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REVERSIBLE IMAGE WATERMARKING USING ADAPTIVE PREDICTION ERROR EXPANSION & PIXEL SELECTION

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ABSTRACT

Reversible image watermarking enables the embedding of copyright or useful information in a host image without any loss of information. Here we are proposing a novel technique to improve the embedding capacity i.e. reversible watermarking using an adaptive prediction error expansion & pixel selection. This work is an improvement in conventional PEE by adding two new techniques adaptive embedding & pixel selection. Instead of uniform embedding we adaptively embed one or two bits into the expandable pixels as per the regional complexity. Adaptive PEE can obtain the embedded rate up to 1.8 bits per pixel as compared to the 1 BPP of conventional PEE. As an intermediate step of prediction error expansion we also propose to select relatively smooth pixels and ignore the rough ones. In other words, the rough pixels may remain unchanged, and only smooth pixels are expanded or shifted. Also we get a more sharply distributed prediction error histogram and a larger proportion of prediction-errors in the histogram are expanded to carry hidden data. So the amount of shifted pixels is diminished, which leads to a better image quality.

KEYWORDS: Reversible Image Watermarking, Adaptive Prediction Error Expansion, Gradient Adjusted Prediction, Pixel Selection (PS)

INTRODUCTION

Among different kinds of digital watermarking schemes, reversible watermarking has become a research hotspot recently. Compared with traditional watermarking, it can restore the original cover media through the watermark extracting process; thus, reversible watermarking is very useful, especially in applications dictating high Fidelity of multimedia content, such as military aerial intelligence gathering, medical records, and management of multimedia information.

Visible watermarks are routinely added to digital images as a form of copy protection, but their presence essentially destroys the picture, obliterating information within altered pixels in a way that cannot be reversed. The system could be used for the authentication of military images. Inexpensive image editing software is now available that can be used to make essentially undetectable "photo realistic" changes to almost any photograph. In a military setting it is important to prevent unauthorized manipulation of digital images and to be able to demonstrate credibility and provenance.Digital watermarking has been widely used to protect the copyright of digital images. In order to strengthen the intellectual property right of a digital image, a trademark of the owner could be selected as a watermark and embedded into the protected image. The image that embedded the watermark is called a watermarked image. Then the watermarked image could be published, and the owner can prove the ownership of a suspected image by retrieving the watermark from the watermarked image. we can determine the ownership of the suspected image.

The earliest reversible watermarking scheme was invented by Barton in 1997 in his paper ‘Method and Apparatus for Embedding Authentication Information within Digital Data’, after that no. of reversible watermarking methods have been reported in the literature.

The Reversible watermarking algorithms are generally classified into following categories:

- Reversible watermarking using data compression,
- Reversible watermarking using difference expansion [4].
- Reversible watermarking using histogram operation.
- Reversible watermarking using integer transform [7].
- Reversible watermarking using Prediction Error

  Expansion Method [5]

In the above techniques PEE becomes can be prefered due to its potential to well exploit the spatial redundancy in natural images.

Prediction Error expansion is an improved version of Tian's Difference Expansion PEE algorithm is developed by Thodi & Rodriguez [5] in 2007 in their paper of Expansion embedding techniques for reversible watermarking, where they propose prediction-error expansion, a new method for expansion embedding reversible watermarking. Prediction-error expansion combines the advantages of expansion embedding with the superior de correlating abilities of a predictor, resulting in a higher data-embedding capacity than with difference Expansion (DE).After that no. of PEE methods developed using different prediction algorithm.

Here our objective is

- The PEE technique is further investigated and an Efficient reversible watermarking scheme is proposed .
- Incorporating in PEE two new strategies, namely, adaptive embedding and pixel selection.
- Adaptively embed 1 or 2 bits into expandable pixel according to the local complexity.
- Propose to select pixels of smooth area for data embedding and leave rough pixels unchanged

SYSTEM ANALYSIS

Existing System

Early reversible watermarking algorithms are mainly based on lossless compression, in which certain features of host image are losslessly compressed to save space for embed- ding the payload. These methods usually provide a low capacity and may lead to severe degradation in image quality. Later on, more efficient algorithms have been devised which emphasize increasing the capacity and keeping the distortion low. Mean- while, several valuable techniques are proposed, e.g., the technique of histogram shifting, the technique of difference expansion (DE), the technique of prediction-error expansion (PEE) , the technique of integer transform, etc.

Disadvantages of Existing System

- Previous methods usually provide a low capacity.
- Previous method may lead to severe degradation in image quality

PROPOSED SYSTEM

First, image pixels are predicted to get the prediction-error histogram which is a Laplacian-like distribution centered at 0. Then, a capacity-parameter is determined according to the capacity, and one gets the so-called inner region and outer region. Finally, each pixel of inner region is expanded to carry 1 bit, and pixels of outer region are shifted to eliminate ambiguity. Here, expanding or shifting a pixel means to expand or shift its prediction-error in the prediction-error histogram.

Advantages of the Proposed System

- PEE can embed a large payload by exploiting the prediction-error histogram.
- Proposed work control the distortion by simultaneously utilizing expansion embedding and histogram shifting.

System Architecture

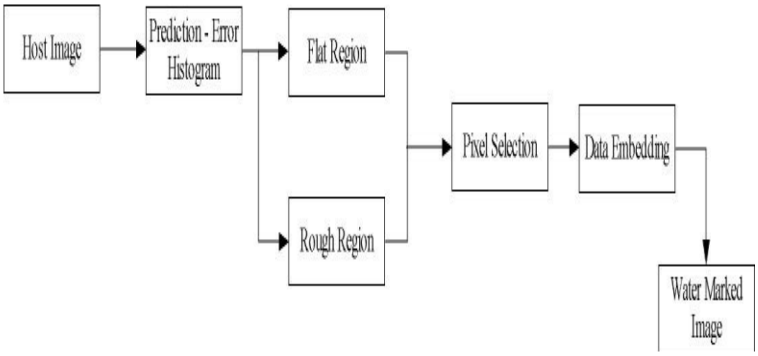

Figure 1

ALGORITHM

Algorithm (Data Embedding)

Step 1: Read into the image files, get the data matrixes of host and watermark image I(i, j) and watermark image W(i, j) , write the size of watermark into the head of the host image. I(i, j), i =1 : M, j = 1 : N, M and N are the row and column of host image respectively. W(i, j), i = 1 : m, j = 1 : n, m and n are the row and column of watermark respectively.

Step 2: Calculate the prediction error in each of the pixels.

Step 3: Divide the image pixes by flat region and rough region this can be done by Prediction-error histogram.

Step 4: Take the pixel selections for the data embeding based on prediction error resulted between a threshold.

Step 5: a. If capacity<watermark_size, the size of watermark image extends the capacity of host image, and the algorithm stop; b.If capacity<watermark_size, the watermark image can be embedded into the host image in the selected pixes. Therefore the pixel will be expanded.

Step 6: Embed the watermark data into the divided selected pixels. And export the complete image data matrix.14

Algorithm (Data Extraction)

The extraction algorithm is a reverse process to the embedding process. The detailed extraction procedures are as follows:

Step 1: Extract the size of the watermark from the head of host image data.

Step 2: calculate the prediction error in each of the pixels.

Step 3: divide the image pixes by flat region and rough region this can be done by Prediction-error histogram.

Step 4: take the pixel selections for the data extraction based on prediction error resulted between a threshold.
Step 5: extract the expanded bytes of watermark data until all bytes are extracted.

Step 6: Recover the watermarked image. that anticipate your paper as one part of the entire proceedings, and not as an independent document. Please do not revise any of the current designations.

Description

Modules

- Image partition
- Pixel Selection
- Adaptive Data Embedding
- Data Extraction

Image Partition

We first divide image pixels into two parts to get “flat regions” and “rough regions” according to local complexity; then we adaptively embed 2 bits into each expandable pixel of flat regions and 1 bit into that of rough regions. When the capacity is high, this avoids expanding pixels with large prediction-errors and reduces embedding impact by decreasing the maximum modification to pixel values. These partition are made by composed of pixels whose forward-variances are less than a threshold.

Pixel Selection

According to the capacity, the capacity-parameter and the threshold (pixel-selection-threshold) are determined which will be used to select pixels.

We pro-pose to select relatively smooth pixels (i.e., pixels located in smooth area) and ignore the rough ones. In other words, the rough pixels may remain unchanged, and only smooth pixels are expanded or shifted. In this way, compared with conventional PEE, a more sharply distributed prediction-error histogram is obtained, and a larger proportion of prediction-errors in the histogram are expanded to carry hidden data. So the amount of shifted pixels is diminished, which leads to a better image quality.

Adaptive Data Embedding

Image pixels from left to right and top to bottom are scanned, and watermark message is embedded. The embedding contains two stages. one is Expansion embedding and another one is Histogram shifting. In Expansion embedding: If the prediction-error belongs to the inner region, is expanded, and the watermarked value is computed. Data bit is embedded into the pixel. In Histogram shifting: If, the pixel does not carry any data and the prediction-error is simply shifted by to maintain the quality of image. In the above embedding procedure, the maximum modification to pixel values is the capacity-parameter, and it is the magnitude of shift which is an important. factor to the embedding performance. So, to minimize the distortion in PEE, the capacity-parameter is taken as the smallest integer such that the inner region can provide sufficient expandable pixels to embed the payload

Data Extraction

In our extraction procedure, when decoding the pixels. The decoder can only compute the backward-variance and gap from those watermarked pixels. The decoder can unambiguously.

RESULTS

For an appropriate, the predictor works better with selected pixels and the prediction-error histogram derived from selected pixels is more concentrated than the original as shown in figure 2.

As a result, a larger proportion of prediction-errors in the histogram are expanded to carry hidden data, and we get a smaller N_S.

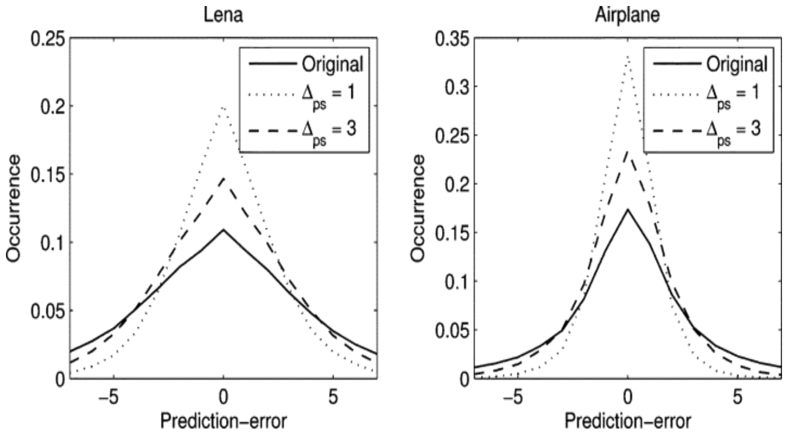

Figure 2

As we compare between conventional PEE and the PEE with pixel selection as shown in Figure 3. From this figure, we can say that significant improvement is there.

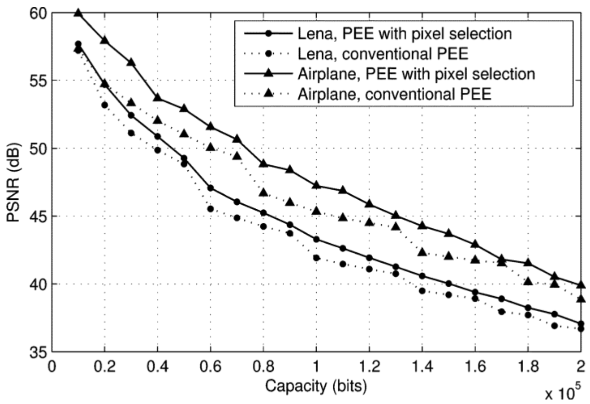

Figure 3

Output Images

Figure 4: Original Image

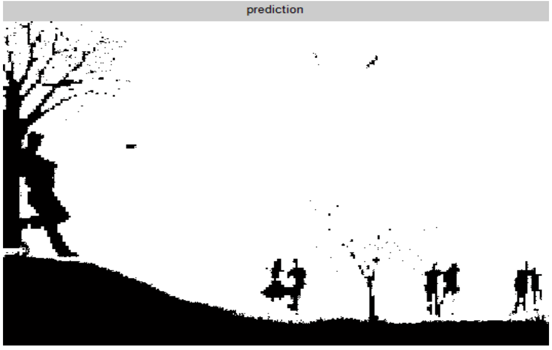

Figure 5: Prediction Image

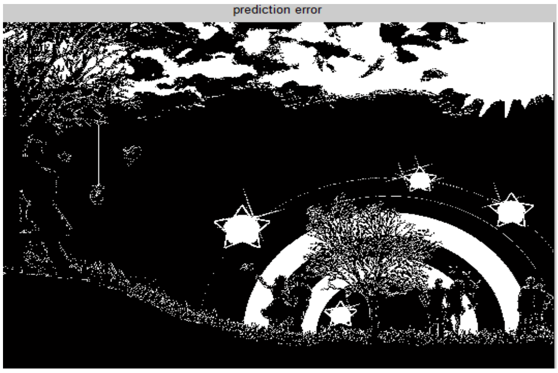

Figure 6: Prediction Error Using GAP Algorithm

Figure 7: Watermark

Figure 8: Watermarked Image

CONCLUSIONS

Here, PEE technique is further investigated and an efficient reversible watermarking scheme is presented using Adaptive prediction error expansion & pixel Selection. Unlike conventional PEE which embeds data uniformly we adaptively embed 2 bits into each expandable pixel of flat regions and 1 bit into that of rough regions. Adaptive PEE can achieve an ER as high as 1.8 BPP. As an intermediate step of PEE, we proposed to select relatively smooth pixels (i.e., pixels located in smooth area) and ignore the rough ones. It can embed larger payloads with less distortion.

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AUTHOR'S DETAILS

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