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A Review on Enhanced Reversible Data Hiding on Encrypted Images by Hierarchical Embedding Method

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Abstract: - Bettered reversible data hiding scheme in encoded images using Data Security deals with securing data from unauthorized users and data corruption. A vital data security measure is encryption, where digital data are encoded. Reversible data caching can restore the image after the secret data is extracted. Security and integrity of data are two challenging areas for exploration. Further attention is paid to reversible d caching in encoded images as the original cover image can be lossless recovered after embedded data is extracted while securing the confidentiality of the image contents. This paper compares two approaches used for reversible data caching. The PSNR value of the recovered image of both ways is compared. The main idea of the hierarchical embedding method (HEM) is that an image proprietor encrypts a cover image, and a data hider embeds secret information in the encoded image. With information concealment, a receiver can extract the embedded data from the hidden image; with encryption, the receiver reconstructs the original image. Experimental results prove that the proposed system not only realizes high-capacity reversible data hiding in encoded images but also reconstructs the original image in the fully operational area like the Military, Medical where minor changes in the original image content affect a lot. This literature survey discusses all the existing data-hiding methodology and their performance. An experimental study shows that the proposed scheme outperforms the existing schemes in terms of embedding rate without compromising encryption efficiency.

Keywords: *Reversible Data Hiding, Digital Watermarking, Image Encryption, Image Decryption, Image Recovery, PSNR, Robustness.*

I. INTRODUCTION

In the Health care Sector, during the secure transmission of healthcare reports over the network, the sensitive data of a patient can be transmitted by embedding data in medical images. This technique improves the security of the data. Reversible Data Hiding is a technique mainly used in the case of embedding data in encrypted images. Therefore, the security of the cover image can be ensured. We can use this technique where the transmitted data and the cover image are confidential. Encryption provides security to confidential data.

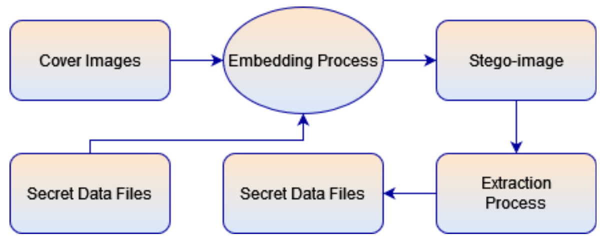

Fig. 1. The framework of the hierarchical embedding method

The two significant areas, steganography and cryptography, provide secure data transmission over the internet. Reversible Data Hiding (RDH) is based on steganography. The data to be hidden is embedded in an encrypted image. At first, the image is encrypted using any encryption algorithm then the data to be hidden is embedded in the encrypted image. If the receiver has the data-hiding key, he can extract the hidden data from the encrypted image even though he does not know the contents of the image. Suppose the receiver has the key for encryption. In that case, he can decrypt the received data to recover an image similar to the original but cannot extract the hidden data. If the receiver has both keys, he can extract the hidden data and recover the original content, which is errorless.

We can say that a data-hiding method is reversible if the original image content can be ideally recovered from the image containing embedded data. Reversible data hiding (RDH) is a technique to embed secret information into a cover image by slightly modifying pixel values. Existing RDH methods are mainly divided into three categories: lossless compression [1], histogram shifting [2] and difference expansion [3]. These methods are designed to ensure that secret information is not detected, and the secret data and the original image can be completely restored from the marked image. Due to this reversible feature, the RDH method can be applied in many fields, such as medical and military images. For an RDH method in the plaintext domain, rate-distortion of an image is generally used to evaluate its performance, that is, to maximize the embedding rate while minimizing image distortion. Therefore, various RDH algorithms have been proposed to achieve better rate-distortion performance [4-8].

II. RELATED WORK

A considerable amount of research on reversible data hiding has been done over the past few years. Some essential techniques are discussed here. Various techniques have been proposed, and research has been done on reversible data hiding. **Yang et al.** [6] proposed a method before embedding messages into the texture area of the medical images to improve the quality of the details information and help in accurate diagnosis. Again, this paper also proposed a message sparse representation method to decrease the embedding distortion while enhancing the contrast of the texture area. Various experiments implemented on medical images showed that the proposed method enhances the contrast of texture area compared to previous methods. They proposed an RDH method in medical images with texture area enhancement based on histogram stretching. The proposed method consists of four parts: 1) rhombus prediction and texture-based sorting; 2) embedding scheme and enhancing the contrast of texture area; 3) message sparse representation; 4) message extraction and cover image recovery. **Shuang Yi et al. [7]** the original work randomly selects pixels from an original image to obtain the estimation error for secret data embedding. In this work, we estimate half of the pixels in the original image to obtain the estimation error so that the maximum embedding rate can be significantly improved while keeping a high image quality of the marked decrypted image. This method is first to estimate a part of the pixels in an original image using the rest pixels and obtain the estimation errors. Then we encrypt the estimation errors and the rest pixels. The data hider then embeds the secret data into the encrypted estimation errors and scrambles the image using the sharing key. On the receiver side, the personal data and original image can be extracted and recovered separately using different security keys. **Wei Liu et al. [8]** in this proposal a resolution progressive compression scheme is used which compresses an encrypted image progressively in resolution such that the decoder can observe a low-resolution version of the image, study local statistics based on it, and use the statistics to decode the next resolution level. The encoder starts by sending a down-sampled version of the cypher text. At the decoder, the corresponding low-resolution image is decoded and decrypted, from which a higher-resolution image is obtained by intra-frame prediction.

The predicted image and the secret encryption key are used as the side information (SI) to decode the next resolution level. This process is iterated until the whole image is decoded. So, this multi-resolution approach allows access to part of the spatial source data to generate more reliable spatial and temporal side information. But there is a need to increase overall data compression efficiency to avoid data loss. **Zhenxing Quian et al.** [9] proposed a Reversible Data Hiding Technique (RDH) using distributed source encoding. It consists of three phases: image encryption, data embedding and data extraction/image recovery. In the first phase, the sender turns the original image into plain bits by decomposing each pixel into 8 bits. The owner then chooses an encryption key to generate pseudo-random bits using a stream cypher function and encrypts the bit stream of the original image.

After the image encryption, the content owner sends the encrypted image to the data hider. The data hider first decomposes the encrypted image into four sub-images of equal sizes to embed additional data into the image. Bits of three MSB planes of the sub-images are collected, and using a selection key, the data hider pseudo-randomly selects L bits from them and shuffles the selected bits, and A shuffle key controls it. The shuffled bits are divided into groups. Then the data hider uses the Slepian-wolf codes to compress the selected bits C. The hidden data can be extracted using the embedded key on the receiver end with the marked encrypted image. The original image can be approximately reconstructed using the encryption key or lossless recovery using both keys.

Mark Johnson et al. [10] proposed the novelty of reversing the order of these steps, i.e., first encrypting and then compressing, without compromising the compression efficiency or the information-theoretic security. This method first uses data encryption, and then the encrypted source is compressed. Still, the compressor does not have access to the cryptographic key, so it must be able to compress the encrypted data without any knowledge of the source. At first glance, it appears that only a minimal compression gain, if any, can be achieved since the output of an encrypt will look very random. However, at the receiver, there is a decoder in which decompression and decryption are performed in a joint step. In a broad spectrum of this approach, the encrypted data can be compressed using distributed source-coding principles as the key will be available at the decoder, but in some cases, the possibility of first encrypting a data stream and then compressing where the compressor does not know the encryption key. **Pun et al. [11]** proposed a new novel

RDHEI method based on reversible image reconstruction content owner rearranges the cover image to construct a redundancy image; simultaneously, the content of the cover image is made invisible rearranged image is used as an encrypted image. **Xinpeng Zhang et al. [12]** propose a lossless, reversible, combined data-hiding scheme for encrypted ciphertext images. In the lossless scheme, the ciphertext pixels are replaced with new values to embed the additional data. The reversible scheme uses preprocessing to shrink the image histogram before image encryption. The data extraction procedures of the two schemes are very different. The additional data embedded by the lossless scheme cannot be extracted after decryption, while the additional data embedded by the reversible scheme cannot be extracted before decryption. So, we combine schemes to construct a new scheme in which data extraction in either of the two domains is feasible. That means the additional data for various purposes may be embedded into an encrypted image. A part of the additional data can be extracted before decryption, and another can be extracted after decryption. **Jun Tian et al. [13]** proposed reversible data embedding, also called lossless data embedding, which embeds invisible data into a digital image in a reversible fashion. The quality degradation of the image after data embedding should be low as an essential requirement. A captivating feature of reversible data embedding is the reversibility, i.e., one can remove the embedded data to restore the original image. A common approach of high-capacity reversible data embedding is to select an embedding area, for suppose, the least significant bits of some pixels in an image and embed both the payload and the original values in this area needed for the exact recovery of the original image into the such area. Here DE (difference expansion) technique discovers extra storage space by exploring the redundancy in the image content. DE technique is employed to embed a payload into digital images reversibly. The primary significance of this method is the payload capacity limit and the visual quality of embedded images. Still, suppose there is reversible data embedding. In that case, it is a fragile technique because when the embedded image is manipulated and lossy compressed, the decoder will find out it is not authentic.

Thus, there will be no original content restoration in **Zhenxing Qian et al. [14]** research in which the content owner, the data hider, and the recipient are three parties. The content owner encrypts the original image. The data-hider divides the encrypted image into three sets and embeds a message into each set to generate a marked encrypted image. The recipient extracts the message using an extraction key. An approximate image with good quality can be obtained by decryption if the receiver has a decryption key. When both keys are available, the original image can be lossless recovered by progressive recovery. This paper limits the distortion to three LSB layers and improves the embedding rate accordingly. **W. Zhang et al. [15]** introduce a fast algorithm to resolve optimal marked-signal distribution as we are familiar with RDH, a reversible data hiding technique used to hide the information with their characteristic. It is further extracted and covers itself. In DE, i.e., different expansion approach differences of each pixel group are expanded. The proposed algorithm estimates the optimal marginal distribution faster than the BFI algorithm. Therefore, it seems that the proposed algorithm performed better than the previous BFI algorithm and is efficient and scalable for practical applications. **Chunqiang Yu et al. [16]** Reversible data hiding in encrypted images (RDHEI) is an effective data security technique. Most state-of-the-art RDHEI methods do not achieve desirable payload yet. We propose a new RDHEI method with hierarchical embedding to address this problem. Our contributions are twofold. (1) A novel hierarchical label map generation technique is proposed for the bit-planes of plaintext images. The hierarchical label map is calculated using the prediction technique and compressed and embedded into the encrypted image. (2) Hierarchical embedding is designed to achieve a high embedding payload. This embedding technique hierarchically divides prediction errors into three kinds: small-magnitude, medium-magnitude, and large-magnitude, which are marked by different labels. Different from conventional techniques, pixels with small-magnitude/large-magnitude prediction errors are used to accommodate secret bits in the hierarchical embedding technique, contributing a high embedding payload. Experiments on two standard datasets are discussed to validate the proposed RDHEI method.

III. EXPECTED OUTCOME

In the field of reversible data, hiding found low PSNR and high error in hierarchical embedding method based on BHS in base paper main problem low PSNR and more error rate but overcome through, proposed method improving performance, low error and high PSNR.

IV. CONCLUSION

The research was done on reversible data hiding based on the hierarchical embedding method (HEM) based on block histogram shifting. HEM, the original cover, can be recovered after the embedded data is extracted from the image, but PSNR values are low.

Reversible data hiding is performed in encrypted images by a reserving room before the encryption technique is more accessible for the data hider to reverse embed data in encrypted images. It saves the time needed for creating space after encryption. Image recovery is free of any error. This paper compares various techniques and methodologies and their reversible data hiding, which is used for data hiding in encrypted images. Our main goal is to hide essential data in the encrypted image and extract data without a slight change in the original content or image. Original content recovery plays a vital role in secure communication and gives the best result in fields like a medical and army. Data hiding is gaining interest due to its provision for a secure environment. Data hiding reversibly in encrypted images provides double security for confidential data using techniques such as image encryption. Existing systems (HEM) there is no provision for efficient security. Thus, developing an efficient and effective system that provides data embedding and recovery without distortion and better security is necessary.

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