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Local Prediction Based Difference Expansion Reversible Watermarking

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ABSTRACT: The use of local prediction in difference expansion reversible watermarking provides very good results, but at the cost of computing for each pixel a least square predictor in a square block centered on the pixel. The same predictors are recovered at detection. Experimental results shown that by computing PSNR for different block sizes improves the quality of an image without any loss in performance.

KEYWORDS: Reversible watermarking, local prediction, difference expansion.

I.INRODUCTION

In the classical watermarking the permanent distortion introduces so that to recover the original signal and to embed the data we uses the reversible watermarking. The reversible watermarking approaches are reversible watermarking based on lossless compression, on histogram shifting and on difference expansion. [1] In the lossless compression, it substitutes a part of the host with the compressed code of the substituted part and the watermark In order to avoid artifacts, the substitution should be applied on the least significant bits area where the compression ratio is poor. This limits the efficiency of the lossless compression reversible watermarking approach. A more efficient solution is the histogram shifting approach. [1] In the histogram shifting approach, the histogram of a pixel based image feature is considered. A histogram bin is selected and the space for data embedding is created into an adjacent bin. In a single embedding level, the approach provides an embedding capacity of the same order as the size of the selected bin. The embedding is performed into the smallest two bins, one from the left and the other for the right that provide the needed capacity. Since only the tails of the histogram must be shifted, the distortion is minimized. As the required embedding capacity increases, more embedding stages are performed. While in a single embedding stage the histogram shifting approach introduces distortion of at most one gray level per pixel, this is no longer true for multiple embedding levels. In such cases, the most efficient approach is difference expansion (DE).The difference expansion approachexpands two times the difference between adjacent pairs of pixels. Then, if no overflow or underflow appears, one bit of data is added to the expanded difference. In fact, the expansion is a simple multiplication by two.

Thus, the least significant bit (LSB) of the difference is set to zero and is substituted by a bit of data. The embedded pixels are identified by using a location map with one bit for each pair of pixels. The map is lossless compressed and embedded into the image as well. At detection, the embedded bits are immediately recovered as the LSBs of the pixel differences and the original pixels are recovered. A major advance for the DE algorithms is the increase of the theoretical embedding bit-rate to 1 bits per pixels obtained by embedding into each pixel. For medical images, a practical solution to increase the embedding bit-rate is the adaptive switching between difference expansion and histogram shifting in order to embed the large white (or black) regions of such images. Fast DE schemes have also been proposed .A continuous effort in DE and generally in reversible watermarking is devoted to the improvement of the quality of the algorithms. The aim is to reduce the embedding distortion. An important advance in this direction is the replacement of the location map by a histogram shifting procedure allowing the identification of the embedded pixels based on the corresponding difference .More precisely, the pixels that cannot be embedded are modified in order to provide, at detection, a greaterdifference than the embedded ones. The pixels that cannot be shifted or embedded are identified by an overflow/underflow map. The overflow/underflow map is considerably more efficiently compressed than the original location maps the results of the local prediction based schemes are very good, but their mathematical complexity is rather high.

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In this correspondence we focus on the reduction of the mathematical complexity of local prediction reversible watermarking. The basic idea of this approach is to compute a distinct predictor not for each pixel, but computing it for the pixel grouping

II. RELATED WORK

Ioan-Catalin Dragoi, Member, IEEE, and DinuColtuc,[1]The local prediction based reversible watermarking is used in this paper and the original local prediction based watermarking introduces the mathematical complexity, but using local prediction with groups of Pixels provides almost the same results, at a considerably lower complexity. For groups of two vertical (horizontal) pixels the computational complexity is reduced without degradation in performance. The best compromise between quality and complexity can be obtained for vertical/horizontal grouping of four pixels, namely the computational complexity is reduced.

P.Tsai, Yu-ChenHub,,Hsiu-LienYeh [4]In this paper, the reversible image hiding scheme is used for medical approaches. As we know, the histogram-based reversible data hiding is limited by the hiding capacity, which is influenced by the overhead of position information that has to be embedded in the host image. To solve this problem, the similarity of neighbouring pixels in the images was explored by using the prediction technique and the residual histogram of the predicted errors of the host image was used to hide the secret data in the proposed scheme. In addition, the overlapping between peak and zero pairs was used to further increase the hiding capacity.

J.Tian[8] This paper proposes a novel reversible data embedding method for digital images. It explores the redundancy in digital images to achieve very high embedding capacity, and keep the distortion low. Mostly the reversible watermarking techniques are used nowadays because to recover the original signal.

Diljith M. Thodi and Jeffrey J. Rodríguez,[6] In this paper the new technique introduces the pixel correlation which is nothing but the difference expansion scheme which enables the original signal without degradation of information.so uses the histogram shifting technique to embedding the data in to an image. In this paper the new technique is used which is of the prediction error expansion. The combination of the histogram shifting and the prediction error expansion technique gives affective results.

V. Sachnev, H. J. Kim, J. Nam, S. Suresh, and Y. Q. Shi,[2]In this paper the reversible watermarking algorithm is used without using the location map. This algorithm uses the prediction error to embed data into an image. So in this paper a sorting technique is used to record the prediction errors based on magnitude of its local variance.

X. Li, B. Yang, and T. Zeng,[3] In this paper Prediction error expansion technique is used which embed the payload into an images results into an low distortion. And also the adaptive embedding and the pixel selection these two new embedding techniques are included in this paper.

From the methods discussed above, we can conclude that the difference expansion reversible watermarking approach is better than the lossless compression & histogram shifting approach. And the novel local prediction used in difference expansion reversible watermarking provides good result but investigates the mathematical complexity. Hence, we propose the method that uses the local prediction based reversible watermarking with grouping of two vertical (horizontal) pixels the computational complexity is reduced without degradation in performance.

III. PROPOSED SYSTEM

Figure 1 shows a block diagram of proposed system. In which the input image is predicted by applying the local prediction. And then the data is embedded to an input image. Resulting the reversible watermarking difference expansion scheme is used for the groups of pixels to recovers the original data.

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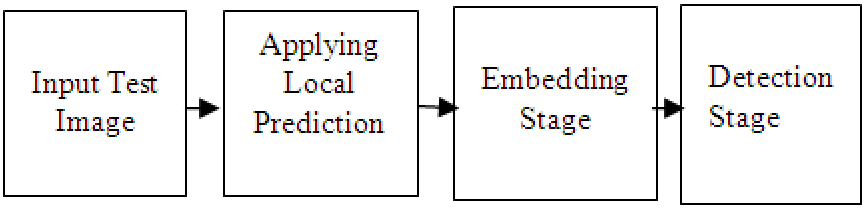

Fig. (1) Proposed System for Reversible Watermarking

- **Local prediction for groups of pixels:**

The basic prediction error expansion scheme predicts pixels and, if the prediction error is less than a predefined threshold and no overflow or underflow appears, the error is expanded and a bit of data is embedded into the prediction error. The expansion consists in the addition of the prediction error to the current pixel. For each pixel, least-squares predictor in a B × B block centered on the pixel. Half of the pixels within the block are modified (they have been embedded or shifted) and half are original, not modified pixels. Once predicted, the current pixel is modified (either embedded or shifted). Obviously, in order to recover the same block at detection, the current pixel should not be considered in the computation of the current predictor.
This problem is solved by replacing the pixel with an estimated value before the computation of the LS predictor. The grouping is performed in order to ensure a close neighbourhood between the pixels and, implicitly, a good correlation between them. The pixels of each group are numbered according to the processing order at the embedding stage.

$$\tilde{x}_{i,j} = x_{i-1,j} + x_{i+1,j} + x_{i,j-1} + x_{i,j+1} / 4 \quad \ldots\ldots. (1)$$

- **Basic difference expansion reversible watermarking scheme:**

After the prediction, the centered pixel value is replaced by the Estimation of the central pixel. This value is embedded using basic reversible watermarking scheme.

1. Calculating the difference value.
2. Partitioning the difference values into four sets.
3. Creating a location map.
4. Collecting original LSB values.
5. Data embedding by replacement.

The detection proceeds pixel by pixel and row by row, starting with the last marked pixel. According to pixel position, the appropriate predictor is selected. If the pixel is a border Pixel, the fixed predictor is used. Otherwise, the least square predictor is computed for the data block centered on the current pixel. If the pixel has been embedded, the message bit is extracted and the original pixel is recovered.

IV.EXPERIMENTAL RESULTS

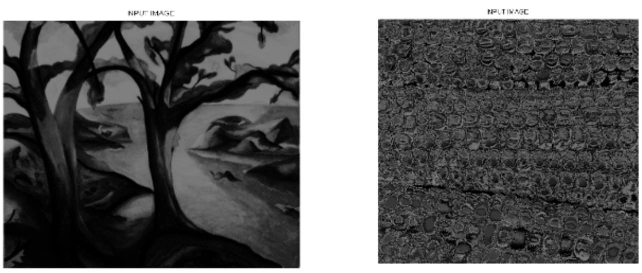

Fig.(2) Test images: Trees, Corn

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Fig.(3) Test images: Pout, Moon

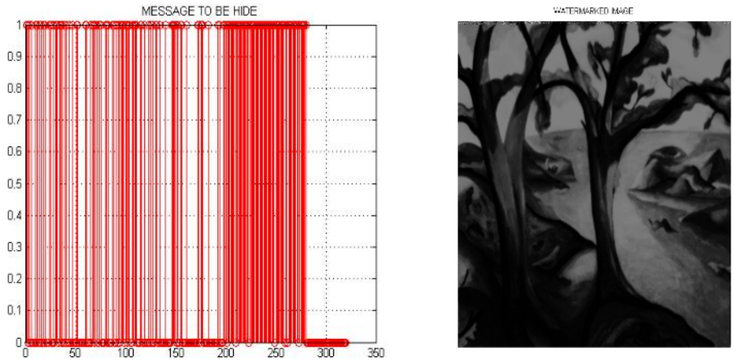

Fig.(4) Experimental results for the test image Trees

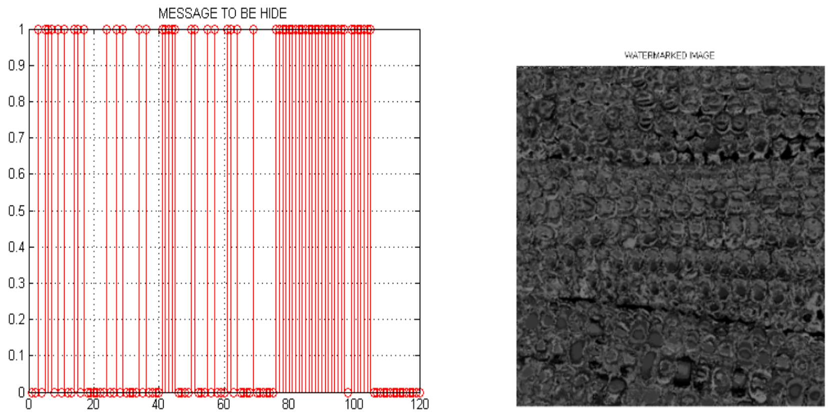

Fig.(5) Experimental results for the test image Corn

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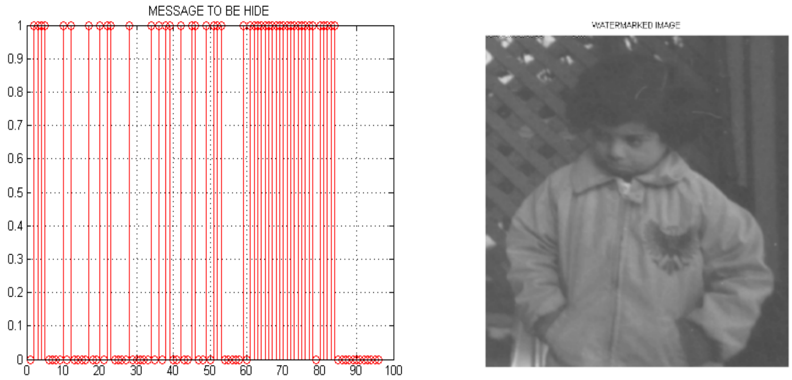

Fig.(6) Experimental results for the test image Pout

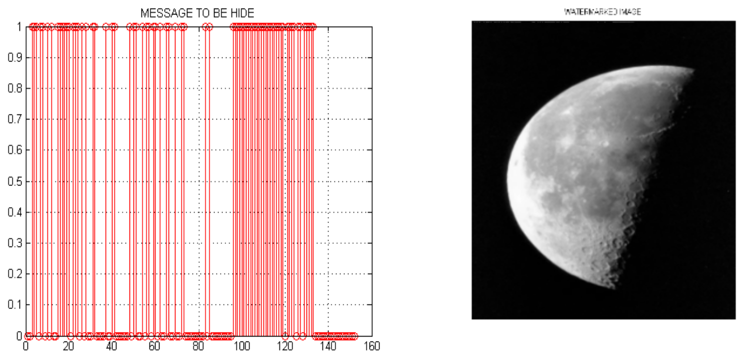

Fig.(7) Experimental results for the test image Moon

PSNR COMPARISONS WITH DIFFERENT BLOCK SIZES

Test image	Block Size(PSNR)		
	8 x 8	12x12	16x16
Trees	58.58	58.68	59.17
Corn	58.26	58.38	58.98
Pout	57.44	57.65	58.43
Moon	61.36	62.16	62.90
Boat	57.39	57.70	59.03
Tifany	55.44	55.90	57.89
LenaTest2	57.71	58.01	59.57
Barbara	57.61	57.86	58.83
Baboon	56.97	57.27	58.43

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V.CONCLUSION

The local prediction based reversible watermarking with grouping of pixels has been proposed using the difference expansion approach Compared with the different block sizes. With increasing of block size the PSNR increases and the test image quality improves.

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