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Bidirectional Histogram Shifting Based Reversible Watermarking

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ABSTRACT: A new reversible watermarking has been proposed, which involves histogram shifting modulation and takes care of the local specificities of the image content. These methods allows the user to restore exactly the original image from its watermarked version by removing the watermark and thus it becomes possible to update the watermark content with less distortion. In this bidirectional histogram shifting modulation both the payload and PSNR value will be high were we can embed the secret image with less distortion and error. By applying it to the image prediction-errors and by proposed inserts data in the textured areas, a classification process is used for identifying parts of the image that can be watermarked with most suited reversible modulation. This classification is based on a reference image derived from the image itself, a prediction of it which has the property of being invariant to watermark insertion. In that way the watermark embedder and the extractor remain synchronized for image extraction and reconstruction. Here we are going to use Odd-Even Histogram shifting method through which we can hide two images for watermarking and based on the type application the data may vary for example the data can be an image, text or binary values. The experiments conducted so far on some natural images and on medical images show that capacities smaller than 0.7 bpp here we can insert more data with lower distortion. In Bidirectional Histogram Shifting we are going to embed and extract two or more images were the PSNR value and the Payload will be high while comparing to the existing watermark.

KEYWORDS: Reversible watermarking, Medical/Military image, data hiding, Predictive errors, PSNR

I.INTRODUCTION

Reversible watermarking has been proposed for several years for the purpose of protecting images of sensitive content like medical images or military images of which any modification may impact their interpretation which may be used for security purpose (e.g., digital signature or some authenticity codes).The motivation of Reversible watermarking is distortion-free data embedding. Even a very small change in pixel value may not be desirable especially sensitive images such as medical data or military data. In such scenario every bit of information is important. The introduction of the concept of reversible watermarking in the Barton patent, several methods have been proposed. Among these solutions, most recent schemes use Expansion Embedding (EE) modulation, Histogram Shifting (HS) modulation or, more recently, their combination. One of the main concern with these modulations is to avoid underflows and overflows. This is the reason why, there is still a need for reversible techniques that introduce the lowest distortion possible with high embedding capacity

II. REALTED WORKS

Diljith M. Thodi and Jeffrey J. Rodríguez [1] proposed Reversible watermarking enables the embedding of useful information in a host signal without any loss of host information and the method suffers from undesirable distortion at low embedding capacities and lack of capacity control due to the need for embedding a location map.] G. Coatrieux, C. Le Guillou [2]have proposed a new reversible watermarking scheme which originality stands in identifying parts of the image that are watermarked which uses Chess-Board method of Histogram shifting technique offers a very good

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compromise in terms of capacity and image quality preservation for both medical and natural images. This scheme can still be improved.
F. Bao, R. H. Deng, C.Ooi [3] proposed were the Authenticator can remove the reversible watermark and can extract the original image which is a possible for single data. H. M. Chao, C. M. Hsu [4]has presented a technique for embedding digital watermark into the images. The embedding and extracting methods of the DCT-based approach have been described.J. M. Barton [5] which involves the compressed bit stream of the location map and the data is ready to embed changeable bits of difference number in integer domain.
G.Xuan, Y.Q.Shi [6] proposes a sophisticated watermark to discourage unauthorised copying of the images we embed the watermarks with visually recognizable patterns into the images by selectively modifying the middle-frequency parts of the image.

III.REVERSIBLE WATERMARKING

A. Introduction to watermarking:

Watermarking is a data hiding technique. The basic idea of watermarking is to embed some secret information in digital images so that the secret message or information cannot be overviewed. The watermarking technique can be of visible watermark and invisible watermark.A visible watermark is a semi-transparent text or image overlaid on the original image. It allows the original image to be viewed, but it also provides copyright protection by making the image as its owner's property. Visible watermarks are more robust against image transformation thus they are preferable for strong copyright protection of intellectual property that's in digital format. An invisible watermark is an embedded image which cannot be perceived with human eyes. Only electronics devices or specialized software can extract the hidden information to identify the copyright owner. Invisible watermarks are used to mark a specialized digital content that can be a text, image or even audio content to prove its authenticity. The invisible watermark techniques consist of an encoding and decoding process. The process of embedding the invisible watermark in image is called encoding.

B.Watermarking Techniques

i. Spatial domain - Spatial domain watermark is easy to implement and the retrieval process can be done without referencing the original image.

ii. Frequency domain - Modify the coefficients of the image proper transforms, such as DCT, FFT, DWT

C. Reversible watermarking Technique

Reversible watermarking is data hiding technique that embeds secret information into a host media without loss of host information. These methods allow the user to restore exactly the original image from its watermarked version by removing the watermark.Reversible data hiding method based on histogram shifting which can recover the original image losslessly after the hidden data has been extracted from the stego-image. The method of prediction is adopted in our proposed scheme and prediction errors are produced to explore the similarity of neighbouring pixels. Thus it becomes possible to update the watermark content. The original image can be recovered without any loss from the watermarked image after extracting the secret message embedded.

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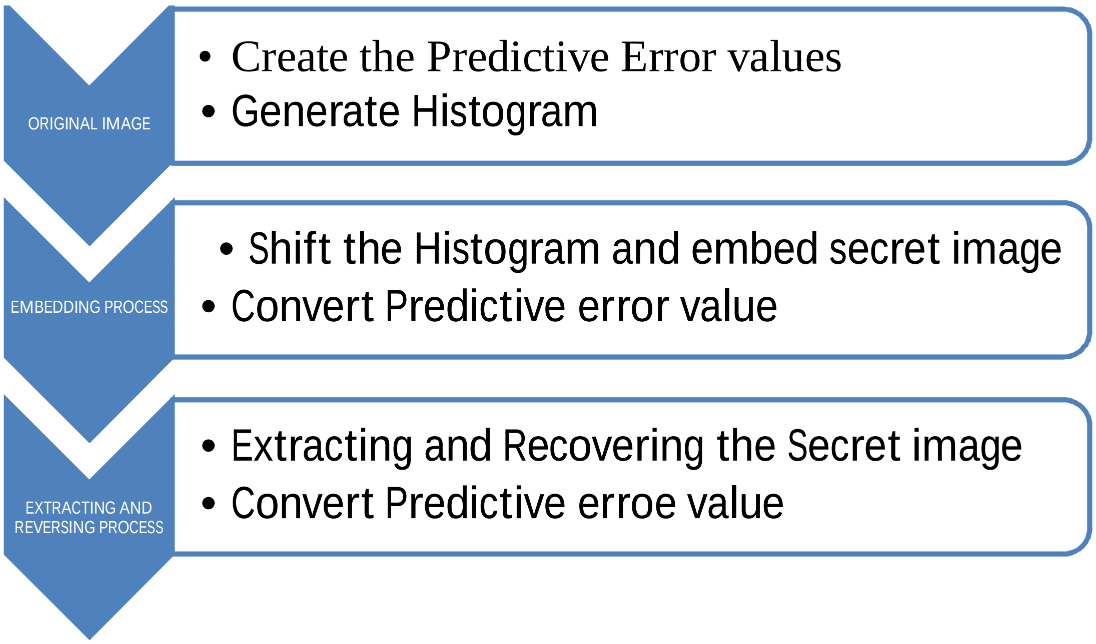

Fig.1. SYSTEM OVERFLOW

D. Histogram shifting technique

Histogramshifting (HS) is a useful technique of reversibledatahiding (RDH). With HS-based RDH, high capacity and low distortion can be achieved efficiently. The HS technique and present a generalframeworkto construct HS-based RDH. By the proposed framework, one can get a Histogram shifting algorithm by simply designing the so-called shifting and embedding functions. Moreover, by taking specific shifting and embedding functions, we show that several HS algorithms reported in the literature are special cases of this general construction. It is expected that more efficient HS algorithms can be devised according to the proposed framework by carefully designing the shifting and embedding functions.

The histogram shifting involves calculating, of the prediction errors to generate a difference image from the correlation of the neighbourhood pixels and then embedding the secret bits in the prediction errors. Here, we cannot predict the complete image at one go as in traditional prediction technique because in that case the error propagation will be very large. So, to generate the prediction errors, an image is divided into non-overlapping blocks and then uses the prediction technique to generate the prediction error blocks. From gray-value distribution in an image, we observed the characteristics of an image carefully and found out that the pixel values are highly correlated among each other. The prediction, we have to leave some pixels unused for successful reconstruction. We propose to use prediction errors to apply the histogram shifting algorithm. The reasoning behind this is that the histogram shifting algorithm uses the peak point to embed the secret information into the algorithm. In the Fig.1 the Embedding phase has been shown were we are going to embed the type of data based on the application we are using. In the Odd-Even histogram shifting first we are going to consider the Odd columns and then the Even columns were we are going to find the Highest peak points for data insertion. First the secret image is hidden inside the cover image and in the highest peak point the data has been embedded for watermarking. In this type of data insertion the Payload will be high while comparing to the previous systems.

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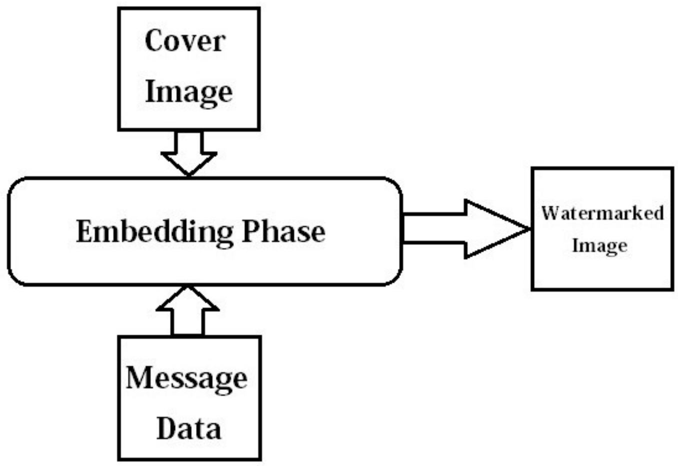

Fig.2. Embedding Data

IV. PROCEDURE

For the Bidirectional Histogram shifting modulation there is a step by step process for calculating the predictive errors of the image and there by embedding and extracting the data in the reversible watermarking technique include,

Step 1: Create the predictive errors.
Step 2: Generate the histogram of the image by Histogram shifting algorithm.
Step 3: Shift the histogram and embed the secret data.
Step 4: Convert the predictive error values.
Step 5: Extracting the secret data and recover the predictive error values.

A. Predictive error values

The embedding process of our proposed scheme involves calculating the prediction errors to generate a difference Image from the correlation of the neighbourhood pixels are then embedding the secret bits in the prediction errors. Here, we cannot predict the complete image at one go as in traditional prediction technique because in that case the error propagation will be very large. So, to generate the prediction errors, an image is divided into non-overlapping blocks and then uses the prediction technique to generate the prediction error blocks.

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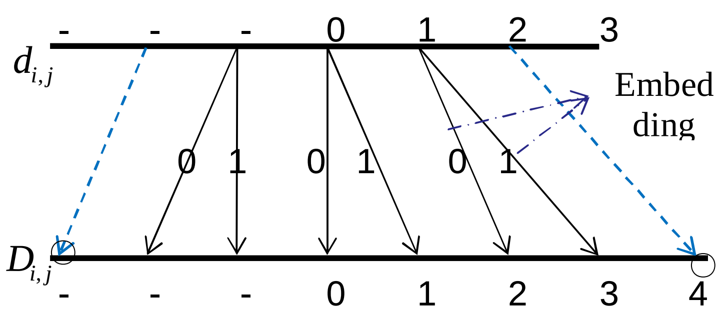

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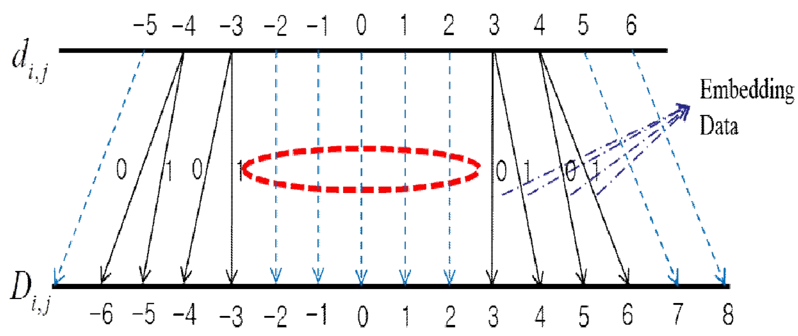


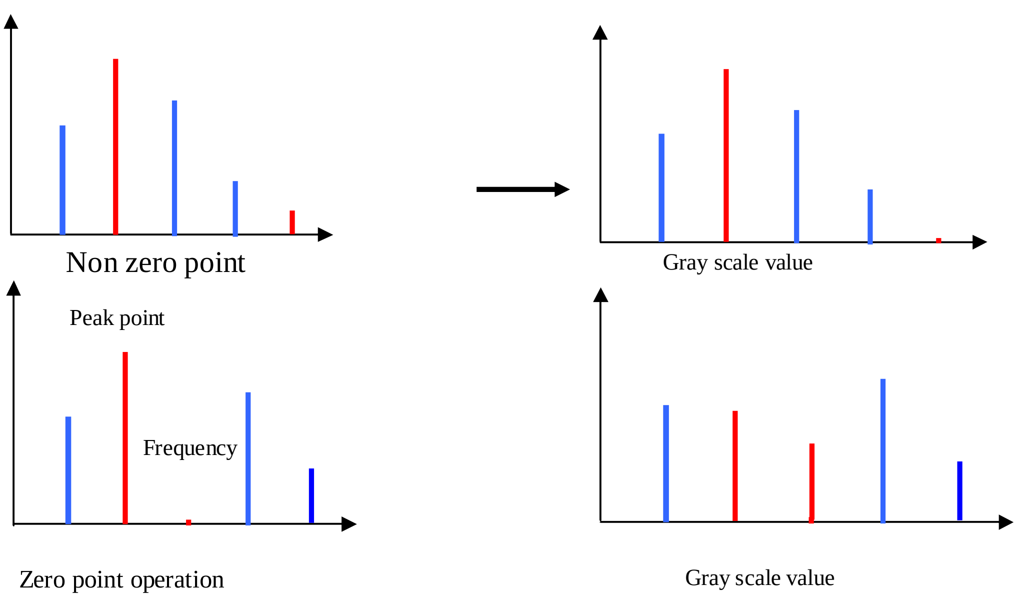
Fig.3. Finding Predictive error

B. Modified Shifting Algorithm

The histogram shifting algorithm technique is used in reversible watermarking process. Since, we know that the difference image histogram comes from prediction error, its histogram follows a Laplacian distribution and hence it will consist of peaks centered aroundnon zero and zero points near the extremes. So, in order to achieve high embedding capacity we first describe how to select peak points and achieve shifting. The modified shifting algorithm is shown as below.

1. Search for the two maxima or peak points, i.e. error values having the highest number of pixel values.
2. Find the corresponding zero points (m1, m2) such that m1 is just smaller to the first peak point (M1) and m2 is just greater than the second peak point (M2). This is done in order to avoid overlapping in the shifting phase.
3. Shift the histogram between (m1, M1) left by 1 unit and the histogram between (M2, m2) right by 1 unit.

Traditional histogram shifting algorithm is based on the pixel values, which utilizes the redundancy of the Host image statistical information to hide secret data, the sketch map is shown as follows.



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The histogram shifting is extended to the pixel differences or predictive errors to improve the performance. Reversible data hiding methods, which the proposed scheme belongs to, is based on histogram shifting. The proposed a reversible data hiding method which shifts slightly the part of the histogram between the maximum point (also called the *peak point*) and the minimum one to the right side by one pixel value to create an empty *bin* besides the peak point for hiding the input message. The knowledge of the maximum point and the minimum point of the histogram is necessary for retrieving the hidden data and restoring the stego-image losslessly to the original state. An advantage of this method is that it is unnecessary to record the knowledge of the location of the peak point because the peak location will not be changed after data hiding. But a location map is still required to store the information for restoring the cover image. The hiding capacity when compared is smaller and the peak signal-to-noise ratio (PSNR) of the stego-image gets worse in some case. The block division technique was also employed in this study to increase the hiding capacity. An important characteristic of reversible data hiding methods based on histogram shifting is that more peaks imply higher hiding capacities. Therefore, in this study we try to explore the possibility of using a larger number of peaks, instead of just one, in a block to increase the data hiding capability and decrease the distortion in the stego-image. We propose a new reversible histogram-shifting data hiding method which uses an adaptive block division is used for improving the data hiding capacity and stego-image quality. In the proposed method, each non-overlapping square block in a cover image is divided by four ways of sub-block decompositions. And the way providing the highest data hiding capacity is chosen adaptively. Compared with the existing histogram-shifting based methods, much larger hiding capacities with lower stego-image quality degradations can be achieved. The images we are considering for watermarking technique are natural images and based on the application we are considering these input images ie,

Fig.4. Natural Input images

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The concept of reversible watermarking includes Expansion embedding modulation [EE] and Histogram shifting modulation [HS].

C. Expansion embedding modulation

Expansion embedding is the technique of embedding a bit into a feature element by expanding the feature element to create a vacant position (generally at the least significant position) and inserting the bit into the vacant position. The magnitude of the feature element doubles in the process of creating a vacancy at the LSB. The distortion resulting from expansion embedding primarily depends on the magnitude of the feature elements that are expanded. Therefore, it is desirable that most of the elements of the feature set have small magnitudes. Difference expansion can be considered as a specific case of expansion embedding where the features that are expanded are the pixel differences.

D. Difference expansion with Histogram shifting

We first decompose the image into differences and integer averages and determine the expandable locations. The overflow map is losslessly compressed. The compressed overflow map and a header segment constitute the auxiliary information. The auxiliary information stream is formed by concatenating the compressed idea is based on the observation that many of the expandable differences are capable of undergoing multiple expansion/shifting. Any such difference will also satisfy the expandability criterion at the decoder. In order to further illustrate this idea, we now define the order of modifiability, which associate with every location an integer which is a measure of the ability of the difference value at a location to undergo modification. It also has dependency on the selected threshold.

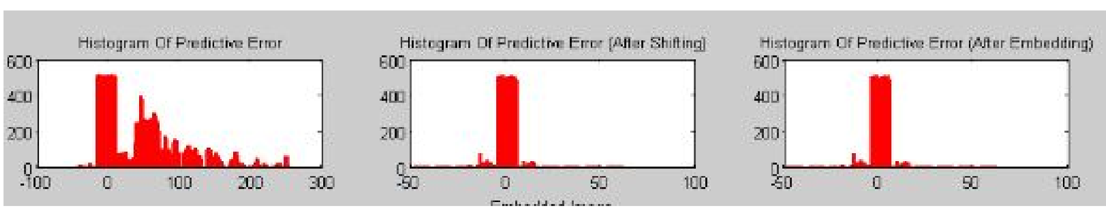

Fig.5. Predictive error values of the image

V. EXPERIMENTS RESULTS AND DISCUSSION

The proposed algorithm has been tested on different types of images. We compare our method with Extended DE method prediction- error-expansion-based method is one of the best. We evaluate the performance of these algorithms by using the embedding capacity versus compressed (overflow) location map length curve and the embedding capacity versus image quality curve. For common images like man, the histogram is sharp and narrow, compressed overflow location map has a constant length at different embedding rates, and the compressibility of the overflow location map is high. The compressed overflow location map has changing lengths for different payloads. Our overflow location map has even higher compressibility though the advantage is not large, has very good performance, but our method is slightly better than previous in PSNR (peak signal-to-noise-ratio) values under the same payload. The location map of previous method DE method has very poor compressibility. When the payload is small, the compressed location map consumes far more embedding space than the payload. This is because the method lacks capacity control capability. As the payload becomes larger the compressibility of the image also improves.

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	WITH SINGLE DATA		WITH TWO DATA	
File Name	PSNR Value	Payload	PSNR Value	Payload
Natural Image 1	48.864	0.10212	56.845	0.1350
Natural Image 2	49.675	0.10298	54.678	0.1245
Natural Image 3	45.657	0.10667	53.845	0.1156
Natural Image4	47.235	0.10345	55.845	0.1456

Fig.6. Difference between the PSNR and Payload

VI. CONCLUSION

A new reversible watermarking Scheme has been proposed that is Bidirectional Histogram shifting based Reversible Watermarking, which originality stands in identifying parts of the image that are watermarked using two distinct HS modulations: Pixel Histogram Shifting and Dynamic Prediction Error Histogram Shifting (DPEHS). The latter modulation is another original contribution of this work. By better taking into account the signal content specificities, our scheme offers a very good compromise in terms of capacity and image quality preservation for both medical and natural images. In this Bidirectional histogram shifting modulation Odd-Even histogram shifting algorithm has been obtained were both the payload and PSNR value will be high were we can embed the secret image with less distortion and error. This scheme can still be improved. Indeed, like most recent schemes, our DPEHS can be combined with the expansion embedding (EE) modulation, as well as with a better pixel prediction. However, this method is fragile as any modifications will impact the watermark. Even though some solutions have already been proposed and questions about watermark robustness are largely open. This is one of the upcoming challenges that our histogram- shifting-based algorithms perform better or as good as the other extensions.

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