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SEMICUSTOM IMPLEMENTATION OF REVERSIBLE IMAGE WATERMARKING USING REVERSIBLE CONTRAST MAPPING

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***Abstract* - In this paper, proposed a reversible image watermarking method based on contrast mapping. This algorithm accomplishes transform applied on pixels and their least significant bits are used for data embedding. It is invertible if the least significant bits of the transformed pixels are lost during data embedding. Reversible contrast mapping offers high embedding data at low visual distortion. Distortion caused due to embedding should be made small. This lead to the original and the watermarked image equivalent so that embedded data remains imperceptible on visualization. These type of imperceptible distortion is not acceptable in medical and military image. This has led to an interest on reversible watermarking, where the embedded watermark is not only extracted but also perfect restoration of the original signal is possible from the watermarked image. Low computation cost and ease of semicustom make it attractive for real time implementation**

Keywords:Reversible image watermarking, Reversible contrast mapping, Semicustom

I. INTRODUCTION

Digital watermarking is expressed as a knowledge concealing technique that is developed for functions like identification, copyright protection and classification of digital media content. During this technique, a secret information referred to as watermark is embedded into the digital transmission content with in the decoder, watermark information is extracted from the watermarked signal in an exceedingly loss less manner though original signal can't be obtained back. In some

necessary applications like military notional, rhetorical law and medical notional, distortion within the original signal might cause fatal results. For instance, a tiny low distortion in an exceedingly medical image might interfere with the accuracy of document identification. Distortion issues which can arise in an exceedingly applications will be fastened in a reversible watermarking technique.Reversible image watermarking algorithms can be divided into five groups. Lossless compression based algorithms, difference expansion based algorithms, and histogram shifting based algorithms, prediction error expansion based algorithms and integer to integer transform based algorithms. Performance of a watermarking algorithm is categorized into three parts. They are visual quality, payload capacity and computational complexity.

A hardware implementation can be designed on a field programmable gate array board or custom integrated circuit. The difference between FPGA and custom IC implementation is a trade-offamong the cost, power consumption and performance. Hardware implementation using FPGA has advantages of low investmentcost, simpler design cycle, field programmability and desktop testing with medium processing speed. On the other side, due to lower unit cost, full customcapability and from an integration point, custom implementation application specific integrated circuit design may be more useful. During past years, FPGAs wereselected primarily for lower speed, complexity, volume designs, but today's FPGAs can easily push upto the 500 MHz performance barrier

A literature survey is survived for various papers which are important to know the previously available techniques and their advantages and limitations. It also includes the various supporting papers for the proposed technique and their advantages. There are many techniques available for reversible image watermarking. The reversible contrast mapping method provides to embed and extract the watermarking. The data of secretly hiding and communicating information has gained immense importance in the two decades due to the advantages in generation, storage, and communication technology of digital content. Watermarking is solutions for tamper detection and protection of digital content. Watermarking can cause damage to the information present in the cover work. At the receiving end, the exact reconstruction of the work may not be possible. In addition there exist certain applications that may not pass even small distortions in report work priority to the downstream techniques. In that applications, reversible watermarking instead of other watermarking is occupied. Reversible watermarking of digital image allows full extraction of the watermark along with the complete reconstruction of the cover work. In past years, reversible watermarking process are gaining popularity because of its increasing applications in important and sensitive areas, i.e., military information, health care, and law-enforcement. Due to the rapid evolution of reversible watermarking process, a latest survey of recent research in this field is highly desirable.

In 2001, Honsinger et al was introduced one of the first reversible watermarking method. They utilized modulo addition to achieve reversibility in their watermarking process. Macq developed a reversible watermarking approach by modifying the patchwork algorithm and used modulo addition. Although, proposed reversible techniques are the imperceptibility of their approaches is not magnificent. The watermarked images resulting from these techniques can't tolerate from salt and pepper noise due to the use of modulo addition. A reversible watermarking technique without using modulo addition was then introduced by proposed the concept of compressing the least significant bit plane of cover image to make space for the watermark to be embedded.In 2013 Luo et al reported a reversible watermarking method using interpolation technique. The watermark bits are embedded in the unsampled pixels until no unsampled pixel is left. After that, the remaining of the watermark bits are inserted into the sampled pixels, which are interpolated using nearby watermarked pixels. This scheme provides low embedding distortion and less computational cost, which result in good image quality and efficient algorithm. But the pixels having value 0 or 255 are unconsidered for embedding in order to prevent overflow/underflow.Correlation between adjacent pixels is efficiently uncorrelated with interpolation process. Embedding capacity is improved by adaptive embedding algorithm. Pixel selection process is utilized to obtain good visual quality. Interpolation value is estimated by using enclosing pixels to obtain better prediction. Structural similarity index is another metric which measures the similarity between different images.

the original image is partitioned into 8×8 or 32×32 non-overlapping block of pixels. Later on each block is partitioned into pairs of pixel values.

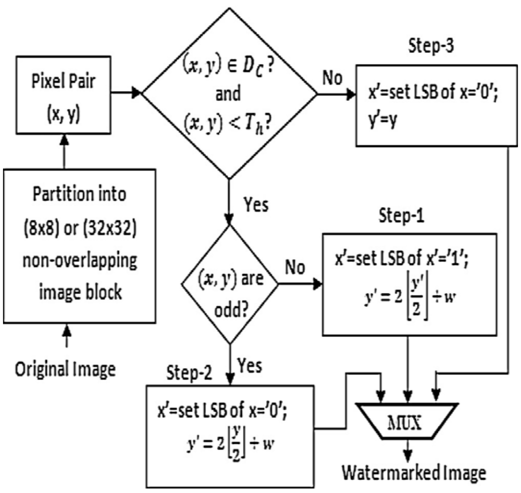

Fig 1. Dataflow diagram of watermark embedding

- Read cover image
- Read watermark image

II. REVERSIBLE CONTRAST MAPPING ALGORITHM

Let (x, y) be the values of pixel pair in an image, then the pixel intensity values are bounded between [0, 255] for an 8-bits or pixel gray scale image. The forward integer transform for a pair of pixel values is defined. To prevent the overload and the under load problem, the transform pair is restricted within a sub-domain. The inverse transformation can perfectly restored the pixel pair values even if the least significant bits of the transformed pixel pairs are lost, except when both pair of pixels are odd set of values. The occurrence of odd pair of pixels is expected to below with respect to the total possibility of occurrence of other combinations, hence a large set of pair of pixels may be available for data embedding. So that reversible contrast mapping provides high embedding bit rate and this is achieved at a very low mathematical complexity.High payload embedding through passing more data insertion introduced many visual distortions. Distortion control is needed to reduce recognized degradation. A straight forward attempt to control such distortion is to transform pair of pixel values only if they do not exceed a predefined error thresholdor distortion threshold.

III. WATERMARK EMBEDDING

To realize reversible contrast mapping algorithm, the original image is partitioned into non overlapping groups of pixels pairs following either horizontally or vertically, like any space filling curve. Aim of this work is to develop semicustom,

- Partition watermark image into 32x32 blocks
- Partition watermark image into 32x16 blocks
- Mapping
- Divide pixel pairs into different sets
- Initialize various index values
- Set S1 contains all pixels that satisfy the difference value condition
- Set S2 contains all expandable pixel pairs that are not in S1
- Set S21 contains all pixel pairs whose difference value is less than threshold
- Set S22 contains all pixel pairs whose difference value is greater than threshold
- Set S3 contains all changeable pixel pairs embedding is performed in set S3

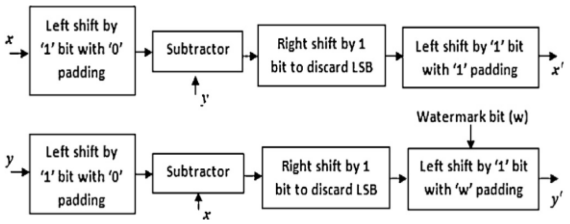

Fig 2. Data path for step-1 of watermark embedding

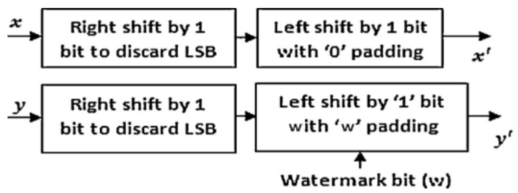

Fig 3. Data path for step-2 of watermark embedding

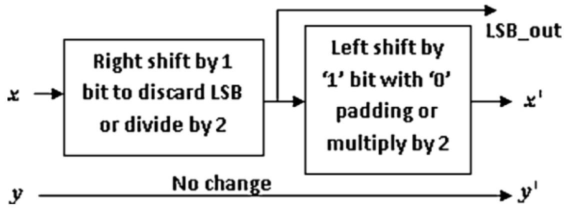

Fig 4. Data path for step-3 of watermark embedding

Fig 2 indicates that the resultant value is left shifted by 1 bit with 1 padding. Similarly the watermark bit is embedded into the LSB of y. Fig 3 indicates the Step-2 operation of watermark embedding,where LSB of xis made 0 by two consecutive shifting operations.The value of x is first right shifted by 1 bit to discard its LSB, then 1bit left shifting operation with 0 padding is performed to generatethe final result. In the similar way watermark data is embeddedinto the LSB of y.Fig 4 indicates that Step-3, is the simplest amongthe three.

IV. WATERMARK EXTRACTION

The steps are similar as in watermark embedding process. Here the watermarked image is partitioned into smaller block size of 8×8 or 32×32 and each block is a gain partitioned into pairs of pixels and using horizontal partitioning method as used in embedding. The marked image is partitioned a gain into pairs of pixels. Then any one step is followed subject to two different conditions check as. The process is repeated until it covers all the pixel pairs. The following steps represents the watermark extraction process and recovery of the original/ host image.

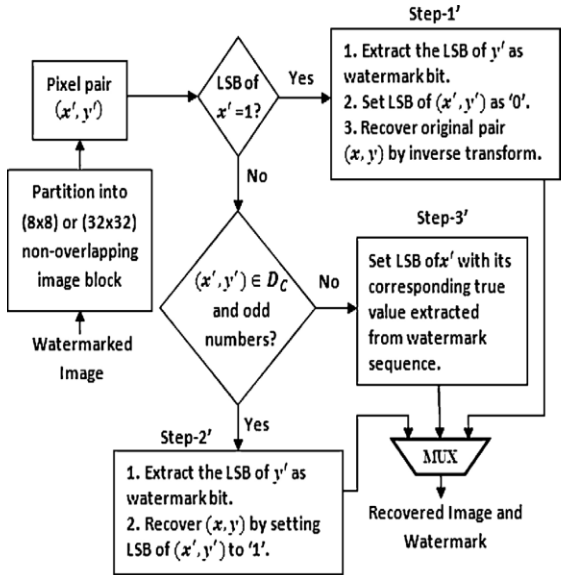

Fig 5. Data flow diagram of watermark extraction

- Load stego image
- Partition watermark image into 32x32 blocks
- Divide pixel pairs into different sets initialize various index values
- Set S1 contains all pixel pairs that satisfy the difference value condition
- Set S2 contains all expandable pixel pairs that are not in S1
- Set S21 contains all pixel pairs whose difference value is less than threshold
- Set S22 contains all pixel pairs whose difference value is greater than threshold
- Set S3 contains all changeable pixel pairs embedding is performed in set S3
- Set S4 contains all non-changeable pixel pairs
- Determine size of watermarked image in Height and Weight
- Use LSB of watermarked image to recover

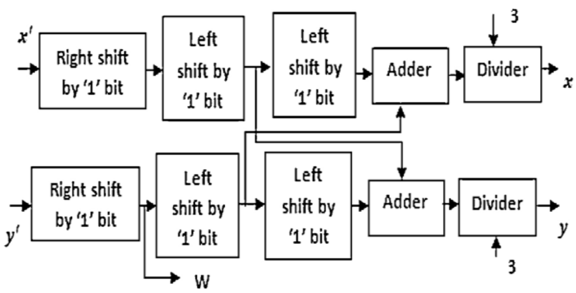

Fig 6. Data path for step-1 of watermark extraction

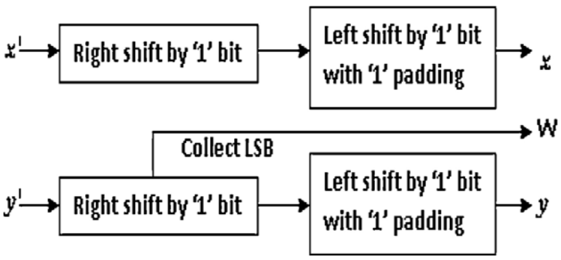

Fig 7. Data path for step-2 of watermark extraction

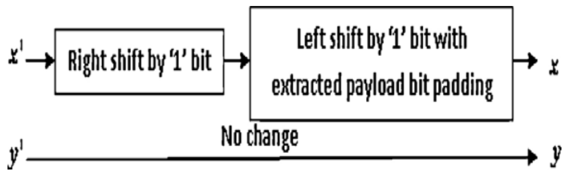

Fig 8. Data path for step-3 of watermark extraction

Fig 6. Illustrates that in step 1 for watermark extraction, the input is given as x1. Then it is left shifted by 1 bit for 2 times and it is added with the value w, divided by 3 and the output will be x. same process repeated for y1.Fig 7 illustrates that in step 2 for watermark extraction, the input is given as x1, and it is right shifted by 1 bit and the left shifted by 1 bit with 1 padding. The output will be same process is repeated for y and LSB also extracted.Fig 8 illustrates that in step 3 for watermark extraction, the input is given as x1 and it is right shifted by 1 bit and left shifted by 1 bit with extracted payload bit padding and the output will be x. Next y1 is given as input without change the output will be y.

V. HDL CODER

A hardware description language enables a precise, formal description of an electronic circuit that allows for the automated analysis, simulation, and simulated testing of an electronic circuit. It also allows for the compilation of an HDL program into a lower level specification of physical electronic components, such as the set of masks used to create an integrated circuit.The HDL Workflow Advisor in HDL Coder automatically converts MATLAB code from floating-point to fixed-point and generates synthesizable VHDL and Verilog code. This capability lets model the algorithm at a high level using abstract MATLAB constructs and System objects while providing options for generating HDL code that is optimized for hardware implementation.

VI. RESULTS AND DISCUSSION

Fig 9. Input image

Fig 10. Secret Image

Fig 11. Watermarked image contains secret image

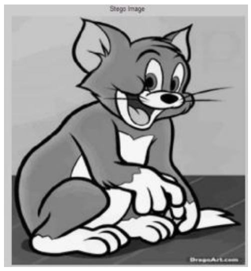

Fig 12. Stego image

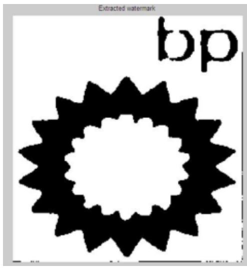

Fig 13. Extracted watremark

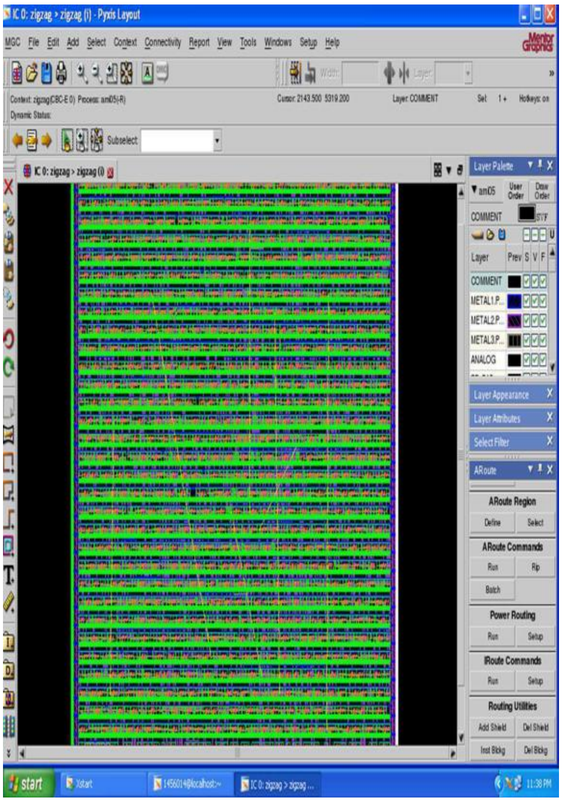

Fig 14. Semicustom Layout

Fig 13 illustrates that the input image, Fig 10 illustrates that secret image, Fig 11 illustrates that watermark image contains secret image, Fig 12 illustrates that stego image, Fig 13 illustrates that extracted watermark,Fig 14 illustrates that semicustom layout. After generating HDL code, net list is created. By using net list, semicustom is implemented in mentor graphics.

VII. CONCLUSION

The pixel values marked by rectangular block indicate a particular case where those pixel values are not considered for embedding operations. So need to store their LSBs of x as a side information or overhead information. On the other hand, for the rest of the pixel values, need not have to store the corresponding LSB values of x. This is marked by 'X'. The area in semicustom layout is 2.85nm.

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