A Comparative Case Study on The Various Techniques of Reversible Data Hiding

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Abstract-: **Secured transmission of data is an important concern now a days. A number of techniques are available for hiding and transmitting the data through the images. It may be a simple or a complex technique. In the receiver part if the host image is recovered without any loss it is said to be reversible data hiding. In this paper it is proposed to compare the reversible and lossless data hiding techniques where both the host image and the hidden data can be recovered without any loss. There are many techniques that is presented as block based, pixel based and interpolation based techniques. In the past data was embedded in encrypted images with irreversible data hiding and now it is reversible .The PSNR and the data hiding capacity que for these methods are compared in this paper.**

Keywords: **- RDH (Reversible data hiding), PSNR, host Image , Image hiding Capacity.**

I. INTRODUCTION

The concept of encrypting the data was developed to secure the data from hackers and unauthorised users .Now a days the interest towards the encryption of data and images have increased due to the rapid increase in the data and image transfer over the internet. The interest in securing the data was achieved by cryptography and stegenography. Where in cryptography the data will by encrypted using the encryption algorithms and they will be converted into cipher text before the transmission. The receiver end can decrypt the image by sing the shared public or private keys .In stegenography the encrypted cipher text can be embedded on a image (hidden data) and then transmitted .In stegenography the host image is not of interest and the data can be decrypted that makes the process as a irreversible method as host image cannot be retrieved. In the advancement of this technique even the host image and the data can be retrieved that is reversible lossless data hiding techniques.

The various available RDH methods are

1. Block based RDH
    - Histogram and color histogram
    - Mapping
    - Pixel differencing
    - Authentication
2. Pixel based RDH
    - Pixel modification
    - Pixel differencing
    - Arithmetic coding
3. Interpolation Based RDH

Not only images even audio and video can be used as a host medium or cover medium. Some information as business logo and private annotations can be the data that can be embedded on an cover medium. By this means claims of digital content, copywrite protection can be fulfilled these image hiding techniques can be used for covert communication i.e., named as stegnography and those used for ownership and copyright protection is called watermarking. Irreversible data hiding techniques were initially intended for the securing the data but in major applications as remote sensing ,medical image system and military applications the host medium or the host image also has to be recovered with greater accuracy. Reversible data hiding (RDH) techniques hides the data that has to be secured in an image and only the authorised person will be able to decode the data and the image used in the reversible data hiding technique so the RDH provides authentication also. The efficiency of the reversible data hiding algorithm is calculated by estimating the visual quality and security of the data and image, degree of complexity involved in the technique and the payload capacity. In the reversible data hiding technique equal importance is to be given to the security both the data and the image or audio or video that is used for hiding.[3]

The encryption process converts an plaintext into an encrypted cipher text. The method of lossless data hiding is said to be lossless when the cover signal or host signal having the hidden data is same as that of unique host. for example the pixels in a picture with the most utilized shading are doled to some rarely used or unused shading lists for conveying extra information. Now even though the pixel values are modified, the original pixel values are still retained which will make the

process as reversible process.[4] Lossy data hiding helps to hide a large amount of data but host image cannot be recovered. In some applications the data security is of major concern .There are some cases when the content owner may not want the data to be known to the data hider. Here the data can be encrypted before going for data hiding. In real time applications the secured medical image of a patient can be transmitted securely without being viewed by the channel administrator or inferior assistant by first encrypting the image and then the personal information of the patient may be embedded into the encrypted medical image to maintain the records in the database of the hospital. Here the channel administrator can embed information without knowing the medical image of the patient. There are basically two levels of security in encrypting the signal i.e., low level and high level. In low level the visual quality has degraded compared to the original image and still the information is readable by the viewers[5][6].In high level the image looks like a random noise and it is not understandable by the viewer at all. The data hiding technique is simply linking the set of data's to be transmitted safely with the set of data in the host medium that is an image. These techniques are used for stegno analysis and authentication**.**

Some of the approaches for data hiding are block based, pixel based and interpolation based techniques. Block based reversible data hiding technique are generally adopted techniques as other techniques require more capacity.

II. BLOCK BASED RDH

A. Histogram :

In the histogram approach there are various schemes that was adopted like colour histogram, adaptive histogram, difference histogram. Histogram involves adaptive division of cover images and they are formed as blocks to provide good quality and improved capacity to store data. Adaptive histogram provides better PSNR. Dividing the cover image into blocks enhances the hiding capacity. Peak pixel is generated for each of the block .Later development in histogram instead of peak pixel in the block the neighbouring pixels were used to embed data. The 8x8 image is divided as 4x8, 8x4, 4x4 and complete 8x8

The histogram based shifting of reversible data hiding technique is completed using four steps that is histogram shifting, encoding process, embedding and extraction process. Histogram shifting depends on the following as converting a difference image for a grey scale image, using histogram bins for extension embedding and modification of pixels.

The concept of histogram is dividing the host image into blocks and the pixels in the image is converted into even and odd values by computing the optimal value mean value ,median value or min max average nearer to the pixel in the block is the optimal value. On the receiving end the data is extracted and host image can also be recovered by calculating the same optimal value. Histogram based on shifting was initially proposed and this involves two stages an error prediction stage and an error modification stage. A scheme has been reported is the difference histogram in which there are totally nine basic scan paths that are formed and this method by selecting the best scan and the best pixel difference large number of data could be hidden. Another effective method was proposed in which the host image is divided into titles and histogram shifting of low and high frequency image parts. Another method (RW-HPBS) in this method original image can be used for data hiding in two steps that is by dividing the image into non overlapping sub blocks and then a wavelet transform is applied to each of the sub block. This method provided a better visual effect after embedding the data and also better PSNR. In a next recent paper in 2006 by Ni et al.[14] Message was hidden into histogram bins. The hiding capacity reported here was low in this method.

In 2007 a new approach was reported by chrysochos called as quasi lossless method in which least occurring colours were used for incrementing the hiding capacity.[13] The image quality of host message was improved in this method with reduced hiding capacity. From single level multi level data hiding technique was developed but this schemes efficiency was depending on mainly the histogram modification scheme involved. Another paper was proposed with lossless data hiding using interior wavelet transform.

The approach of hiding data in grey scale was extended to colour image increasing the multipeek histogram. The spatial domain of RGB is used for hiding image. Below figure shows the histogram way of data hiding.

B. Mapping:

Block based mapping scheme there are look up table, location mapping and control mapping methods exist. Look up table (LUT) embed data inside the media by using the lowest distortion look up table. Mapping the data is mapped into the stable responses instead of unstable responses. Contrast mapping is a rapid watermarking embedded scheme.

C. Authentication and pixel differencing:

Block based authentication the algorithms are categorized as fragile authentication, embedding capacity, semi fragile authentication.

Another method in block based method is the block based pixel differencing scheme. Similar to the previously proposed scheme the neighbouring pixel difference is considered.

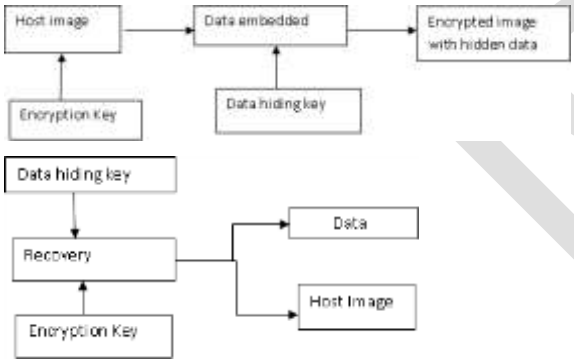
Because of the greyscale values adjacent pixel values are close to each other and that is used for hiding the data**.**

III. PIXEL BASED RDH

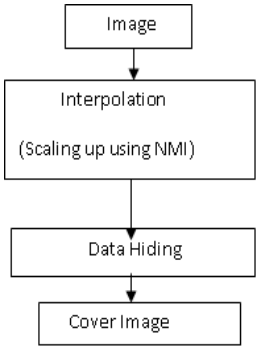
RDH (Reversible data hiding) has second alternate method as pixel based where the pixels are either modified or shifted or undergoes some logic based arithmetic computation.

In the pixel modification the pixels pairs that contain the confidential data imply matrix and they create the stegno image. After generating the stegno image the cipher text data can be hidden into the image by modifying the little data with the encrypted image. In the receiver side the encrypted image is first decrypted using the encryption key and then the code conversion helps to recover the image.

In the pixel differencing scheme by keeping the distortion low the dispersion of pixel is used to achieve large hiding capacity. In the pixel based on arithmetic coding the host image is recovered by first subtraction of embedded information .The subtraction of image and data is done by using the arithmetic coding techniques. By the prediction based encoder coding the compression efficiency is increased without losing the data embedding capacity.[11,12]



Interpolation based data hiding scheme is based on neighbour mean interpolation using R weighted coding method developed in 2010.In 2014 a reversible data hiding method with high capacity was developed based on the neighbouring mean method .



IV. COMPARISON RESULTS

The experimental comparison results given in various papers has been studied and the PSNR and the capacity of data hiding in each of the methods are tabulated

S.no	*Method used*	*authors*	*PSNR*	*capacity*
1	Color histogram	Thanuja et al. [5]	44.47	1080033
2	Histogram modification	Gui et al. [7]	35.39	262144
3	Histogram shifting	Hong et al. [6]	48.93	86178
4	Location map	Jia et al. [8]	55.40	163840
5	Contrast mapping	Lu et al. [9]	41.17	52628
6	Block based authentication	Shi et al. [10]	44.20	39321
7	pixel modification	Chang et al. [11]	45.11	262144
8	Arithmetic coding	Celik et al. [12]	38.00	9325

V. CONCLUSION

The various methods of reversible data hiding schemes has been analysed and it can be concluded that the RDH techniques discussed provide a good tool for the secured transmission of data. While analysing the experimental results the wavelet transform methods are more efficient than the spatial transform.

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