Review "An Evaluation Review of Steganography Using a Hybrid Method Technique of Quad Chain Code and Discrete Shearlet Transform"

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Abstract - **Because of the great development taking place in the field of information transfer, media, and the Internet, which has become an essential thing in daily life, it has become necessary to provide ways to protect this information and data while transferring it from one place to another. One of the most important ways to provide this protection is to hide confidential information from unwanted people using steganography, which is a science / art to hide confidential information in a way that makes the attacker believe that the message does not exist at all, by hiding it inside a digital medium (image, audio, video) so that it is difficult to detect. In this review, a new method was proposed to hide confidential data using quad chain code (QCC) that detects the edges of the object in the image so that the secret data is hidden in these edges by using one of the well-known hiding techniques such as the LSB and then using the shearlet transformation to convert the medium that contains the secret message from one domain to another domain in order to complicate the process of retrieval and disclosure of the secret message to the attacker.**

Keywords: Steganography, Chain codes, Object boundary, DST.

I. INTRODUCTION

Because of the technological development that is increasing over time and the great expansion in the areas of Internet use and the huge increase in the number of internet users that has reached hundreds of millions, as the internet has turned into an essential and excellent element in transferring information from one place to another all over the world, and because dealing with information and data it is very sensitive and needs security or a way to ensure that the information reaches the correct user. There are two basic strategies for securing information and data during its transmission from the sender to the recipient, which are encryption and information concealment. Since the encryption strategy changes the overall structure of the secret message, this system is discoverable if it is the unwanted party knows the encryption method used, as

for steganography, it is a method used to hide any object, message, audio file, or text in another medium, such as audio, image, or video for detection. Its main goal is to exchange and transfer important data from one place to another in a safe and imperc65eptible way, and to cover up the message sent by hiding it [1]. It is possible to hide the secret message in the cover image and it is hidden in pixels that are determined based on the chain code, and the chain code was used to represent the boundaries of the object in the image [2].

And the Shearlet transform converted the image from the spatial domain to the frequency domain using a modern approach, which is discrete shearlet transform (DST), where the shearlet is the most effective model in representing multidimensional data such as digital images [3]. As the location of this transform among other transformations is that there are no limits to the number of directions that it can represent, unlike other transformations that are limited in directions [4]. And in previous studies, which will be mentioned later, the use of DST in Steganography achieved the largest percentage of merging the hidden image with the cover image at a ratio of one bit per pixel, and achieved high incomprehensibility with a very high load capacity [5].

The aim of this study is to precede the possibility of using a new hybrid method for Steganography consisting of the quad chain code method and the Shearlet transformation, to present the reason for choosing these two methods, and to explain the advantages of each of the quad chain code and the Shearlet transformation that make the realization and success of this method possible with a high percentage. The review includes: An Introduction, Related research, Steganography, The chain code method, Shearlet transform, Conclusion.

II. STEGANOGRAPHY

Is a method of communication that reduces attacks on users while sending and receiving data [6]. The main idea of steganography is to hide the existence of a secret communication from an unwilling recipient. Since the basic concept of hidden communication lies in the secrecy of

transmission, so it is more suitable and used in many applications in the field of industry, smart cities, medical imaging and military applications [7]. Information steganography techniques have been developed with digital means due to the great progress in the ability of computers to process and that modern information steganography methods are not only restricted in hiding confidential information within images, but also help include confidential data in text, symbols, audio, video and DNA[8]. Researchers have preferred images as a cover to hide confidential data, the presence of extra pixels in the image makes it more suitable and better for including confidential data, hiding confidential data is defined in the image steganography (IS) [7].

III. CHAIN CODE

The chain code is a common way to represent the edges of objects in an image where a series of commands are used that lead to the extraction of a specific series of numbers, depending on the method, representing the directions of the edges of the object in the image[9]. Basically this algorithm has several ways to represent the boundaries of the object such as (vertices chain code (VCC), histogram chain code (HCC), markove chain code (MCC), and the proposed method quad chain code (QCC)) but there is a basic method that is adopted and then developed to generate other new methods called freeman chain code.

3.1 Freeman Chain Code

The freeman chain code was named after the first person to introduce it, freeman in 1961 the workflow of this code is clockwise and moves from one pixel to another adjacent pixel until the edges of the object are completely selected [10, 11]. This type is the basis of method and has two ways to represent the edges of objects which are 4- neighborhood method or 8- neighborhood method the first is known as (F4 - freeman chain code in four directions) and contains four symbols, which are (0,1,2,3) and the second is known as (F8 - freeman chain code in eight directions) and contains eight symbols, which are (0,1,2,3,4,5,6,7) [12, 13].

3.2 Quad Chain Code

The freeman chain code was developed by taking a quadruple pixel instead of a single pixel, and searching for the chain code of the image based on one of the two methods eight directions or four directions [14].

IV. DISCRETE SHEARLET TRANSFORM (DST)

It is a new method that has multiple solutions, and it has attracted a great deal of attention because of its application in many areas of image processing such as reducing the amount

of noise in the image, zooming the image with high accuracy, drawing the image with highlighting the fine details and for providing high performance in dealing with signals of huge dimensions [15]. Shearlet transformation has become the most successful scheme for efficiently representing multidimensional data such as (digital image) as it has the ability to represent features that are disparate in their properties and enables shearlet transformation to provide a large number of new tools that analyses and process large multidimensional data that it is limited in processing in other transformations [4]. As it was found that its representation is not restricted to a limited number of directions. The shearlet transformation (ST) is used to deal with anisotropic images and directional features. It also has the ability to effectively capture edge information for geometric shapes [5].

V. RELATED RESEAGHES

(In 2016) Prof. Dr. Tawfiq A. Al-asadi and others presented a study on "A New Steganography Method for Hiding Message in Image Based on Quad Chain Code and DCT" where this paper presents a new approach to information Steganography based on the quad chain code (QCC) and discrete cosine transform (DCT). The proposed system consists of two general stages, the first stage is to hide the secret message in the cover image, and the second stage is to extract the secret message from the cover image. The first stage takes place in several steps, the first step is the application of QCC, and the second step is dividing the blocks in the image into a size of (8*8) pixels, and the third is the application of the two-dimensional conversion-DCT per block The fourth is to hide the number of bits (message) in some block locations The fifth step is to save (the starting point of the quartet string code, the string code stream, the number of bits) within The cover image and rebuilding the block in the hidden image. The second stage is extracting the secret message from the cover image, which is done by specifying (the number of blocks, the string code stream, the number of bits per block), as this information helps to extract the secret message from the cover image. Through the results, it was found that this method QCC gives a good force against the attacker because the method depends on the random distribution of bits, and this random distribution was obtained by selecting the four pixels in a non-sequential and random manner (may take a zigzag shape), which increases the complexity of the process of discovering the secret message on the attacker [16].

(In 2015) Zhao Jian and other presented a research paper titled "Image Watermark Based on Extended Shearlet and Insertion Using the Largest Information Entropy on Horizontal Cone" in this research, the researchers try to implement a watermark image by exploiting the unique and good features

of the discrete shearlet transform. The location of the watermark embedding was determined based on the highest connection to the information, because of the advantages of discrete shearlet DST and its development into extended shearlet its capabilities have made the watermark system more embedded and invisible. The experimental results showed that the watermark became embedded in a better way than the other transform, it is better than the DWT and DCT transform at the same time, this proposed transform can resist the attack that can occur to detect the watermark for that, and thus the DST and its development can be considered the extended shearlet as a suitable transformation of the digital watermark [17].

(In 2019) Mohammed Abbas Fadhil Al-Husainy & Diaa Mohammed Uliyan presented a study on "A SECRET-KEY IMAGE STEGANOGRAPHY TECHNIQUE USING RANDOM CHAIN CODES" this paper presents a technique of image steganography based on random chain codes used to hide parts of the secret message inside the cover image. This technique achieves the use of all pixels in the cover image and choosing pixels randomly helped increase the complexity of the attacker's access to the secret message. The results showed that the use of this technique achieves the three conditions of steganography, it is the capacity, robustness, and un detectability, and thus this technique can be used effectively in the field of concealing information [18].

(In 2018) Baharak Ahmaderaghi and others presented a study on "Blind Image Watermark Detection Algorithm based on Discrete Shearlet Transform Using Statistical Decision Theory" in this study was proposed discrete shearlet transform DST as a new embedding domain for blind watermarking. The method was evaluated in terms of imperceptibility, robustness and payload against various attacks (Gaussian noise, blurring, cropping, compression and rotation) using the proposed DST. The method shows greater flexibility in windowing with more sensitivity to features, directivity when compared to discrete wavelets and contourlet. Through the experimental results, it was shown that the modulation based on DST achieved good incomprehensibility, very improved load, and also showed superior durability against image processing, and compared with other conversions, it was found that DST is more noticeable in compression, noise, and rotation [15].

(In 2022) Yasir Ahmed Hamza and others presented a study on "Enhanced Approach of Image Steganography Using Discrete Shearlet Transform and Secret Sharing" in this research paper, an improved method was proposed to hide information with images with the use of encryption to enhance security, where the secret logo is encrypted using the (share 2out 2) method, and two secret logos are generated, then

include the first secret tag in the cover image whose layers are divided into (red, green, blue) (RGB) and then modify the blue layer using the discreet shearlets transform according to the experimental results, the basic requirements of steganography were achieved, which are incomprehensibility and embedding capacity, as it was found that the use of discreet shearlets transform instead of other transformations such as (wavelet, contourlet and a discrete cosine) is the best in image steganography and increases the percentage of incomprehensibility and embedding capacity [5].

(In 2021) E. Laxmi Lydia and other presented "a study Application of discrete transforms with selective coefficients for blind image watermarking" in the study A model consisting of a combination of intelligent transforms such as the discrete shearlet transform and the discrete curvelet transform (DCurT) is proposed, where the imperative of incomprehensibility is achieved by using these transformations, the confidential data is embedded in the host images to make it secure. The embedding process is reverse extracted, the proposed method was tested on 20 digital images, and different attacks applied to the proposed watermark model. Note that the image has a watermark it looks lossless compared to the host image, through the experimental results, it has been observed that this method has the following advantages the proposed method has strong robustness compared to the traditional method against signal processing attacks and engineering attacks. The proposed algorithm combines encryption and transformations that make it more secure [4].

(In 2020) Deepak Kushwahah and other presented a study on "Text Message and Digital Image Secure for Discrete Shearlet Transform" the research talks about that the science of concealment needs a strategy by which unwanted customers are defeated. Access to the secret message discrete cosine transform (DCT) and discrete shearlet transform (DST). The proposed system has so far achieved good results durability increases but is not independent of file format. The goal of this exploration is to build a security system Independent of the file format, the security of this system is increased by a combination of transformations and the least significant bit (LSB) masking method, the results proved that this method is strong against pressure and sensitive other changes [19].

See Table 1 It contains a summary of the previous studies that were cited in this research in terms of the algorithm used, the work and the result that was drawn from each research.

Table 1

Source Number	The Year	Method	The Work and Result
[16]	2016	Quad Chain Code	1. The QCC method was used to extract the boundaries of the object in the image. 2. It became clear from the use of this method that it gives strength and durability to the concealment that will occur within the boundaries of the object in the image, where the distribution of the bits to be hidden will become random and difficult to retrieve by the attacker.
[17]	2015	Discrete shearlet transform	1. The (DST) was used to convert the image containing the watermark from one field to another, more complex. 2. As a result of using the (DST), it was found that the inclusion of the watermark became more invisible than if another transformation was used.
[18]	2019	Freeman chain code	1. (FCC) is used to extract the boundaries of the object in the image to be used as a cover to hide secret information. 2. It was found that the use of this method leads to a good use of the pixels in the image in which information is intended to be hidden, and that the use of this method leads to random selection of the pixels to be hidden, which increases the difficulty and complexity of detect the hidden information in it.
[15]	2018	Discrete shearlet transform	1. (DST) was used as the domain to include the watermark. 2. It was found that the (DST) transform achieved more robustness, incomprehensibility, and high load capacity against most of the attacks that the image could be subjected to extract the watermark compared to other types of transformations.
[5]	2022	Discrete shearlet transform	1. Include a secret watermark inside the blue layer of the colour (RGB) image that has been modified using (DST). 2. It was found through the results that the use of (DST) instead of other transformations increases the embedding of inclusion and incomprehensibility, which enhances the concealment of information in the image
[4]	2021	Discrete shearlet transform	1. (DST) was used to embed a watermark within an image and make it undetectable. 2. As a result of applying some attacks on the image that includes the watermark, it was noticed that the use of shearlet transform is very strong against the attacks on the image.
[19]	2020	Discrete shearlet transform	1. Hide text inside a digital image and use (DST) to make hiding more robust. 2. It was found through the experimental results that the use of this transformation and its combination with other transformations led to the formation of a strong method towards image compression and less sensitivity to external changes that occur to the image.

VI. CONCLUSION

From reading and reviewing previous studies that dealt with the chain code method in extracting the edges of the object in the image it turns out that this method of extraction is the simplest method and gives difficulty in revealing the hidden message because of the random selection of pixels in which the secret message will be hidden and the studies that used the shearlet transformation in the field of steganography as well as in the watermark gave strong concealment and high durability and be less sensitive to attacks with increased modularity of pixels as well as gives a high load capacity , it was found that merging this method with the shearlet transformation can lead to the formation of a method hybrid hiding is difficult to detect and complicates hiding so that it is difficult for an attacker to see the secret message hidden in the digital medium.

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