



# **Comparison of Frequency Domain Digital Watermarking Techniques on the Basis of PSNR**

Sangeeta Yadav<sup>1</sup>, Priyanka Anand<sup>2</sup>

M Tech Scholar, Dept. of ECE, Bhagat Phool Singh Mahila Vishwavidhyalaya, Sonapat, India<sup>1</sup>.

Assistant Professor, Dept. of ECE, Bhagat Phool Singh Mahila Vishwavidhyalaya, Sonapat, India<sup>2</sup>.

**ABSTRACT:** In today's world, a large number of data is available on the Internet. It is almost impossible to deal with numerous challenges like copyright protection, content identification, verification and authentication of digital data. Watermarking is a technique that is used all over the world to solve the issue of copyright protection. Digital watermarking is used due to its wide range of applications from copyright protection, protection of digital data, digital fingerprinting to author authentication to many more. This paper mainly deals with a different video watermarking technique based on frequency domain and their comparison is evaluated on the basis of Peak-Signal-To-Noise (PSNR) Ratio. This comparison is done in the MATLAB/Simulink which is an interactive tool for simulation purposes.

**KEYWORDS:** Frequency Domain; Digital Video Watermarking; Discrete Fourier Transform; Discrete Cosine Transform; Discrete Wavelet Transform; Attacks.

## **I. INTRODUCTION**

With the recent advancements in the field of network technology the issue of protection of digital data has become more prominent these days. Due to the digital nature of data, it is possible that the multimedia data (video, image, audio, text, etc.) can be copied, multiplied, modified without the knowledge of the person who own the data [1]. The trends of piracy of multimedia data are hiking at the fast pace. Digital watermarking is a tool to address this problem of digital piracy. It is a technique that embeds mark/logo into the original multimedia data that represents the identity of the owner [2]. This mark/logo that is hidden in the document is termed as the watermark. This watermark could be visible or invisible to the viewer depending upon the choice of the person that embeds it into the document. This whole process of embedding watermark into digital data is called as digital watermarking. The embedded watermark could be retrieved/extracted at the another end. There are separate techniques for retrieving watermark .

Watermarking is generally divided into:

- Visible Watermarking
- Invisible Watermarking

In this paper, visible watermarking is applied in which the watermark is visible to the user. In invisible watermarking technique, the watermark is not visible to the user under normal viewing condition.

## **II. RELATED WORK**

A lot of work has been done in the field of digital watermarking by several authors. Abhishek Basu [3] implemented the real time application of DSP using SysGen in MATLAB. He formulated an architecture of the information hiding network. In this network, he embedded information into host image in the form of bits. Design and implementation are carried out using Spatron-3A DSP. Rohollah Mazrae Khoshki [4] implemented FPGA based image watermarking system. The system is developed in the MATLAB/Simulink environment and ALTERA DSP builder that is integrated



# International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 5, May 2015

with inbuilt embedder coder in Simulink. It is quite easy and very portable to achieve the implementation of the watermark on FPGA board. Anumol T J [5] checked the quality of watermarking through calculating various parameters like colour correction, image correlation, PSNR etc. Conversion of RGB into HSV image is carried out and DWT is applied to it for the watermarking purpose. Sabyasachi Padhiary [6] described Redundant DWT to overcome the defects of DWT based watermarking techniques. He concluded that RDWT is robust to watermarked image. PSO has used to find the scaling factor. Ranjit Kumar S [7] implemented watermarking technique using 2D-DWT/IDWT compression and decompression methods. Simulation result is carried out in Simulink and conclusions drawn on the basis of simulation results.

### III. DIGITAL WATERMARKING TECHNIQUES

Digital watermarking techniques could be divided into two types:

- Spatial domain
- Frequency domain

Frequency domain is widely used for the digital watermarking technique. In frequency domain methods, the conversion of the original image into the frequency domain with the help of transform is carried out. Discrete Fourier Transform (DFT), Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT) are the transforms used for this purpose. The watermark/logo is embedded into the mid frequency range to obtain more perceptibility and robustness. In this paper, watermarking based on DFT, DCT and DWT is implemented in Simulink. Simulink is an interactive tool that integrates the real time application with the simulation environment [8]. The user has the ability to see the results instantly and the ability to dynamically change the parameters of interest to make it more user friendly.

#### A. Discrete Fourier Transform

The DFT/FFT algorithm computes the Discrete Fourier Transform having a sample size such that has an integer power of 2. The algorithm divides the whole block into Radix-2 or Radix -4 decomposition and either Decimation-in Time or Decimation-in Frequency is applied to it [9]. The formula for computing DFT is given as:

$$X(t) = \sum_{n=0}^{N-1} x(n)e^{-jnt 2\pi/N} \text{ where } t = 0, 1, \dots, N-1$$

$X(t)$  is a sequence of  $t = 0, 1, \dots, N-1$ .

The inverse DFT is computed as:

$$X(n) = 1/N \sum_{t=0}^{N-1} X(t)e^{jnk 2\pi/N} \text{ where } n = 0, 1, \dots, N-1$$

The watermarking is carried out by converting the image into the frequency domain using DFT and the watermark is embedded by converting it into suitable bit format and both are combined. Inverse DFT is then applied in the subsequent step. The image that is obtained at this step is the watermarked image.

#### B. Discrete Cosine Transform

In Discrete Cosine Transform the original image is converted into the frequency components which is the sinusoidal sum of different frequency and magnitude [10]. The formula for calculating DCT is given by the formula:

$$Y_{pq} = \alpha(p)\alpha(q) \sum_{m=0}^{M-1} X(m) \sum_{n=0}^{N-1} X(n) \cos \frac{(2m+1)p\pi}{2M} \cos \frac{(2n+1)q\pi}{2N}$$

here,  $0 \leq p \leq M-1$   
 $0 \leq q \leq N-1$

$X(mn)$  is the input image and  $Y(pq)$  is the output image.

# International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 5, May 2015

The Inverse DCT is calculated as:

$$X_{mn} = \alpha(p)\alpha(q) \sum_{p=0}^{M-1} Y(p) \sum_{q=0}^{N-1} Y(q) \cos \frac{(2m+1)p\pi}{2M} \cos \frac{(2n+1)q\pi}{2N}$$

here,  $0 \leq m \leq M-1$   
 $0 \leq n \leq N-1$

The watermark is embedded into the sub band of the mid frequency band. The visibility of image in the mid frequency sub band remains unaffected when it is removed by compression techniques [11]. It gives an efficient method of inserting watermarks into the host image.

### C. Discrete Wavelet Transform

Discrete Wavelet Transform divides the image into sub bands. Small waves which are called wavelets transform an image into the frequency domain [12]. This transform is advantageous than the others transforms. Applying DWT on the digital image divides it into four non overlapping sub bands called LL, LH, HL and HH [13]. Coarse scale of DWT coefficients is represented by LL while fine scale coefficients are represented by LH, HL and HH sub bands.

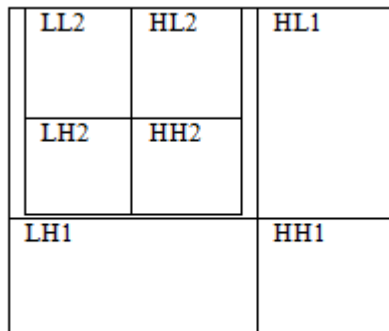


Fig 1: 2 level DWT decomposition.

## IV. IMPLEMENTATION OF WATERMARKING TECHNIQUES IN SIMULINK

The implementation of the digital watermarking techniques in frequency domain will be implemented in MATLAB Simulink. Simulation results of the proposed model is interactive and friendly to the end-user [14]. In MATLAB Simulink, the user has the choice to dynamically adapt to the varying situations. A user has the choice to create block based model, simulate it, creation of codes and validation of the model. Simulink has a vast library that contains a large repository of in built functions [15]. From this library, the user has a option to choose any function of his choice. In these proposed models, the 2D DCT, 2D DFT and 2D DWT are taken from the library of Simulink.

The Simulink models for watermarking technique has been proposed using the Discrete Fourier Transform (DFT), Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT) and the models are as shown below in figures.

The Fig 2 shows the Simulink model for digital watermarking using Discrete Cosine Transform. It consists of image from file, multimedia file, image data type conversion, resize, DFT, IDFT blocks. The result is shown in the video viewer.

# International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 5, May 2015

One of the input block is for the original video while the another block is for the watermark image. The watermark image is embedded into the original video by resizing it into the suitable size and applying transform to it. Inverse transform is applied at the reverse end.

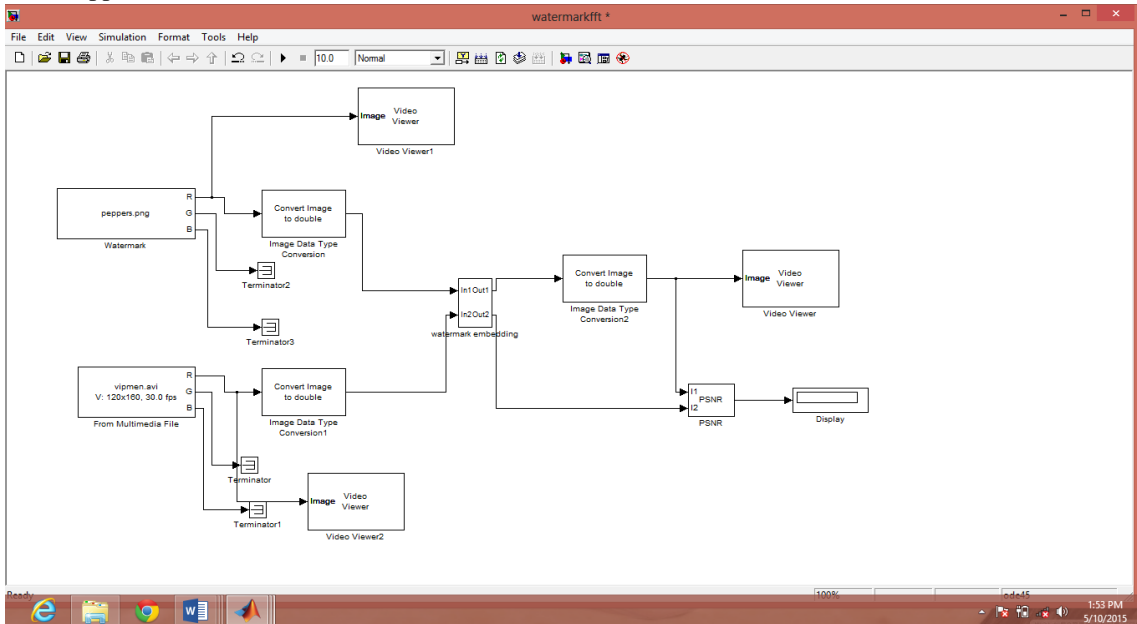


Fig 2: Simulink model for digital watermarking using Discrete Fourier Transform(DCT).

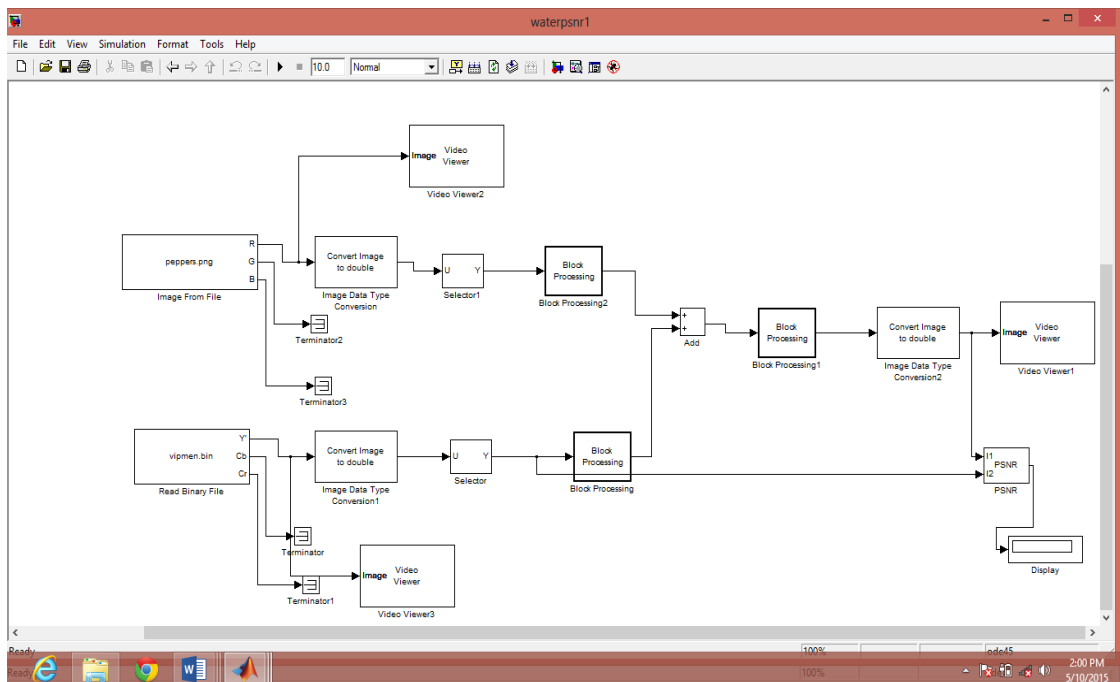


Fig 3: Simulink model for watermarking using Discrete Cosine Transform (DCT).

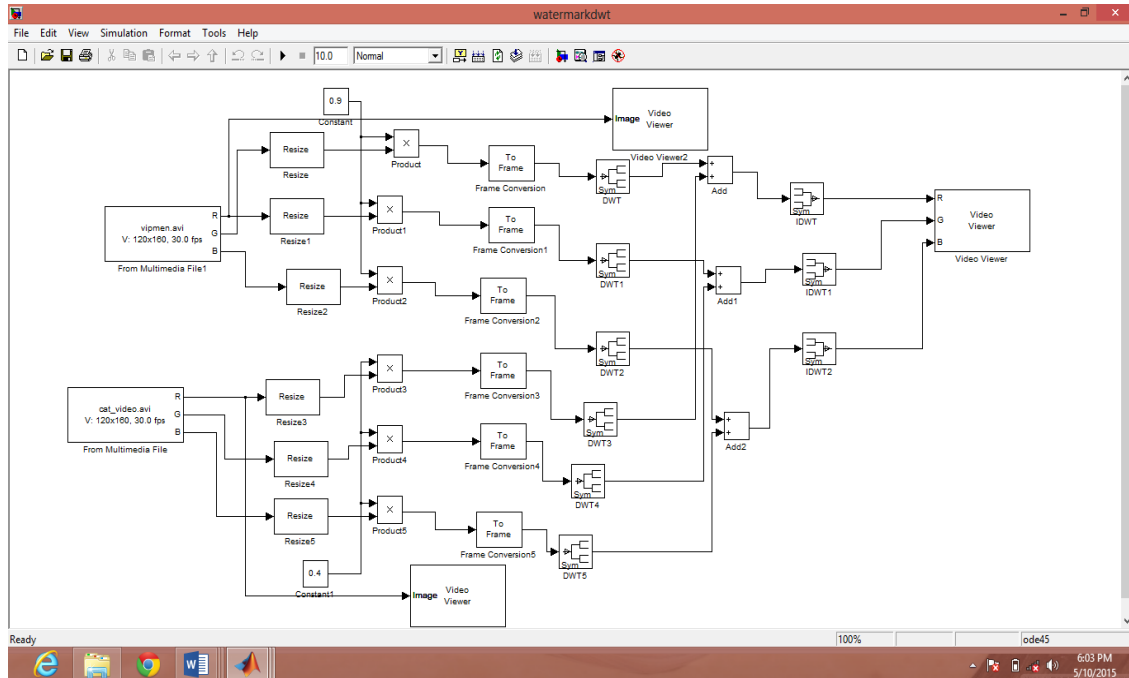


Fig 4: Simulink model of watermarking using Discrete Wavelet Transform (DWT).

Fig 4 shows the digital watermarking model in Simulink using discrete Wavelet Transform. IDWT block computes Inverse DWT that has a filter bank. This filter bank reconstruct the original video into sub bands. The filtering action takes alternatively low pass and high pass values. The results of simulation has been displayed in table 1.

## V. RESULTS AND CONCLUSION

Calculation of Peak-signal-To-Noise ratio is carried out in order to compare the performance of different techniques. Attacks shows different responses under different conditions. Hence it is important to study the responses of attacks. PSNR for the DFT, DCT and DWT has been calculated under different attacking situations. The value of PSNR is in dB.

The PSNR is calculated for various attacks and their comparison is shown below in the table.

| Attack                 | PSNR in dB for DFT | PSNR IN dB for DCT | PSNR in dB for DWT |
|------------------------|--------------------|--------------------|--------------------|
| Gamma Correction       | 8.95               | 5.87               | 5.80               |
| Histogram Equalization | 17.30              | 4.75               | 8.53               |
| Median Filtering       | 11.87              | 11.24              | 8.33               |
| Image Complement       | 5.78               | 2.72               | 8.34               |

Table 1 showing value of PSNR for various attacks.

# International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 5, May 2015

The simulation result obtained after implementing the model in the Simulink is as shown below:





# International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 5, May 2015

The watermarking models for DFT, DCT and DWT are implemented in Simulink and the result is shown. Here, a) is the original video and b) is the image that is embedded into the video. The result obtained after applying DFT, DCT and DWT are shown in c), d) and e) respectively. The watermarked video appears exactly same as the original video. The value of PSNR is calculated for different attacks. The DWT gives the best results under different attacks. The models could be realized for hardware implementation of real life problems. DWT based frequency domain watermarking is an effective solution to deal with the problems of copyright violation issues. Combined DCT-DWT implementation of the digital watermarking in the future.

## REFERENCES

- [1] Prachi V. Powar, S. S. Agrawal, "Implementation of Digital Video Watermarking Based on FPGA", International Journal of research in Engineering and Technology, ISSN: 2319-1163, Vol 1, Issue 1, pp. 99-103, 2013.
- [2] Mandeep Singh Saini, Venkata Kranthi B, Gursharanjeet Singh Kalra, "Comparative Analysis of Watermarking Technique in Frequency Domain using MATLAB SIMULINK", International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622, Vol 2, Issue 4, pp. 1136-1141, May 2012.
- [3] Abhishek Basu, Tirtha Sankar Das, "SysGen Architecture for Visual Information Hiding Framework", International Journal of Emerging Technology and Advanced Engineering, Vol 2, Issue 3, pp. 32-40, March 2012.
- [4] Rohollah Mazrae Khoshki, Sami Oweis, "FPGA Hardware Based Implementation of an Image Watermarking System", International Journal of Advanced Research in Computer and Communication engineering", Vol 3, Issue 5, pp. 6400-6405, May 2014.
- [5] Anumol T J, Binson V A, "FPGA Implementation of Low Power, High Speed, Area Efficient Invisible Watermarking Algorithm for Images", International Journal of Scientific and Engineering Research, Vol 4, Issue 8, Aug 2013.
- [6] Sabyasachi Padhiary, "Digital Watermarking Based on Redundant DWT and Singular Wavelet Decomposition", International Journal of Advanced Research in Computer Science and Software Engineering", Vol 3, Issue 2, pp. 431-434, Feb 2013.
- [7] Ranjit Kumar S, Krishan Bhushan, "Implementation of watermarking Techniques in Images and Video using 2D-DWT/IDWT Compression and Decompression Methods", International Journal of Advances in Electronics Engineering, Vol 2, Issue 1, pp. 64-68, 2012.
- [8] Shanshan Zhang, Xiaohong Wang, Shizheng Zhou, "The Research of Image Watermarking Encryption Algorithm", "Fourth International Joint Conference on Computational Sciences and Optimization, cs0, pp.821-824, 2011.
- [9] Kalra, G. S., Talwar, R., & Sadawarti, H., "Robust Blind Digital Image Watermarking Using DWT and Dual Encryption Technique", Third International Conference on Computational Intelligence Communication Systems and Networks, 225-230. IEEE, 2011.
- [10] Wang Huai-bin; Yang Hong-liang; Wang Chun-dong; Wang Shao-ming; , "A New Watermarking Algorithm Based on DCT and DWT Fusion," Electrical and Control Engineering (ICECE), International Conference on , vol., no., pp.2614-2617, 25-27 June 2010.
- [11] Servetto, S., Podilchuk, C., Ramchandran, K., "Capacity Issues in Digital Image Watermarking." In: International Conference on Image Processing, New York, 1998.
- [12] Chandra, M.; Pandey, S.; "A DWT domain visible watermarking techniques for digital images," Electronics and Information Engineering (ICEIE), 2010 International Conference On, vol.2, no., pp.V2-421-V2-427, 1-3 Aug. 2010.
- [13] Maha Sharkas, Dahlia ElShafie, and Nadder Hamdy, "A Dual Digital-Image Watermarking Technique", World Academy of Science, Engineering and Technology, 2005.
- [14] Neha Rawat, Rachna Manchanda, "Designing Sys Generator Model For Digital Video Watermarking Using DFT Algorithm", International Journal of Advanced Scientific and Technical Research", Vol 4, Issue 4, pp. 933-940, July 2014.
- [15] Priyanka Sharma, "Quality Enhancement of Watermarking System Using Discrete Cosine Transform", International Journal of Scientific and Engineering research, Vol 3, Issue 4, April 2012.