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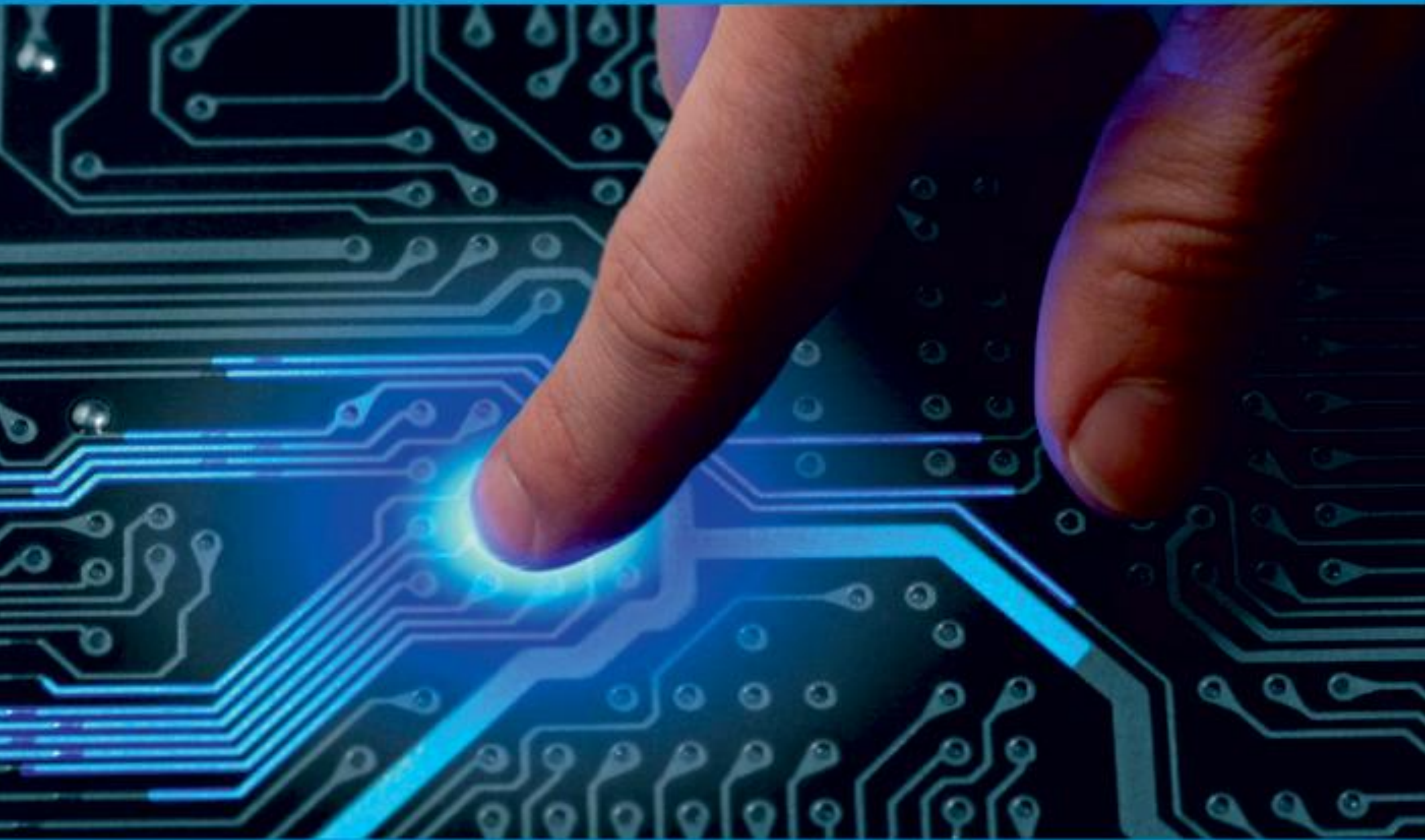

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# MediaCrypt -- Video and Image Steganography

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**ABSTRACT:** This study investigates the technique of hiding information within other data in order to ensure that any modifications to the cover information are undetectable. We specifically focus on improving image security through the use of video steganography. We use the Least Significant Bit (LSB) method to conceal secret information within randomly selected distinct video frames. We use a pseudo-random number generator to produce frames for concealing. The secret image is broken into eight-bit planes and inserted in eight cover frames, each of which is shrunk to match the cover frame dimensions using bit-slicing. Hidden imagine embedding takes exactly eight cover frames, according to the proposed technique. In addition, we provide a practical application of this strategy. This study contributes to the science of steganography by presenting an efficient and secure method for protecting image data in the context of video concealing.

**KEYWORDS**: Steganography, Cryptography, AES algorithm, LSB-Technique

## I. INTRODUCTION

Maintaining the privacy of messages has become a top priority in the modern era of digital communication. Steganography stands out among the many techniques as a special and advanced technology that enables messages to be uniquely identifiable by the sender and recipient. Originating from the combination of "Stego," which means "covered or concealed," and "graphy," which means "writing and drawing," steganography has developed into a sophisticated method of communication security.

In contrast to its cryptographic equivalent, steganography entails hiding signals within ostensibly benign carriers, so impeding the ability of communication interception to persist. In contrast to encryption, which uses covert writing to safeguard data, steganography aims to prevent the message from ever being. This technique requires messages to be hidden inside of different files, including pictures, audio files, or videos, and the data that is hidden could include important text, pictures, audio, or even whole videos.

Steganography is a subset of data hiding that comes in different forms, each designed for a particular media. While text steganography embeds messages within text, image steganography hides information within images, audio steganography entails hiding data within audio files, and video steganography—the focus of this study—hides data within videos. Videos have some intrinsic qualities that make them extremely interesting. They are large in size and have both dynamic visual components and audio.

One clear benefit of video steganography is its ability to disguise a variety of data kinds, such as text, images, audio, and even other movies. The integration of picture and audio steganography methods with video steganography increases the security of large-scale data embedding. Videos store both dynamic visuals and sounds, so there is a significant chance that data is buried within them. This creates an intimidating degree of security.

When it comes to video steganography, a stego-video is created as a result of the embedding process changing the original video file, also known as the cover video. The goal of this project is to investigate the complexities of concealing secret data in the cover video by the manipulation of specific video frames. This will open the door to a more sophisticated comprehension of video steganography and its possible uses.

This study paper delves into the diverse realm of video steganography, shedding light on its concepts, methodology, and implications for secure communication. By investigating the distinct properties of video steganography and its integration with image and audio steganography techniques, we seek to reveal the intricacies and advancements in this subject, contributing to the increasing body of knowledge regarding secure communication methods in the digital era.

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## II. LITERATURE SURVEY

[1] This study suggests strengthening LSB steganography by incorporating a random data distribution method known as Pixel Locator Sequence (PLS). PLS distributes data into the image by randomly changing the LSB of chosen pixels, hence improving detection resistance. The PLS file is encrypted using AES and used as a key for data encryption and decryption. Despite being less space-efficient, this solution stresses security. MSE and PSNR for picture dynamics were measured, and the robustness against steganalysis attacks was tested using tools such as StegExpose, which included Primary Sets, Chi-Square, Sample Pairs, and RS Analysis.

[2] Web development has evolved solutions for online information security, one of which is data obfuscation within HTML web pages. Their suggested approach uses encryption and steganography to improve data security by hiding it in HTML source code. RSA encryption encrypts the secret message, which is subsequently compressed, mapped into Space codes, and placed in HTML sites via subtle code alterations. This strategy offers resilience and security because changes to the code are not visible to potential intruders.

[3] This study used cryptography and steganography to improve data security during transmission. The algorithm uses 3-DES encryption for cryptography and an upgraded LSB technique for steganography, which embeds secret messages within images. PSNR, MSE, and SSIM are used to gauge image quality after embedding. The results show strong PSNR values of up to 75 dB and a low MSE of 0.0018, proving the efficiency of the proposed algorithm across different image formats. When examined alongside standard LSB steganographic algorithms, the algorithm outperforms them in terms of PSNR and MSE while preserving outstanding SSIM, showing its long-term reliability and security.

[4] This research presents an information hiding strategy for coded images that aims to improve security of data in communications and computer networks. The hidden image is first transformed into a bit plane before being molded into a vector. Absolute Moment Block Truncation Coding (AMBTC) is used to code color cover images, reducing their size by encoding each block with two methods, Mb and Ma, as well as a bitmap identifying their binary location. Secret information is embedded by changing the bit-map, with additional complexity introduced by permuting the bit plane vector with a chaotic logistic map. The evaluation supports the method's efficiency, as demonstrated by strong PSNR and low RMSE results, as well as visual assessment before and after embedding, indicating its usefulness in safeguarding data within images.

[5] Nowadays, smartphones are one of the most widely used communication systems. Information provided via this medium is extremely sensitive to the users. As a result, it is critical to protect the message against unauthorized access. This study presented an Android-based secured system called Steg! Developed using the combination of cryptography and steganography. The cryptography algorithm utilized here is Advanced Encryption Standard (AES), while the steganography method is Least Significant Bit. This hybrid solution raises the level of information concealment from unwanted access by encrypting the message and hiding it within the image. The application allows the user to hide/unhide text from an image. The proposed system above has shown to be more powerful and robust than other systems that use cryptography.

[6] Currently, techniques for compressed image steganography embed concealed messages by minimizing distortion or statistical detectability. However, due to solely heuristic distortion definitions and numerically solvable equations in statistical models, no closed-form solutions for JPEG steganography exist. The lack of closed-form expression to model JPEG steganography is the primary barrier to understanding single image and pool steganalysis behaviour. Building on our previously published framework for spatial steganography, this paper presented a statistical framework for JPEG steganography in which the cover and concealed message are represented by a multivariate Gaussian distribution. Based on this statistical model, we offer a novel quantized Gaussian JPEG steganography that can achieve embedding utilizing any costs defined in the discrete cosine transform domain. In their studies, they used a popular database with varied compression qualities to evaluate the efficiency of the suggested methodology. The results showed that their model improves security over prior methods and outperforms state-of-the-art JPEG steganography algorithms. Furthermore, they broaden the closed-form equation of single-image steganalysis error to include pool steganalysis for an omniscient optimum detector. This equation approximates the empirical outcomes of pool steganalysis using single picture steganalysis detection errors. The practical advantage is that this approximation is accurate across a variety of variables such as payload, embedding domain, technique, and steganalysis feature, as long as the pooling strategy is optimal. Furthermore, they used the model to predict the variance behavior of pool steganalysis error, demonstrating mathematically that variance grows with higher pool sizes in small payloads, a tendency that is supported by

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experimental data. We conclude that, while pooling increases detector performance, it also causes instability in low payload and large pool size cases.

[7] The growing popularity of digital media has sparked legitimate concerns about its security risks. Security assaults involving listening in, concealing, and manipulating in a variety of structures are common these days. The branch of digital steganography focuses on masking data in complex record formats. Although the use of steganographic methods like secret picture and sound documents has been extensively investigated, research into the use of other holder less remains limited. The goal of this project is to examine several approaches for safely encoding messages in a mixed media container, employing both the sound and video streams, and to use stegoanalysis to determine their effectiveness. This research proposed a modified CNN-based Steg-analyser to analyse images obtained by steganography using a unique inserting key. The suggested method uses fewer convolutions, has much larger channels in the final convolutional layer, and is increasingly broad, allowing it to handle larger images and lower payloads.

[8] With the recent advancement of video encoding techniques, video transmission on traditional devices and video distribution via networks has increased in a variety of devices, including drones, IP cameras, and small IoT devices. As a result, there is an increased demand for encryption systems like MPEG-DASH for transferring streams over networks. These streaming video encryption methods provide stream secrecy. However, they do not conceal the simple fact that the encrypted stream is being transmitted across the network. Given that sniffing attacks can assess the entropy of the stream and scan massive amounts of network data, a deception method is necessary to overcome this problem, which appears unencrypted but is actually a confidential stream. In the research, they suggested the new deception approach that employs conventional NAL unit rules of video codec, where the unpromised device shows the cover video and the promised device reveals the hidden video for misleading security. This solution minimizes encryption costs and protects the stream against entropy-based sniffing attempts. The suggested stream demonstrates an efficient decoding utilizing five standard decoders resulted in 61% quicker processing performance than the typical encryption approach in the test signal conformance set. Furthermore, HEDGE, a network encrypted stream scan tool, identified our stream as similar to compressed video.

## III.EXISTING SYSTEM

Video steganography has expanded to include a wide range of approaches for flawlessly concealing information within video recordings. Several regularly used methods have distinct properties and uses, which add to the field's resilience and diversity.

1. Parity coding: an essential technique in video steganography. It divides the signal into regions and encodes each bit of the hidden message within the parity bit of the associated sample region. This approach embeds concealed data within video frames in an unnoticeable manner by selectively adjusting parity bits across multiple areas. The success of parity coding stems from its capacity to spatially spread concealed information, which improves the security of the steganography process.

2. Phase coding: a slight alteration of phase elements of video frames that encodes secret data. This technique takes advantage of the intrinsic features of the video frame's phase, ensuring that changes are undetected by the human sight. The intentional manipulation of time information between frames allows for the smooth integration of concealed data, which adds security to the video steganography process. Phase coding's usefulness is most noticeable in situations when visual fidelity is critical.

3. Echo data hiding: it enhances video steganography by embedding secret information in audio data. This approach creates an echo in the original audio signal by varying three important parameters: beginning loudness, decay rate, and offset. By deliberately altering these settings, data is concealed within the echo, creating a clandestine channel for safe communication. The adaptability of echo data concealment enables the use of steganographic techniques across different modalities, supporting the possibility of concealed communication within a video file's audio component.

4. Frequency domain approach: converts video frames to the frequency range using methods such as Discrete Cosine Transform (DCT) or Discrete Wavelet Transform (DWT). Secret data is subsequently integrated by altering coefficients in specified frequency regions, resulting in minimum perceived distortion. These approaches are resistant to reduction and other typical video processing procedures, making them ideal for a variety of video steganography applications.

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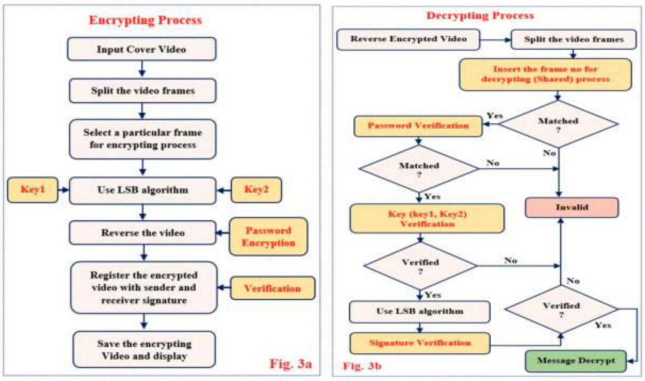
Disadvantages:

- Not efficient to restore the compression frames.
- Pixel information is lost during the transformations.
- Decrease in the capacity of hiding data in a small cover file.
- High time complexity of the algorithm. PSNR ratio performance is neither good nor effective for standard datasets.

## IV. PROPOSED METHODOLOGY

This proposed technique attempts to hide our secret information in dual tiers of picture and text format on the video. The benefits of this strategy include reduced processing time for encryption/decryption of secret data, which results in a significant increase in performance. When we hide secret data in video, the video's quality remains unchanged, and nobody however can deduce the existence of secret data within the video. In this procedure, the stego video must be decrypted twice to obtain the hidden data. These methods include spatial domain, which operates on bits rather than statistically on the cover file.

In video steganography, the goal is to hide data within video files. We present a technique that combines random frame selection, the Least Significant Bit (LSB) method, and image resizing. The architecture of this method is shown below.




Architecture

Considering the versatile nature of video steganography, which allows for concealment using either audio or picture steganography approaches, we chose the image steganography strategy for our application. The algorithm accepts as input the paths to the video file and the hidden picture, as well as the key for the chosen hiding technique approach.

The first step is to transform the video file into frames. Small video files (.AVI,.MPEG, or.MP4) typically create 20-25 frames per second. Each frame in the video fundamentally depicts an image, consisting a collection of pixel values signifying color and intensity, grouped either in matrix form or list structure.

A normal 24-bit bitmap RGB image has 24 bits per pixel, with 8 bits assigned to each of the three colour channels: red, green, and blue. The RGB format is favoured due of its high information richness, which allows for the concealment of secret messages with minimal perceived modifications. Each byte in the image's pixel values has the capacity to store concealed information, and a single bit alteration can conceal data.

The LSB technique embeds the secret information by changing the least significant bit of each byte in the pixel values. This approach has a little visual impact on the image while effectively masking the data. Furthermore, to improve security, the technique may include image scaling, which changes the proportions of an image without dramatically altering its visual look, allowing for more area for data embedding.

Overall, the proposed algorithm provides a strong approach to video steganography, taking advantage of the intrinsic properties of video frames and image manipulation techniques to safely conceal information within video files.
Class Diagram
In software engineering, the Unified Modelling Language (UML) is a basic tool for expressing a system's static structure using class diagrams. These diagrams depict a system's components, including its classes, characteristics, processes, and interrelationships. Class diagrams are the foundation of object-oriented modelling, enabling both high-

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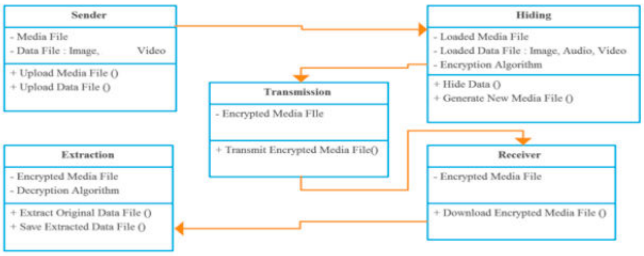
level conceptualization and precise translation of models into executable code. Furthermore, they find use in data modelling projects.

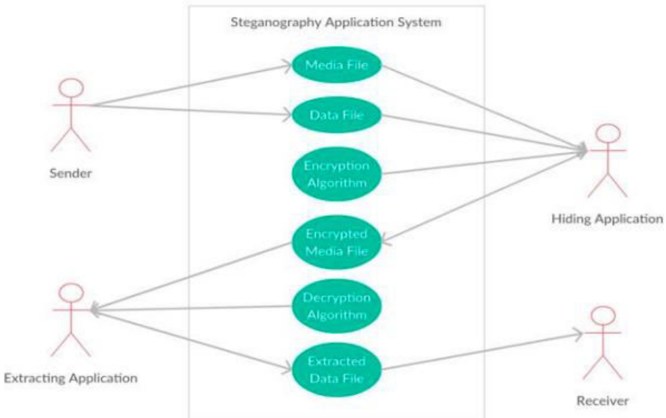
In a class diagram, classes are represented as rectangular boxes with three different sections. The upper section contains the class name, which is styled in bold and centrally positioned, with the first letter capitalized. The centre compartment lists the attributes associated with the class in a left-aligned format, with the first letter in lowercase. Such diagrams are essential for encapsulating the core features and interactions inside an application, as well as defining the classes that must be implemented during the software development process.




Class Diagram

Use-Case Diagram

A use case diagram displays the interplay between actors and system functionalities. It shows the connection between actors and use cases. Actors portray system users or other entities. The picture displays the actions that each module takes to execute a task. Use cases are crucial in system analysis for identifying, clarifying, and organizing system requirements across a wide range of areas, including e-commerce websites. Use Case Diagrams are part of the Unified Modelling Language (UML), which is an internationally recognized language for portraying real-world objects and systems. They surpass other diagrams, such as flowcharts, by providing a more concise and unambiguous exposition of system capabilities and user interactions.




Use-Case Diagram

Bit-Slicing

Bit-slicing for image in video steganography is the act of separating an image into numerous bit-planes in order to prepare it for inserting secret data. This technology provides exact control over which bits are modified throughout the embedding process, resulting in an insignificant perceived effect on the image while efficiently concealing data.

Conversion to Binary Values: To convert to binary values, the image's pixel values are first translated into 8-bit representations. Each pixel in the image is normally made up of three colour channels: red, green, and blue (RGB), each of which contains 8 bits, for a total of 24 bits per pixel.

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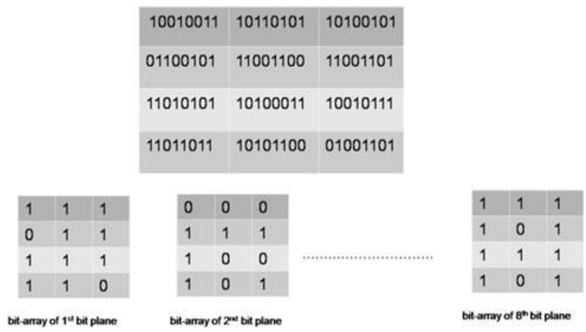
Division into Bit-Planes: After converting pixel data to binary, the image is divided into 8 bit-planes. Each bit-plane represents a specific bit position in the binary encoding of pixel values. For example, the first bit plane contains each pixel's least significant bit (LSB), whereas the eighth bit plane contains each pixel's most significant bit (MSB).

Bit Extraction: The bit-slicing technique extracts the ith bit from each byte of pixel data to create the ith bit-plane image. This entails extracting a specific bit location from each pixel's binary data representation spanning across all color channels.

Naming conventions: The MSB plane, made up of the first bit of each byte, includes the most significant information. The eighth bit-plane, made up of the last bit of each byte, is known as the LSB plane and contains the least significant information.




**LSB-TECHNIQUE**

Understanding Pixel Representation: Each frame in digital video is made up of a grid of pixels, each of which contains data concerning colors represented by binary values. Usually, each of the three color channels (Red, Green, and Blue) has 8 bits of information, for a total of 24 bits per pixel in a 24-bit bitmap RGB image.

Least Significant Bit Modification: The LSB of a binary number is the rightmost bit, which represents the smallest value in the binary number system. The LSB steganography technique alters the least significant bit of each byte in the colour components of the pixel values to contain hidden data. This requires replacing the LSB with a bit from the secret message data.

Embedding Process: For encoding data using the LSB approach, each bit of the secret message is systematically replaced with the LSB of the color channel bytes in the video frames. For instance, if the secret message's next bit is '1', the LSB of the adjacent pixel byte is set to '1'. If it is '0', the LSB is unaffected.

Imperceptibility: Because the LSB represents a very small change in the brightness of the color, changing it has little visible effect on the pixel's color. As a result, alterations produced with the LSB approach are invisible to the human sight, allowing the modifications to go undiscovered.

Retrieval Process: During the recovery process, the LSBs of pixel values in video frames are inspected in order to rebuild the secret message. The encoded message bits can be retrieved and decrypted by reading each pixel's LSBs in sequence.

Frame Selection

This algorithm's embedding procedure hides data by selecting frames at random from the cover video. In order to accomplish this randomness, a random function is used, which creates random integers from a certain range. In addition, a seed value provided by the user serves as a key for obtaining the data.

In order to verify that the picked frames remain distinctive for a given seed value, Python's random.seed(x) method is used, where x is the seed value. This function provides a unique sequence of random numbers based on the seed value, preventing frames from repeating within the supplied seed value.

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$x_n = a^n \bmod m$ which is equivalently $x_n = ax_{n-1} \bmod m$[6]

Here, if m = 2 is uses then, as the above modulus function is cyclic after certain periods, here the maximum possible period is 2k-2.
So function to generate 8 sufficient frames without any repetition is:

$$x_n = 5x_{n-1} \bmod 2^5$$

Let x0 be the initial odd integer then use modulus function to generate successive residues.
We make sure that the created residues are unique within the range of readily accessible frame indices in the cover video, so that those selected frames are sufficient for embedding without duplication. This method preserves randomness and security in the steganographic process while allowing for effective data embedding.

## V.ALGORITHMS

1. For embedding.
   • Read the text and image file.
   • Resize the image to fit the cover video.
   • Divide images using bit-slicing method.
   • Input cover video.
   • Split video into frames.
   • Select 8 frames to embed bit-sliced image.
   • Locate the LSB bit of the cover frames.
   • Embed the bit planes into the picture frames and return them to their original place.
   • Regenerate video frames.

2. For extraction.
   • Input stego video
   • Extract frames
   • Find frames by key
   • Find LSB of frames
   • Extract bits from stego frames.
   • Merge the bits to create the final image.
   • Extract Dual Encrypted Text from Image.

Pseudo Code

1. For Embedding

- Input Video.
- Extract the frames of the given video.
- Using statistical features extract the key frames(K).
- Insert secret data in K-1 frame.
- Secret data will be stored at the LSB location in each K-1 frame.
- Store key frame index number in the LSB of the last frame of the video.
- Combine all the K-1 frames and key frames to generate the video sequence this is
- the Stego video i.e. encrypted video. *secret data is the data from text file in binary format.

2. For Extraction

- Input the Stego video.
- Extract frames from the Stego video.
- Obtain the key frame index by reading the last frame's LSB.
- Retrieve K-1 frames by utilizing the key frame index.
- Examine secret data from the LSB of each K-1 frame.
- Combine data from every K-1 frame to reveal the secret message.

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## VI.CONCLUSION

Finally, the growing dangers to data confidentiality and integrity posed by eavesdropping and illegal web browsing have highlighted the crucial need of information security countermeasures. As internet usage continues to rise, security precautions have received increased attention. Among the various alternatives, steganography appears as an effective technique for protecting sensitive information.

This paper provided a complete overview of numerous video steganography techniques, outlining approaches and merits. The investigation emphasized the critical relevance of the following measures in assuring the efficacy and resilience of video steganography systems:

A. Imperceptibility: The importance of concealing alterations in the cover media, especially since that advanced steganalysis tools are capable of finding small modifications. High imperceptibility highlights the need for steganography techniques that are resistant to steganalysis.

B. Payload: The ability to bury secret messages within cover material, with video becoming increasingly popular due to its high embedding capabilities and quality.

C. Statistical Attacks: The system's reliability is determined by how well stegano-graphic algorithms resist attempts to extract concealed data from stego objects.

D. Security: The embedding mechanism's security is of the utmost significance, demanding techniques with low attack vulnerability and message protection.

E. computer Cost: The effectiveness of steganography methods is measured by the computer resources required for data hiding and retrieval, which affects the system's usability and performance.

F. Perceptual Quality: Balancing embedding capacity with video quality preservation is critical for minimizing potential deterioration and preserving the original content's integrity.

In response to these measures, advances in video steganography techniques attempt to improve security, concealment, and efficiency, strengthening the defence against threats to data confidentiality and integrity in the digital era.

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