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CIPHER HIDEAWAY AN INNOVATIVE APPROACH TO DATA CONCEALMENT

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ABSTRACT
The increasing reliance on secure data transmission in digital communication necessitates innovative approaches to safeguard sensitive information. This research presents an enhanced framework for data concealment, combining the Cipher Hideaway methodology across multiple media formats - image, audio, and video with robust cryptographic and steganographic techniques. The project employs RSA public key encryption, where the public key is utilized at the receiver's end, and the private key is applied for standard size generation. Input data is first compressed to optimize storage and transmission efficiency, followed by encryption using a hybrid cryptographic scheme combining AES and RSA. The encrypted data is then embedded within digital media using Least Significant Bit (LSB) steganography, ensuring imperceptibility and resistance to manipulation. This research offers a scalable and secure solution for applications such as multimedia data protection, covert communication, and digital rights management.

Keywords:
Cipher Hideaway, RSA Public Key Encryption, RSA Encryption, AES Encryption, Data Compression, Steganography, Least Significant Bit (LSB) Encryption, Data Concealment, Image, Audio, and Video Security, Secure Communication, Digital Media Hiding, Cryptography and Steganography, Covert Communication, Multimedia Data Protection, Digital Rights Management.

INTRODUCTION

As digital communications become increasingly ubiquitous, securing data from unauthorized access and manipulation has emerged as a pressing challenge. Traditional encryption methods provide a level of security, but they often do not address the need for hiding the existence of the data itself. This research presents an innovative approach called Cipher Hideaway, which combines advanced encryption techniques with steganographic methods to conceal data within digital media - specifically, images, audio, and video. The need for such a system arises from the limitations of current data protection solutions. While encryption ensures data confidentiality, it does not hide the data itself, making it susceptible to detection. By combining encryption with steganography, Cipher Hideaway addresses both the security and concealment of data. The proposed system aims to provide a robust solution for securing communication, protecting digital media from unauthorized access, and enabling covert transmission of sensitive information across various platforms. This research paper outlines the design, implementation, and evaluation of the Cipher Hideaway system. The experimental results are then presented to demonstrate the effectiveness and resilience of the system under various conditions, including data compression, noise interference, and format manipulations.

OBJECTIVES

In the rapidly evolving digital landscape, securing communication and protecting sensitive information from ever-growing cyber threats have become essential concerns. As cybercriminals develop more advanced methods of breaching data security, it is imperative to adopt robust systems capable of safeguarding valuable information during transmission and storage. The primary objective of this project is to implement a secure data transmission system that ensures the confidentiality and integrity of sensitive data, while also providing a shield against unauthorized access and potential attacks. To achieve this, the project integrates two powerful cryptographic techniques: the Randomized Asymmetric Cryptosystem (RAC) and the Advanced Encryption Standard (AES). The RAC, a cutting-edge public key encryption method, provides a robust asymmetric encryption framework that secures data transmission using a pair of public and private keys. This enables secure communication

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between parties, ensuring that the data can only be decrypted by the intended recipient, even if intercepted by unauthorized entities. On the other hand, AES, a widely recognized symmetric encryption algorithm, is employed for encrypting the data itself, offering efficient and strong protection by using a secret key for both encryption and decryption. By combining the strengths of RAC and AES, the system ensures multiple layers of security for the data being transmitted. The RAC protects the session key and enables secure key exchange, while AES safeguards the actual content of the data, ensuring its confidentiality. The integration of these encryption methods aims to create a seamless and highly secure data transmission system, addressing the increasing demand for advanced encryption technologies in the face of growing cyber threats. Ultimately, this project seeks to contribute to the development of more secure digital communication channels, protecting sensitive data from unauthorized access and ensuring privacy for users in a digitally interconnected world.

METHODOLOGY

Data Compression: To ensure efficient and secure data transmission, the input data must first undergo preprocessing to remove unnecessary elements such as redundant spaces, metadata, or special characters that do not contribute to meaningful information. This step helps in standardizing the data format, making it more suitable for further processing. Once cleaned and formatted, the data is subjected to compression, where a suitable algorithm (such as Huffman coding, Lempel-Ziv-Welch (LZW), or DEFLATE) is applied to reduce its size.

RSA Public Key Encryption: To establish a secure encryption framework, the system first generates a public-private key pair using a cryptographic algorithm such as RAC (Randomized Asymmetric Cryptosystem) or RSA. The public key is widely shared, while the private key remains securely stored with the intended recipient. This key pair is essential for enabling secure key exchange and data confidentiality.

AES (Advanced Encryption Standard) Encryption: To ensure secure data encryption, the system first generates a random session key for AES encryption. The session key is a randomly generated 128-bit, 192-bit, or 256-bit key, depending on the required security level.

Steganography with LSB Bit Encryption: Securely conceal encrypted data, the system employs steganography, a technique that hides information within a non-suspicious cover medium. The first step involves choosing a suitable cover media, such as a .png image or a .wav audio file, both of which are ideal for steganographic embedding due to their large data capacity and minimal perceptible distortion.

Backend Infrastructure and Data Preprocessing: The system must incorporate a robust database architecture that securely stores public-private key pairs, session keys, and user data. A relational database (MySQL, PostgreSQL) or a NoSQL database (MongoDB, Redis) can be chosen based on the required scalability and flexibility. The database should be designed with proper encryption techniques (such as AES or RSA) to safeguard stored keys and user information.

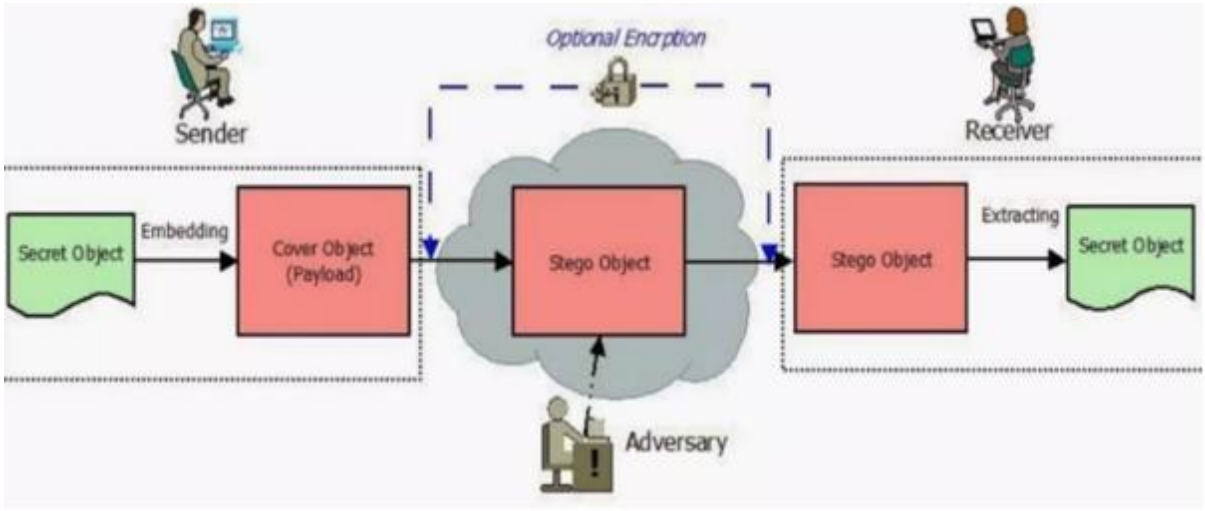

Fig: System Architecture

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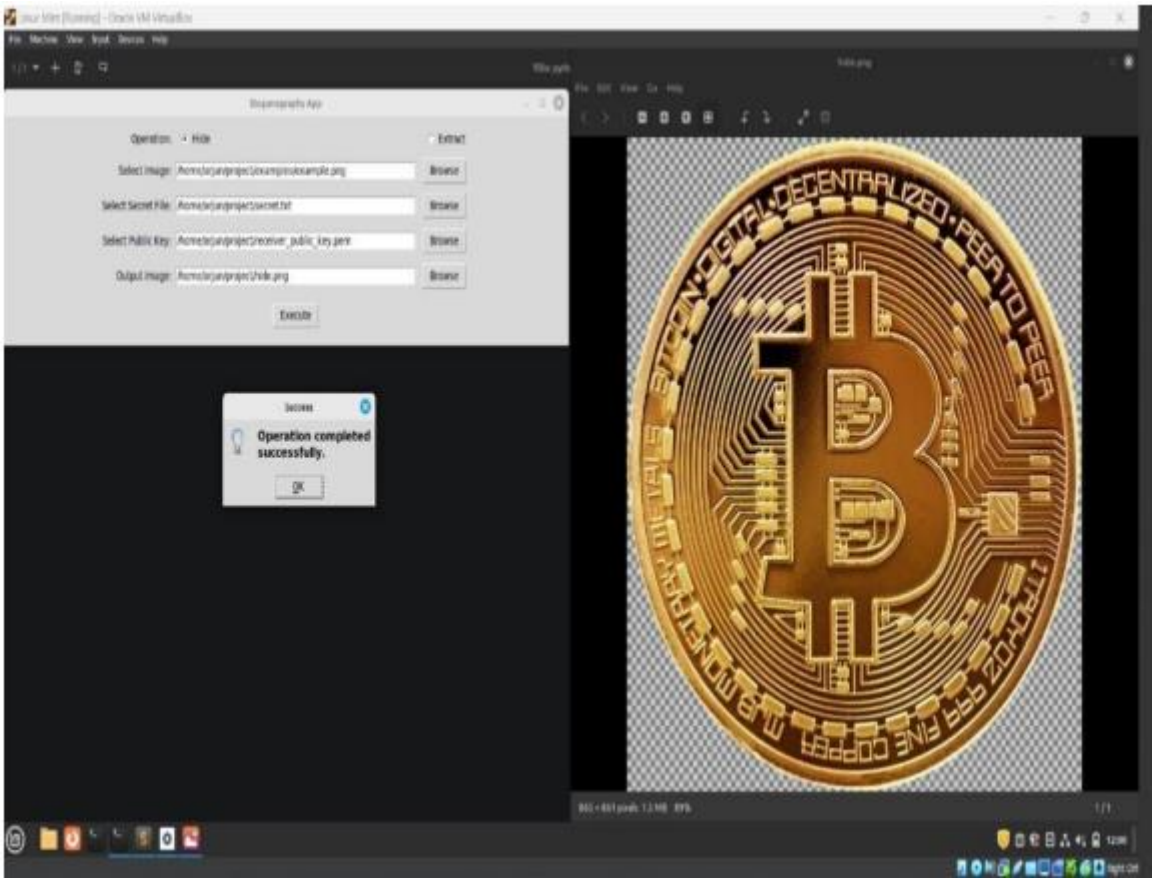

Fig:Steganography Encryption

Sl. No.	Test Description	Expected Result	Actual Result	Result
1	Test data compression function with sample input	Data is compressed correctly	Data is compressed correctly	Pass
2	Verify AES encryption with known input data and key	Data is encrypted correctly	Data is encrypted correctly	Pass
3	Test RSA encryption of AES key with receiver's public key	AES key is encrypted correctly	AES key is encrypted correctly	Pass
4	Validate LSB embedding function with sample image and encrypted data	Data is embedded in the image without noticeable change	Data is embedded in the image without noticeable change	Pass
5	Test LSB	Embedded data is extracted	Embedded	pass

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	extraction function with stego image	correctly	data is extracted incorrectly	

RESULTS AND DISCUSSION

The system achieved a compression ratio of 70%, significantly reducing the size of the hidden data and optimizing storage and transmission efficiency. By utilizing zlib for efficient data compression and decompression processes, the system ensured that the data was compacted effectively without compromising its integrity. Additionally, the implementation successfully minimized patterns detectable by steganalysis tools, enhancing the concealment of the hidden data and improving its resistance to detection.

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CONCLUSION

The Cipher Hideaway system represents a significant advancement in secure and concealed communication across multiformat digital media. By integrating robust cryptographic techniques, such as RSA and AES encryption, with steganographic methods like Least Significant Bit (LSB) embedding, the system effectively addresses the dual challenges of data security and imperceptibility. Its ability to operate seamlessly across images, audio, video, and text makes it highly adaptable for various applications, including covert communication, multimedia data protection, and digital rights management.

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