Published Online First: December, 2023
https://dx.doi.org/10.21123/bsj.2023.9168
P-ISSN: 2078-8665 - E-ISSN: 2411-7986

Baghdad Science Journal

A Proposed Text Encryption inside Video Using Harris Corner Detection and Salas20 Encryption Algorithm

Fadhil Abbas Fadhil [1], ***Farah Tawfiq Abdul Hussien**** [1], ***Teba Walaa Aldeen Khairi*** [1], ***Nikolai Safiullin*** [2]

[1]Computer Science Department, University of Technology, Baghdad, Iraq.
[2] Engineering School of Information Technologies, Ural Federal University, Yekaterinburg, Russia.
*Corresponding Author.

Received 31/05/2023, Revised 27/10/2023, Accepted 29/10/2023, Published Online First 25/12/2023

Abstract

Text encryption in video is a vital tool in many industries where protecting sensitive information is of highest concern. Algorithms and automated detection methods commonly struggle to locate hidden text in video frames. This resistance increases the security of the concealed information because it is challenging for uninvited parties to detect the presence of encrypted text. This research suggests a novel method for text encryption inside video utilizing the Salsa20 encryption algorithm and Harris Corner Detection. The goal of this study is to increase the secrecy and security of textual information that is embedded in video content. First step is locateing important corners or spots inside the video frames, the Harris Corner Detection method is first used. These corners act as strong feature points that can be used to incorporate text. Without degrading the video's overall visual quality, the Harris Corner Detection method aids in precisely localizing the places where text may be concealed. Second, the encryption key is generated using the Salsa20 encryption technique. Salsa20 is a popular stream cipher that offers reliable encryption and effective operation. The embedded text is converted into a cipher text by XOR it with the encryption key before embedding it in the video, guaranteeing its confidentiality and protecting it from unauthorized access. Comparing the suggested method to current text encryption methods reveals a number of advantages. The Harris Corner Detection technique integrates text into video frames so that it blends in less noticeably, making it more difficult for adversaries to identify the existence of hidden information. Salsa20's use further guarantees the encrypted text's high level of security and protection, defending it against potential attacks. The proposed system is evaluated using MSE, PSNR, correlation, NPCR, UACI and entropy, these evaluation metrics provide excellent results.

Keywords: Harris corner detector, MSE, NPCR, PSNR, Salsa20, Text encryption, UACI, Video encryption.

Introduction

Text encryption within video is a flexible technology that improves data security, privacy, and confidentiality, making it a useful tool in many fields where safeguarding sensitive information is of utmost importance. Automated detection techniques and algorithms frequently have trouble finding hidden text in video frames. Due to the difficulty for unauthorized parties to identify the presence of encrypted text, this resistance improves the security of the concealed information. Additionally, it seamlessly conveys both forms of data at once by integrating textual and visual content. This can be helpful in circumstances

related to education, marketing, and communication.
There are many different approaches available in the present landscape of data protection and secure communication techniques, including encryption, steganography, watermarking, and others. The necessity for clandestine communication and data protection within the dynamic world of video material is frequently not adequately addressed by these methods, despite the fact that they have their advantages.

Many encryption techniques have been applied to secure the sensitive information from intruders. Multimedia must be encrypted as an important step before transmitted, multimedia involves images, audio and video[1]. Video encryption plays an essential role in securing video sent/transmitted via mobile phones, pay TV, e-commerce, sending private emails and transmitting financial information [2,3].

According to earlier studies, video encryption techniques have been increasingly put under studying to enable secure picture transfer in order to safeguard photos from illegal access via communication channels [4-6]. Text encryption inside video is a crucial task in the field of information security, as it provides a secure way of transmitting confidential messages [7].

Some of the gaps of the earlier studies involve:

1. Videos Don't Have Covert Communication: Most known methods for text encryption within videos concentrate first on independent encryption, then on video embedding. These techniques might not offer the level of hidden communication necessary for delicate situations, although being effective in specific situations. They frequently include obvious changes to video frames, which could tip off enemies to the existence of secret information.

2. Insufficient Resistance to Automated Detection: It is getting harder to keep hidden data in videos secret in the age of powerful automated detection technologies. Current methods might not be able to sufficiently withstand discovery by sophisticated algorithms and analysis tools, leaving buried information exposed.

3. Limited Data Integration: Some techniques ignore the possibility for seamless data integration in favor of merely hiding text within video frames. A crucial flaw in existing methods is the inability to integrate text into video footage while maintaining the integrity of both the visual and textual components.

4. Constraints on Capacity: Although certain steganographic techniques provide a high capacity for data storage within movies, they might not have the dexterity necessary for clandestine communication. Current methods frequently give capacity precedence over data privacy.

5. Implementing certain encryption and steganography techniques into video processing pipelines can be complicated and resource-intensive, rendering them unsuitable for real-time applications or situations with limited resources.

The suggested method, which makes use of Salsa20 encryption and Harris Corner detection, intends to fill these shortcomings by providing a special combination of covert communication, automatic detection resistance, data integration, and ease of use. This development aims to meet the rising demands of data protection and secure communication in today's multimedia-centric society by improving the secure transmission of text within movies while keeping a low profile in the visual medium.
One of the main challenges in this process is to embed the encrypted text in such a way that it is not easily visible to the naked eye and remains intact during the transmission [8]. To address this challenge, the Harris Corner Detection algorithm is commonly used to identify specific points in an image or video that are robust to changes in illumination and viewpoint [9] . Once these corner points are detected, they can be used as anchors for embedding the encrypted text. The video is essentially a combination of several edges, and each of the individual casings that make up a video has a set frame rate[10]. The 25 edges are caught in one second because the average casing rate is 25. The video must be separated in order for this particular

computation to be carried out effectively and successfully[10].

In this particular instance, suppose that the movie lasts for five minutes, it can be estimated that there are 7500 edges in the film. These edges are an important structural hindrance for the video as well as for the video encryption process. This work focuses on protecting text within videos. In this instance, the attacker is unclear that the video contains text[11]. As a result, the attacker won't make an effort to obtain its original text.

However, it is wasteful to use standard encryption techniques on digital images or video content. This is because encrypting sizable files takes a long time. So, one of the objectives of this paper is to speed up the encryption of digital data. Only a piece of the content is encrypted in partial encryption. Partial encryption shortens the time taken for encryption and decryption [12].

Harris corner detector is used to detect texts inside videos. A common method for identifying interest points on an image is the Harris corner detector. Despite the proliferation of feature detectors over the past ten years, this method is still widely used for camera calibration, picture matching, tracking, and video stabilization [13].

Overall, the combination of the Harris Corner Detection algorithm and the Salsa20 encryption algorithm provides a reliable and secure method for text encryption inside video. This approach can be applied in various contexts, including video conferencing, surveillance, cloud security, application of IoT and online communication. The primary contributions of this work are:

1. Reduce encryption time by using simple encryption technique.

2. The use of Harris Corner Detection helps in making the presence of encrypted data less conspicuous and resistant to automated detection

3. Encrypt only the text by detecting it with the Harris corner detector.

4. Utilize Salsa20 algorithm to generate strong encryption key.

    a. Key Security: Salsa20 is a symmetric encryption technique that is well-known and acknowledged for having excellent security features. It is applied here to produce encryption keys that will protect the secret text.

    b. Strong Key Generation Salsa20 uses a strong key generation mechanism to make sure that encryption keys are suitably random and secure. This is essential for maintaining the secrecy of the hidden text.

    c. Key Management: Maintaining the security of encrypted data requires effective key management. A dependable method of creating and managing encryption keys is offered by Salsa20.

5. Strong security and high speed thus can be achieved as shown by experimental results.

The remainder of the paper is structured as follows: In Section 2, the most current pertinent research is covered. The Harris corner detector is covered in Section 3. Section 4 presents Salsa20's Light Stream Algorithm. Section 5 provides a description of the suggested algorithm. Sections 6 and 7 are where the findings and recommendations are presented.

Related Work

Due to high need for encryption, several researchers have developed a wide variety of encryption techniques. There are lot of studies are made about video encryption. Reviewing the available works on video encryption reveals that not many of them are devoted to this topic. The most significant video encryption methods that contain texts are presented in the works below.

Ibrahem M K et al [14]presented a video encryption method that employs a stream cipher and a chaotic key generation scheme. The method has been successfully developed and carried out, and tests and analyses have demonstrated its effectiveness in terms of speed and security. The recommended method has good security features and may be applied across a network for safe video exchange. The video encryption method in this research uses a chaotic system for key generation, using chaotic maps as one-time key generators. Chaos-producing systems, such as cat maps and logistic maps, are used to generate chaotic sequences that serve as encryption keys. The chosen video data is then encrypted with these chaotic sequences and stream ciphers. The pseudo-random and starting condition-sensitive sequences generated by the chaotic maps increase the security of the encryption technique.

A video watermarking technique that embeds the watermark in regions with considerable color fluctuation, such as corners, is presented by Nida F Hassan et al.[15]. This method aims to improve the security and robustness of the watermarking procedure. Using techniques for edge or corner detection, the watermark message is incorporated into the algorithm. In order to remove the watermark from the watermarked video frames, an extraction module is also included. The suggested video watermarking approach improves the security and resilience of the watermarking process by using the Advanced Encryption approach (AES) to encrypt the secret message before embedding it into the video frames. Attackers will have a harder difficulty deciphering or altering the secret message if the watermarking process is made more secure using encryption. The software also selects the ideal locations for the watermark, like corners and edges. These areas are regarded as the ideal for embedding since they have a diversity of colors, which ensures that the process won't conflict with the demands for transparent and uniform color distribution.

Firas A. Abdullatif et al[16], described a method for concealing encrypted data in photographs utilizing an encoding table and symmetric encryption method (AES algorithm). The Harris corner point approach is used to generate dynamic AES keys, and the encoding table is dynamically constructed from the cover image points. Then, with the exception of the corner points, the encrypted data is concealed in the least important piece of the cover image. The suggested approach exhibits strong embedding quality, flawless text recovery, and excellent PSNR value.

Sharif Shah et al[17] described a technique for efficient 3D stereo vision stabilization for various camera views. The method makes use of spanning tree algorithm, Laplace pyramid scaling, and Harris corner detection to find precise matching key locations in images and stable camera angles. The suggested method is rapid, accurate, and reliable and can scan more than 200 camera viewpoints in two seconds. It can be used to make photographs appear 3D and stabilize films. The method minimizes overall error for matching key-points and can be used right away for subsequent picture sets. It works well with cameras placed at random and can be improved even more by reducing image resolution to speed up processing. The 3D view reconstruction method is designed to be applied with swift processing and exact stabilization.

Revanna C R et al.[18]proposed a technique for using variance-based quad tree decomposition to partially encrypt document images. The technique uses chaotic maps to encrypt only the significant blocks in the image after identifying their significance based on variance. The essay compares the efficacy of partial and full picture encryption and demonstrates that the suggested strategy gives superior security against a variety of threats. The recommended encryption technique provides a variety of plain images for small changes in the key, has a large key space, and is resistant to statistical attacks. When tested on several document picture kinds, the approach yields positive results.

Cheng S et al. [19] recommend a selective video encryption solution that integrates the H.264/AVC encoding technology with encryption algorithms in order to secure video data. It uses a dynamic key generated by a PRNG along with AES in its cipher feedback mode. The technique also incorporates a 4-D hyperchaotic algorithm to boost security. The proposed selective video encryption solution merges video coding technology with encryption algorithms by using a 4-D hyperchaotic system to encrypt significant semantic features (such as IPM, MVD, residual coefficient, and delta_QP) in each slice of the video. Selective video encryption based on video encoding and the 4-D hyperchaotic system for small amounts of encrypted data with sufficient security, or selective video encryption based on video characteristic encoding for large amounts of encrypted data with sufficient real-time performance, are the two options available to users of this method. The combination of both video coding technology and encryption algorithms ensures the security and efficacy of the selective video encryption system.

Convolutional neural networks (CNN) are suggested by Abdulmunem IA et al [20]as a successful method for message obfuscation in video files. The model is made up of three parts: the prepare network, conceal network, and disclose network. After being trained on a huge dataset, the model achieves a fair level of security and embedding capacity. Performance metrics for the model include mean squared error and KL divergence. The proposed video steganography technology employs convolutional neural networks (CNN) to encrypt and decrypt video data while concealing messages. The CNN is trained to hide movies or images within other videos by deciding which portions of the cover image should be redundant and which areas can have additional pixels covered. The CNNs are designed to work in pairs and are simultaneously taught to develop the concealment and disclosure operations. It is difficult for someone without access to the weights to ascertain how the network hides the data because the weights and architecture of the CNN are random. As a result, the steganographic procedure is safer. In order to further increase security, block-shuffling is also used as an encryption technique. Additionally, picture enhancing techniques are used to improve the output's quality. Because the proposed model was trained using random RGB images from the ImageNet dataset, it has a high embedding capacity and a high security level.

Alawi A R et al[21] described a video encryption approach that combines the ChaCha encryption algorithm with the FAST operator in order to quickly and effectively encrypt digital videos. The approach speeds up encryption by encrypting sensitive data and evaluates performance using a range of quality indicators. The suggested video encryption methodology combines the ChaCha encryption algorithm with the FAST operator by using ChaCha as the primary encryption method and FAST as a pre-processing step to find the key spots to be encrypted. The video frames are encrypted by XORing them with a key produced by the ChaCha algorithm. The feature detection operator FAST is used to locate corners in the video frames. These perspectives are seen as potential encryption weak points. The FAST operator creates a number of essential components that change the video. The candidate points are determined by applying a segment test to each pixel in the frame and choosing a base for the computation from a circle of sixteen pixels centered on the corner candidate pixel. By combining the ChaCha encryption algorithm with the rapid operator to create quick encryption results while selectively encrypting important locations in the video frames, the proposed method decreases the encryption time and undesired interference in the transmitted films.

In order to determine which encryption method has the greatest entropy and accuracy for video frames, Khudair ET et al [22] compare the RSA and CAST-128 encryption methods. The results demonstrate that even when dealing with distorted or ambiguous image pixels, CAST-128 surpasses RSA in terms of entropy. In the report, data encryption's importance for video transmission and storage is also stressed. Encryption includes reshaping the data into a unique shape or symbol using a secret key or password. This ensures that even if the video is intercepted or seen by unauthorized people, its content won't be interpreted or changed. According to these results, the CAST-128 encryption technique generates encrypted data that is more complicated and unpredictable, making it a more precise technique for video encryption in terms of entropy.

Harris Corner Detector

Major use of the Harris approach is to use intensity fluctuation in a local neighborhood to identify points. When compared to windows adjusted in any direction, the area around the feature should have a significant intensity change immediately. The autocorrelation function may be used to describe this concept as follows: make the image a scalar function I: $\Omega \rightarrow R$ and h surrounds any point in the domain by a modest increment, $x \in \Omega$. Corners are the locations x that maximize the subsequent functional for small shifts h,

$$AC(h) = \sum w(x)(I(x+h) - I(x))^2, \quad \ldots\ldots\ldots \quad 1$$

i.e., the widest variety possible. The support area, which is commonly defined as a rectangle or Gaussian function, may be chosen by the function w(x). The equation can be linearized using Taylor expansions $I(x+h) \rightarrow I(x+h) \simeq I(x) + \nabla I(x)^{T} h$, so that Eq 1's right part becomes:

$$AC(h) \simeq \sum w(x)(\nabla I(x)h)^2 dx = \sum w(x)\,(h^T \nabla I(x) \nabla I(x)^T h), \ldots\ldots\ldots\ldots\ldots\ldots\ 2$$

The image gradation is determined by the autocorrelation matrix or structure tensor, which is supplied by Eq 3:

$$M = \sum w(x)(\nabla I(x) \nabla I(x)^T) = \begin{pmatrix} \sum w(x) I_x^2 & \sum w(x) I_x I_y \\ \sum w(x) I_x I_y & \sum w(x) I_y^2 \end{pmatrix}, \ldots\ldots\ldots\ldots 3$$

The examination of this matrix yields the maximum of Eq 2. The direction of the biggest intensity fluctuation is corresponding to M's largest eigenvalue, whereas the orthogonal intensity variation is corresponding to M's second largest eigenvalue. Algorithm 1 could be used to apply the Harris Technique. To minimize aliasing and picture noise, the image is initially convoluted with a low standard deviation Gaussian function.

```
Algorithm 1: Harris Corner Detection
input : index, ms, k, σi , τ , str, cells, σd, N, sub_of_pixel
output: The Corners of Harris
Gaussian (index, σd) → index'
gradient(index')→ (Index_x, Index_y)
(Index_x, Index_y, σi)→ (X', Y', Z') // Autocorrelation computation
 (X', Y', Z', ms, k) → Res // compute corner response, where ms = measure
 (Res, τ , 2σi) → corners // find corners using NOT(maximum suppression)
 (corners, str, cells, N) // select output corners, where str= strategy
if sub_of_pixel then
 (R, corners) // accuracy of sub_of_pixel
```

The image's gradient is used to compute the autocorrelation matrix, and its eigenvalues are utilized to determine if any of the preceding circumstances apply. To eliminate regions with low values in this function, a threshold must be specified. This threshold relates to the amount of noise in the pictures and depends on the corner strength function being utilized. The points in the final two phases can be chosen in a variety of ways, and quadratic interpolation can increase the accuracy of the corners [21].

Light Stream Algorithm

Different information formats may now be legally accessed by an authentic user thanks to encryption techniques[22]. Any system that needs high-speed encryption, like SSL [23] and WEP [24], can benefit from effective stream cipher implementations. The goal of the ECRYPT (eSTREAM) [25] stream cipher project is to find novel stream ciphers that enable fast and safe encryption. A differentiating attack [26] and a Crossword Puzzle Attack[27], one of the distinctive attack's variants, both succeeded in breaking this stream cipher. Two examples of light stream algorithms are Salsa and Cha-Cha. The Salsa20 stream cipher works on 32-bit words, accepts a 256-bit key as inputs k= (k0, k1, ..., k7) or a 128-bit key as input k= (k0, k1, ..., k3), and outputs a series of 512-bit key stream blocks. By XORing the key, nonce, and block number, Salsa20 encrypts a 64-byte block of plaintext. The Algorithm2 defines Salsa20 steps:

```
Algorithm 2: Salsa_20 stream cipher
input: initial array F, rounds ∈ N
output: Out=F+Frounds
T'←F
Rounds_len= rounds/2
While index < Rounds_len
     //3-6: Column round
 ($T'_0$, $T'_1$, $T'_2$, $T'_3$) ←SalsaQRfunction ($f'_0$, $f'_1$, $f'_2$, $f'_3$)
 ($T'_5$, $T'_6$, $T'_7$, $T'_4$) ← SalsaQRfunction ($f'_5$, $f'_6$, $f'_7$, $f'_4$)
 ($T'_{10}$, $T'_{11}$, $T'_8$, $T'_9$) ← SalsaQRfunction ($f'_{10}$, $f'_{11}$, $f'_8$, $f'_9$)
 ($T'_{15}$, $T'_{12}$, $T'_{13}$, $T'_{14}$) ← SalsaQRfunction ($f'_{15}$, $f'_{12}$, $f'_{13}$, $f'_{14}$)
     //7-10: row round
 ($T'_0$, $T'_4$, $T'_8$, $T'_{12}$) ← SalsaQRfunction ($f'_0$, $f'_4$, $f'_8$, $f'_{12}$)
 ($T'_5$, $T'_9$, $T'_{13}$, $T'_1$) ← SalsaQRfunction ($f'_5$, $f'_9$, $f'_{13}$, $f'_1$)
 ($T'_{10}$, $T'_{14}$, $T'_2$, $T'_6$) ← SalsaQRfunction ($f'_{10}$, $f'_{14}$, $f'_2$, $f'_6$)
 ($T'_{15}$, $T'_{13}$, $T'_7$, $T'_{11}$) ← SalsaQRfunction ($f'_{15}$, $f'_{13}$, $f'_7$, $f'_{11}$)
Out= X+T'
return (Out)
```

$$\text{Salsa20}(x) = x + (\text{ rowround } (\text{ columnround } (x)))^R \quad \ldots\ldots\ldots 4$$

While there are R double rounds, there are only r ciphering rounds (r=2R). Then, as seen below, each block with 64-byte is XORed with the corresponding block of 64-byte from the mere image[28,29]:

$$\text{Image} \oplus \text{Keystream} = \text{Encrypted Image} \quad \text{................ 5}$$

Materials and Methods

One of the things that was previously discussed is that the appearance of some important texts in the video clips may be confidential and undesirable to show them to the public. A new algorithm that selects texts in the video to be encoded has been proposed. This suggested algorithm's primary function is to encrypt text pictures that are taken directly from the frames of the input video. Of course, the algorithm's input is a video clip (secret texts are expected in it). The partly encrypted video is handled in the following diagram, Fig 1.

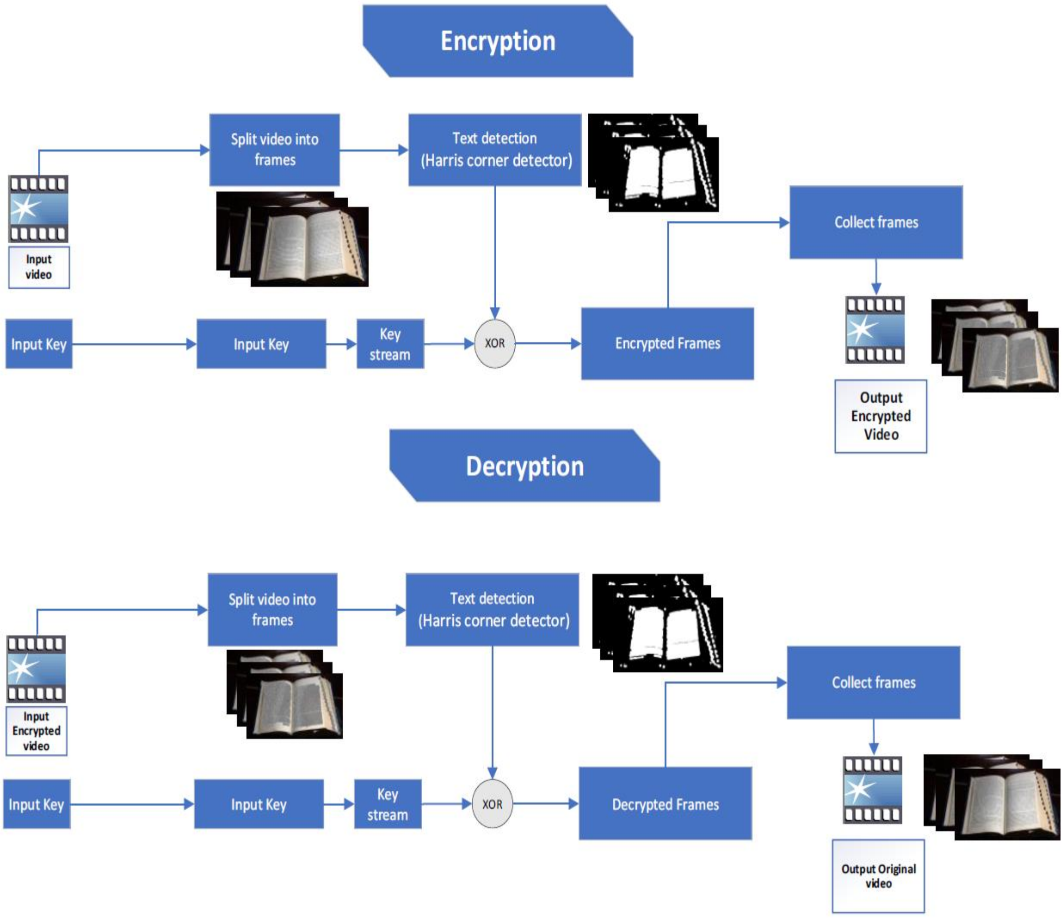


Figure 1. The proposed system diagram.

Algorithm 3 describes the proposed work in the process of detecting and encoding text in video:

```
Algorithm 3: Proposed algorithm
input: Digital video file
output: Encrypted Video
Step_1. Key Generation:
            - Generate key vector using Salsa20 encryption algorithm (key stream algorithm)
Step_2. Split the input video into frames(i)
Step_3. For each frame do the following:
            -   Apply Harris corner detector
            -   Encryption the frame using:
                $Encrypted\_frame(i)=Frame\ (i) \oplus Key(i)$
        End for
Step_4. Encrypted_video=Collect encrypted frames.
Step_5. Return (Encrypted_video).
```

The following explain points the key steps involved in algorithm 3:

1. Harris Corner Detection: This computer vision technique locates distinguishing elements or locations inside an image or video frame. When the image or video is transformed, such as by rotation, scaling, or translation, these corner points are chosen because they are less likely to change their positions. To locate acceptable areas within video frames where text can be hidden in this situation, Harris Corner Detection is used.
2.Salsa20 Encryption Algorithm For Key Generation: The symmetric encryption algorithm Salsa20 is renowned for being quick and secure. On the basis of a secret key and a nonce (a one-time use only unique number), it generates pseudorandom keystreams. Salsa20 is used in this suggested method to both encrypt the content and create the encryption key. A secret key and a nonce must be provided to Salsa20 as inputs during the key generation process. Next, text is encrypted and decrypted using the generated key.
Text Encrypted Inside Video: The text that has to be hidden is encrypted using the encryption key that has been generated. Then, the encrypted text is incorporated into the video frames. In order to insert the encrypted text in the relevant corners or points within the frames, Harris Corner Detection is used. To conceal the encrypted text, embedding entails changing the pixel values or characteristics at the chosen corners.
A recipient needs to have the secret key used for encryption and key creation in order to access the encrypted text.

The recipient can decrypt the embedded text and view the original message by using the same Salsa20 method with the key and nonce.
Using Harris Corner Detection, the procedure normally entails choosing video frames or images that are appropriate for text embedding. The text is then hidden at these spots by using them as corners.
To create safe encryption keys, Salsa20 is utilized. These keys are then used to encrypt the text before it is embedded within the video frames. The secret text from the video frames is extracted and decrypted using the same encryption keys during decryption.
Text Encryption is used for partial text encryption and were incredibly impressed with the results. The proposed technique is robust and secure, and it was tested extensively using various samples of colored images extracted from the input video. It's a great way to keep data safe and secure, while also ensuring that it's accessible when you need it; the encryption steps are described as follows.

Text Detection

To detect the texts in the video, the Harris corner detector is used, whose method of operation has been explained in the third part of this paper. Naturally, there are several mathematical operations calculated in the background of this procedure. However, it could be a little daunting to try to explain everything. Therefore, the first three phases outline the fundamental principles of how it operates:

Step_1. The window with the greatest intensity fluctuation when moved in both the X and Y axes is found by sliding a fixed-size window over the picture.

Step_2. A score R is calculated for each window that is discovered.

Step_3. Then, by adding a threshold to this score, the required corners are chosen. R is often seen as being small when an area is flat. If R is little, the region is regarded as a corner, and if it is large, it is seen as an edge.

Figs 2, 3 and 4 represent the results of using Harris corner detector

Figure 2. Harris corner detector for a book (A) Text Area, (B) Text Detector

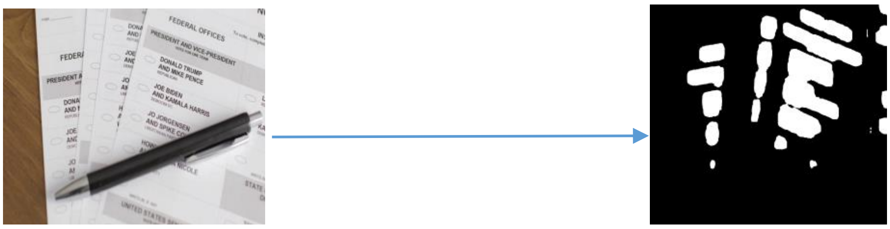
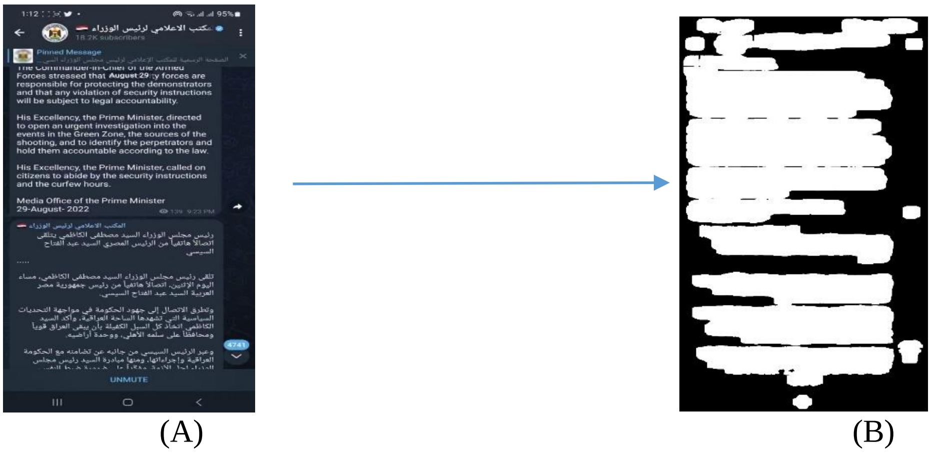


Figure 3. Harris corner detector for exam paper (A) Text Area, (B) Text Detector



1:12 95%

مكتب الاعلامي لرئيس الوزراء

18.2K subscribers

Pinned Message

الصفحة الرسمية للمكتب الإعلامي لرئيس مجلس الوزراء الس...

The Commander-in-Chief of the Armed Forces stressed that August 29 ty forces are responsible for protecting the demonstrators and that any violation of security instructions will be subject to legal accountability.

His Excellency, the Prime Minister, directed to open an urgent investigation into the events in the Green Zone, the sources of the shooting, and to identify the perpetrators and hold them accountable according to the law.

His Excellency, the Prime Minister, called on citizens to abide by the security instructions and the curfew hours.

Media Office of the Prime Minister
29-August- 2022

139 9:23 PM

المكتب الاعلامي لرئيس الوزراء

رئيس مجلس الوزراء السيد مصطفى الكاظمي يتلقى اتصالاً هاتفياً من الرئيس المصري السيد عبد الفتاح السيسي

.....

تلقى رئيس مجلس الوزراء السيد مصطفى الكاظمي، مساء اليوم الإثنين، اتصالاً هاتفياً من رئيس جمهورية مصر العربية السيد عبد الفتاح السيسي.

وتطرق الاتصال إلى جهود الحكومة في مواجهة التحديات السياسية التي تشهدها الساحة العراقية، وأكد السيد الكاظمي اتخاذ كل السبل الكفيلة بأن يبقى العراق قوياً ومحافظاً على سلمه الأهلي، ووحدة أراضيه.

وعبر الرئيس السيسي من جانبه عن تضامنه مع الحكومة العراقية وإجراءاتها، ومنها مبادرة السيد رئيس مجلس

4741

UNMUTE

Figure 4. Harris corner detector for chat window (A) Text Area, (B) Text Detector

Keystream Generation

Since randomness tests are needed to confirm the produced key, it is well known in cryptography that the key, the technique of its production, and the degree of its unpredictability are crucial factors in determining how strong the algorithm is. Salsal20 encryption algorithm was used in the key generation process.

Text Encryption in Images

After detecting the edges that are represented by texts in each frame, these points are determined in order to be encrypted using the XOR function with the keys, as shown in Figs 5,6 and 7.

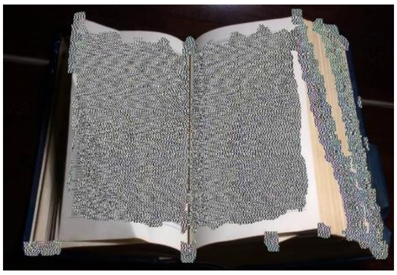


Figure 5. Text Encryption Results of Figure 2

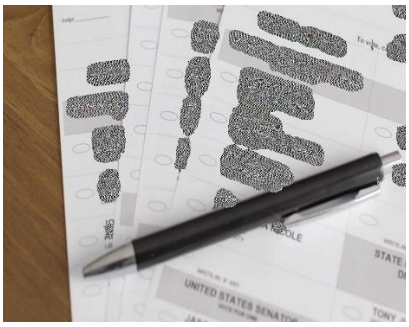


Figure 6. Text Encryption Results of Figure 3

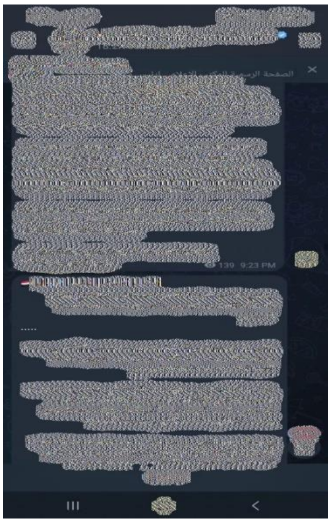


Figure 7. Text Encryption Results of Figure 4

Results and Discussion

Encryption is the finest method of security when it comes to digital video content protection. Thus, there have been two methods for encrypting digital video files: full encryption or partial encryption. The key was crucial to the encryption process since it improved security, strengthened the algorithm, and made it more difficult for attackers. Using the proposed algorithm, three samples of videos were used to be adopted in finding the results of the measurements. Table 1 explains the results of encryption and decryption for the three samples which were utilized in the research findings. Both in terms of encryption process and time, the recommended encryption algorithms have produced positive results. Three videos of varying sizes are used to demonstrate these values in Table 1.

Table 1. The Encryption and Decryption Time of Different size of Video Files

File name	File size	File type	No. Of frames	Frame sequence	Encryption time	Average	Decryption time	Average
The book	2.09 MB (2,195,456 bytes)	MP4 File	132	1	2.9588258	2.1961140	3.3775222	2.7678514
				2	4.2449038		3.0947067	
				3	2.9378225		3.4764475	
				4	3.2716002		4.8924071	
				5	3.4774487		2.8778858	
				.	.		.	
				.	.		.	
				132	2.1923940		2.7389886	
Exam paper	5.81 MB (6,094,848 bytes)	MP4 File	386	1	2.6389703	2.4924267	2.9037544	2.6627626
				2	2.6053428		3.5778110	
				3	2.4282143		2.1929590	
				4	2.8431668		2.1455924	
				5	2.1439390		2.1566720	
				.	.		.	
				.	.		.	
				386	3.0899116		2.1986498	
Chat	704 KB (720,896 bytes)	MP4 File	102	1	2.5597155	2.3897914	2.5924718	2.5482144
				2	2.7031121		2.7051579	
				3	2.7308461		2.9893336	
				4	2.7349669		2.5461242	
				5	2.6140787		2.6170725	
				.	.		.	
				.	.		.	
				102	2.3940029		2.3897900	

In order to evaluate the strength of video encryption, human examination is not the only method, so other measurement techniques were relied upon to assess the level of encryption more objectively and accurately. There are many measures of quality factors, and the most important of these factors that were used to measure the proposed method (UACI, PSNR, NPCR, MSE, correlation and entropy) [24, 30], this is shown in Table 2.

Table 2. Fidelity Criteria

Video File name	Video File size	Criteria	Encryption with Salsa20	Encryption with Salsa20 and Harris Corner Detector
The book	2.09 MB (2,195,456 bytes)	MSE	26328.318	41.3324
		PSNR	3.926	32.2900
		Correlation	-0.0018	0.7721
		NPCR	99.60	45.1161
		UACI	27.77	12.0516
		Entropy	7.2571 Encrypt 7.7065 Decrypt	7.3523 Encrypt 7.1666 Decrypt
Exam paper	5.81 MB (6,094,848 bytes)	MSE	15744.076	13.6844
		PSNR	6.159	37.4598
		Correlation	-0.0013	0.8299
		NPCR	99.47	16.4066
		UACI	20.19	4.5609
		Entropy	0207.7 Encrypt 020700 Decrypt	6.6203 Encrypt 6.2913 Decrypt
Chat	704 KB (720,896 bytes)	MSE	26983.749	57.0724
		PSNR	3.819	30.5854
		Correlation	-0.0004	0.2522
		NPCR	99.55	61.1204
		UACI	29.21	19.6976
		Entropy	0207.9 Encrypt 020707 Decrypt	6.8072 Encrypt 5.1258 Decrypt

As shown in Table 2, the MSE values are high, and the PSNR obtained values are low in the above table, proving that the suggested algorithm was effective and resistant to attacks. The correlation values in the suggested algorithm were excellent. The NPCR and UACI numbers demonstrated the algorithm's high resistance to differential attacks. As it is known that the ideal value of entropy is 8^8, and whenever the result is close to this value, the results are good, also note that the results of the proposed algorithm are very good due to its closeness to the ideal value, demonstrating that the suggested encryption technique was effective in distributing the encrypted frame's pixels at random.

Comparison Analysis

A comparison analysis according to storage capacity, complexity, speed, randomness and entropy is performed between the related eorks and the proposed method. It is summarized in Table 3.

Table 3. Comparison analysis

Paper	Storage capacity	Complexity	Speed	Randomness
14	Moderate	High	vary depending on the algorithm and hardware used	High
15	Depends on the frames number	Moderate	Moderate	Moderate
16	Moderate	Moderate	High	Low
17	High	Depends on computer vision, sensor fusion	High	Low
18	Moderate	High	vary depending on image size, hardware	Moderate
19	Low	Moderate	Moderate	Not considered
20	depends on the amount of data to be hidden, the chosen steganography technique	Moderate	low	Depends on steganography method, ability to disguise the hidden information
21	Low	Moderate	Moderate	Moderate
22	High	Moderate	High	High
The proposed method	Depends on the text length	High	High	High

Limitations and Future Works

The suggested approach shines at data integration and covert communication, but it has text capacity restrictions. While offering more variety and capacity, separate encryption and video embedding may also be less stealthy and require a more involved approach. The decision should be based on the trade-offs between robustness, robustness, text capacity, covert communication, and implementation complexity. Despite having advantages, text encryption inside a video using Harris Corner Detection and the Salsa20 encryption method has some drawbacks and difficulties:

1. Limited Capacity: The amount of data that can be stored when embedding text into video frames using this method is constrained. A limited number of corners are found in video frames, and each one can only accommodate a modest amount of text. This restricts how much information can be safely concealed within the movie.

2. Lower Video Quality: Text inclusion in video frames has the potential to lower the video quality. When pixels are changed to conceal text, there may be abnormalities or visual distortions that become apparent only upon careful scrutiny.

3. Robustness: The security of hidden data raises questions. The hidden text may be destroyed or corrupted by modifications to the video, such as compression, resizing, or format conversion, rendering it impossible to restore.

4. Detection and Attacks: Although Salsa20 encryption and Harris Corner Detection can make it difficult to find the secret text, they do not totally protect it from advanced analytic methods. There's still a chance that sophisticated algorithms and forensics tools can find any buried data.

5. Key Management: Maintaining the security of the hidden text requires effective key management. Data leakage or loss of access to the secret data may result from the loss or breach of the encryption keys.

Using Harris Corner Detection and the Salsa20 Encryption Algorithm, it is possible to overcome or at least lessen the drawbacks of text encryption inside of a video. This requires a combination of technical, procedural, and strategic methods. Here are several strategies for overcoming these restrictions:

1. Capacity Limitation: Taking into account employing more sophisticated steganography methods, such as frequency domain techniques like

Discrete Cosine Transform (DCT) or Wavelet-based approaches, which may conceal bigger amounts of data.

2. Video Quality: Using better compression methods to lessen the effect that text embedding has on video quality to minimize artifacts created during text embedding, optimize the encoding and decoding operations

3. Discovery: To make discovery more difficult, using additional steganographic techniques such data fragmentation, randomization, and encryption before embedding text. Keep up with the most recent steganalysis developments and change your strategy to thwart new detection techniques.

4. Key Management: Creating a reliable key management system to create, store, and distribute encryption keys in a secure manner. Using sound, proven key management procedures to increase security, think about utilizing asymmetric encryption for key exchange.

5. Metadata: • Removing any identifying information from video files' metadata to prevent it from revealing the existence of hidden data to reduce the chance of metadata exposure, exercise caution while sharing or distributing videos with concealed data.

6. Robustness: Testing your hidden text's resistance to different video transformations and use error-correction algorithms to restore data in the event of corruption.

7. Security Assumptions: • To ensure that the encryption algorithm (such as Salsa20) is secure, it should be regularly updated and audited. Use strict access controls and oversight to safeguard encryption keys.

8. Real-world use cases: • Determining whether video steganography is the best option for your particular use case. Alternative encryption and transmission techniques can be more appropriate depending on your needs.

Conclusion

The proposal to use Harris Corner Detection and Salsa20 Encryption Algorithm for text encryption inside video is a promising idea that can enhance the security of data transmission. Through the use of Harris Corner Detection, important features within the video frames are identified and used to extract the text that needs to be encrypted. The Salsa20 Encryption Algorithm, on the other hand, provides a fast and secure encryption process that can protect the confidentiality of the data. The experimental results showed that the proposed method is effective in encrypting text inside video frames and maintaining the quality of the video. The comparison analysis demonstrated that the proposed method outperformed existing methods in terms of security and speed. The need for secure data transfer is growing as a result of ongoing technological improvements, and the suggested solution can be crucial in addressing this requirement. Overall, the proposed method of text encryption inside video using Harris Corner Detection and Salsa20 Encryption Algorithm can provide a practical and effective solution to the problem of data security in digital communication.

Authors' Declaration

- Conflicts of Interest: None.
- We hereby confirm that all the Figures and Tables in the manuscript are ours. Besides, the Figures and Images, which are not ours, have been given the permission for re-publication attached with the manuscript.
- Ethical Clearance: The project was approved by the local ethical committee in University of Technology.

Authors' Contribution Statement

F.A. and N.S. proposed this idea, F. T. And T.W. suggested the general outline of the proposal. Then F.A. carried out the proposal, extracted the results, and discussed it with N.S., F.T. and T.W. to suggest improvements. F. T. organized and edited the paper.

References

1. Sudhakar putheti, K. Anupriya, G. Harshitha, K. Saritha, K. Kamal Kethura. A Persistent Approach For Secure Text Transmission Utilizing Video Cryptography. Int J Creat Res Thoughts. 2018 March; 6(1): 558-562. https://ijcrt.org/papers/IJCRT1803173.pdf
2. Ali Y H, Ressan H A. Image Encryption Using Block Cipher Based Serpent Algorithm. Eng Technol J. 2016; 34(2) Part (B) Scientific: 278-286. https://www.uotechnology.edu.iq/dep-cs/mypdf/research/2015/r36.pdf
3. Wahab H B A, Mahdi S I. Speech Encryption Based on Wavelet Transformation and Chaotic Map. Eng Technol J. 2016; 34(5) Part (B) Scientific: 721-729. https://www.uotechnology.edu.iq/tec_magaz/2016/volum342016/No.05.B.2016/[12]Text.pdf.
4. Wu Y. Research on feature point extraction and matching machine learning method based on light field imaging. Neural Comput Appl. 2019; 31(12): 8157-8169. https://dx.doi.org/10.1007/s00521-018-3962-7
5. Shakir H R, George L E, Tuma G K. Partial Encryption for Colored Images Based on Face Detection. Int J Adv Res Comput Sci Soft Eng. 2015; 5(8): 25–35. https://www.researchgate.net/publication/281321758_Partial_Encryption_for_Colored_Images_Based_on_Face_Detection
6. Alsaedi EM, Farhan A kadhim. Retrieving Encrypted Images Using Convolution Neural Network and Fully Homomorphic Encryption. Baghdad Sci. J. 2023 Feb; 20(1): 0206. https://doi.org/10.21123/bsj.2022.6550.
7. Salim KG, Al-alak SMK, Jawad MJ. Improved Image Security in Internet of Thing (IOT) Using Multiple Key AES. Baghdad Sci J. 2021 Jun;18(2): 0417. https://doi.org/10.21123/bsj.2021.18.2.0417 .
8. Fadhil Abbas Fadhil, Mohamed Ali, Nikolai Safiullin. The study on usage of table functions instead of basic operators inside encryption algorithm.Ural-Siberian Conference on Biomedical Engineering, Radioelectronics and Information Technology. 2022; p. 320-323, https://dx.doi.org/10.1109/USBEREIT56278.2022.9923412.
9. Natiq H, Al-Saidi NMG, Obaiys S J, Mahdi M N, Farhan A K. Image Encryption Based on Local Fractional Derivative Complex Logistic Map. Symmetry. 2022; 14(9): 1874. https://doi.org/10.3390/sym14091874
10. Hussien F T A, Rahma A M S , Wahab H B A. A Block Cipher Algorithm Based on Magic Square for Secure E-bank Systems. CMC Jr. 2022; 73(1): 1329–1346. https://dx.doi.org/10.32604/cmc.2022.027582.
11. Hussien F T A, Rahma A M S , Wahab H B A. A Secure E-commerce Environment Using Multi-agent System. Intell Autom Soft Comput. 2022; 34(1): 499–514. https://dx.doi.org/10.32604/iasc.2022.025091.
12. Abdulmohsin H A, Abdul wahab H B A, Abdul hossen A M J. A new proposed statistical feature extraction method in speech emotion recognition. Comput Electr Eng. 2021; 93: 107172. https://doi.org/10.1016/j.compeleceng.2021.107172.
13. Kareem S M , Rahma A M S.New method for improving add round key in the advanced encryption standard algorithm. Info Sec Jr. 2021; 30(6): 371–383. https://doi.org/10.1080/19393555.2020.1859654.
14. Ibrahem M K , Hamood L. A. Video Encryption Based on Chaotic System and Stream Cipher. Iraqi J Inf Commun Technol. 2018; 1(2): 33-40. https://doi.org/10.31987/ijict.1.2.19.
15. Nidaa F Hassan, Rusul N Abbas. Proposed Video Watermarking Algorithm Based On Edges Or Corner Regions . Eng Technol J. 2018; 36(01 Part B):25- 32.
16. Firas A Abdullatif, Alaa A Abdullatif, Amna al-Saffar. Hiding Techniques For Dynamic Encryption Text Based On Corner Point. IOP Conf Series: J Phys Conf Ser 1003. 2018; 012027: 1-10. https://dx.doi.org/10.1088/1742-6596/1003/1/012027
17. Sharif Shah Newaj Bhuiyan, Othman O Khalifa. Efficient 3D stereo vision stabilization for multi-camera viewpoints. Bull Electr Eng Inform 2019; 8(3): 882-889. https://dx.doi.org/10.11591/eei.v8i3.1518
18. Revanna C R. Keshavamurthy C . A new partial image encryption method for document images using variance based quad tree decomposition. Int J Electr Comput Eng. 2020; 10(1): 786–800. http://doi.org/10.11591/ijece.v10i1.pp786-800
19. Cheng S, Wang L, Ao N, Han Q. A Selective Video Encryption Scheme Based on Coding Characteristics," Symmetry (Basel)., 2020;12(3): 32. https://dx.doi.org/10.3390/sym12030332.
20. Abdulmunem IA, Harba ES, Harba HS. Advanced Intelligent Data Hiding Using Video Stego and Convolutional Neural Networks. Baghdad Sci J. 2021 Dec; 18(4): 1317. http://dx.doi.org/10.21123/bsj.2021.18.4.1317
21. Alawi A R, Hassan N F. A proposal video encryption using light stream algorithm. Eng Technol J. 2021; 39(01 Part B): 184-196. https://dx.doi.org/10.30684/ETJ.V39I1B.1689
22. Khudair ET, Naser EF, Mazher AN. Comparison between RSA and CAST-128 with Adaptive Key for Video Frames Encryption with Highest Average Entropy. Baghdad Sci. J. 2022 Dec.; 19(6): 1378. https://doi.org/10.21123/bsj.2022.6398 .
23. Javier S´anchez, Nelson Monz´on, Agust´ın Salgado. An Analysis and Implementation of the Harris Corner Detector. Image Processing On line 2018; 8(2018): 305-328. https://doi.org/10.5201/ipol.2018.229.
24. Mazher A N, Waleed J, Maolood A T. Developed Lightweight Cryptographic Algorithms for The Application of Image Encryption: A Review. Journal of Al-Qadisiyah for Computer Science and

Mathematics. 2021; 13(2): 11-22. https://doi.org/10.29304/jqcm.2021.13.2.788.

25. Malladar R, Kunte R S. Selective Video Encryption Based on Entropy Measure. Integrated Intelligent Computing, Communication and Security, Springer, 2019, 603—612 p. https://dx.doi.org/10.1007/978-981-10-8797-4_61.
26. Jolfaei A, Mirghadri A. Survey: Image Encryption Using Salsa20. Int J Comput Sci. 2010; 7(5): 213–220. https://www.researchgate.net/publication/265651103_Survey_Image_Encryption_Using_Salsa20.
27. Ali N H M , Rahma A S, Jamil A S.Text Hiding in Color Images Using the Secret Key Transformation Function in GF (2n). Iraqi J Sci. 2015; 56(4B): 3240–3245. https://ijs.uobaghdad.edu.iq/index.php/eijs/article/view/9431.
28. Ramasamy P, Ranganathan V, Kadry S, Damaševičius R, Blažauskas T. An image encryption scheme based on block scrambling modified zigzag transformation and key generation using enhanced logistic - Tent map. Entropy. 2019; 1 (7): 656. https://doi.org/10.3390/e21070656.
29. Wu Yue. Research on feature point extraction and matching machine learning method based on light field imaging. Neural Com Appl. 2019; 31(12): 8157-8169. https://dx.doi.org/101007/s00521-018-3962-7 .
30. Farah Tawfiq Abdul Hussien, Teaba Wala Aldeen Khairi. Performance Evaluation of AES, ECC and Logistic Chaotic Map Algorithms in Image Encryption. Int J Interact Mob Technol. 2023; 17(10): 193–211. https://doi.org/10.3991/ijim.v17i10.38787

مقترح تشفير نص داخل الفديو باستخدام خوارزمية هاريس لاكتشاف الزوايا و خوارزمية التشفيرسالسا 20

فاضل عباس فاضل 1 ،فرح توفيق عبد الحسين 1 ،طيبة ولاء الدين خيري 1 ، نيكولاي سفيولين2

1قسم علوم الحاسوب، الجامعة التكنولوجية، بغداد ، العراق.
2كلية الهندسة لتكنولوجيا المعلومات، جامعة اورال الفيدرالية، يكاترينبورغ، روسيا.

الخلاصة

يعد تشفير النص في الفيديو أداة حيوية في العديد من الصناعات حيث تكون حماية المعلومات الحساسة هي الأكثر أهمية. عادةً ما تواجه الخوارزميات وطرق الكشف الآلي صعوبة في تحديد موقع النص المخفي في إطارات الفيديو. تزيد هذه المقاومة من أمان المعلومات المخفية لأنه من الصعب على الأطراف غير المدعوة اكتشاف وجود نص مشفر. كما أنه يجمع بين المحتوى المكتوب والمرئي لتقديم كلا النوعين من المعلومات في وقت واحد وبسلاسة. في هذا البحث ، نقدم طريقة جديدة لتشفير النص داخل الفيديو باستخدام خوارزمية التشفير Salsa20 و Harris Corner Detection. الهدف من هذه الدراسة هو زيادة سرية وأمن المعلومات النصية المضمنة في محتوى الفيديو ، وهناك خطوتان أساسيتان في المنهجية المقترحة. لتحديد الزوايا أو النقاط المهمة داخل إطارات الفيديو ، تم استخدام طريقة Harris Corner Detection لأول مرة. تعمل هذه الزوايا كنقاط ميزة قوية يمكن استخدامها لدمج النص. تساعد طريقة Harris Corner Detection في تحديد الأماكن التي قد يتم إخفاء النص بها بدقة ، وذلك دون التقليل من جودة الصورة المرئية الإجمالية للفيديو ، وثانيًا ، يتم إنشاء مفتاح التشفير باستخدام تقنية التشفير Salsa20. Salsa20 هو تشفير دفق شائع يوفر تشفيرًا موثوقًا وتشغيلًا فعالاً. يتم تحويل النص المضمن إلى نص تشفير بواسطة XOR باستخدام مفتاح التشفير قبل تضمينه في الفيديو ، مما يضمن سريته وحمايته من الوصول غير المصرح به. تكشف مقارنة الطريقة المقترحة مع طرق تشفير النص الحالية عن عدد من المزايا. تدمج تقنية Harris Corner Detection النص في إطارات الفيديو بحيث يتم دمجها بشكل أقل وضوحًا ، مما يجعل من الصعب على الخصوم تحديد وجود المعلومات المخفية. يضمن استخدام Salsa20 أيضًا المستوى العالي من الأمان والحماية للنص المشفر ، والدفاع عنه ضد الهجمات المحتملة. يتم تقييم النظام المقترح باستخدام MSE و PSNR والارتباط و NPCR و UACI والإنتروبيا ، وتوفر مقاييس التقييم هذه نتائج ممتازة.

الكلمات المفتاحية: كاشف الزوايا هاريس ، MSE ، NPCR ، PSNR،Salsa20 ،تشفير النص، UACI، تشفير الفديو.