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Enhancement of the Security of Data by Associating Obfuscation Technique Along with Steganography

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Abstract - The safety of stored data in the cloud is of the utmost significance. There is a lot of room for user data in cloud storage. This technology has proven to be a groundbreaking effort because of its ability to offer cheap, extensive computational storage that users may access from anywhere at any time. By entrusting their data to the cloud, users may take advantage of services that are flexible, efficient, and run smoothly. Once data has been transferred to the cloud, the onus for its administration shifts entirely to the CSP. Data stored in the cloud raises a number of security problems, in addition to the benefits. Data in transit and data at rest are both susceptible to assaults when users move their data to the cloud. Data protection and building confidence in cloud services are now top priorities. Data should be kept in an encrypted or masked format to prevent unauthorised access. One major problem with cloud computing is the lack of assurance around data protection. By integrating obfuscation with steganography, this study reveals a novel and advanced method to strengthen data security. To guarantee confidentiality, the proposed method incorporates obfuscation and steganography techniques. In contrast to steganography, whose main goal is to mask the existence of information, obfuscation primarily seeks to transform data into a different form while simultaneously concealing the original data. Using the Least Significant Bit (LSB) replacement technique, the hidden text may be hidden inside a picture. The results of the experiments show that the proposed method may successfully integrate large amounts of data and generate high-quality stego images.

Keywords - Data Security, Data storage, Steganography, Cloud service provider, Least significant bit.

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1. INTRODUCTION

Cloud computing refers to the utilisation of laptop assets which might be supplied as services across a community, encompassing each hardware and software additives. The IT commercial enterprise is heavily stimulated by using the cloud because of its amazing features. The National Institute of Standards and Technology (NIST) defines cloud computing as a framework that enables big and simple get entry to to a shared pool of configurable computing resources: networks, servers, garage, packages, and offerings. Allotting and releasing those assets is a breeze and calls for minimum intervention from the carrier issuer. On the cloud, you may discover three separate offerings: IaaS, SaaS, and PaaS. One version for supplying computing assets in conjunction with garage, servers, and facts centres to cease users is called Infrastructure as a Service (IaaS). One of the principle skills of cloud computing is garage as an issuer, or StaaS. Cloud garage is a service that entails the far flung maintenance, manipulate, and backup of facts that is then accessible to customers over a network. The computing infrastructure is improved with an enormous array of lots of pc systems and servers, resulting in elevated processing capability. The cloud infrastructure includes numerous information centres strategically located at some stage in numerous worldwide regions, making sure reliable carrier transport to clients. It gives countless company supply with none manual intervention.

Data protection is the number one problem in cloud computing. Cloud Service Providers (CSPs) have the duty of keeping and monitoring the information that has been outsourced to them. The cloud is a publicly to be had platform that provides numerous possibilities for data breaches. Cloud storage introduces safety issues, especially in terms of facts

outsourcing. Once information is moved to the cloud, the obligation for its renovation, oversight, and management shifts to the cloud carrier companies (CSPs). Outsourcing statistics transmission to the cloud is something that many businesses and companies have begun doing currently. This presents a susceptible public placing with several opportunities for compromising character records. The utmost priority inside the cloud environment is protection. Third-birthday celebration cloud carrier corporations store outsourced data at the cloud. Data in the cloud is probably prone to assaults originating each inside and externally. Data protection is confident via the usage of safety capabilities together with confidentiality, integrity, and availability.

Cloud computing has become a vital generation within the age of virtual transformation, offering unmatched scalability, flexibility, and performance in storing and dealing with statistics. As businesses regularly switch their facts to the cloud, making certain the safety of these records turns into of most significance. The major impediment in cloud computing is ensuring the protection of sensitive statistics from unauthorised get admission to and cyber threats. This studies objectives to improve data protection in cloud storage with the useful resource of integrating two exceptional strategies: records obfuscation and steganography. Through the integration of severa strategies, our purpose is to offer a resilient answer those not only hides the statistics but moreover notably will growth the problem for malevolent entities to perceive and decipher it.

1.1 Data Obfuscation

Data obfuscation is a technique used to difficult to understand or cover information on the way to make it hard for unauthorised people to recognize or access. The individual did no longer provide any text. Data obfuscation is a protection method that modifies the unique facts so that you can render it incomprehensible to unauthorised customers, on the equal time as yet maintaining its capability for widespread features. The number one goal of obfuscation is to safeguard touchy facts through rendering it exhausting to decipher or contrary-engineer the obfuscated facts without proudly owning the excellent technique hired. This technique is usually used to protect code, facts structures, and personal facts in lots of packages, which encompass software program software development and information storage.

Data obfuscation encompasses many strategies that can be employed to cover or difficult to recognize sensitive information.

Tokenization: refers back to the approach of breaking down a textual content into smaller gadgets referred to as tokens. This method substitutes sensitive information portions with non-touchy counterparts, referred to as tokens, which could only be related decrease lower back to the proper statistics by using the usage of legal customers. It is frequently utilised in charge processing systems.

Data shielding: This method consists of obfuscating private statistics through substituting it with fabricated however manageable information. It is usually utilised in finding out situations at the same time as actual facts makes no sense.

Permutation: refers back to the affiliation of things in a particular order. The unique series of statistics objects is obscured without the crucial component because of their rearrangement consistent with an genuine pattern or set of rules.

Encryption-based totally Obfuscation: is a manner that complements protection through using combining everyday encryption strategies with an extra layer of obfuscation. This includes encrypting records and then in addition obscuring it.

1.2 Steganography

The practice of concealing information in different, ostensibly innocent media that allows you to keep away from discovery is known as steganography. In comparison to cryptography that is concerned with encrypting information to render it unintelligible with out a decryption key steganography seeks to hide the records's mere lifestyles. By the use of this technique, personal facts may be stored and communicated discreetly without drawing hobby to oneself.

1.3 Methods for Steganography

- **Substitution of the Least Significant Bit (LSB):** This extensively used method encrypts concealed information with the useful resource of changing the least essential quantities of the host medium, along with an photo or audio report. The modifications are normally subtle and invisible to the bare eye.
- **Domain Steganography in Frequency:** This approach alters the host media's frequency components in area of without delay enhancing the facts. Information is embedded within the frequency domain the use of methods including Discrete Wavelet Transform (DWT) and Discrete Cosine Transform (DCT).
- **Spatial Domain Encryption:** To conceal data, this entails directly altering the pixel values in a picture or the audio file's samples. While it is

simpler than frequency domain approaches, it is also more prone to detection.

- **Filtering and Masking:** This method makes data more resistant to modification and compression by using digital watermarking techniques to conceal it in more important sections of the host medium, including the noise levels or masked areas.

This research details a way to keep secrets using steganography and the obfuscation method known as Magical Rolling Alpha Digits Obfuscation (MRADO). It all starts with data obfuscation using the MRADO approach. In addition, the Least Significant Bit (LSB) replacement method is used to integrate the hidden data into an image. In addition to producing very high-quality images, the hybrid method described here offers a large embedding capacity.

2. LITERATURE OF REVIEW

Kavitha et al. (2023) The objective of this research is to create an ML model that improves cloud data security. Researchers enhance data security by using a preprocessed data collection with particular specifications. Message learning models are fed preprocessed data that has been through a number of processes. Using these parameters, three distinct ML models the ANN, KNN, and RF algorithms are trained and evaluated. They measure learning. Parameters like as accuracy, sensitivity, and specificity are used to assess the efficacy of these models. By combining an ANN algorithm with a simulated bee colony, the most efficient feature extraction approach and ML model combination is found. The model is well-suited for use in cloud computing applications, where it improves data security, with a final accuracy of 93.8%. To further strengthen data security, this method may be used in conjunction with cloud computing services.

Rahman et al. (2022) the progress in technology and the internet has enhanced the accessibility of communication, but, it has also rendered data transfer susceptible to external threats. In order to tackle this issue, steganography plays a key role in ensuring secure communication. The Least Significant Bit (LSB) replacement method is suggested as an innovative approach to obscure digital pictures such as RGB, Grey Scale, Texture, and Aerial photos. This approach strives to attain superior levels of security, detectability, capacity, and resilience in comparison to current systems. The experimental findings demonstrate that the suggested technique surpasses the next-best current methodology by 5.561 percent in terms of PSNR Correlation score and achieves a 6.43 percent improvement in PSNR with a variable measure of code placed in identical pictures with various dimensions. When encrypting the same amount of information in photos of varied sizes, there is an approximate improvement of 6.77 percent. Similarly, embedding different sizes of a certain secret message in different images results in a score improvement of roughly 5.466 percent.

Nagaraju P. Et al. (2019) Cloud computing is the exercise of storing, coping with, and processing information utilizing net-based computers located remotely. This technique presents bendy resources and price benefits due to the capacity to scale up or down as wanted. Traditional organisations are adopting cloud computing because it gives benefits in terms of value, pace, productiveness, performance, and protection. Nevertheless, it's far imperative to tackle safety vulnerabilities together with malevolent insiders, cyber intrusion, human fallibility, and Distributed Denial of Service (DDoS) attacks. Proposed processes along with obfuscation are counseled to growth safety and privateness in cloud computing. Obfuscation is the act of remodeling complex code right into a programme that capabilities identically to the unique source code but is more tough to recognize. The cause of this survey is to enhance the security and privacy of cloud computing with the aid of reading obfuscation strategies. These strategies are designed to safeguard information towards dangerous assaults in an unregulated placing. A complete examination of modern obfuscation strategies is accomplished, ensuing within the manufacturing of a paper that examines cutting-edge processes and algorithms for software program obfuscation. Implementing those measures will enhance the security of laptop systems and networks, subsequently bolstering common corporate operations.

Hosseinzadeh et al. (2018) Diversification and obfuscation are techniques used to improve software security by making it difficult for attackers to exploit vulnerabilities. This paper uses a systematic literature review to select studies discussing these techniques. The study collected 357 articles from 1993 to 2017 and analyzed the extracted data, classifying the data, and identifying research gaps. The techniques have been widely used for various security purposes and impeding various types of attacks. There are various techniques to obfuscate/diversify programs, targeting different parts of programs and different phases of the software development life-cycle. The paper also highlights research gaps in the field, such as potential applications in cloud computing, IoT, and trusted computing. It also presents potential ideas for applying these techniques in these environments.

Mary et al. (2017) Cloud data storage security is paramount. Cloud storage provides massive user data space. Its capacity to provide vast computational storage at low cost to any customer at any time has made it a new endeavor. To take advantage of the cloud's scalability, efficiency, and faultless service, users move their data there. The data becomes the exclusive responsibility of the CSP after it has been sent to the cloud. Apart from the perks, cloud data security is a problem. Data at rest and in transit might be attacked when a user outsources to the cloud. Now the question is data security and cloud service reliability. Data should be encrypted or disguised to prevent unauthorised access. Data security is a fundamental barrier to cloud computing adoption. Combining obfuscation and steganography is an innovative and elegant way to secure data. The suggested obfuscation-steganography secrecy method. Obfuscation changes data and hides the original data, whereas steganography hides information. Least Significant Bit (LSB) replacement hides obscured text in images. Experimental findings show that the suggested method embeds well and produces high-quality stego pictures.

3. METHODOLOGY

An approach to bolstering the safety of data kept in the cloud is laid forth in this paper. The suggested method makes use of obfuscation and steganography to hide the data within the photos. Unauthorised access is the target of this strategy. It is possible for an attacker to decipher hidden data inside an image. It is recommended that the hidden data be encrypted or obfuscated. This approach uses the MRADO technique to obfuscate the data, and then the LSB embedding method to embed the obfuscated data into an image. Data hiding using just LSB alteration is not very secure. The embedded data will be more secure with the combination of these two methods. Without revealing the concealed information, the created steganographic picture may be safely stored on a cloud platform. Plus, the de-obfuscation process would be required to decipher the obscured data, even if the attacker were to succeed in overcoming the steganographic method used to detect the data concealed inside the stego-image. In picture 1 we can see the procedure. You may find this method's pseudocode below.

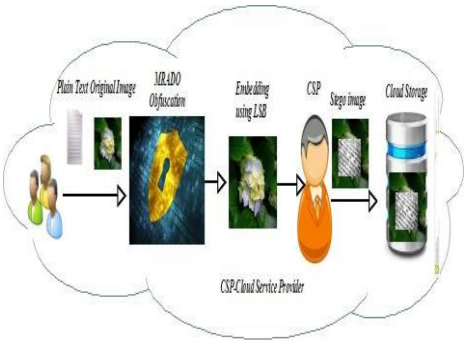

Figure 1: Proposed Methodology

Pseudo Code

Input: Image file (gif, jpg, bmp), Plain Text
Output: Image file (gif, jpg, bmp)
Method:

1. Start
2. Read L from file
3. Read C from L
4. NC←Convert W into Numeric Code by corresponding C position is multiplied with ASC
5. LT←NC,L
6. N← Count of NC
7. for i←1 to N
8. MO(i)←NC%64 i=0,1,2,.....N
9. S←Seed
10. Generate MRADO Square based on S
11. OT(i)← Convert MO(i) based on its position in MRADO
12. end for
13. embed the OT into the last bit of LSB of RGB pixels of cover image
14. end

- **The MRADO technique**

The MRADO Technique is an improvement on conventional obfuscation techniques that incorporates ASCII values, transposition, and replacement. Present obfuscation tactics include swapping out, deleting, redacting, shuffling, and blurring. The proposed fix is irreversible because it uses data obfuscation to hide the true value. Making Line (L) lists from the raw text is the first step. The provided lines convert the characters (C) to their corresponding ASCII values. When we know where a character is in a word, we may multiply its ASCII value by that value. As a consequence, a Numerical Code (NC) for the matched word is generated by taking the product of the values of two characters and adding them together. The procedure involves creating a look-up table (LT). It keeps the line and the NC value that goes along with it, which is calculated from the lines. We divide NC by 64 using the Modulo Operation (MO) to get the remainder and quotient. Starting with a Seed(S), the MRADO Square may be constructed using the following

elements: lowercase letters (a–z), capital letters (A–Z), the numbers 0–9, and the symbols @ and #. A single integer or string of characters may be represented by the value S. According to the S value, the MRADO square is filled with letters and numbers in a certain order. Figure 2 shows the square's traverse. The remainder of the NC value is used to assign the values of the alpha-digits. Alpha-Digits are mixed together to produce obfuscated text (OT).

- **Use of the Least Significant Bit (LSB) in Pixel Processing**

It is necessary to include the encrypted data into the overall image once it has been encrypted. Pixels, which are tiny units of colour, are what make up an image. The RGB colour space describes pixels that are created using the primary colours of the visible spectrum: red, green, and blue. The density of a colour is represented by the one byte of information contained in each pixel. The Most Significant Bit (MSB) is the first bit in an 8-bit system, whereas the Least Significant Bit (LSB) is the last bit [15]. Encrypted data inside the image is hidden using the Least Significant Bit (LSB). So, the last bit of pixels is all that needs changing. The following arguments support the usage of LSB in data patching.

1. The visual intensity is altered by either 1 or 0 when the information is concealed.
2. The change in intensity is binary, with values of either 0 or 1, as determined by the change at the final bit.

For example, the binary numbers 11111000 and 11111001.

The alteration consists of a single bit, ensuring little impact on the image's intensity while facilitating effortless data transmission.

4. ANALYSIS AND RESULT

The Java programming language is used to perform the proposed method. The obfuscation and steganography methods have been combined in this way. We use the MRADO technique to line-by-line obfuscate the plain text. A character-by-character technique is now used in the obfuscation strategy. This technology will make data transfer faster while also making it more secure. It takes more time to generate a magical rolling square of alphanumeric digits. It is not essential to provide extra time for the operation of obfuscation and de-obfuscation.

The MRADO square's intrinsic unpredictability greatly enhances the protection of the hidden material. The seed value determines the formation of the MRADO square. Each line is individually obfuscated to hide numerical and non-numerical data. The stego image is then generated by replacing the cover picture with the concealed data using LSB. In Figure 2, you can see the illustrated cover and stego.

Using the PSNR (Peak Signal to Noise Ratio) statistic, we may examine how nicely the blended method works. When evaluating two pictures, the PSNR determines the highest signal-to-noise ratio (in dB) among them. When comparing the authentic and compressed versions of a picture, this ratio is on occasion used to determine the relative first-class. When the Peak Signal-to-Noise Ratio (PSNR) is better, it approach that the compressed or reconstructed photograph is of higher fine. One manner to measure and evaluate the exceptional of image compression is with the Mean Square Error (MSE), at the same time as any other is with the Peak Signal to Noise Ratio (PSNR). Comparing the unique and compressed photos, the Mean Squared Error (MSE) measures the overall squared difference, even as the Peak Signal-to-Noise Ratio (PSNR) shows the best mistakes. The block uses equation 1 to calculate the suggest-squared blunders earlier than acquiring the PSNR.

$$MSE=\frac{1}{MN}\sum_{i=1}^{M}\left(P(i)-s(i)\right)$$

Equation 1 uses the variables M and N to represent the enter photographs' row and column counts, respectively. The block then uses the provided equation to get the Peak Signal-to-Noise Ratio (PSNR).

$$PSNR = 10\ LOG\ 10\ \frac{}{MSE}$$

The proposed strategy is contrasted with the technique outlined in reference [9] in Table 2. Specifically, the photographs of Baboon, Lena, and Peppers, which have a size of 512 × 512, are used to hide hidden information in the comparison. In comparison to technique [9], the results show that the proposed strategy has a higher Peak Signal-to-Noise Ratio (PSNR) and a higher hiding capacity. According to table 1, this shows that the proposed method outperforms the current method in terms of hiding capacity and PSNR value.

Table 1: Evaluate the current method and compare it to the suggested one

Cover image 512x512	Hiding Capacity(bytes)	PSNR of existing Method	Hiding Capacity of Proposed Technique(KB)	PSNR of Proposed Method
Image 1	63.408	42.8113	1.34	69.14
Image 2	62.208	44.9678	1.34	67.73
Image 3	62.000	44.8326	1.34	68.48

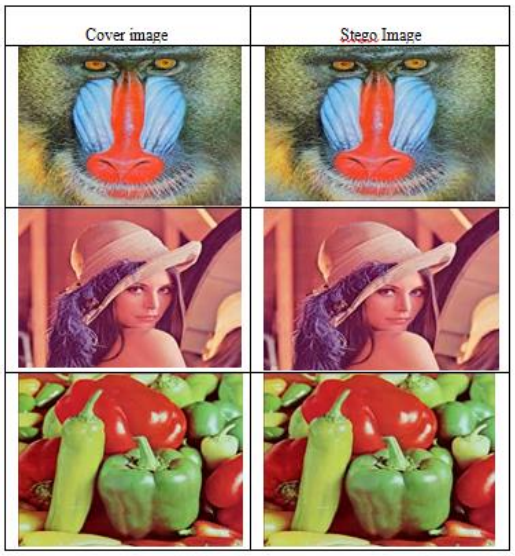

Figure 2: The cover and stego picture are compared.

5. CONCLUSION

Businesses and individuals alike may take advantage of cloud storage's low prices. The capability to outsource data transport to the cloud is enormous. There is a dearth of on-premises data storage and management infrastructure across companies and businesses. With data outsourcing, cloud storage may be used to efficiently manage data. Many potential points of attack exist during transmission and storage of user data when it is uploaded to the cloud. To improve the safety of data kept in the cloud, this study investigates the use of steganography and confidentiality-enabled obfuscation. Cloud storage makes the disguised data vulnerable to attacks from malevolent actors. The inclusion of the obfuscated data within the image makes it difficult to differentiate between a cover photo and a stego image. The experimental results show that the proposed technique may improve the visual quality of the stego photos while concealing a much bigger amount of information than the present method. Data storage security will be improved by using the proposed method.

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