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Reversible Image Watermarking using Histogram Shifting Method

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Abstract—

Digital watermarking is a kind of data hiding technology. It is a way of embedding information in multimedia data, such that the embedded watermark can be later retrieved from the watermarked data for the purpose of content protection or authentication. In the context of data hiding, it is an interesting and challenging issue to be able to recover the host image from the watermarked image without any loss. Among different kinds of digital watermarking schemes, reversible watermarking has become a research hotspot recently. There are several reversible watermarking schemes have been introduced for protecting images of sensitive content, like law enforcement or military images, for which any modification may impact their interpretation. These methods allow the user to restore exactly the original content from its watermarked data by removing the watermark. Note that although the recovery phase guarantees the complete recovery of the original image, it is still noted that the distortion caused by data hiding should be as small as possible. The difference between watermarked image and original image is the distortion caused by the embedding process. However, if the reversibility property relaxes constraints of invisibility, it may also introduce distortion in data protection. In fact, the image is not protected once the watermark is removed. So, even though watermark removal is possible, its imperceptibility has to be guaranteed as most applications have a high interest in keeping the watermark in the image as long as possible.

Keywords— Reversible watermarking, Histogram shifting

I. INTRODUCTION

Over the past few years, the enormous increase in the use of digital content has increased the issues such as online data vulnerability and copyrights violation. One of the prominent solutions is the watermarking of the digital content. However, watermarking can cause damage to the sensitive information present in the cover work, and thus at the receiving end, the exact recovery of cover work may not be possible. Reversible watermarking, also known as lossless watermarking, allows full extraction of the embedded information along with the complete restoration of the cover work. Reversible watermarking can thus be considered as a special case of watermarking.

During the last decade, reversible watermarking has found a huge surge of experimentation in its domain as there is a huge need to recover the original image after extracting the watermark arises in various applications such as law enforcement, medical and military image system, it is crucial to restore the original image without any distortions. Encoding an identifying code into digitized music, video, picture or other file is known as a digital watermark. The main purpose to embed code into digital signal is to trace ownership or protect privacy. Taking advantage of the continuous protection watermarking offers in the storage, transmission and also processing of the information. This is the reason why, there is still a need for reversible techniques that introduce the lowest distortion possible with high embedding capacity.

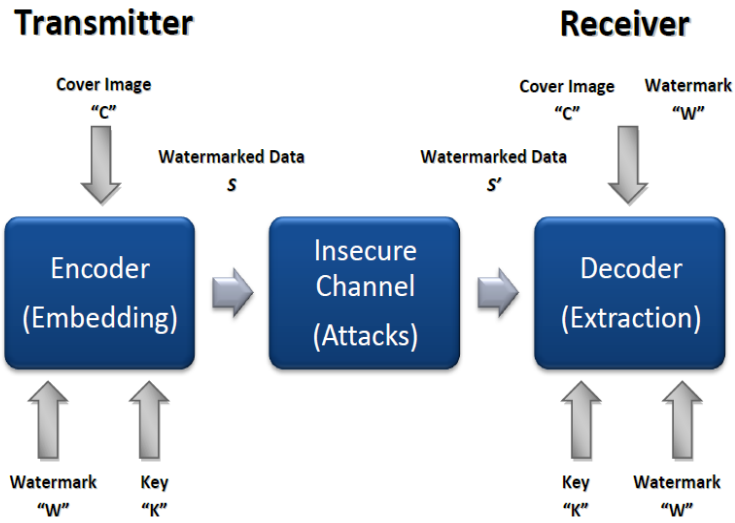

Fig-1: Basic Reversible Image Watermarking Scheme

A general framework representing reversible image watermarking is illustrated in Fig-1. All digital watermarking schemes could possibly partake in the same generic principal of the watermarking implementation which are the two watermarking systems and known as embedding and extracting systems. The scheme's input is watermark itself and it can be such image or secrete key. The digital watermark can be formed in many different forms such as a text, a number or even an image. The real use of key the scheme has is to compel the security which then can prevent those unauthorized parties from manipulating either from recovering the watermark. The watermark scheme will have an output which is the watermark data

II. SCOPE AND RELATED SURVEYS

Reversible watermarking has found a huge surge of experimentation in its domain in past decade as the need of recovering the original work image after extracting the watermark arises in various applications such as the law enforcement, medical and military image system, it is crucial to restore the original image without any distortions.Reversible watermarking schemes can be divided into three categories[3]: reversible watermarking based on lossless compression, reversible watermarking based on difference expansion and reversible watermarking based on histogram shifting. Reversible watermarking schemes based on lossless data compression use the coding redundancy in images. They compress image data so that it takes less space and use the remaining space to embed watermark data. These schemes generally require high computational complexity and their capacity is relatively small.

Difference expansion-based schemes use the interpixel redundancy that exists in natural images. Most of these schemes generate a small value based on original image and then expand the value to embed the watermark bits. Generally their capacity is higher than the previous scheme and they have less computational complexity.

Histogram shifting method was first introduced by Ni et al. [4]. This scheme uses maximum and zero (or minimum if no zero points are available) points of histogram of image and shifts the values between these points. Although this method was an effective technique, it required that some additional information be transmitted to receiver separately from watermarked image. This technique is very simple however it has a low capacity. There are several advantages of the histogram 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 characteristic (PSNR vs. embedded watermark size) of the watermarked image is superior compared to many of the existing reversible watermarking techniques. 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. Additionally, the computational overhead of the algorithm is less compared to most proposed reversible watermarking techniques.

III. SYSTEM DESCRIPTION

Over the years, several methods have been developed, each with its own advantages and disadvantages. It is witnessed that the methods for image watermarking developed so far are still having the problem of distortion up to certain extend. To reduce the distortion of watermarked image with respect to original grayscale image it is proposed to develop Histogram Shifting Technique for reversible watermarking.

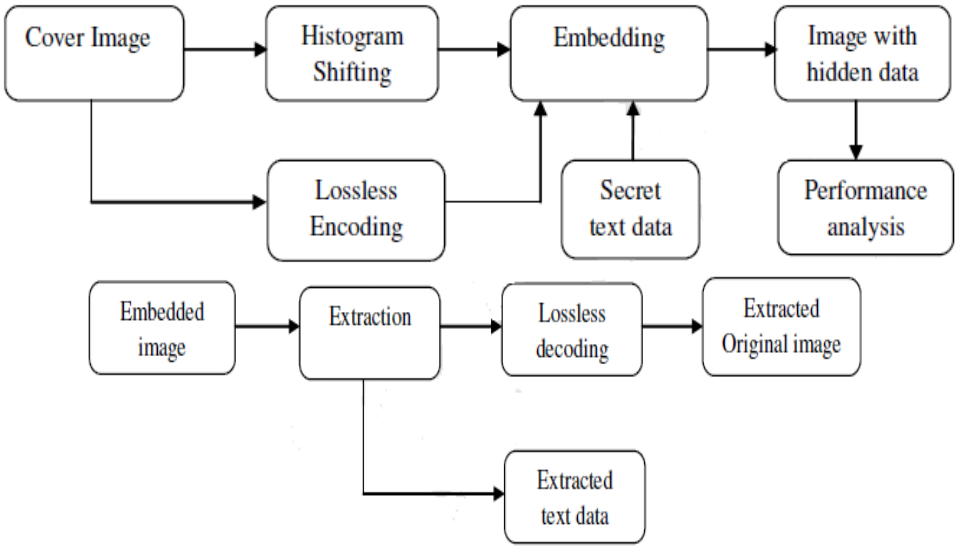

Fig-2: Block Diagram of Reversible Image Watermarking

The block diagram of reversible image watermarking is shown in Fig-2. In Histogram shifting reversible watermarking process, the sender embeds the watermark to original image by using embedding technique in a lossless manner so that we get watermark image. After receiving suspected/watermark image, de-watermarking scheme extracts it. After the message is extracted from the watermarked image, the exact copy of the original image is obtained. Note that even though the distortion introduced by hiding is completely reversible, we are most concerned to minimize the amount of the embedding distortion.

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. Here, the peak point acts as the "embed point", i.e. 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.

3.1 Algorithm:

1. Loading Input Image
2. Finding Histogram with 25 Bins
3. Bin Identification
4. Histogram Shifting
5. Loading Watermark
6. Watermark Embedding in Image
7. Parameter Calculation
8. Watermark Extraction
9. Parameter Calculation

IV. RESULT DESCUSSION

This session will gives result discussion of reversible image watermarking based on histogram shifting technique using MATLAB. These results will be used for system development.

Following figures shows an example of sample input image and the resulting output image. As this mainly focused on reversible image watermarking using histogram shifting technique embedding process, extraction process and calculation of parameters. The results will be used for system development.

For example, we will take one sample image as a original image when we run the program it will display main window, original image, histogram of original image, identify bins in histogram, shifted histogram and display histogram shifted image one by one. For embedding process watermark is required. It embeds watermark with original image and display watermarked image, it calculate PSNR, MSE, BPP of watermarked image. After this it extracts watermark from watermarked image and it recovers original image back. It also display histogram of recovered original image and calculate PSNR as well as MSE of that image. The final window will be display as shown in Fig-3.

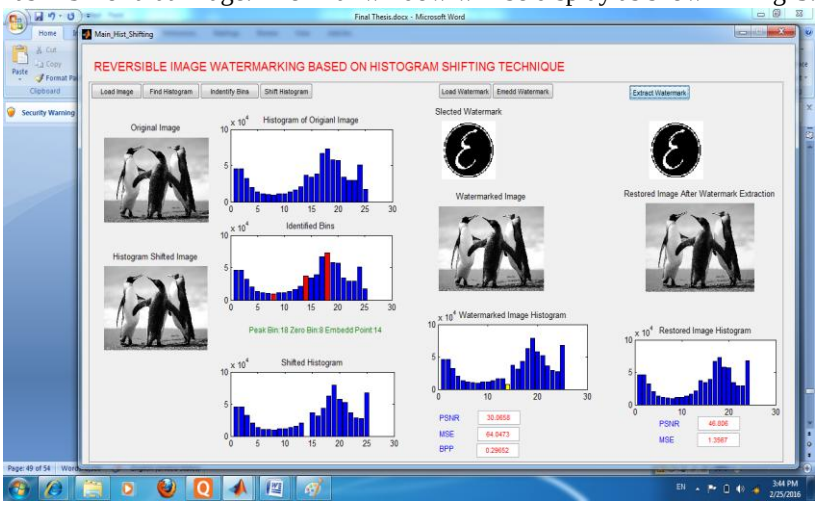

Fig-3: Final window

After embedding process and extraction process result for different input images is given in Table-1 and Table-2 respectively.

Table-1: after embedding process

Sr. No.	Name of Input Image	PSNR	MSE	BPP
1.	Chrysanthemum	30.5257	57.6119	0.30734
2.	Jellyfish	31.4386	46.6895	0.22513
3.	Lighthouse	29.9082	66.4138	0.32317
4.	Penguins	30.0658	64.0473	0.29652

Table-2: after extraction process

Sr. No.	Name of Input Image	PSNR	MSE
1.	Chrysanthemum	57.4239	0.11768
2.	Jellyfish	57.4032	0.11824
3.	Lighthouse	57.3033	0.12099
4.	Penguins	46.806	1.3567

Two reversible watermarking algorithms based on histogram shifting technique have compared that is proposed histogram shifting technique with previous histogram technique.

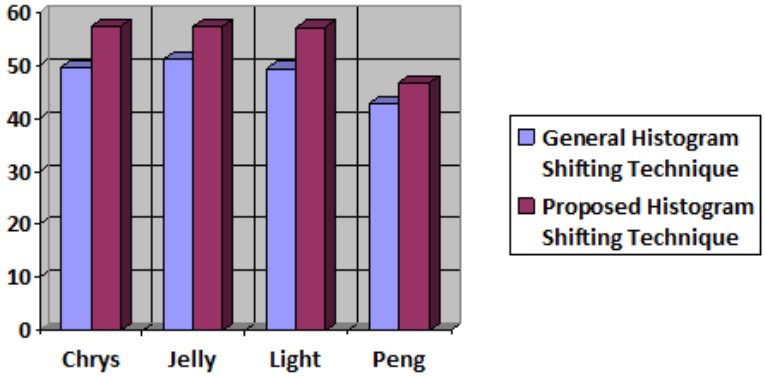

Chart-1: Graphical representation of comparison

Experimental results on four standard test images show that PSNR of proposed scheme is improved. Chart-1 shows graphical representation of comparison.

V. CONCLUSION

Histogram bin shifting is a reversible watermarking technique, well–known for its computational simplicity. Here, I have proposed a histogram bin shifting technique to minimize the cover image distortion, depending on the size of the watermark embedded. The improvement is brought about in the proposed scheme by optimal embedding point selection in the cover image frequency histogram. This process considerably reduces the number of pixels to be shifted while embedding the watermark. These enhancements considerably reduce the cover image distortion, as shown by our experimental results. This paper provides basic mechanism of reversible watermarking and by reviewing some fundamental papers in this area, momentarily discussed development and advantages of different reversible watermarking techniques based on histogram shifting. Histogram shifting based techniques reduces the size of auxiliary data and is either semi-fragile or robust.

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