International Journal of Latest Engineering Research and Applications (IJLERA) ISSN: 2455-7137

Volume – 02, Issue – 08, August – 2017, PP – 79-82

Data Security in Medical Images Using Reversible Data Hiding Techniques: Survey

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Abstract: Data Security deals with protecting data from unauthorized users and data corruption. An important measure of data security is encryption, where digital data are encrypted. Data hiding is a type of steganography that embeds data into digital media. In Health care sector massive amount of highly confidential patient information and images such as scan reports have to be transmitted over the network. This information can be accessed only by the intended recipient. More security is required in transmission of highly confidential data. To improve the security mechanism the confidential data can place inside an encrypted image. Therefore confidentiality of both the image and the data embedded in the image can be maintained. Later the embedded data and also the encrypted image can be restored without any error. These types of techniques are known as Reversible Data Hiding Techniques. There are various methods of data hiding under Reversible Data Hiding Technique. In this Review Paper we are conducting a survey on different Reversible Data Hiding Techniques.

Key words: Data Hiding, Steganography, Reversible Data Hiding

1. Introduction

In Health care Sector during the secure transmission of health care reports over 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 kind of technique that is mainly used in case of embedding data in encrypted images. Therefore the security of the cover image can be ensured. We can use this technique where situation in which both the transmitted data and the cover image is confidential. Encryption provides security to confidential data. The major two areas steganography and cryptography provides secure data transmission over internet. Reversible Data Hiding (RDH) is based on the steganography. The data is to be hide is embedded in an encrypted image. At first the image is encrypted using any encryption algorithm then the data to be hide 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. If the receiver has the key for encryption , then he can decrypt the received data to recover an image similar to the original image, but not able to extract the hidden data. If the receiver has both the keys, then he can extract the hidden data and also he can recover the original content which is errorless. We can say that a data hiding method is reversible if the original image content can be perfectly recovered from the image containing embedded data.

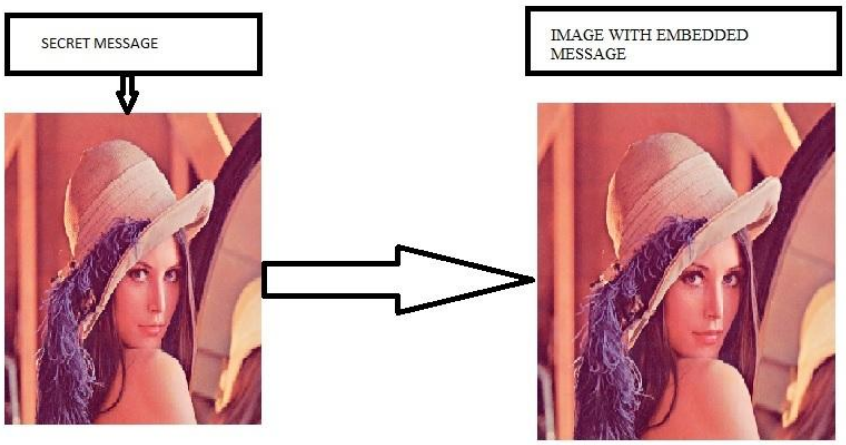

Figure 1.1 Image Based Data Hiding

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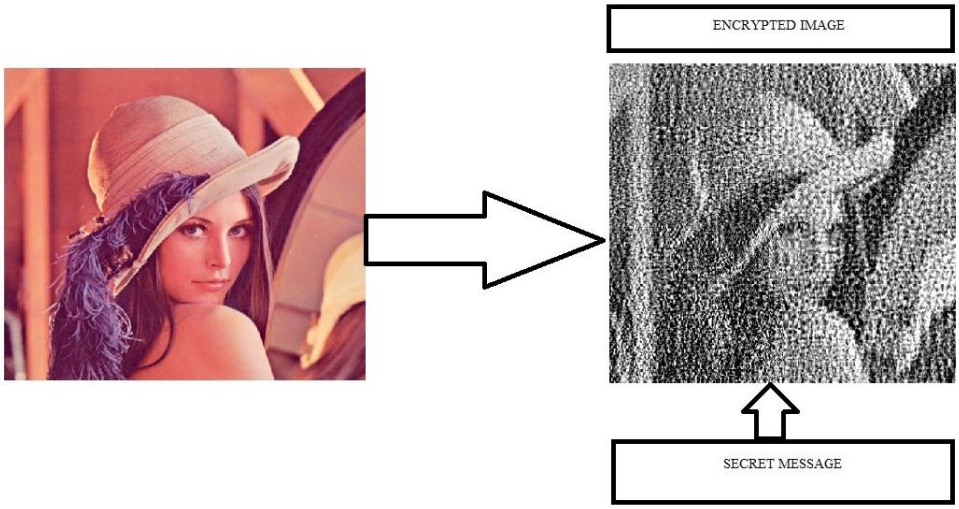

Figure 1.2 Encrypted Image Based Data Hiding

2. Related Works

Yang Yang et.al proposed a method [1] priors to embed message into the texture area of the medical images for improving the quality of the details information and helping in accurate diagnosis. Again in order to decrease the embedding distortion while enhancing the contrast of the texture area, this paper also proposed a message sparse representation method. Various experiments implemented on medical images showed that the proposed method enhances the contrast of texture area when compared with previous methods. They proposed a RDH method in medical images with texture area enhancement based on the idea of histogram stretching. The proposed method consists of four parts: 1) rhombus prediction and texture-based sorting; 2) embedding scheme and enhancing contrast of texture area; 3) message sparse representation; 4) message extraction and cover image recovery.

Smita Agrawal and Manoj Kumar proposed, a novel reversible data hiding technique, based on integer-to-integer wavelet transform and histogram-bin-shifting for medical images[2]. In that proposed system images are divided into blocks and entropy of each block is calculated to evaluate the smoothness of the blocks. Integer-to-integer wavelet transform was applied over smooth blocks and watermark was embedded in all sub bands of detail part. Histogram-bin-shifting technique was used to embed the watermark. The proposed scheme was applied on various medical images and also compared with one of the recent existing reversible data hiding techniques. Higher PSNR values demonstrate the effectiveness of the proposed scheme.

Yun-Qing Shi et.al [3]discussed the various RDH algorithms into the following six categories: 1) RDH into image spatial domain; 2) RDH into image compressed domain (e.g., JPEG); 3) RDH suitable for image semi-fragile authentication; 4) RDH with image contrast enhancement; 5) RDH into encrypted images, which is expected to have wide application in the cloud computation; and 6) RDH into video and into audio. For each of these six categories, the history of technical developments, the current state of the arts, and the possible future researches are presented and discussed.

Zhenxing Quian and Xinpeng Zhang proposed a Reversible Data Hiding Technique (RDH) using distributed source encoding[4]. 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 cipher 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. To embed additional data into the image, the data hider first decomposes the encrypted image into four sub images of equal sizes. 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. It is controlled by a shuffle key. The shuffled bits are divided into groups. Then the data hider uses the stepian-wolf codes to compress the selected bits C. On the receiver end, with the marked encrypted image, the hidden data can be extracted using the embedded key, and the original image can be approximately reconstructed using the encryption key, or lossless recovery using both of the keys.

Xiaochun Cao and Ling Du proposed a high capacity RDH in encrypted images using patch-level sparse representation[5]. Here the cover image is first divided into patches that are then represented according to

an over complete dictionary via sparse coding. Then the smoother patches with lower residual errors are selected for room reserving. These selected patches are represented by the sparse coefficients and the corresponding residual errors are encoded and reversibly embedded into the other non selected patches with a standard RDH algorithm. Finally the room preserved and self embedded image is encrypted to generate the final version. After the data hider scans each selected patch in the encrypted image and simply makes use of bit replacement to substitute the corresponding bits reserved for secret data. The data extraction and image recovery can be processed separately based on keys available.

Jiantao zhou , Weiwei Sun, et,al proposed a reversible data hiding scheme over encrypted images. The data embedding is achieved through a public key modulation mechanism and so there is no need of a secret key[6]. There is a powerful two class SVM classifier at the receiver side to distinguish between encrypted and non-encrypted image patches and it also allows to jointly decoding the embedded message and the original image. The data embedding is done by simple XOR operations, without the need of accessing the secret key. The proposed technique is compared with the state-of-the-art methods, and provides higher embedding capacity and is able to perfectly reconstruct the original image as well as the embedded message.

Sabeen Govind P.V, M.Wilscy proposed a technique which is a modification to the RDH scheme based on directional interpolation[7]. Directional interpolation yields a better approximation to the original pixel which improves the capacity of embedding. The effectiveness of the proposed scheme was tested using standard test images and the proposed scheme gives better results in terms of embedding capacity and visual quality. In the proposed scheme, the pixels in a cover image C sized NX N are classified into two types namely reference pixels and embeddable pixels. Prediction value of all embeddable pixels is computed from its neighboring reference pixels. Data is embedded in a pixel if the prediction error is less than a predetermined threshold. Otherwise, the scheme performs a histogram shift operation. In order to increase the payload capacity, the proposed scheme embeds secret bits into the reference pixels too. The proposed scheme has two phases- the data embedding phase and the secret extraction and image recovery phase, which have been explained in the following subsection.

Nirmal S. Nair et.al proposes a reversible data hiding method for encrypted images that guarantees reversibility, i.e., the exact recovery of secret data and cover image by the receiver. Spatial correlation of pixels in the cover image is exploited for data hiding [8]. In the proposed method, the sender proactively chooses suitable blocks in the cover image to hide secret data. The stego image is then encrypted so that privacy of cover image as well as secret data is protected. The proposed method achieves reversibility at all block sizes, while significantly improving the embedding capacity over many of the state-of-the-art methods.

Arindam Das et.al proposes an efficient technique to hide text information in 3D medical images such as MRI and PET[9]. It embeds text information only in the non-anatomical pixels. It ensures that no anatomical part of the 3D medical image gets contaminated. It makes the retrieval of 100% data. The technique has been tested on several MRI and PET images.

Hsiang-Cheh Huang et.al introduced a scheme for Reversible Data Hiding for Health Care Information [10]. In their proposed method with the fundamental definition of reversibility, the hidden data can be embedded into the original image by the designed algorithms at the encoder. At the decoder, with the aid of side information provided, both the original image and the hidden data should both be recovered. Reconstructed image and recovered hidden data should be identical to their counterparts at the encoder

3. Conclusion

Reversible data hiding in encrypted image is a powerful technique for the security of data. Data hiding in encrypted images provides double security for the data such as image encryption as well as data hiding. Existing System under Reversible data hiding technique have many limitations. Many RDH schemes may result in occurrence of error in the extracted data as there will be data loss. After data extraction the image recovered does not contain the qualities as the original cover image. Some distortions are present in that image. Data hiding in medical image requires extreme care when embedding additional data within the medical images because the additional information must not affect the image quality. The Time Complexity factor is also higher in existing schemes.

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