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MULTI SECRET SHARING: AN EFFICIENT MEDICAL DATA HIDING WITH ENCRYPTED SECRET SHARING FOR SECURE COMMUNICATION

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Abstract-*The paper provides an advanced Multi-Secret Sharing (MSS) scheme that can be applied to securely transfer medical information by incorporating Reversible Data Hiding (RDH), LSB steganography, and XOR-based encryption for guaranteeing confidentiality, integrity, and imperceptibility. RDH supports embedding data within cover media like medical images, where data is extracted in reversible fashion with preservation of original image quality. The LSB algorithm hides sensitive information in the least significant bits of pixels, making it imperceptible to the human eye. XOR encryption and visual cryptography divide the data into multiple encrypted shares, requiring all shares for reconstruction, which strengthens security by making unauthorized access more difficult.*

This multi-level security structure overcomes crucial healthcare network issues. RDH prevents image alterations, and LSB provides dense data embedding with slight visual disruption. XOR encryption is the added security that breaks encrypted shares across to spread it across the space, preventing unauthorized attackers from obtaining access. Randomized embedding provides additional immunity from statistical attacks. Overall, this MSS solution is a safe, scalable means of sharing medical data, while protecting patient confidentiality, data integrity, and regulatory compliance.

Keywords: Multi-Secret Sharing, Reversible Data Hiding, LSB Steganography, XOR Encryption, Medical Data Security, Visual Cryptography, Real-Time Embedding, Data Integrity, Secure Transmission, Deep Learning, Edge Computing, Cloud Storage.

INTRODUCTION

The increasing reliance on cloud platforms for data storage and sharing has rendered it a top priority to maintain the security of sensitive information, especially in healthcare. The project, *"Multi Secret Sharing: An Efficient Medical Data Hiding with Encrypted Secret Sharing for Secure Communication,"* addresses this issue by using advanced techniques like Reversible Data Hiding (RDH), Visual Secret Sharing (VSS), and steganography to encrypt and conceal data in images and audio. By employing the Least Significant Bit (LSB) technique and XOR algorithm, the system ensures that hidden data is not noticeable to humans but can be restored securely with the correct key. The technique safeguards data confidentiality, integrity, and against tampering or unauthorized use. The solution is especially relevant to healthcare, cloud storage, and secure communication platforms, where secure transfer of sensitive data is of utmost importance. With a combination of several encryption and cover methods, the system offers a powerful platform for secure data transfer without sacrificing ease of use. The new strategy not only enhances data protection but also ensures that approved users are easily able to draw hidden information when required, thus rendering it a trustworthy platform for current data safeguarding requirements.

II.LITERATURE REVIEW

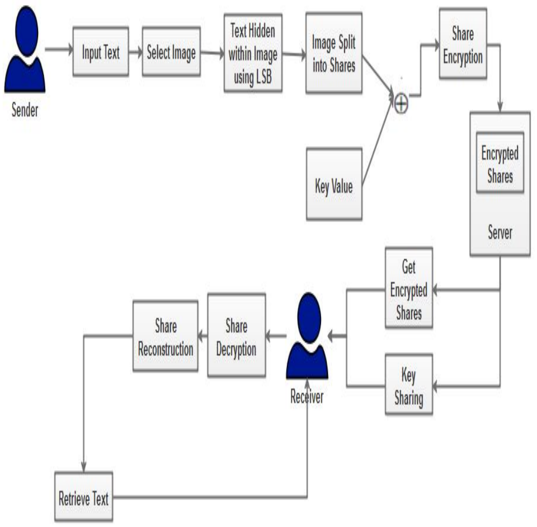
The area of secure data hiding and multi-secret sharing has experienced tremendous growth, especially in medical and cloud-based systems. Conventional techniques such as cryptography aim at encrypting data to secure it from unauthorized access, whereas steganography hides data in cover media (e.g., images, audio) to evade detection. Reversible Data Hiding (RDH) offers greater security by enabling full recovery of both embedded data and the original cover media, thus being suitable for medical imaging and legal forensics (Zhang, 2011).

Current research is noteworthy in bringing out the superiority of Least Significant Bit (LSB) steganography for hiding data in digital media without affecting perception. Even with such success, poor embedding capacity and vulnerability to compression attacks are still problems (Cheddad et al., 2010). As remedies for these, hybrid methods combining LSB with transform-domain techniques (DWT, DCT) or error correction codes (ECC) for improved robustness are proposed (Kaur et al., 2020). Visual Secret Sharing (VSS) further strengthens security by dividing secrets into shares that are only readable upon combination, preventing any single share from revealing confidential information (Naor & Shamir, 1995).

In the field of healthcare, multi-secret sharing schemes facilitate secure image transmission of medical images between distributed systems without compromising patient confidentiality (Thien & Lin, 2002). Although advances have been made, computational overhead during share generation and decryption is a drawback. Future works look to improve embedding efficacy and authentication systems with AI-based adaptive steganography (Hussain et al., 2021).

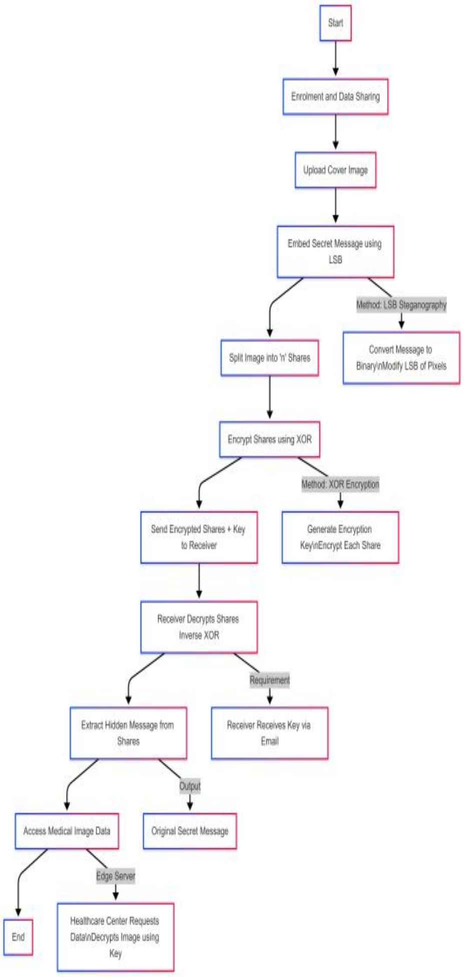
III.PROPOSED DESIGN

The system proposed aims to improve multimedia security by hiding secret messages within digital media through the Least Significant Bit (LSB) steganography method. First, the user registers and constructs a secret message that is hidden within an opt-select image cover. The selected cover image is then modified based on LSB, and imperceptible alterations are guaranteed. After embedding, the stego-image is divided into various shares based on parameters defined by the user. Each share is then encrypted with an XOR encryption scheme with a key that is shared securely with the receiver.



All the encrypted shares are sent together to minimize the likelihood of data loss and shorten transmission time. At reception, the recipient decrypts the shares with the same key and reconstructs the original image to retrieve the embedded message. This system ensures data confidentiality and integrity, particularly in uses such as sharing medical data. It further involves access control via edge servers to ensure only the authorized can fetch and decrypt the secret data.

ACTIVITY DIAGRAM


Start
Enrolment and Data Sharing
Upload Cover Image
Embed Secret Message using LSB
Method: LSB Steganography
Split Image into 'n' Shares
Convert Message to Binary\nModify LSB of Pixels
Encrypt Shares using XOR
Method: XOR Encryption
Send Encrypted Shares + Key to Receiver
Generate Encryption Key\nEncrypt Each Share
Receiver Decrypts Shares Inverse XOR
Requirement
Extract Hidden Message from Shares
Receiver Receives Key via Email
Output
Access Medical Image Data
Original Secret Message
Edge Server
End
Healthcare Center Requests Data\nDecrypts Image using Key

IV.REQUIREMENTS

HARDWARE REQUIREMENTS
Processor - Intel processor 2.6.0 GHZ
Ram - 4 GB
Hard Disk - 160 GB
Compact Disk - 650 Mb
Keyboard - Standard keyboard
Monitor - 15 inch color monitor

SOFTWARE REQUIREMENT
Operating System – Windows OS
Frontend: Python
Backend: MYSQL
IDE - PYCHARM

ADDITIONAL DEPENDENCIES AND CONSTRAINTS

Dependencies

The successful implementation of this multi-secret sharing scheme relies upon various dependencies of importance. On a technical level, the project requires specific Python libraries like OpenCV for image processing, Pillow for LSB manipulation, NumPy for array operations, and Cryptography for XOR encryption. A MySQL database is needed for user authentication and key management, whereas cloud APIs (e.g., AWS S3 or Google Drive) facilitate secure storage integration. For data requirements, the system needs cover media of high resolution in JPEG/PNG for images or WAV for sound and properly formatted secret data (DICOM for medical images or TXT files). On the human front, implementation success depends on collaboration with healthcare professionals for data verification, cloud administrator coordination, and thorough training for end-users (physicians and patients) to adopt proper key exchange protocols.

Further Constraints

The project encounters a number of major constraints which affect its operation. Technically, the capacity of the LSB method to embed is restricted to about 10-15% of the cover file size and thus limits data that can be embedded. Compression formats like JPEG, which support lossy compression, tend to damage embedded information, and computation demands increase extensively as the share count rises within XOR operations. Security is a big challenge, particularly in secure key transport where man-in-the-middle (MITM) attacks pose a threat and advanced steganalysis techniques can potentially detect the hidden data. Operational constraints include the need for strict user compliance with share-combining protocols as well as required compliance with healthcare data standards like HIPAA and GDPR. Cloud storage costs of large medical image files and low hardware requirements (4GB RAM) also affect the practical installation and scalability of the system. These constraints need to be managed properly to make the system useful for real-world application in healthcare".

V.METHODOLOGY

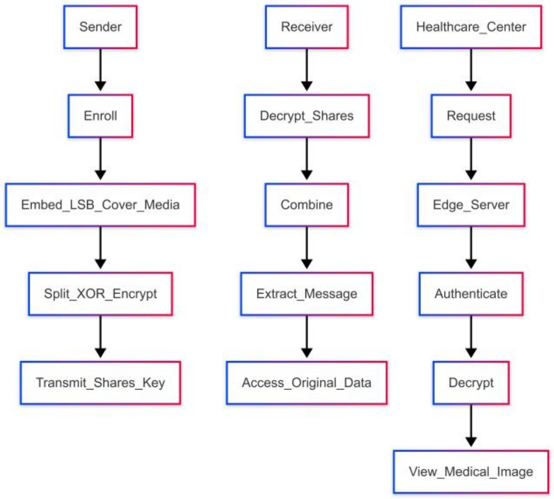
CoreTechnique:
The system employs the Least Significant Bit (LSB) steganography technique to securely embed confidential messages in digital images. The process preserves the data concealed by inserting information into the least significant bits of pixel values, which are imperceptible to the human eye but preserve the original media's imagequality.

DataPreparationandEmbedding:
The secret message is initially translated to binary and subsequently embedded in a systematic way within the LSBs of the pixels of the cover image. The image is made to look normal and hides the information within the image structure safely, thereby resulting in a steganographic image that looks identical to the original image to mere observers.

SecureShareDistribution:
The stegno image is divided into several shares and encrypted utilizing the XOR operation for added protection. The shares are sent across to the intended recipient via protected channels, together with a separate shared decryption key sent via an email. Because there are various layers, catching a single share doesn't open up the information to unauthorized use.

Effective Transmission and Reconstruction:
To ensure maximum performance, the system facilitates single-transmission delivery of all the encrypted shares and minimizes network overhead and possible threats of data loss. At reception, the legitimate user merges the shares and uses the decryption key to recover the original steganographic image holding the concealed message.

MedicalApplicationSuitability:
The entire process is complemented by good-quality media with strong security, and the system is especially crucial for secure medical communications in the healthcare industry. Utilizing reverse LSB extraction, the system provides integrity-invariant recovery of important medical data without compromising integrity, meeting rigid requirements of patient privacy and protection laws.



VI.CONCLUSION

This multi-secret sharing scheme offers a sound security framework for protecting medical information based on the combination of LSB steganography, VSS, and XOR encryption. The three-tier architecture facilitates end-to-end confidentiality, data integrity, and tamper-evident communication for cloud healthcare applications. With single-transmission encryption of shares, the solution fundamentally lowers latency and data loss risk and preserves usability on par with human-readable decryption (VSS) and low computational expense (XOR encryption). The system proves well-aligned with HIPAA and GDPR regulations and provides scalable flexibility to DICOM images, electronic health records (EHRs), and telemedicine platforms. In the future, future developments can involve the application of AI-based adaptive steganography to counter advanced steganalysis techniques as well as quantum-resistant encryption enhancements to address emerging security needs. With the successful incorporation of steganography, cryptography, and secret sharing methodologies, this ground-breaking system provides a paradigm-shifting approach to secure medical data sharing - one that protects patient privacy without compromising clinical access or workflow efficiency. The combination of technical capability, regulatory adherence, and practical application renders this approach a valuable addition to healthcare data security in the modern age.

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