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FPGA IMPLEMENTATION OF INVISIBLE WATERMARKING USING MATLAB SIMULINK

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ABSTRACT

In the present era, the digital information can be easily obtained by the unauthorized users. To avoid this security must be provided to such digital information in the form of image. Image watermarking is the best solution to maintain the security of image. In this paper the MATLAB Simulink based model for invisible image watermarking is implemented on FPGA platform and hardware simulation results are carried out.

Keywords: Discretewavelet Transform, MATLAB, Simulink, Xilinx System Generator Tools, Watermarking.

I. INTRODUCTION

The digital communication technology, like internet technology confronts various troubles related to the privacy and security of the data. Security techniques are required because of illegal access of data without permission. Therefore, it is necessary to protect data in the internet technology. For providing the security of digital data various techniques are used like encryption, decryption, cryptography, steganography and digital watermarking. The digital watermarking is a process of information hiding. There are various techniques for hiding the information in the form of digital contents like image, text, audio and video[1]. Digital watermarking is used in the hiding of secret message or information within an ordinary message and its extraction at its destination[2].The image watermarking method is embedding some watermark image into the original input image which can later be extracted or detected for various purposes like authentication, content protection, content protection and copyright protection. Image watermarking is used for security of the authenticated image from illegal users. The main purpose of image watermarking is to increase the robustness of image. The types of embedding watermark image in the input image may be visible or invisible. Invisible watermark are designed to be very small under normal viewing conditions. Invisible watermarks are not to be detectable to viewer or the person who will use it in illegal way. This can be used but the original owner of the digital document remains same. If they would try to remove watermarking, the quality of the document, image or video will be reduced and it should be easily detectable [3].The 2D original image as well as the watermarked image is converted matrix into array . The technique proposed to convert the image into frequency domain is Discrete Wavelet Transform(DWT) which provides robustness against attacks. The embedding of watermark image into original image takes place using Xilinx system generator simulink tools. The output image is obtained on Xilinx Spartan 6 FPGA starter kit. The embedding of watermark image into original image takes place on FPGA. The use of FPGA platform enables low power consumption and substitutes the use of a computer hardware which increases

the portability of system. The FPGA device provides cost effective solutions for real time image processing applications [4].MATLAB is used to display the results of watermarking. Finally, the result of software simulation and hardware implementation are compared.

II. PROPOSED METHOD

The most applicable and accurate method of invisible watermarking is proposed in this project . The fundamental steps followed in the project are:

1. Pre-processing of image
2. Embedding watermark using algorithm
3. Post-processing of image

The pre-processing of image involves the conversion of original 2D gray scale image as well as the watermark image into an array of data. This array of data is to be converted into frequency domain using Discrete Wavelet Transform(DWT).The Discrete Wavelet Transform(DWT) technique is preferred because it is more advantageous compared to the Discrete Cosine Transform(DCT) technique[4].The DWT decomposition here is done using Haar Wavelet. The Haar wavelet in discrete 2 sample form is described as (0.7071,-0.7071) . We have used two 1D- DWT to implement 2D DWT. The 1D-DWT is,

(L, H) = DWT (I)

Then,

(LL, LH) = DWT (L)

And

(HL, HH) = DWT (H)

Hence,

(LL, LH, HL, HH) = 2DDWT (I)

The watermark image is added in all the sub-bands (LL, LH, HL, HH) using selection tree algorithm, explained below.

2.1 Selection Tree Algorithm

The selection tree works as shown in Fig 1 shown below. Every (i) th pixel of watermark image is added in LL sub band. Every (i+1) th pixel is added in LH band, every (i+2) th pixel is added in HL band . While, (i+3) th pixel is added in HH band. Where, i = 1, 5, 9 ...253.The IDWT is carried out similarly using same wavelets.

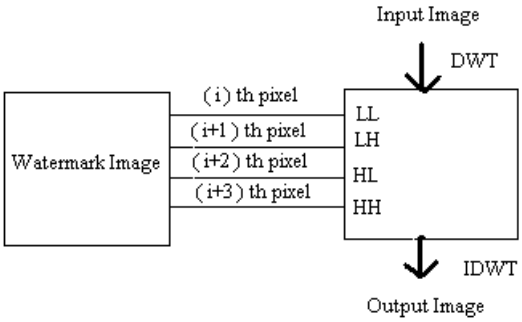

Fig1: Selection Tree algorithm

The obtained output is passed through the Inverse Discrete Wavelet transform ,to obtain the array form of image. This process completes the watermark embedding in original image.In the last step of post processing,the array form of image is converted into matrix form . This output watermarked image obtained at the output is displayed using MATLAB.

III. SIMULATION AND RESULTS

As mentioned above the processing of images that is the pre-processing, watermark embedding and post processing are done using xilinx system generator simulink tools and MATLAB is used just to display the output image. The input image is shown in Fig. 2 and the watermark image to be added is shown in Fig. 3. In the first step both the images fed as input are converted into array form for further processing. These arrays are converted into frequency domain using DWT of both the images separately. The detail explanation of Discrete Wavelet Transform is given in the above section,this DWT is implemented using Xilinx System generator tools. This objective lead to the use of Xilinx System Generator tool with a high level graphical interface *i.e.* Simulink, based on blocks which makes it very easy to handle with respect to other softwares for the hardware design and implementation [5].

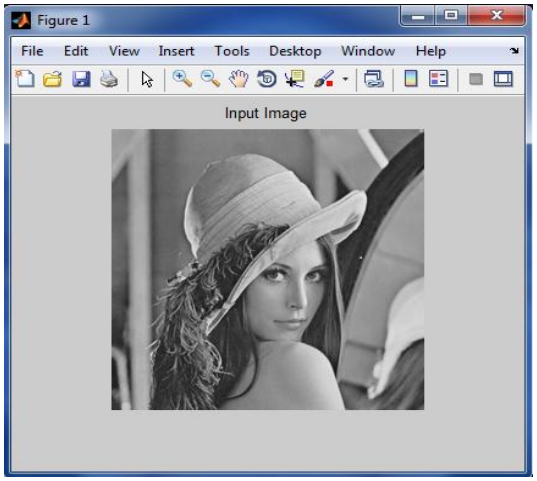

Fig. 2: Input image

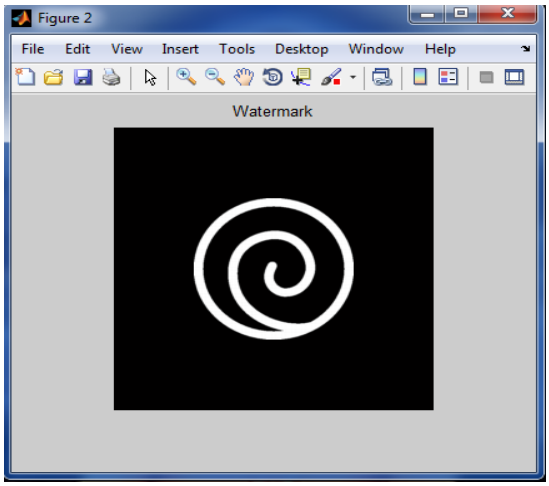

Fig. 3 Watermark Image

For implementation of invisible watermarking of Simulink model on FPGA platform it is necessary to create a Hardware co-simulation block .The Hardware co-simulation block is created by providing the information of hardware used for implementation, here Spartan 6 XC6SLX4-2tqg144.The block has two inputs namely ,the input image DWT and watermark image DWT, and one output i.e., watermarked image.

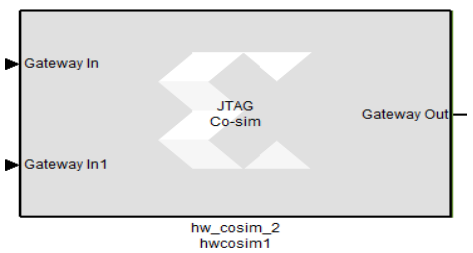

Fig4: Hardware Co-Simulation Block

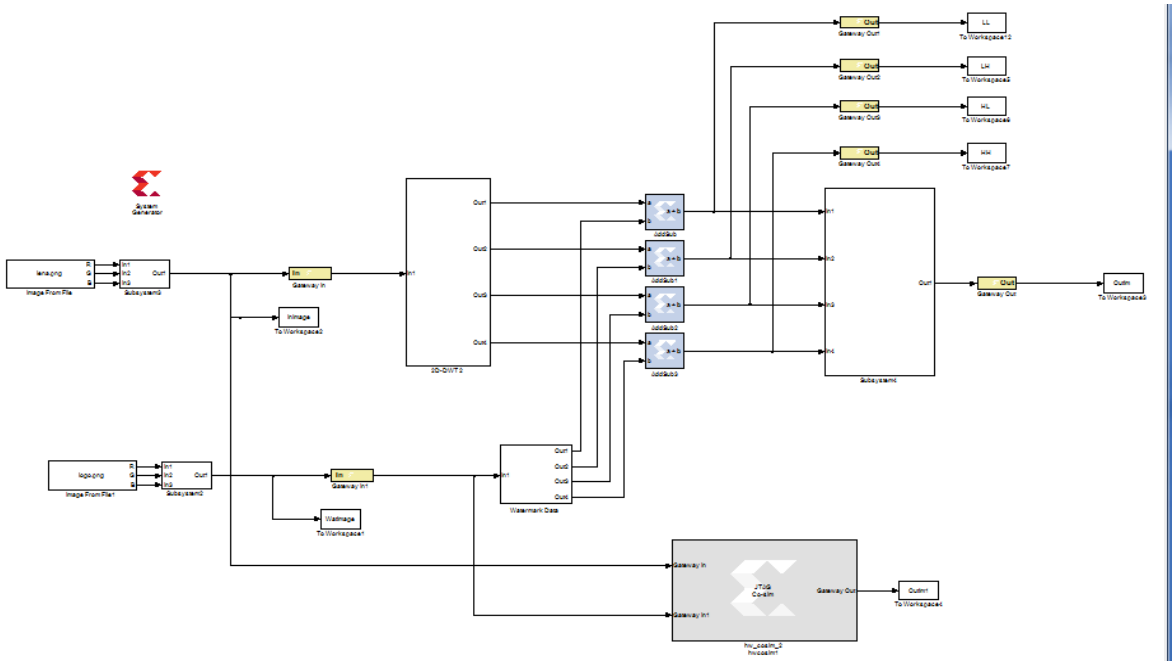

Fig5: Simulation Window

Fig. 6 Final output image

This block is added to the software simulation as shown in Fig 5. In the results of Invisible watermarking gives only one output image and that is the Watermarked image. The final output window displays the output of Software simulation as well as the output of Hardware implementation.

IV. CONCLUSION

With the proposed method we can maintain the security of original image by addition of watermark image, which is invisible. The future work will be focused on the high performance efficient FPGA implementation of

the invisible watermarking with video display connected to the FPGA kit output so that we can get the real time results.

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