IMAGE ENCRYPTION AND DECRYPTION USING CHAOTIC-DNA ALGORITHM

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ABSTRACT:

Image communication is widely used in personal, medical, military, and professional applications. With the rapid increase in digital image transmission over open networks, ensuring image security has become a critical challenge. Unauthorized access, hacking, and data manipulation can lead to serious information loss and privacy issues. The Image Encryption and Decryption project using a Chaotic DNA Algorithm aims to provide strong protection for digital images. It combines chaotic maps and DNA computing techniques to perform secure pixel scrambling and encoding. The encrypted image can be safely transmitted and accurately recovered only with the correct secret keys, ensuring confidentiality, integrity, and reliable image security.

Keywords: ***Image Encryption, Image Decryption, Chaotic Algorithm, DNA Computing, Image Security, Information Protection***

INTRODUCTION:

In today's digital era, digital images play a vital role in communication across personal, medical, military, and professional domains. However, the widespread transmission of images over open networks exposes them to security threats such as unauthorized access, data tampering, and information leakage. The Image Encryption and Decryption using Chaotic DNA Algorithm project addresses these challenges by providing a highly secure image protection mechanism. The system integrates chaotic maps with DNA

computing principles to achieve strong encryption. Chaotic sequences are used for pixel permutation and diffusion, while DNA encoding, decoding, and logical operations increase complexity and resistance to cryptographic attacks. The original image is converted into an encrypted form using secret keys, ensuring that unauthorized users cannot access the data. The decryption process accurately reconstructs the original image only with the correct keys. By combining chaos theory and DNA-based operations, this project delivers a robust, efficient, and reliable solution for secure image storage and transmission.

LITERATURE SURVEY:

Several studies have investigated image encryption techniques to enhance the security of digital images. Traditional encryption algorithms such as DES and AES provide strong security but are not optimized for large image data due to high computational complexity. To overcome this, researchers introduced chaos-based image encryption methods that exploit the sensitivity and randomness of chaotic systems. Fridrich (1998) demonstrated the effectiveness of chaotic maps for pixel permutation and diffusion. Later, DNA computing was integrated with chaotic algorithms to further improve security by increasing complexity and key space. Zhang et al. (2014) showed that DNA encoding combined with chaotic sequences offers strong resistance against statistical and differential attacks. The proposed Image Encryption and Decryption using Chaotic DNA Algorithm builds upon these studies by integrating chaotic maps with DNA-based operations to achieve efficient, secure, and reliable image protection suitable for real-time applications.

RELATED WORK:

Over the years, several approaches have been proposed to enhance the security of digital images through encryption techniques. Early image protection methods relied on traditional cryptographic algorithms such as DES and AES, which provide strong security but are computationally expensive for large image data. To overcome these limitations, chaos-based image encryption methods were introduced, exploiting properties like sensitivity to initial conditions and pseudo-randomness. Later, researchers integrated DNA computing concepts with chaotic systems. In comparison, the proposed Image Encryption and Decryption using Chaotic DNA Algorithm combines chaotic maps with DNA computing to deliver an efficient,

secure, and reliable image protection system suitable for real-time applications.

EXISTING METHOD:

Over the years, several methods have been developed to secure digital images through encryption. Early approaches relied on traditional cryptographic algorithms, which provided strong security but were inefficient for large image data. Chaos-based encryption techniques improved performance by using properties such as randomness and sensitivity to initial conditions for pixel permutation and diffusion. Image preprocessing methods converted pixel values into suitable forms for encryption operations. Later, DNA computing–based approaches enhanced security by introducing DNA encoding, decoding, and logical operations, increasing complexity and key space. Although these methods significantly improved image protection, some faced challenges in balancing security and efficiency. The proposed Image Encryption and Decryption using Chaotic DNA Algorithm addresses these issues by combining chaotic maps with DNA computing to deliver a secure, efficient, and reliable image protection solution suitable for real-time applications.

PROPOSED METHOD:

The proposed Image Encryption and Decryption system provides secure and efficient image protection in real time. The input image is first preprocessed and converted into pixel data suitable for encryption operations. Chaotic maps are used to generate pseudo-random sequences that control pixel permutation and diffusion, effectively scrambling the image structure. The pixel values are then encoded using DNA computing rules, and DNA-based logical operations are applied to enhance complexity and security. The encrypted image is transmitted securely and can only be recovered using the correct secret keys during the decryption process, which reverses the chaotic and DNA operations. This approach combines chaos theory and DNA computing to ensure high security, robustness against attacks, making it suitable for secure image storage and transmission applications.

SYSTEM ARCHITECTURE:

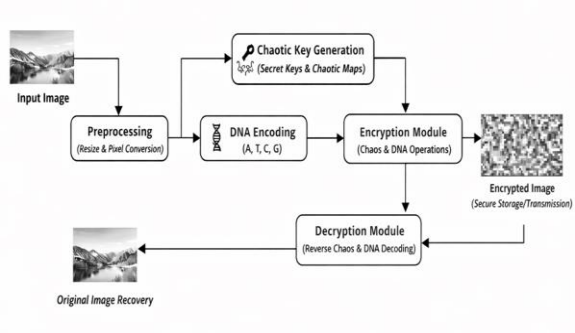

Fig.1: Architecture of Image Encryption and decryption System

METHODOLOGY DESCRIPTION

Input Collection: Digital images are collected from users or standard image datasets for secure processing and transmission.

Preprocessing: The input image is resized if necessary and converted into pixel values suitable for encryption operations.

Chaotic Sequence Generation: Chaotic maps are used to generate pseudo-random sequences based on secret keys, providing high sensitivity and randomness.

DNA Encoding: Image pixel values are encoded into DNA sequences using predefined DNA rules (A, T, C, G) to increase complexity.

Encryption Process: Chaotic sequences control pixel permutation and diffusion, while DNA-based logical operations are applied to produce the encrypted image.

Decryption Process: Using the correct secret keys, the encrypted image undergoes reverse chaotic operations and DNA decoding to accurately recover the original image.

Secure Storage/Transmission: The encrypted image can be safely stored or transmitted over insecure networks without data leakage.

System Interface: A user-friendly interface allows users to upload images, perform encryption/decryption, and view results.

Outcome: This approach ensures high security, robustness against attacks, and efficient image protection for secure image storage and transmission.

RESULTS AND DISCUSSION:

Fig.2: Application Home Page

This is the home page of the Image Encryption and Decryption system using the Chaotic-DNA algorithm. It allows the user to navigate to different options like About, Detect, and Contact to start using the system.

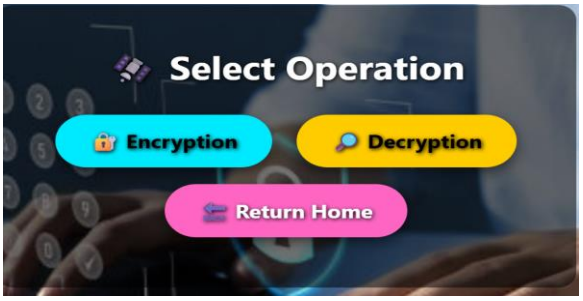

Fig.3: Detection Page

This is the Detection page where the user selects whether to perform image encryption or image decryption.

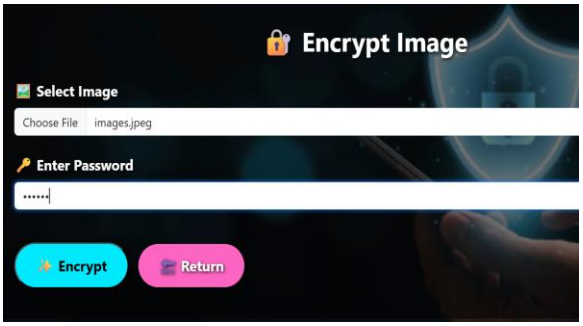

Fig.4: Encryption Page

This is the Encryption page where the user selects an image and enters a secret password. The system uses the Chaotic-DNA algorithm to encrypt the image and convert it into a secure, unreadable form.

Fig.5: Encryption Result

The original image is transformed into a completely unreadable encrypted image, ensuring data security.

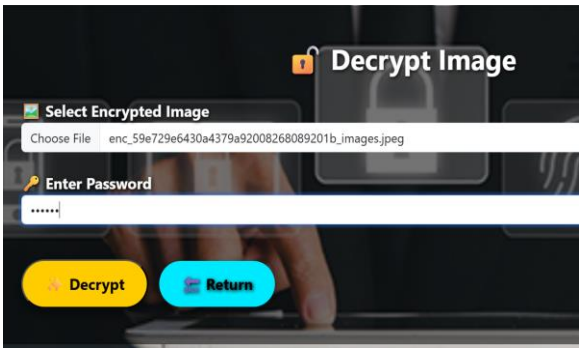

Fig.6: Decryption Page

This is the Decryption page where the user selects the encrypted image and enters the correct secret password. The system uses the same Chaotic-DNA algorithm to decrypt the image and recover the original content.

Fig.7: Decryption Result

This is the Decryption Result page where the decrypted image is displayed after successful decryption.

CONCLUSION AND FUTURE ENHANCEMENT:

The Image Encryption and Decryption system effectively applies chaos theory and DNA computing to secure digital images by transforming pixel data into highly complex encrypted forms using chaotic maps and DNA encoding operations. Experimental analysis demonstrates strong security performance, showing resistance to statistical and differential attacks while enabling accurate image recovery during decryption. The system ensures efficient processing and reliable protection for image transmission and storage. For future enhancement, advanced chaotic models, hybrid encryption schemes, and hardware acceleration can be explored to further improve security, speed, and scalability, making the system suitable for large-scale and real-time image security applications.

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