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Hardware Implementation of Robust Digital Image Watermarking using Neural Network

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ABSTRACT: The recent study has involved the multimedia application rapidly. Because of the increasing enhancement in networking and communication era, protection of the data packets has become a mandatory part. One among the solutions for this problem is the watermarking; that includes protection of copyright and data authentication in the network. Content owners and service provides are having the major importance of maintaining their data security. Watermarking is becoming one of the best methods that provide the security on data. In the proposed method we have worked on image watermarking in two level languages i.e. MATLAB as well as in Xilinx. Most robust technique in watermarking, DWT is been used as the main technique with PRN sequences generated for security maintenance. Decomposing the cover image into four level of bands and then applying Random sequence number and embedding the secrete image are the main concepts covered under watermarking here. Then while reconstructing how the noise in the environment affects the performance of the reconstruction of image is also depicted in our study. The results section includes the PSNR and MSE values of the study for individual images.

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KEYWORDS: DWT, Watermarking, Sequence Number**.**

I. INTRODUCTION

The widely used technique watermarking includes the fields such as; copyright protection, digital fingerprints security, monitoring radio and television programs and so on. The major digitization of the data and information was taken place at this time. The sources of type text, image and audio as well as video are under the digitization, where the information is stored, maintained with proper technique and finally shared in the form of digital. The problems of safety and security started rising in the digital word; when it became an easy task for anybody to access the data in the digital form. The multiple copies created by the owner in the digitization caused a threat on the authentication and identification of the data. For this purpose, to make proper authentications, protection against copyright issue, source tracking and to make valid broadcast monitoring; watermarking is used. In Digital watermarking information of any kind is embedded into the information of another type with no permanent damage to the carrier data and the main data too, By means of providing protection to the original data. This process can be done in both spatial as well as transform domain [01].

II. LITERATURE SURVEY

Nasrin M et.al, [02] introduced a robust and secure watermarking technique that provides the better perfmrnce for the copyright protection. Author made use of techniques such as, integer Wavelet Transform (IWT) and the reduction method singular Value Decomposition (SVD). The two level transformations provide unique and auxiliary robustness to the watermarking technique against the attacks. As watermarking is the procedure of hiding the information using chaos embedding module, and extracting the information easily at the receiver end. The reconstruction of the image is done here at both sides; i.e. from left eye and right eye scenes. The author made a calculation of imperceptibility and robustness of the proposed watermarking module by making use of monoscopic images.

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Yahya AL Nabhani et.al, [03] proposed a module for watermarking with a conclusion that the original image is not a mandatory part for any watermarking module. Author worked on the discrete wavelet transform, combining with Haar filter that embeds generated binary watermarked image into coefficients selected by the user in the blocks. To extract the image he used neural network of probabilistic module. Study of parameters such as PSNR and Normalized cross correlation (NCC) are made for the comparison purpose of the performance of the module. In the proposed module calculated PSNR and NCC are 68.27db and 0.9779 respectively.

In paper [04], a new robust blind image watermarking scheme based on Region of Interest (ROI) using Arnold scrambling is proposed. The proposed scheme satisfies the requirements via using a watermark generated from the host image, the used embedding strategy and Arnold scrambling. In this paper, the ROI of the host image is used as the watermark image. First-level DWT is applied to the watermark and approximation coefficients are chosen as information to be embedded. Each approximation coefficient is embedded into the low frequency sub band of a selected block of the host image in the wavelet domain. Before embedding, Arnold scrambling is performed on the approximation coefficients of the watermark as well as the blocks of the host image. This makes the scheme more robust and secure.

In [05] paper, combining the robustness of vector norm with that of the approximation components after the discrete wavelet transform (DWT), a blind and adaptive audio watermarking algorithm is proposed. In order to improve the robustness and imperceptibility, a binary image encrypted by Arnold transform as watermark is embedded in the vector norm of the segmented approximation components, the count of which depends on the size of the watermark image, after DWT of the original audio signal through quantization index modulation (QIM) with an adaptive quantization step selection scheme. Moreover, a detailed method has been designed to search the suitable quantization step parameters.

In [06] paper, the proposed method exploits rotation invariance, high reconstruction capability and computation accuracy of the Quaternion Radial moments' (QRMs), subject to the tradeoff between robustness and imperceptibility. The current system manages to multi-embed binary logos to color images applying QRMs as information carriers. A novel adaptive system adjusts the watermark's embedding strength (online) by taking into account image's morphology, with respect to robustness and imperceptibility. The method manages to experimentally justify and further eliminate the attack-free phenomenon that state-of-the-art methods suffer. The simulation results justified that the proposed framework manages to highly secure its carrying information under common signal processing and geometric attacking conditions.

In [07] paper, authors discussed the development and implementation of the hardware architecture of Digital Image Watermarking in transform domain using a newly developed simple yet secured algorithm. Walsh Transform is used to convert the cover image from spatial domain to transform domain as it is a secured Transform function and it is also feasible to synthesize the developed architecture using HDL (Hardware Description Language) synthesizer. The proposed architecture is not very resource rich. The proposed watermarking architecture will be very useful particularly for image authentication process and secured transmission of message inside an image. It is difficult to design the hardware architecture of Digital Image Watermarking with very high precision when the algorithm involves more theoretical computational complexity.

In [08] paper, the author says in recent years, the applications about multimedia have been developed rapidly. Due to rapid development in the network and communication field, it has become necessary to protect the data during transmission. Digital watermarking is a solution to the copyright protection and authentication of data in the network. Protection of digital multimedia content has become an increasingly important issue for content owners and service providers. So there has been growing interest in developing effective techniques to discourage the unauthorized duplication of digital data In this technique, based Image robust watermarking technique for color and gray scale images was performed. The RGB image is converted to HSV and watermarked by using discrete wavelet transform. Watermarking embedded stage and extraction stage is designed using invisible watermarking algorithm. Here the host signal is an image and after embedding the secret data a watermarked image is obtained and then extracts secret image and original image separately.

In [09] paper, Digital watermarking is the process that embeds data called a watermark into a multimedia object such that the watermark can be detected or extracted later to make an assertion about the object. Several software

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implementations of the proposed algorithms are available, but very few attempts have been made for hardware implementation. Watermarking is also a type of information hiding where secret codes are embedded in the hidden from inside an image file, audio file or video file. This Paper proposes to implement the invisible LSB- watermarking technique in Lifting compression technique by using the micro blaze Processor.

In [10] paper, the digital information can be easily obtained by the unauthorized users in the present era. 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.

III. METHODOLOGY

From the block diagram we can conclude that we have kept one part as it is from the base paper and extended the work for bit level embedding and reconstructing the image. Here using DWT image is decomposed and then watermark embedding is done. This results parameters are calculated and extraction of the image is made using IDWT. This gives the original image as the cover image. Both embedded image and extracted image are passed to bit level conversion module. The results are dumped on Spartan 6 board and synthesized output report is noted. Blocks module is given in the following block diagram for both existing and proposed. The embedding block will give a representation of the implementation of the watermarking of image using DWT with the PRN sequence. Here the DWT is used for image decomposition, after the embedding the decomposed image is reconstructed using IDWT. Similar to this for extraction of the image into original format the DWT and IDWT are utilize that will full fill the transformation level work.

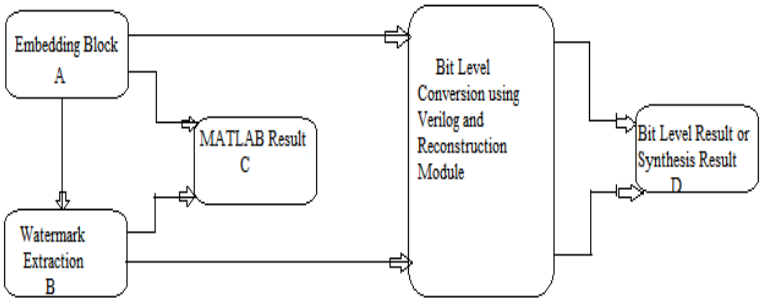

Fig 1: Overall Architecture of proposed mode

A. Watermark Embedding

The embedding operation is performed by using DWT and reconstructed by using IDWT which is show in below figure 2.

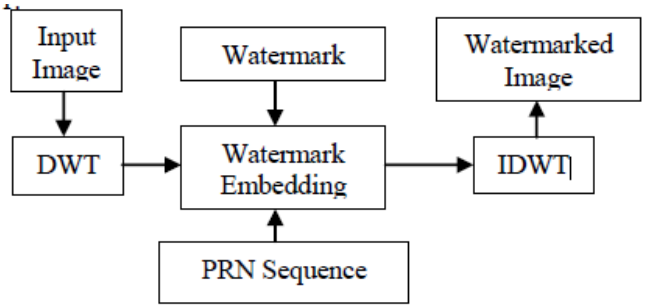

Fig 2: Block diagram of watermark embedding.

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The above block diagram represents the watermark embedding method. Initially input image is decomposed into four sub-bands using DWT and the secret image or watermark image is added with pseudo random number generated by neural network are embedded and the image is reconstructed by using IDWT.

Embedding algorithm:

- Read the input image and its size.
- Read the watermark image and store it. This image decides whether PRN numbers are added or subtracted from the input image pixel to be watermarked.
- Decompose the original image into four sub-bands like, approximation(LL), horizontal(LH), vertical(HL) and diagonal(HH) using haar wavelet transform with 3-level, the sub-bands are of 8*8 size.
- Add horizontal and vertical sub-bands.
- PRN sequence is added to watermark, which is generated by elman neural network.
- The following logic is applied depending on reference image pixel LSB corresponding cell of image is added or subtracted from related PRN number,
  If(pixel lsb(reference image)==1) then,
  Z(m)=z(m)-PRN(m); else
  Z(m)=z(m)+PRN(m);
  Where z(m) is mth cell of input image, PRN(m) is mth cell of PRN sequence.
- The input key is encoded with PRN sequence and embedded the image.
- The Z watermarked matrix is separated as vertical and horizontal sub-bands as,
  Modified LH=Z-original HL
  Modified HL=Z-original LH
- Watermarked image is reconstructed by using IDWT.

B. Watermark extraction

The extraction of original image can be done by using discrete wavelet transform and inverse discrete wavelet transform, which is shown in below figure 3.

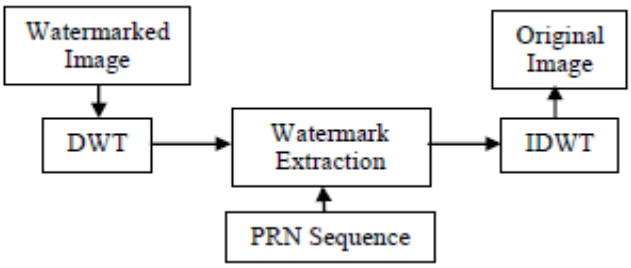

Fig 3: Block diagram of watermark extraction.

The watermarked image is taken as input and decomposing it by using haar DWT and watermark is extracted by applying PRN sequence then IDWT is performed to get back proper image.

Extraction algorithm

- Read the watermarked image.
- Encode the user key by using previous encryption method during watermarking. PRN number are noted and used for extracting the image.
- Image is decomposed into four sub-bands like HL,LL,LH and HH by haar transform with 8*8 size.
- Add LH and HL bands.
- PN sequence and image is splitted into cells.
- Addition or subtraction of related image cells occurs based on the LSB of watermark image.
  If(pixel lsb(reference image)==1) then,

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z(m)=z(m)+PN(m); else
z(m)=z(m)-PN(m);
z(m) is input image of mth cell;
PN(m) is PN sequence of mth cell;

- The Z watermark matrix is splitted as horizontal and vertical sub-bands
  Modified LH=Z-original HL;
  Modified HL=Z-original LH;
- Finally image is reconstructed using IDWT and original image is obtained.

The embedding as well as extraction procedures are performed based on the above mentioned algorithms by using MATLAB software. The parameters PSNR, MSE and CRC are noted. This embedding and extraction procedures are converted into bit file using Xilinx software, and checked the synthesis report. This synthesis report is explained in result part. The MATLAB operation is extended by adding three types of noise such as Gaussian noise, Salt and Pepper noise and Speckle noise, and parameters are measured. The figure 4 represents the flow of noise attack system.

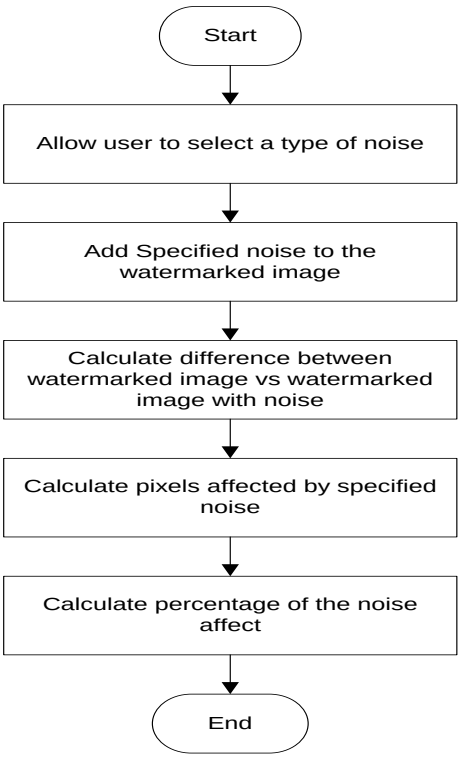

Fig 4: Flow chart of noise attack measurement.

The embedded image when it is passed over the transmission media will get involved with the environmental issues and the noise will get attacked on the respective image. Hence a study is made here on the different noises based on the type of noise the parametric calculations will vary. The specified noise is added in the embedded image and then parametric calculations are made, with this the number of pixels affected is calculated for different sets of noises and the percentage is depicted in the results section.

IV. RESULT

The proposed system consists of the three different modules in it, and those are; implementation of image embedding and extraction in MATLAB, image embedding and extraction in Xilinx and noise affect calculations on embedded image. The results details are provided here in three different cases.

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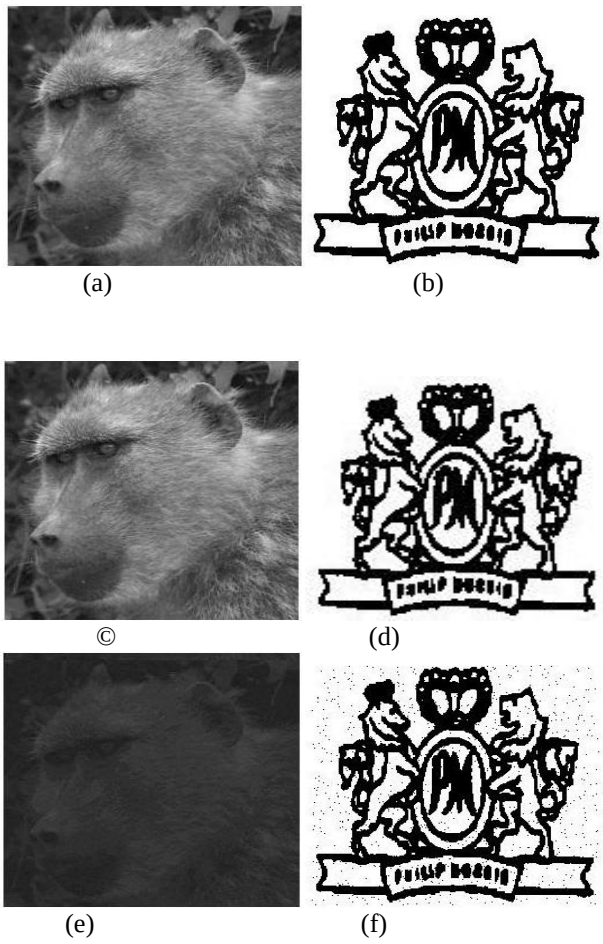
Case I:



(a) (b)

© (d)

(e) (f)

Figure 5: MATLAB and Xilinx Embedding De-embedding Outputs, (a) Cover Image, (b) Secrete Image, (c) Embedded image from MATLAB, (d) extracted Image from MATLAB, (e) Embedded image from Xilinx, (d) extracted Image from Xilinx.

(a) (b)

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(c)

(d) (e)

Figure 6: Noise Attack on Embedded Image, (a) Cover Image, (b) Secrete Image, (c) Embedded Image, (d) Noise Affected Embedded Image, (e) Reconstructed Image.

Case II:

The work in continued with same flow in Xilinx to get the reconstructed image. The results of Xilinx reconstruction using MATLAB is shown in Figure 5 (e) and (f). the proposed module is dumped on Spartan kit of frequency 92.747MHz. Circuit required the power of 80.98 mW for the process. proper utilization of IOBs is made and the work got synthesized completely. For the working module of 256 bits of image it took delay of 7.616ns for logic gates similarly for 128 bits of image it took 10.782ns of delay.

Case III:

The study is further extended to the noise calculations. We included four types of noises here. The result of this section is shown in the following Figure 6. And details of noise affected calculations are done by calculating PSNR and MSE; the values are given in the table. Noise will create a loss of information in the reconstructed image as shown in the Figure 6.

TABLE 1: Pixels Affected by Noise

Types of Noise/ Parameters	Pixels Affected by Attack	Percentage of Attack
Gaussian Noise	1585	2.4185%
Salt & Pepper	659	1.0056%
Speckle Noise	4621	7.0511%
Without Attack	0	0%

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TABLE 2: PSNR and MSE of Reconstructed Image

Types of Noise/ Parameters	Reconstructed Image	
	PSNR	MSE
Gaussion Noise	61.4498	0.04657
Salt & Pepper	61.8865	0.042114
Speckle Noise	58.2829	0.096558
Without Attack	∞ (Infinity)	0

	Cover image and watermarked image			Cover image and attacked watermarked image			Without attack watermarked and with attack watermarked image			Reconstructed image		
Gaussian Noise	PSNR	MSE	CRC	PSNR	MSE	CRC	PSNR	MSE	CRC	PSNR	MSE	CRC
	54.22	0.2457	0.999	53.79	0.2715	0.999	64.065	0.025	0.999	61.23	0.048	0.736
Salt and Pepper Noise	PSNR	MSE	CRC	PSNR	MSE	CRC	PSNR	MSE	CRC	PSNR	MSE	CRC
	54.22	0.24579	0.9998	43.61	2.8319	0.9080	43.995	2.5914	0.908	62.033	0.040	0.7689
Speckle Noise	PSNR	MSE	CRC	PSNR	MSE	CRC	PSNR	MSE	CRC	PSNR	MSE	CRC
	54.22	0.2457	0.9998	53.133	0.31606	0.9998	59.724	0.069	0.999	58.546	0.090	0.5709

TABLE 3: Overall Parameter calculation for different noise.

V. CONCLUSION

Our proposed method decomposed original image in the wavelet domain using discrete wavelet transform and watermarks it with a PRN sequence. The watermark is extracted to recover the original image. The neural network generated PRN sequence is a highly random sequence providing high level of security. After the generation of results in MATLAB, we repeated the process for in Spartan 6 board by using bit level formation of the watermarking. For reconstructing a image from FPGA may ways we discussed like VGA and USB. And we synthesized by using VGA. This can be extended by reconstructing image from FPGA through VGA cabel.

REFERENCES

[1] Nasrin M.Makbol, Bee EeKhoo, "A new robust and secure digital image watermarking scheme based on the integer wavelet transform and singular value decomposition", Journal-Elsevier, Year 2014.
[2] Ali Al-Haj, Mahmoud E. Farfoura, Ahmad Mohammad, "Transform-based watermarking of 3D depth-image-based-rendering images", Journal-Elsevier, Year-2016.
[3] Yahya AL-Nabhani, Hamid A. Jalab, Ainuddin Wahid, Rafidah Md Noor, "Robust watermarking algorithm for digital images using discrete wavelet and probabilistic neural network", Journal of King Saud University – Computer and Information Sciences ,Year- 10 September 2015.
[4] Razieh Keshavarzian, Ali Aghagolzadeh, "ROI based robust and secure image watermarking using DWT and Arnold map", International Journal of Electronics and Communications (AEÜ), Year- 3 December 2015.
[5] Xinkai Wang, Pengjun Wang, Peng Zhang, Shuzheng Xu, Huazhong Yang, "A norm-space, adaptive, and blind audio watermarking algorithm by discrete wavelet transform", Journal-Elsevier, Year 9 November 2012.
[6] E.D. Tsougenis, G.A. Papakostas, D.E. Koulouriotis and E.G. Karakasis, "Adaptive color image watermarking by the use of quaternion image moments", Journal Elsevier, vol. 41, issue-14.
[7] Dibya Das, Mriganka Gogoi, "Design and implementation of an MSI number based image watermarking architecture in transform domain", Journal-IEEE, Year- 16 February 2016.
[8] Anumol T J, Binson V A, Soumya Rasheed, "FPGA Implementation of Low Power, High Speed, Area Efficient Invisible Image Watermarking Algorithm for Images", International Journal Of Scientific & Engineering Research Volume 4, Issue 8, August-2013.
[9] Somisetti Asha Latha, Maddireddy Sowjanya, "FPGA Implementation of a Digital Watermarking using Discrete Wavelet Transformation", International Journal of Scientific Engineering & Technology Research, Vol.03,Issue.27 September-2014.
[10] Shamali Vijay Chavan, S. S. Patil, "FPGA Implementation Of invisible Watermarking Using Matlab Simulink", International Journal of Advanced Technology in Engineering & Science, Vol-4, Issue-08, Year Aug 2016.
[11] Prabhishek Singh, R S Chadha, "A Survey of Digital Watermarking Techniques, Applications and Attacks", International Journal of Engineering and Innovative Technology (IJEIT) Volume 2, Issue 9, March 2013.
[12] Rajni Goyal, Naresh Kumar, "LSB Based Digital Watermarking Technique", International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 3, Issue 9, September 2014.