A Secure Online Application Safeguarding Data with Stegnography based Watermarking

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***Abstract*— Digital watermarking is the act of hiding information in multimedia data (images, audio or video), for the purposes of content protection or authentication. In digital watermarking, the secret information (usually in the form of a bit-stream), the watermark, is embedded into a multimedia data such as cover data in such a way that distortion of the cover data due to watermarking is almost negligible perceptually. Reversible data hiding enables the embedding of messages in a host image without any loss of host content and which is proposed for image authentication that if the watermarked image is deemed authentic so we can revert it to the exact copy of the original image before the embedding occurred. *Reversible watermarking* constitutes a class of fragile digital watermarking techniques that find application in authentication of medical and military imagery. In this techniques ensure that after watermark extraction and the original cover image can be recovered from the watermarked image pixel-by-pixel. We present an improved histogram-based reversible data hiding scheme based on prediction and sorting. This paper presents a novel reversible watermarking technique as an improved modification of the existing *histogram bin shifting* technique. And also we develop an optimal selection scheme for the "embedding point" grayscale value of the pixels hosting the watermark and take advantage of multiple *zero frequency pixel values* (if available) in the given image to embed the watermark. This technique improves the peak signal to noise ratio (PSNR) of the watermarked image compared to previously proposed histogram bin shifting techniques**

Index Terms: Digital Image Watermarking, histogram bin shifting, reversible watermarking, Reversible data hiding, image authentication, lossless watermarking, data hiding, fragile watermarking

I. INTRODUCTION

The last couple of decades have seen rapid growth of research consideration in the field of reversible watermarking of multimedia data. The main goal of reversible watermarking is to maintain perfect integrity of the original content after watermark extraction. Such a feature is desirable when highly sensitive data is watermarked for example in military and medical imaging applications. Several reversible watermarking schemes have been proposed by researchers till date. An overwhelming majority of those schemes have been proposed for digital images. The researchers have continually been trying to improve the capabilities of those reversible watermarking schemes in terms of parameters such as maximum watermark embedding capacity and perceptual cover data (image) distortion. Our goal is to develop a platform, such that it is capable of analyzing and evaluating reversible watermarking algorithms, in theory as well as through simulations. Now we are presently focusing on reversible watermarking of digital images and the problem related to reversible digital watermarking which will mainly be defined as "A Theoretic Evaluation Platform Development for Reversible Watermarking Algorithms".

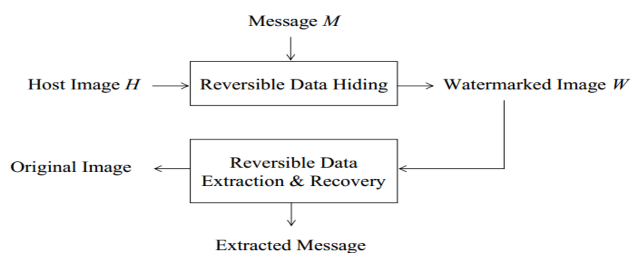

Fig. 1 The Reversible Data Hiding Procedure

Digital watermarking is one way of embedding information that means watermark in multimedia data such as image audio and video such that the embedded watermark can be later retrieved from the watermarked data for the purpose of content protection or authentication. Now in this work we concentrate on grayscale image watermarking. The Reversible watermarking is a special kind of digital watermarking which enables exact retrieval of the original image is defined as the "cover image" from the watermarked image along with embedded watermark. Then these reversible watermarking algorithms find applications in many domains where distortion free recovery of the original image after the watermark extraction is of utmost importance e.g. in medical, legal and military applications. Several classes of reversible watermarking techniques have been proposed previously. With these, *histogram bin shifting* constitute a class of techniques which are simple to implement but very effective. Here the common feature of the different variants of the basic technique is to take advantage of a pixel value for which there are no corresponding pixels in the image. For example in a 8 bit grayscale image, with the pixel values being unsigned integers in the range between 0 to 255 often there is no pixel with the grayscale value 255. Such a pixel value is often termed a *zero point*.

There are several advantages of the histogram bin shifting technique, perhaps the most significant among them being that there is no need to store the *location map*, a piece of additional information needed to retrieve the original image, if the image has at least one zero point. The distortion characteristics PSNR vs. embedded watermark size of the watermarked image is superior compared to many of the existing reversible watermarking techniques. Additionally, the computational overhead of the algorithm is less compared to most proposed reversible watermarking techniques. However, there are a few disadvantages of the histogram bin shifting based schemes, namely, the embedding capacity is less compared to most other reversible watermarking technique; the PSNR is almost independent of watermark length; and the proposed variants do not take the advantage of having multiple zero points in the given image to increase the PSNR ratio. These are the shortcomings that we strive to overcome in this work, through the adoption of the following techniques:
• In previously proposed variants of the histogram bin shifting based technique, the pixels with the most common grayscale value (“peak point”) determined the pixels that are to be used to embed the watermark. In contrast, we select the embedding point not to be always the peak point, but a variable point capable of accommodating the given watermark, and minimum pixel count away from the zero point. This reduces the number of pixels to be shifted to embed the watermark, so that the distortion of the watermarked image with respect to the original image is less. This improves the PSNR for a given watermark. • We choose the optimal zero point if multiple zero points are present in the image to further enhance the distortion characteristics of the image.

II. RELATED WORK

Performance analysis of reversible watermarking algorithms in extreme environments:

Reversible watermarking techniques find application in military and medical imagery where integrity of the cover image is of utmost importance. Though in practice, many military data transmissions occur over communication channels whose noise levels are so high that the receiving system is unable to correct all errors in the received data. During that case we are bound to get non zero distortion in the recovered cover image as well as the extracted watermark in spite of using reversible watermarking techniques. To aim investigate the effect of high data error rates on different state of the art reversible watermarking algorithms which would help users to choose the most suitable reversible watermarking scheme depending on whether the distortion of the retrieved cover image or the distortion of the retrieved watermark is the primary concern.

Reversible Application for watermarking to areas other than grayscale image security:

We tends to investigate the applicability of existing state of the art reversible watermarking algorithms to color images as well as other forms of multimedia, viz. video and audio. Another goal is to develop efficient reversible watermarking scheme for halftone images such are used in books, magazines, printer outputs, fax documents and routinely transmitted over computer networks in large numbers, in printing and publishing industries.

Localization of Tamper in reversible watermarking algorithms:

The goal of reversible watermarking is mainly twofold:

- For authenticate an image at the receiver side.
- To recover the cover image without the loss of even one bit.

Till date a number of reversible watermarking algorithms have been developed which help to achieve both these goals. In those algorithms, the cover image is accepted at the receiver side once it is authenticated, but it is entirely rejected if even a single bit is proved to be corrupted. This leads to false rejection of a large number of pixels. We intend to develop a scheme to reduce this false rejection rate by exact localization of the tampered pixels. In other words we focus to minimize the area of the cover image, surrounding the tampered pixel(s), which get discarded if authentication fails at the receiver side.

Implementation Analysis:

The existing reversible watermarking algorithms suffer from large runtime requirements when implemented using the standard image processing software such as MATLAB. This is because of the various complex operations needed for achieving the reversible property of those algorithms. One such necessary operation which is absent in other classes of watermarking is the mechanism of managing additional cover image retrieval information. Taking into account this major issue, we feel that efficient implementation of reversible image watermarking needs to be addressed. We aim to develop efficient software (e.g. through multi-threaded programming) as well as hardware implementations of reversible watermarking algorithms.

Theoretical evaluation platform development:

Having solved all the above mentioned issues we aim to develop a theoretical platform for analyzing and evaluating reversible watermarking algorithms and this would help a user to select an algorithm or a particular class of algorithms suitable for his need.

Modification of Histogram:

Ni et al. introduced a reversible data hiding scheme based on histogram modification that we will describe briefly in this section. This histogram modification technique involves generating histogram and finding the peak point and the zero point and shifting histogram bins to embed message bits. For a given host image, we first generate its histogram and find a peak point and a zero point. A peak point corresponds to the grayscale value which the maximum number of pixels in the given image is assumed. On the adverse a zero point corresponds to the grayscale value which no pixel in the given image assumes. It was explained in example the histogram of the grayscale Lena image (512×512×8) is adorned in Fig 2 where the peak point is at 154 and zero point is at 255. Let P be the value of peak point and Z be the value of zero point. The range of the histogram, [P+1, Z-1], is shifted to the right-hand side by 1 to leave the zero point at P+1. Once a pixel with value P is encountered, if the message bit is “1,” increase the pixel value by 1. Otherwise, no modification is needed. We find that the number of message bits that can be embedded into the image equals to the number of pixels which are associated with the peak point.

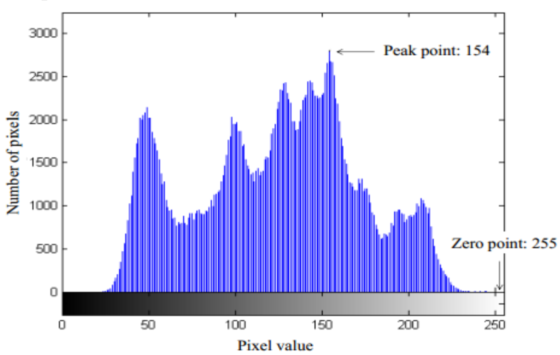

Fig 2 Histogram of the 'Lena' image

The data extraction is actually the reverse process of data hiding. When a pixel with value P+1 is met, message bit “1” is extracted and the pixel value reduces to P. When a pixel with value P is met, message bit “0” is extracted. After all message bits have been extracted, shift the range of the histogram, [P+2, Z], to the left-hand side by 1. Note that zero point defined above may not exist in some image histograms. In this consider, a minimum point that is defined as the grayscale value which the minimum number of pixels in the given image assumes is often used in place of the zero point. Though, the grayscale value and coordinate of the pixel that is associated with the minimum point need to be recorded as overhead bookkeeping information. Therefore, if the required payload is larger than the actual hiding capacity that is referred to as pure payload more pairs of peak and minimum points need to be used.

III. PROPOSED SYSTEM

Proposed Watermark Embedding Procedure

A number of algorithms have been proposed by various researchers for reversible watermarking. With the existing reversible watermarking algorithms are classified into three classes depending on their operating principles, by Feng et. al. We expand the three-way classification proposed in to have the following five classes of reversible watermarking algorithms:

- ✓ Integer transforms.
- ✓ Data compression.
- ✓ Histogram bin shifting
- ✓ Prediction of pixel values
- ✓ Alteration of frequency domain characteristics
- ✓ Lastly we discuss the main principles of the above classes of techniques in brief

In existing histogram bin shifting algorithms, the distortion of the watermarked image with respect to the original image depends on the number of pixels between the peak point and zero point of the image. Now, the peak point acts as the embed point, the pixel value used to embed the watermark. Hence, it should be possible to reduce the distortion by reducing the number of pixels between the embed point and the zero point by choosing an appropriate embed point. In our proposed scheme, from the obtained histogram we find the zero point. Then, we choose a pixel value as the embed point (not necessarily the peak point) such that its frequency is greater than or equal to the watermark size (i.e., number of bits in the watermark to be embedded), and additionally, the number of pixels between the chosen pixel value and zero point must be minimum. If there is no zero point in the given image, then the grayscale value which corresponds to the minimum number of pixels is chosen as the zero point, as in the case of existing histogram bin shifting schemes. After obtaining the embed point and the zero point, the embedding procedure is same as that of existing histogram bin shifting techniques.

All the pixels between the embed point and the zero point are shifted by one position towards the zero point and the watermark bits are inserted into the image. Note that with the increase of watermark size, the peak point itself may be the chosen as the embed point. Here, if we choose the peak point (i.e., grayscale value 2) to embed the watermark, the number of pixels needed to be shifted will be more; however, if we choose an appropriate embed point as shown, the number of pixels needed to be shifted will be less, and thus improving the PSNR. Using Multiple Zero Points The distortion can be reduced further by choosing the optimal zero point, if multiple zero points are present in a given image. For each zero point, we find the corresponding embed point. Then, provided the embed point frequency is sufficient to host the watermark, for each pair of embed point and zero point we calculate the number of pixels between them. We choose a pair (embed point and zero point) which has minimum number of pixels between them among all the pairs. This ultimately decreases the distortion of the water marked image with respect to the original image.

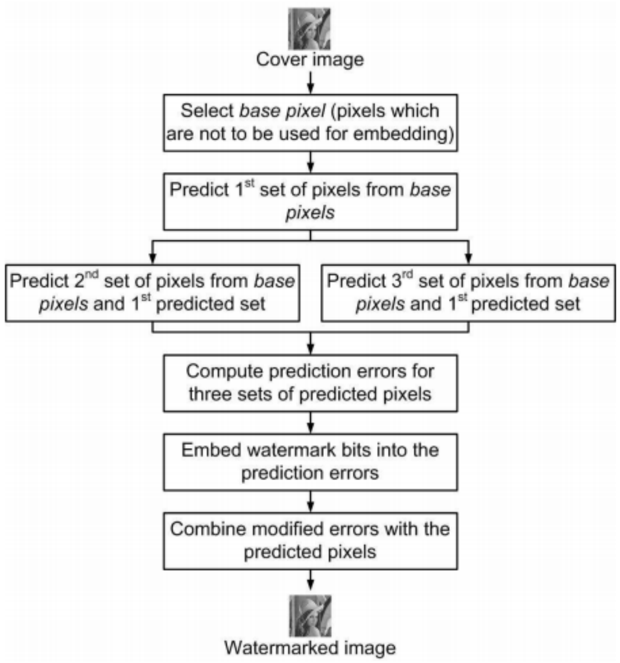

Fig 3 Watermark embedding algorithm

Proposed Algorithm [1]

The proposed algorithm utilizes usually high spatial correlation among neighboring pixel values in grayscale images. Grayscale values of a pixel are predicted from those [2] of its neighboring pixels and the watermark bits are embedded [3] into the prediction failures. Depending upon the order of prediction, pixels are divided into four classes as follows:

- The pixels of the cover image whose values remain unchanged during the watermarking process are termed base pixels.
- From the base pixels, the first set of predicted pixel values is derived.
- Further, the second and third sets of predicted pixel values are derived from the base pixels and first set of predicted pixel values.

Proposed Watermark Extraction Procedure

The watermark extraction is same as that of original histogram bin shifting as described in Section II B, the only difference being that in our proposed scheme instead of the peak point, the embed point is used for extracting watermark. whenever a pixel with grayscale value 251 is encountered, the retrieved watermarked bit is inferred to be ‘1’, and if a pixel with grayscale value 250 is encountered then the retrieved watermarked bit is inferred to be ‘0’. If a pixel with grayscale value € (250,254] is encountered, then the pixel value is decremented.

IV. CONCLUSION

In this paper we have presented a review of various classes of reversible watermarking algorithms. Reports also present a simulation based study of the performances of existing reversible watermarking algorithms in extremely noisy environment, through which we aim to provide an effective selection criteria for reversible watermarking algorithms in specific domains. Our reproduction results show that in such an environment, DCT based schemes allow cover image retrieval with the least distortion, whereas to retrieve the watermark with minimum bias, schemes based up on data compression are the most relevant. We have developed a novel watermarking algorithm which works by predicting pixel values utilizing coordinate logic operation. A study on color space appropriateness in histogram-bin-shifting based reversible watermarking of color images has also been presented in this paper, where YCbCr color spaces are found to be more appropriate than RGB color space, in both scenarios i.e. theoretical as well practical. We have also discussed reversible watermarking of halftone images as well as come up with an efficient reversible watermarking algorithm.

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