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EMBEDDING MECHANISM BASED ON MULTI HISTOGRAMS MODIFICATION

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Abstract:

In this paper, based on two-dimensional difference histogram modification, a novel Reversible Data Hiding (RDH) scheme is proposed by using Difference-Pair-Mapping (DPM). First, by considering each pixel-pair and its context, a sequence consisting of pairs of difference values is computed. Then, a two-dimensional difference-histogram is generated by counting the frequency of the resulting difference-pairs. Finally, reversible data embedding is implemented according to a specifically designed DPM. By the proposed approach, compared with the conventional one-dimensional difference-histogram and one-dimensional prediction-error-histogram-based RDH methods, the image redundancy can be better exploited and an improved embedding performance is achieved. Moreover, a pixel-pair-selection strategy is also adapted to priory use the pixel-pairs located in smooth image regions to embed data. This can further enhance the embedding performance.

Index Terms: Reversible Data Hiding (RDH) & Difference-Pair-Mapping (DPM).

1. Introduction:

Reversible data hiding (RDH) aims to embed secret message into a cover image by slightly modifying its pixel values, and, unlike conventional data hiding, the embedded message as well as the cover image should be completely recovered from the marked content. RDH is a special type of information hiding and its feasibility is mainly due to the lossless compressibility of natural images. The reversibility in RDH is quite desirable and helpful in some practical applications such as medical image processing, multimedia archive management, image trans-coding and video error-concealment coding, etc. Generally, the performance of a RDH scheme is evaluated by the capacity-distortion behavior. For a required embedding capacity (EC), to obtain a good marked image quality, one expects to reduce the embedding distortion as much as possible.

Steganography is the art and science of writing hidden messages in such a way that no one, apart from the sender and intended recipient, suspects the existence of the message, a form of security through obscurity. The word steganography is of Greek origin and means "concealed writing" from the Greek words steganos meaning "covered or protected", and graphei meaning "writing". The first recorded use of the term was in 1499 by Johannes Trithemius in his Steganographia, a treatise on cryptography and steganography disguised as a book on magic. Generally, messages will appear to be something else: images, articles, shopping lists, or some other cover text and, classically, the hidden message may be invisible ink between the visible lines of a private letter.

The advantage of steganography over cryptography alone is that messages do not attract attention to themselves. Plainly visible encrypted messages no matter how unbreakable will arouse suspicion, and may in themselves be incriminating in countries where encryption is illegal. Therefore, whereas cryptography protects the contents of a message, steganography can be said to protect both messages and communicating parties.

2. Related Works:

A novel reversible data hiding algorithm, which can recover the original image without any distortion from the marked image after the hidden data have been extracted, is presented in this paper. This algorithm utilizes the zero or the minimum points of the histogram of an image and slightly modifies the pixel grayscale values to embed data into the image. It can embed more data than many of the existing reversible data hiding algorithms. It is proved analytically and shown experimentally that the peak signal-to-noise ratio (PSNR) of the marked image generated by this method versus the original image is guaranteed to be above 48 dB. This lower bound of PSNR is much higher than that of all reversible data hiding techniques reported in the literature. The computational complexity of our proposed technique is low and the execution time is short. The algorithm has been successfully applied to a wide range of images, including commonly used images, medical images, texture images, aerial images and for the images in CorelDraw database.

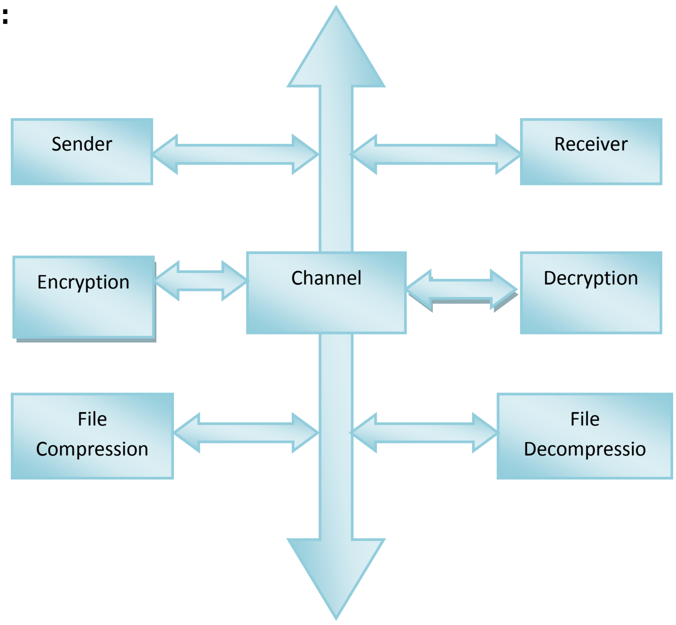
3. Proposed Work:

In the proposed method, by considering a pixel-pair and its context, a local image region is projected to a two-dimensional space to obtain a sequence consisting of difference-pairs. Then, a two-dimensional difference-histogram is generated by counting the difference-pairs. Finally, reversible data embedding is implemented according to a specifically designed difference-pair-mapping (DPM). Here, the DPM is an injective mapping defined on difference-pairs, and it is a natural extension of expansion embedding and shifting techniques used in current histogram-based methods. By using the two-dimensional difference-histogram and this specific DPM, compared with the conventional one-dimensional histogram based methods, more pixels are used for carrying data while the number of shifted pixels is reduced as well, and thus an improved embedding performance is achieved.

Advantages:

- ✓ Two-dimensional difference-histogram is fully utilized
- ✓ Image redundancy will be better exploited.
- ✓ More data bits can be embedded without degrading the marked image quality.
- ✓ PSNR is slightly improved.
- ✓ Improved embedding performance is achieved.

System Architecture:



Module:

- ✓ Generation of 2-D Difference Histogram
- ✓ Histogram modification using DPM
- ✓ Embedding Information and Compression
- ✓ Decompression and Data Extraction
- ✓ Image Restoration.

Generation of 2-D Difference Histogram:

For the proposed method, by considering a pixel-pair and its context, a local image region is projected to a two-dimensional space to obtain a sequence consisting of difference-pairs. Then, a two-dimensional difference-histogram is generated by counting the difference-pairs. By using the two-dimensional difference-histogram and DPM, compared with the conventional one-dimensional histogram based methods, more pixels are used for carrying data while the number of shifted pixels is reduced as well, and thus an improved embedding performance is achieved.

PPM in which a subset of is divided into two disjointed parts as black points and blue points, each black point is mapped to a blue one (indicated by a green arrow) and each blue point is mapped to another blue point. Here, each point represents the value of a pixel pair and the black points are used for expansion embedding while the blue ones for shifting. According to this PPM, for a cover pixel-pair, its market value can be determined in the following way:

- ✓ If (i.e., is a red point), the marked pixel pair is taken as itself.
- ✓ If or (i.e., is a black point)
- ✓ If the to-be-embedded data bit, the marked pixel-pair is taken as itself.
- ✓ If the to-be-embedded data bit, the marked pixel-pair is taken as its associate blue point.
- ✓ If or (i.e., is a blue point), the marked pixel-pair is taken as its associate blue point.

The corresponding data extraction and image restoration process can also be demonstrated according to the PPM since it is an injection, i.e., each point has at most one inverse. The trivial description is omitted. From the PPM viewpoint, Lee *et al.*'s difference-histogram based method is actually implemented by modifying the two dimensional pixel-intensity-histogram. Lee *et al.*'s method only modifies the second pixel of the pair. Thus two modification directions, up and down, are allowed in data embedding. This is to say, in PPM, a point can be either mapped to its upper neighbor or lower neighbor. Actually, one can also modify the first pixel without introducing additional distortion resulting in modification directions left and right. In this way, the associate mapped point of has four choices: or Based on these for modification directions, Lee *et al.*'s method can be improved by designing a new PPM .According to this figure, one can see that more pixel-pairs (black points) are utilized for expansion embedding, and the number of shifted pixel-pairs (blue ones) is reduced as well.

Histogram Modification Using DPM:

In this module, an injective Difference Pair Mapping (DPM) is done to the 2D Difference Histogram obtained from the previous module. The advantage of DPM over Pixel Pair Mapping (PPM) is that this method uses more redundant data and so more data can be embedded (Embedding capacity of the system is increased).

Embedding Information and Compression:

The proposed data embedding procedure contains several basic steps. First, divide the cover image into non overlapping pixel-pairs. Then, embed the secret message into a part of cover image (noted as I''). Next, record the least significant bits

(LSB) of some pixels of (noted as) to get a binary sequence, and embed this sequence into the rest part of, i.e., I-I'. Finally, by using LSB replacement, embed the auxiliary information and the compressed location map into I.

Decompression and Data Extraction:

The corresponding data extraction process is as follows. The data extraction is carried in two basic steps.

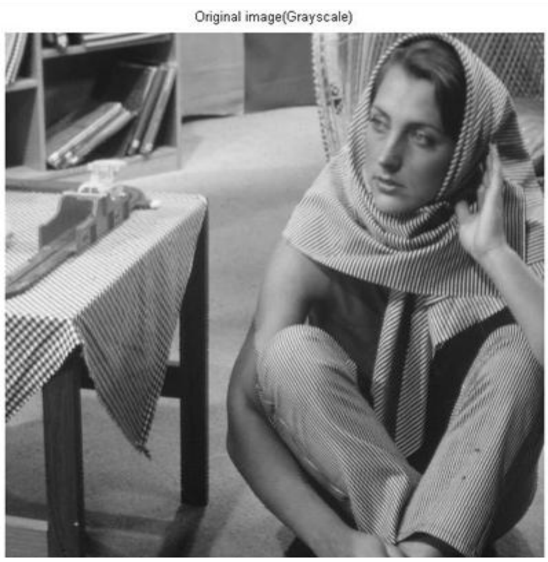
- ✓ In the first step, the compressed location is determined and the location is decompressed.
- ✓ In this step, we extract the LSB sequence which was defined during the data embedding process.

Image Restoration:

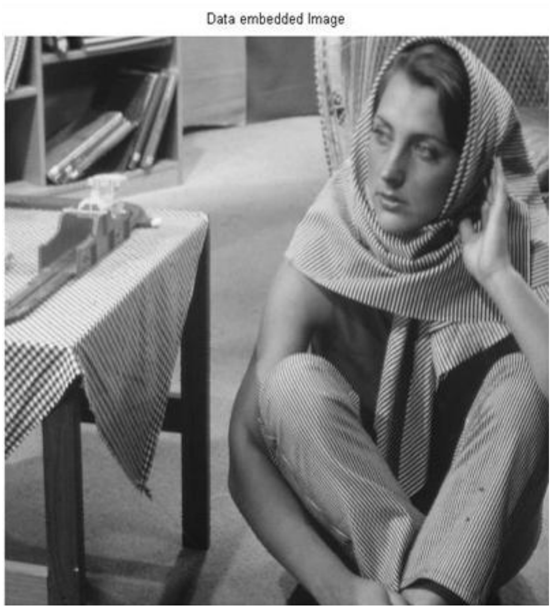
The extracted data is restored in this module. Replace LSB of the first image pixels by the sequence extracted in the step above. Then use the same method as Step-2 of MODULE 4 to extract the embedded message from the first pixel-pairs, and meanwhile to realize restoration for these pixel-pairs.

4. Experimental Analysis and Results:

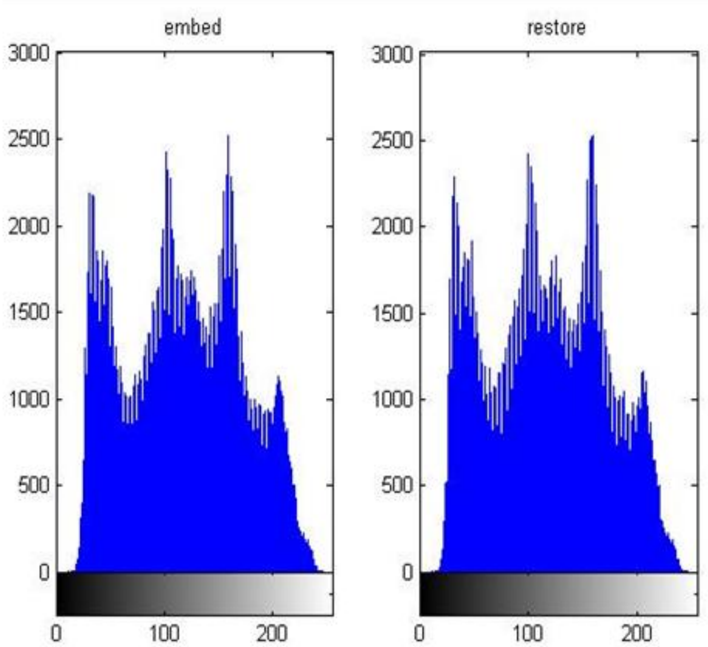
RGB Input Image:



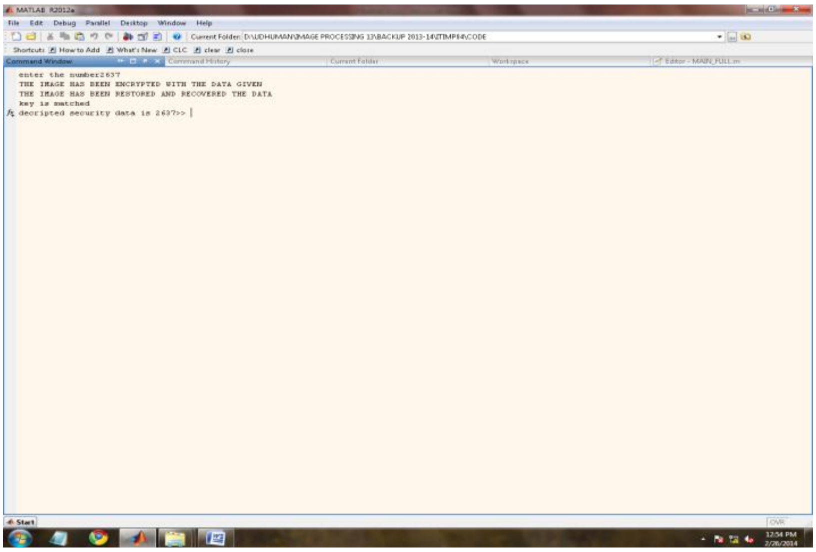
Embedded Image:



Histogram For Input Vs Embedd Image:



Command Window:



5. Conclusion:

In this paper, we presented a novel RDH scheme by using a two-dimensional difference-histogram according to a specifically designed DPM. In addition, a pixel-pair-selection strategy is also proposed to further enhance the embedding performance. This work is the first attempt to employ higher dimensional histogram to design RDH. Compared with the previously introduced one-dimensional histogram based methods, our approach can exploit the image redundancy better and achieve an improved performance. However, since only one pixel of a pixel-pair is allowed to be modified by 1 in value, our EC is low.

6. References:

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