the-center assault, understanding secrecy, replay assault, known-key security property, information classification, information non-disavowal, message confirmation, pantomime assault, meeting key security and patient unlink capacity. The proposed convention with existing related conventions in same cloud based TMIS. The proposed convention guarantees of all alluring security requirements and dealt with the productivity as far as calculation and correspondence costs for cloud-helped TMIS.

3. PROPOSED METHODOLOGY

The suggested approach improves the confidentiality and secrecy of the original picture transmitted between the sender and recipient. The RGB (Red-Green-Blue) values of the original image are extracted and used to construct a distinct matrix for each component based on their pixel values[21]. The picture is then separated into chunks before being encrypted and decrypted. Essentially, the block size is 4 by 4. The blocks in each color component are encrypted using the ECC algorithm. The ECC method's key generation procedure creates the private key at random during the encryption and decryption processes [22].

In the suggested method decryption procedure, the private key is created using an optimization strategy that includes the CSO.The image's performance is used as a fitness value for the optimization process, with the peak signal-to-noise ratio (PSNR) value being considered[23]. After the encryption procedure, the encrypted picture is decrypted using the encryption's reverse process. When the decryption procedure is complete, the output picture is compared to the original image to evaluate their performance using the peak signal-to-noise ratio (PSNR), mean square error (MSE), and correlation coefficient (CC) as quality criteria.

3.1 Elliptical Curve Cryptography

ECC is one method for using public key cryptography with asymmetric key cryptography. This approach uses a fixed base point and the prime number function to compute the maximal limit, and the encryption is as follows:[24] The fundamental ECC equation is presented in equation (1).

$$y^2 = x^3 + ax + b \tag{1}$$

Here, a and b are the integers

In every cryptographic process, the level of encryption is determined by the key generated. The suggested technique supports two types of key generation [25][26]. First, a public key is generated to encrypt the message from the receiver end, followed by the creation of a private key to decode the original picture at the receiving end. If the value "P" is any point on the curve, pick a random integer number "H", which is a private key, in the area of "1 to n-1", then the public key "Q" is created as (2).

$$Q = H \times P \tag{2}$$

3.1.1. Encryption method

During the encryption stage of the method, each color band of the input image is split into blocks. These four blocks are encrypted using the suggested encryption algorithm [27][28]. The total count of blocks is displayed as. Where i and j denote the number of rows and columns in the image's blocks. The pixels and points are acquired in (3) and (4).

$$C_1 = H \times P_e \tag{3}$$

$$C_2 = (P_x, P_y) + C_1 \tag{4}$$

3.1.2. Decryption method

The decryption component of the technique uses the private key (H) to decode the information and the point of equation (5) to decrypt the pixel point.

$$C_3 = H \times C_1 \quad (5)$$
$$C_{ij} = C_2 - C_3 \quad (6)$$

In this process the represents the final result. In the procedure of decryption, the secret key (H) is produced by the proposed CSO technique, which gives the best optimized values compared to the existing ECC technique.

3.2 CSO Optimization Technique

The CSO computation is performed to find the optimal position for the main module. It often replicates the mating pattern of chicken preservatives, and its food demands activity.[29][30] CSO computations show that the chicken has the highest fitness score and the chicken coop has the lowest health score. The remaining characteristics are assigned to a flock of chickens. The process for selecting the optimal hub is described in the accompanying

Step1: Initialize the population of N chicken x andchoose a 128-cycle key phrase set for ECC.

$$x_{i,j}^{t+1} = lb + Rand(ub - lb) \quad (7)$$

With lb and ub are lower bound and upper bound of the search space. This is done to ensure that subsequent placements are in a popular region.

Step2: To determine the fitness and start the best position N_{best} t=1

$$F = Min(Key_{space}) \quad (8)$$

Because the chick holding kit comprises of a small set of key chains constructed from an elliptical ring, the most similar home furnishings among the roses were picked using the irregular age subset approach. The principal use of the subset generation approach is to limit focus space by managing the rate of popularity.

Step3: Assess the logic of the throng of chickens and demonstrate the hierarchy in the group. Divide the chicken sword into several groupings and assess their connection.

$$x_{i,j}^{t+1} = x_{i,j}^{t} * S1 * Rand * (x_{i,j}^{t} - x_{i,j}^{t}) + S2 * Rand * t \quad (9)$$

$$(x_{i,j}^{t} - x_{i,j}^{t}) = t \quad (10)$$

Step4: Update the chicken, hen, and chicken populations. Updates for roosters are performed using the calculations (11) and (12).

$$x_{i,j}^{t+1} = x_{i,j}^{t} * (1 + Rand(0, \sigma^2)) \quad (11)$$

$$\sigma^2 = \left\{ \begin{array}{ll} 1, & if \quad f_i \le f_k \\ \exp\left(\dfrac{f_k - f_i}{|f_i| + \varepsilon}\right) & otherwise \; k \in [1, N], k \ne 1 \end{array} \right\} \quad (12$$

4. RESULTS AND DISCUSSION

This section discusses the experimental findings about the proposed image encryption scheme. The image findings in this paper are based on five test images from the USC-SIPI image database [31]. The method of encrypting and decrypting two images is tabulated. Table 1 and 3 shows encryption and decryption of the original image. Table 2 and 4 shows the reconstruction process of decryption images. After decryption, the final output image is compared to the original image in order to determine their performance using quality parameters such as PSNR, MSE, and CC values. The PSNR value shows whether the resulting image's quality is improved or deteriorated. If the PSNR value is extremely high, the image's quality is excellent. 52.94 and 50.85 were the PSNR values obtained here. It is shown unequivocally that the suggested approach produces the original picture with the highest possible PSNR.

Table1: Results obtained for the proposed methodInput Image Color bandShare creation Combined Sharing EncryptionDecryption

Input Image	Color band	Share creation	Combined Sharing	Encryption	Decryption
	R1				

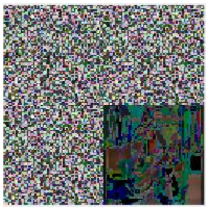
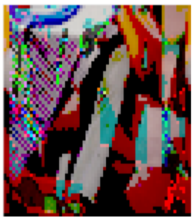
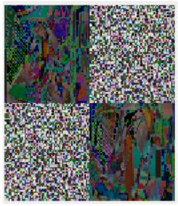
	G1				
	B1				
	R2				
	G2				
	B2				

Table 2: Reconstruction images for the proposed method

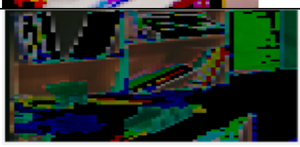
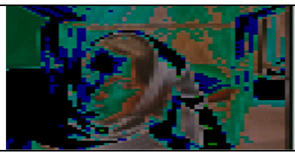
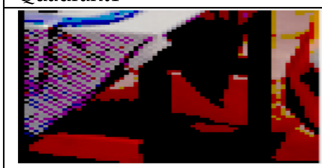
Input image	**Reconstruction**		**Reconstructed image**
	Upper left Quadrant	Upper right Quadrant	
			
			
	Lower left Quadrant1	Lowerright Quadrant1	
			

Table 3:

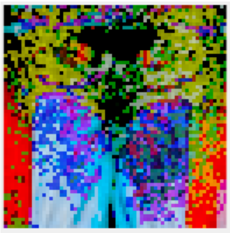
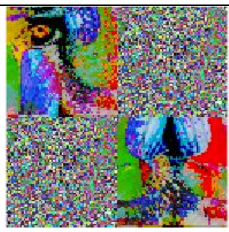
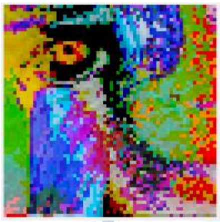
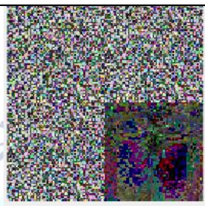
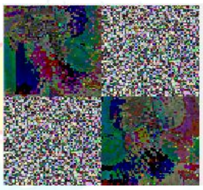
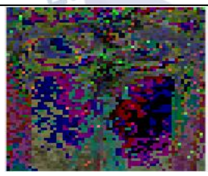
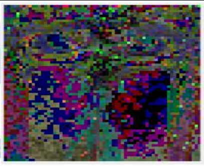
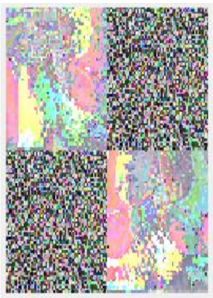
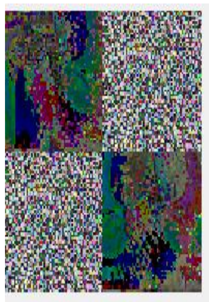
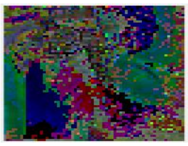
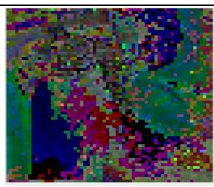
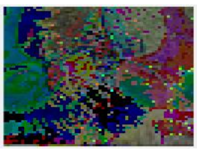
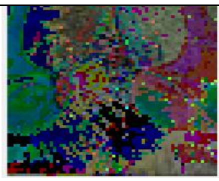
Input Image	Color band	Share creation	Combined Sharing	Encryption	Decryption
	R1				
	G1				
	B1				
	R2				
	G2				
	B2				

Table 4: Reconstruction results for baboon image

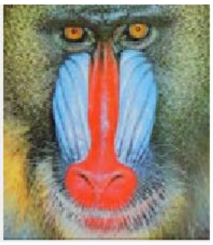
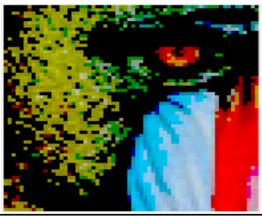
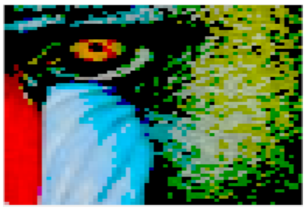
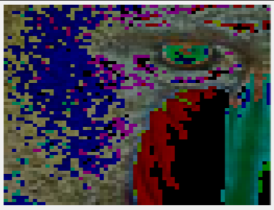
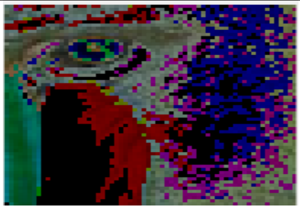
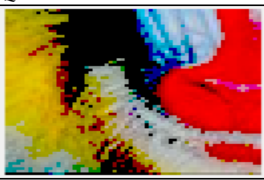
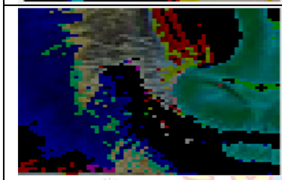
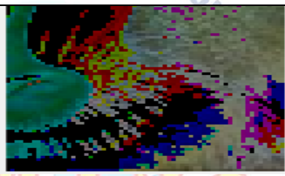
Input image	Reconstruction		Reconstructed image
	Upper left Quadrant	Upper right Quadrant	
			
			
	Lower left Quadrant1	Lowerright Quadrant1	
			
			

Table 5: Caparison of results obtained with the proposed method and ECC method

Input	Method	PSNR	MSE	CC
	ECC	45.94	1.67	0.9
	CSO	52.94	0.33	1
	ECC	46.07	1.62	0.9
	CSO	52.72	0.35	1
	ECC	46.23	1.56	0.9
	CSO	52.85	0.34	1
	ECC	46.61	1.43	0.9
	CSO	52.48	0.37	1
	ECC	46.35	1.52	0.9
	CSO	52.04	0.41	1

Table 5 compares the proposed ECC with CSO approach to the ECC methodology based on PSNR, MSE, and CC values for pictures Barbara, Baboon, train fingerprint, and eye images. According to the table, the suggested approach improves picture quality since its PSNR value exceeds that of the ECC algorithm. The comparative research shows that the proposed photo encryption method provides an adequate degree of security. It clearly shows that the suggested technique outperforms the ECC approach.

5. CONCLUSION

The study describes an ECC-based image encryption scheme that is optimized using the CSO method. The recommended approach clearly provides a higher-quality image, with an average PSNR value of 52.94 between the original and finished photos. The mean square error is also reduced in all images, implying that almost all photographs have a correlation coefficient of roughly one. Histogram and correlation coefficient analyses clearly show that the encryption process stays unchanged and ensures the security of the secret picture. A comparative analysis shows that the recommended approach beats ECC in terms of encryption quality and PSNR values. In the future, we will investigate the proposed method's resistance to other types of assaults, including salt and pepper, filtering, cropping, and blurring.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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