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Reversible Watermarking Technique using Histogram Shifting Modulations

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Abstract— This paper proposes creating new reversible marking technique. This originally based on indentifying parts of the image which are watermarked using two different Histogram Shifting (HS) modulations. One is Pixel Histogram shifting and other is Dynamic Prediction Error Histogram Shifting (DPEHS). This technique offers a very good compromise in terms of capacity and image quality preservation for medical image and natural image. The Prediction Error Histogram Shifting (DPEHS) can be combined with the expansion embedding (EE) modulation as well as pixel prediction.

Index Terms— Dynamic Prediction Error Histogram Shifting (DPEHS), Expansion Embedding (EE), Histogram Shifting (HS), Pixel Histogram Shifting (PHS).

I. INTRODUCTION

What Is Image Processing?

Image processing is one of the methods which helps to convert image into digital form and also performs some various operations on it using various techniques. This image processing technique helps to obtain image with additional features or obtain hidden important information. In this type of study input is image which may be in video form or in picture or photograph form and gives output only image or image with characteristics. Normally in image processing image is considered as two dimensional signals and applying set as signal processing methods to them. It is used in various areas with its applications like business, research area engineering and computer science disciplines.

Normally Image Processing consists of three steps as follows:

- *Importing*- In this step the image imported with optical scanner or by digital photography.
- *Analyzing and manipulating*- Here the image analyzed and manipulated having data compression , image enhancement, spotting patterns which are not to human eyes (satellite photographs)
- *Output*- This is the final stage in which can be altered image or report based on image analysis.

General purpose of Image Processing

The general purpose of image processing consists of five groups as follows:

1. *Pattern Measurement:* Measure the interesting objects in an image.
2. *Image recognition or image understanding:* Distinguish or recognize the objects in an image.
3. *Image sharpening and image restoration:* Make an image better
4. *Visualization:* Objects that can be displayed on monitors which are not seen earlier
5. *Image retrieval:* Search for the image of interest

Types of Image Processing

Normally two types of image processing are:

- Analog Image Processing.
- Digital image processing.

Analog image processing is used for various hard copies example printouts, photographs. Various visual techniques used for analog image processing. For image processing analyst must have knowledge. By combining analyst personal knowledge and collateral data image processing done .Analog image processing data present in between 0 to 1. Digital image processing techniques is used for manipulation of digital images by using computers. This technique contains deficiencies example data from imaging sensors, from satellite platform. To obtain originality of information, raw data must undergo through various phases of image processing. Basically three general phases are considered while using digital techniques .The Phases are:

1. Pre- processing,
2 .Enhancement and display
3. Information extraction

Introduction to Watermarking:

Watermarking is a data hiding technique. The basic idea of watermarking is to insert some secret information in digital images so that the secret message or information cannot be viewed. The watermarking technique can be of two types:

- Visible watermark.
- Invisible watermark.

A watermark is nothing but a semi-transparent text or image on the original image. This allows the original image viewed along with copyright protection through the image as its owner's property. Visible watermarks are preferable for strong copyright protection which present in digital format. An invisible watermark is the inserted image which cannot be viewed with human eyes. Only some electronic devices or some special software helps to extract hidden data to identify the copyright owner.

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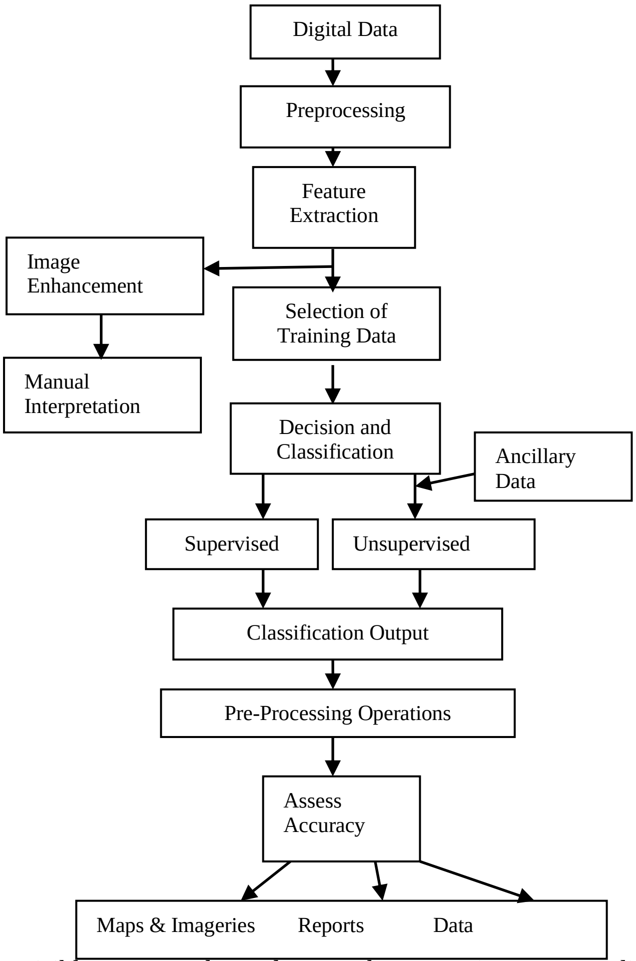
Working diagram of Image Processing:



Invisible watermark used to mark a text, image or 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.

Watermarking Techniques are:

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* – Frequency domain will modify the coefficients of the image proper transforms, such as DCT, FFT, DWT

Types of watermarking

Basically there are four types of watermarking as follows:

a) *Text Watermarking:-* Text can be added into image is called text watermarking [1]

b) *Image watermarking:-* Image can be added into an original image is called image watermarking[2]

c) *Audio watermarking:-* Some audio signals are added into audio clip is called audio watermarking[3]

d) *Video watermarking:-*Some video clips are added into video is called video watermarking[4]

Reversible watermarking Technique

Reversible watermarking is data hiding technique that embeds secret information into a host media without loss of host information. Reversible watermarking technique allows the user to restore the original image from its watermarked image with the help of removing the watermark. Reversible watermarking based on histogram shifting .histogram shifting helps to recover the original image lossless when hidden data is extracted from the steno-image. The method of prediction is used in our proposed technique and prediction errors are produced to get similarity of neighboring pixels. Hence this helps to update the watermark content. Here the original image can be obtained from the watermarked image without any loss after extracting the inserted secret message. **The watermarking techniques satisfy those requirements that are known as reversible watermarking. Reversible watermarking is designed so that it can be removed to completely restore the original image.** Reversible watermarking was a mile stone in the development of secure data hiding and digital watermarking. Several methods have been proposed to protect highly sensitive images like military images and medical images. The basis for expansion embedding was first proposed by Tian in [5], which was further generalized by [6]. Expansion embedding can also be applied to pixel prediction error. In [7] Sachnev proposed one. In [8], Ni introduced a famous HS, which was related to single histogram maxima and minimum, and shifting of all pixels between that ranges. Overhead data also need to be inserted along with original data. In [9], Neela proposed a good HS based watermarking. Watermarking and Reversible watermarking requirements based upon various attacks VIZ. Low pass filtering attack, Geometric attack, VQ attack, cropping attack are as follows

a) Security

b) Imperceptibility

c) Capacity and

d) Robustness [10].

In this paper a combination of expansion embedding along with invariant image classification is used .The invariant image classification was proposed by Gouneou Coatrieu in [11], along with histogram shifting. The method proposed by us improves the PSNR value by minimizing the image distortion

II. EXISTING SYSTEM

Normally in the Barton patent [12], various methods are proposed for the introduction of the reversible watermarking. But many latest techniques use (EE) Expansion Embedding modulation, (HS) Histogram Shifting modulation or combination of both modulations. These modulations helps to avoid underflows and overflows .The addition of a watermark signal with the original image caution must be taken which helps to remove negative value or gray level value called underflows and positive value called overflows in the watermarked image when minimizing at the same image distortion. Generally Expansion Embedding (EE) introduced by Thodiet [13]. Expansion Embedding (EE) is the concept of difference expansion modulation introduced by Tianet [14] this expands the difference between pixels which are shifted to left using its binary presentation. Hence least significant bit (LSB) can be used for data insertion. Expansion Embedding (EE) is applied in some transformed domains example wavelength domain or prediction error domain errors.

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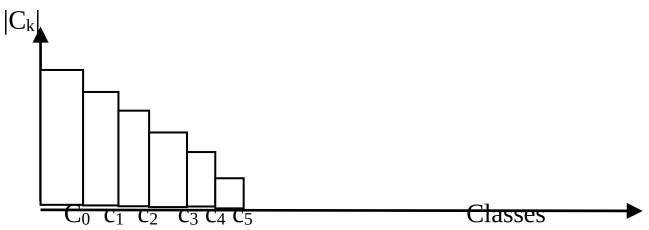
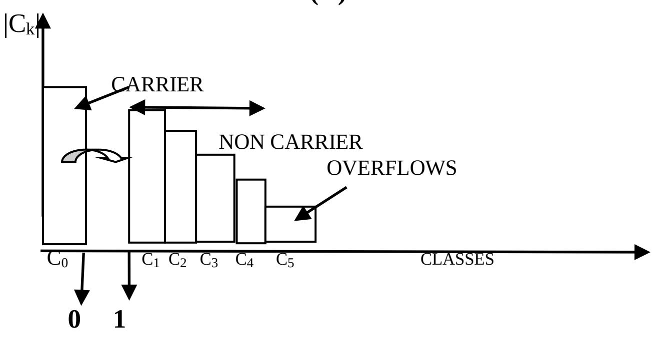
(EE) Expansion Embedding is generally consist of Least Significant Bit (LSB) substitution applied to samples but that cannot expanded due to some limitations or to maintain the quality of image. In, [7] Ni gives Histogram Shifting (HS) Modulation. Histogram Shifting (HS) adds gray values to some pixels due to which a range of classes of the image histogram is shifted and a 'gap' near the histogram maxima is created . Pixels which from the class of the histogram maxima called "Carrier-class" are transferred to the gap or kept as it is to encode one bit of the message '0' or '1'. Other pixels called "non-carriers" are shifted. Several techniques apply (HS) Histogram Shifting to some transformed coefficients or pixel prediction-errors, histograms are most of the time concentrated around one single class maxima located on zero. Due to this Histogram Shifting (HS) capacity is maximized and also the re identification of the histogram classes of maximum cardinality at the extraction stage is simplified. To reduce the distortion when preserving the capacity, some preprocessing techniques have been suggested to find pixels, transformed coefficients or prediction-errors which are not part of the histogram maxima classes ("non-carrier classes"). Normally maximum number of different techniques depends on prediction-errors do not watermark pixels inside a neighborhood of high variance; these pixels belong to histogram classes are shifted without message embedding. Hwanget [12] proposes the set of carrier-classes as the classes which minimize, for a given capacity, image distortion. The set of carrier-classes is explained for the full image and the execution time of this approach is high

DRAWBACKS OF EXISTING SYSTEM:

- Not efficient.
- Allows discontinuity in data protection.
- The modulation is overflow and underflow.
- Image is not protected in correct way.
- The image distortions are more.



(A)



(B)

Fig. 1 Histogram Shifting Modulation. (a) Original Histogram. (b) Histogram of the Watermarked Data

III. Proposed System

The proposed system used to adapt dynamically the carrier-classes by using the local characteristics of the image. We just use the local neighborhood of every prediction error to calculate the most adapted carrier-class for message introduction. The proposed system is depending upon the selection of the most locally modified lossless modulation. Reversible modulations are more or less efficient which depend on image content. This is special case for the medical images where large black areas present called the background area. By directly applying Histogram Shifting (HS) on pixels of these regions, it may be more efficient and of smaller complexity instead of applying it on prediction-errors. The histogram maxima equal to the null gray value; capacity is increased and by shifting pixel value to the right means by adding positive gray value underflows easily avoided. Thus when working on prediction-errors in these regions, the management of overflows or underflows is very hard as the shift amplitude can be positive or negative. So that by observing the local content of the image locally modified lossless modulation is selected. Thus, the proposed system allows us to optimize the compromise capacity or image deformation.

BENEFITS OF PROPOSED SYSTEM:

- Directly trying (HS) Histogram Shifting on pixels may be more powerful and of smaller difficult than trying it on prediction-errors.
- The extractor will restore the same source image so that the watermark embedder and extractor remain synchronized. This process used to select the most locally proper watermarking modulation.
- It provides robustness
- The image is well protected.
- Better pixel prediction.

IV. Implementation

At time of implementation various modules are observed as follows:

- ❖ User Module
- ❖ Invariant Image and Reversible Watermarking
- ❖ Histogram Shifting Modulation
- ❖ Error Refinement
- ❖ Reversible Watermarked Image

Modules Description:

1. User Module

In this module, the user gets login for secret data sharing by correct adding username and password. The user wants to send the privacy image for secret communication. User Interface is designed which gives facility for uploading cover image in embedding module and extracting secret data in extraction module.

2. Invariant Image and Reversible Watermarking

In this module, the user makes the two invariant images as input and then the watermarking is done both the images and again the reversible watermarking (Embedding of two invariant images as front and back) is done.

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These methods allow the user to restore the original image which obtained watermarked version by removing the watermark. Hence this helps to update the watermark content, as for Example security attributes (e.g., one digital signature or some Authenticity codes), at any time without adding new image distortions.

3. Histogram Shifting Modulation

In this module, dynamic histogram is done. Histogram shifting is a graphical representation data (input image).

HS Modulation consists of:

- PHS (pixel histogram Shifting)
- DPEHS (Dynamic Prediction Error Histogram Shifting)

Based on the pixels Image histogram shifting modulation is done. Our proposed scheme makes use of a classification process to identify parts of the image and that can be watermarked with the most appropriate reversible modulation.

4. Error Refinement

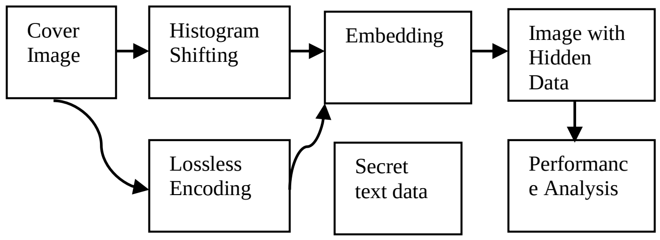
Refining and prediction of errors is done in this module. One part of the message is embedded in PHS (pixel histogram) and other part in DPEHS (Dynamic Prediction Error Histogram Shifting).A new reversible watermarking technique which originally stands in identifying parts of the image that are watermarked using two distinct HS modulations.

5. Reversible Watermarked Image

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. Our DPEHS can be combined with the expansion embedding (EE) modulation, as well as with a better pixel prediction the classification is depend upon a reference image got from the image itself, a prediction of it, which has the feature of being constant to the watermark introduction. Thus the watermark embedder and extractor remain synchronized for removal of message and image restoration.

V. PROCESS DIAGRAM

EMBEDDING



EXTRACTION

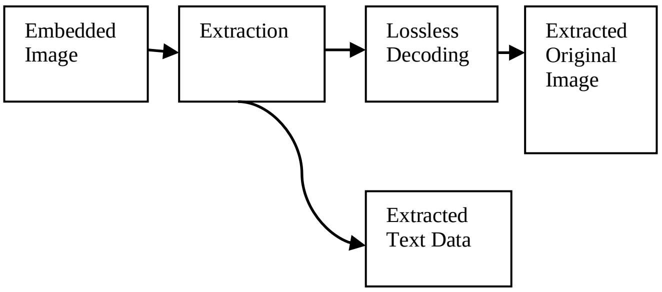


Fig. 2 Embedding and Extraction

In [7], Ni introduced a reversible data hiding algorithm which can embed about 5–80 kb of data for a 512×512×8 grayscale image with PSNR higher than 48 dB. The algorithm is depending upon the histogram shifting (HS) modification, in the spatial domain, of the original image. In Figure 2(a), the histogram of Lena is shown.

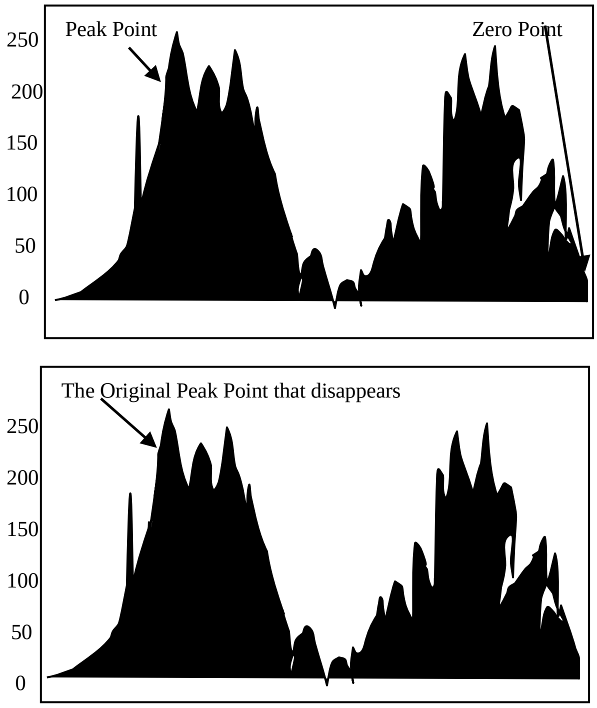


Fig. 2. (a) Histogram of Lena Image, (b) Histogram of Watermarked Lena Image

Given the histogram of the original image, the reversible data hiding algorithm initially finds a zero point (no value of that gray level in the original image) or minimum point when zero point does not exist, and then the peak point (maximum frequency of that gray level in the original image). In Figure 2(a), h (255) gives the zero point and the peak point is obtained from h (154). The number of bits that can be inserted into an image is the frequency value of the peak point. Let us consider this histogram as an example.

The first step in the embedding process (after scanning in sequential order) is to increase by 1, the value of pixels between 155 and 254 (including 155 and 254). The range of the histogram is shifted to the right-hand side by 1, leaving the value 155 empty. The current image is examined again in the same continuous order, when a value of 154 is encountered, such value is incremented by 1, if the bit value of the data to embed is 1; otherwise, the pixel value remains intact. In this case, the data embedding capacity corresponds to the frequency of peak point. In Figure 2(b) the histogram of the marked Lena is displayed. Let a and b such that a < b, the peak point and the zero point (or minimum point), respectively, of the marked image. The algorithms scan the watermarked image in sequential order (the order used in embedding phase). When a pixel with grayscale value a+1 is encountered, bit "1" is extracted.

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If a pixel with its value a is encountered, a bit "0" is extracted. The algorithm explained above is applied to one pair of minimum point as well as maximum point. An extension of the proposed system considered for many pairs of minimum and maximum points. The many pair can be treated as the many iteration of the technique for one pair. The lower bound of the PSNR of the marked image generated by the proposed algorithm can be larger than 48 dB. This value derives from the following equation.

$$PSNR = 10 \log 10 \left(\frac{255^2}{MSE}\right) = 48.13db \qquad (1)$$

In embedding process the value of pixel (between the minimum and maximum point) is added or subtracted by 1. In the worst case, MSE=1. Another advantage of the algorithm is the low computational complexity. Also the experimental results demonstrate that the overall performance of the proposed technique is good and better than many other reversible data hiding algorithm.

VI. EXPERIMENTAL RESULTS

This embed one payload with a vertical pairing then on the embedded image .This embed another payload with a horizontal pairing .The decoding will also be two parts ,first decode the horizontally embedded payload, then decode the horizontally embedded payload .The last restored image will be identical to the original un watermarked image .

VII. CONCLUSION

This paper helps to hide information in data for the purpose of protection or authentication. In this the secret information is usually in the form of bit stream. The watermark is embedded into a data (called cover data).Here the covered data restored after the watermark extraction is identical to the original cover data bit by bit

REFERENCES

1. S.W. Weng, Y. Zhao and J.-S. "Pan Reversible watermarking resistant to cropping attack", IET Inf. Secur., 2007.
2. B. Macq , J. F. Delaigle and C. De Vleeschouwer , "Circular interpretation on histogram for reversible watermarking," in IEEE Int. Multimedia Signal Process. Workshop, France, Oct. 2001.
3. Aweke NegashLemma,JavierAprea,WernerOomen,and Leon van de Kerkhof, "A Temporal Domain Audio Watermarking Technique", IEEE transaction,APRIL 2003.
4. W. Su , Z. Ni , J. Zhu, J. Chen, G. Xuan and Y. Q. Shi "Distortionless data hiding based on integer wavelet transform," in Proc. IEEE Int. Workshop Multimedia Signal Process., St. Thomas, U.S. Virgin Islands, Dec. 2002.
5. J. Tian, "Reversible data embedding using a difference expansion," IEEE Trans. Circuits Syst. Video Technol ,Aug. 2003.
6. F. Bao ,R. H. Deng ,B .C .Ooi ,and Y .Yang ," Tail ored reversible watermarking schemes for authentication of electronic clinical atlas," IEEE Trans. Inf. Technol, Dec. 2005.
7. V. Sachnev, H. J. Kim, J. Nam, S. Suresh, and Y.-Q. Shi, "Reversible watermarking algorithm using sorting and prediction," IEEE Trans. Circuit Syst. Video Technol. , Jul. 2009.
8. Z. Ni, Y. Q . Shi , N .Ansari ,and S .Wei ," Reversible data hiding, " IEEE Trans. Circuits Syst. Video Technol., Mar. 2006.
9. Vidya hari1, A.Neela madheswari "Improving Security in Digital images through Watermarking using enhanced Histogram modification " Springer, Advances in Intelligent Systems and Computing
10. Xiangyang Wang, Jun Wu, and Panpan Niu, "A New Digital Image Watermarking Algorithm Resilient to Desynchronization Attacks", IEEE transaction,DEC 2007.
11. G.Coatrieux, W. Pan, N. Cuppens-Boulahia, F. Cuppens, and C. Roux, "Reversible Watermarking Based on Invariant Image Classification and Dynamic Histogram Shifting " IEEE Transactions On Information Forensics And Security, January 2013
12. J. M. Barton, "Method and Apparatus for Embedding Authentication Information Within Digital Data," U.S. Patent 5 646 997, 1997.
13. D.M. Thodi and J. J. Rodriquez, "Expansion embedding techniques for reversible watermarking," IEEE Trans. Image Process, Mar. 2007.
14. J. Tian, "Reversible data embedding using a difference expansion,"IEEE Trans. Circuits Syst. Video Technol ,Aug. 2003.

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