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# DWT BASED SCHEME FOR VIDEO WATERMARKING

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**Abstract -** *This paper describes Digital Video Watermarking scheme based on Discrete Wavelet Transform. Due to increase in growth of internet users, security and copyright protection are becoming important issues in multimedia applications and services. Digital watermarking is a technology used for copyright protection of digital media. As achieving robustness and other properties is a main concern for achieving a successful digital watermarking scheme in videos. In this paper we used Discrete wavelet transform for video watermarking and observed that the performance of DWT is robust against various attacks.*

***Key Words*: Digital video, Discrete Wavelet Transform, Embedding watermark, Extracting watermark, Attacks on video.**

## 1.INTRODUCTION

Now-a-days, with the rapid development of information technology, the use of digital information is increasing day by day. And it is challenging to protect this information from piracy and other type of attacks. Digital watermarking techniques have been developed to protect the copyrights of multimedia such as audio, video and images. The success of a digital watermarking technology depends on its robustness to deal with different attacks that are aimed at removing or destroying the watermark from its host data. Video Watermarking can be done either in Spatial domain or in Frequency domain. Spatial domain refers to image plane itself and is based on direct manipulation of the pixels in an image. It is easy to implement but it has low information handling capacity and it can be easily erased by lossy image compression. Frequency domain is based on modifying the fourier transform of an image. Some of the Frequency Domain techniques are DCT (Discrete Cosine Transform) and DWT (Discrete Wavelet Transform).

This paper is on Video Watermarking which is performed in Frequency Domain by using DWT (Discrete Wavelet Transform). DWT is robust when compared to DCT and DWT has high compression ratio, high PSNR (Peak Signal to Noise Ratio), low MSE (Mean Square Error), low BER (Bit Error Rate) and it takes less time.

## 2. SCHEME OF IMPLEMENTATION

## 2.1 Discrete Wavelet Transform

The DWT is computed by successive low pass and high pass filtering of the discrete time-domain signal as shown in figure. This is called the Mallat algorithm or Mallat-tree decomposition. Its significance is in the manner it connects the continuous time multi-resolution to discrete-time filters. In the fig.1, the input signal is image. The low pass filter is denoted by G while the high pass filter is denoted by H. At each level, the high pass filter produces detail information, while the low pass filter associated with scaling functions produces coarse approximations. The output of 1-level DWT is four sub-bands i.e. LL, LH, HL and HH. LL sub-band contains low resolution version of the image. LH sub-band contains horizontal edge data. HL sub-band contains vertical edge data. HH sub-band contains diagonal edge data.

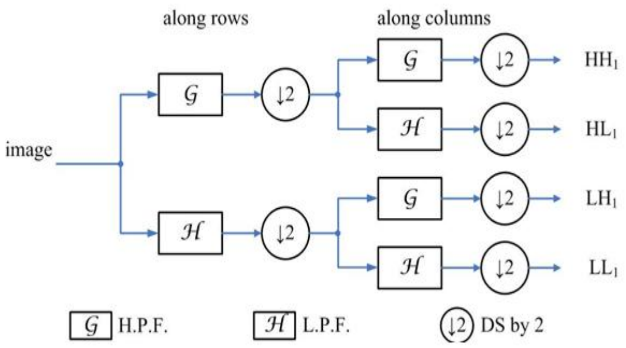



**Fig-1:** Decomposition of 1- level DWT

The filtering and decimation process continued until the desired level is reached. The maximum number of levels depends on the length of the signal. The DWT of the original signal is then obtained by concatenating all the coefficients starting from the last level of decomposition. In this paper, two level DWT is used.

Watermark is embedded in LL and HH bands obtained by Wavelet decomposition which increases the robustness. So that resultant watermark video become susceptible to different attacks that have both low pass and high pass characteristics.

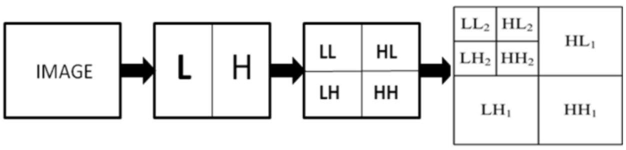


**Fig-2:** DWT sub-bands in two levels

Basically, the reconstruction is the reverse process of decomposition. The approximation and detail coefficients at every level are up-sampled by two, passed through the low pass and high pass synthesis filters and then added. This process is continued through the same number of levels as in the decomposition process to obtain the original signal.

The proposed scheme uses a watermark (cover image) which is embedded into a video and then the watermark is extracted.

## 2.2 Watermark Embedding Process

In this process, an image is embedded in a video by giving original video and the watermark image as inputs and the output of this process is the watermarked video. The following are the steps for the embedding process.

1. Video is divided into frames. RGB frames are converted to YUV frames. 2.
2-level DWT is applied on it. After applying 2-level DWT, the video frame is divided into 16 sub-bands i.e. 4 LL, 4 LH, 4 HL and 4 HH.
3. RGB watermark image is converted into a binary image of zeros and ones.
4. This binary image is again divided into n parts. Then each part is embedded into each of the corresponding LL and HH sub-bands. The watermark pixels are embedded with strength x into the maximum coefficient Mi. The following embedding equation is:
**Yi=Mi+xIi**

Where, x is the watermark embedding strength
Ii is the watermark
Watermark is done in LL and HH sub-bands as most part of the information is present in these bands.

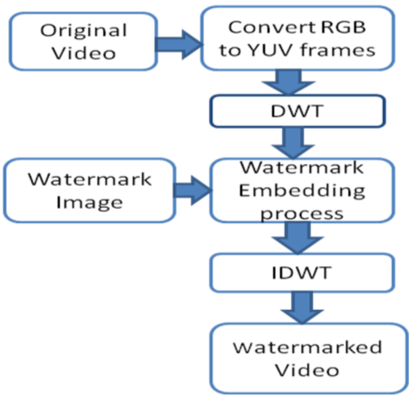



**Fig-3:** Block diagram for watermark embedding process

5. Inverse DWT is applied to obtain the watermarked luminance component of the frame. YUV frames are converted back to RGB frames. Finally watermarked frame is reconstructed and watermarked video is obtained.

## 2.3 Watermark Extraction Process

In this process, the watermark which is embedded into the video is extracted. The inputs to this process are original video and the watermarked video and the output is the extracted watermark.

1. Watermarked video is converted into frames. Each RGB frame is converted to YUV representation.
2. DWT is applied. LL and HH sub-bands divided into nxn non-overlapping blocks.
3. The following equation is used to extract the watermark.

**I2=(Yi-Mi)/x**

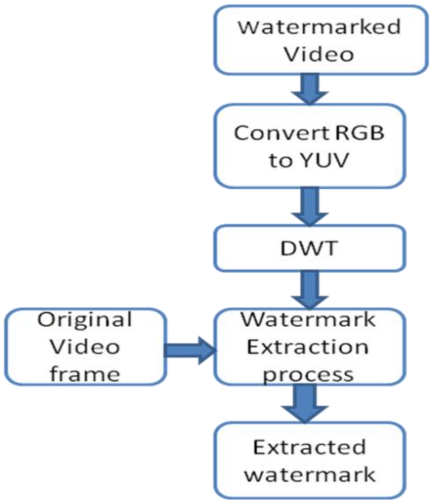



**Fig-4:** Block diagram for watermark extraction process

4. The extracted watermark is compared with the original watermark.

## 2.4 Performance Criteria

The performance criteria of video watermarking using DWT is evaluated from the following parameters.

### PSNR (Peak Signal-To-Noise Ratio):-

It is used to measure deviation of the watermarked and attacked frames from the original video frames and is defined as:

$$\mathbf{PSNR} = 10\log_{10}\left\{\frac{255*255}{\mathbf{MSE}}\right\}$$

Where, MSE (mean square error) between the original and distorted frames (size mxn) is defined as:

$$\mathbf{MSE}=\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[\mathbf{I}(i,j)-\mathbf{K}(i,j)]^2$$

Where, I and K are the pixel values at location (i , j) of the original and the distorted frame respectively. It is expressed in decibels (dB).

### NC (Normalised Correlation):-

It is used to measure the robustness of watermarking and its peak value is 1. NC value is 1 when the original watermark and the extracted watermark are identical.

$$NC = \frac{\sum_{(i,j)} I1(i,j).I2(i,j)}{\sqrt[2]{\sum_{(i,j)} I1^2(i,j).\sum_{(i,j)} I2^2(i,j)}}$$

Where, I1 and I2 are original and extracted watermarks respectively.

## 2.5 Attacks Performed on the video

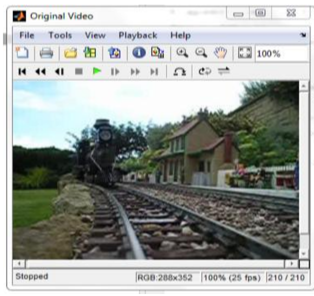
The design of a secure watermark system requires the study of different attack methodologies and the development of appropriate counter measures. The watermarked video can be prone to attacks. In this paper we analysed the following attacks:
(i) Rotation attack (ii) Cropping attack (iii) Salt & pepper noise attack.


**Fig-5:** Block diagram for attacks on a video

# 3. RESULTS & ANALYSIS

The watermark is embedded in LL and HH parts of all the video frames. After executing the code the following results are obtained.

## 3.1 Watermark Embedded in LL and HH bands with embedding strength x=0.1



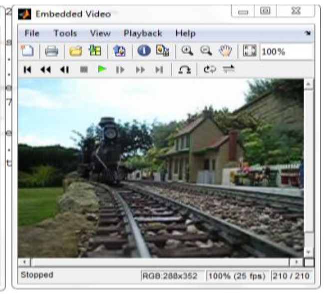
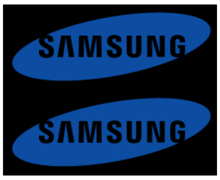




**Fig-6:** Original video **Fig-7:** Embedded video



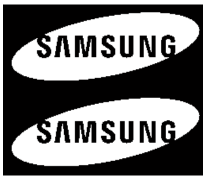




**Fig-8:** Original watermark **Fig-9:** Extracted watermark

The watermark shown in Fig-8 is embedded in LL and HH bands of train video with embedding strength x=0.1. The original video is shown in Fig-6 and the embedded video is shown in Fig-7. There is no difference between original video and embedded video. The extracted watermark is shown in Fig-9.

## 3.2 Watermark Embedded in LL and HH bands with embedding strength x=30

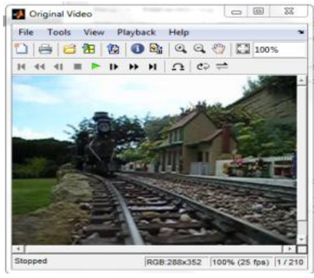
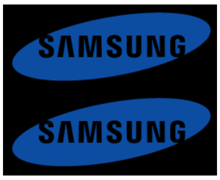




**Fig-10:** Original video **Fig-11:** Embedded video



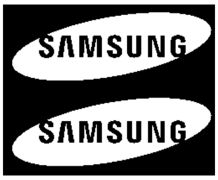




**Fig-12:** Original watermark **Fig-13:**Extracted watermark

The watermark shown in the Fig-12 is embedded in LL and HH bands of train video with embedding strength x=30. The original video is shown in Fig-10 and the embedded video is shown in the Fig-11. We can see some distortion in the embedded video. The extracted watermark is shown in the Fig-13.

**Table-1:** Parametric values for various embedding strengths

| Strength | MSE | PSNR | NC |
|---|---|---|---|
| X=0.1 | 0.0045 | 164.91 | 1 |
| X=5 | 0.2237 | 126 | 1 |
| X=10 | 0.4474 | 119 | 1 |
| X=20 | 0.8949 | 112 | 1 |
| X=30 | 1.3423 | 107.88 | 1 |
| X=50 | 2.2372 | 102 | 1 |
| X=100 | 4.4744 | 95 | 1 |

As the embedding strength increases, PSNR decreases and MSE increases and MSE and PSNR are proportional to each other. NC value is 1 when there is no attack to a video but when the video is attacked, NC value decreases.

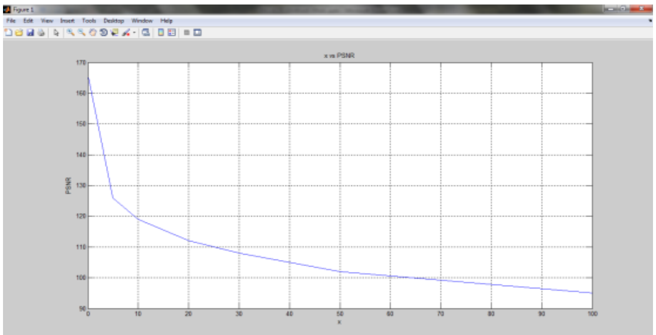


**Fig-14:** PSNR vs Embedding strength(x)

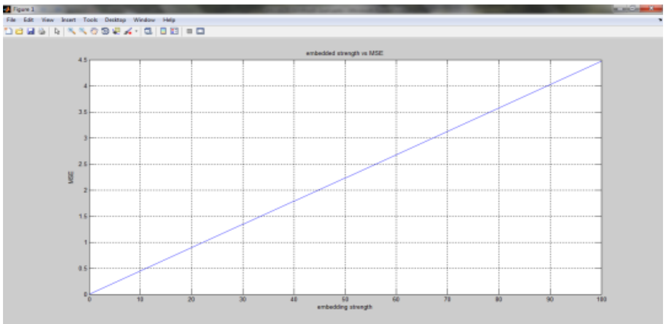


**Fig-15:** MSE vs Embedding strength(x)

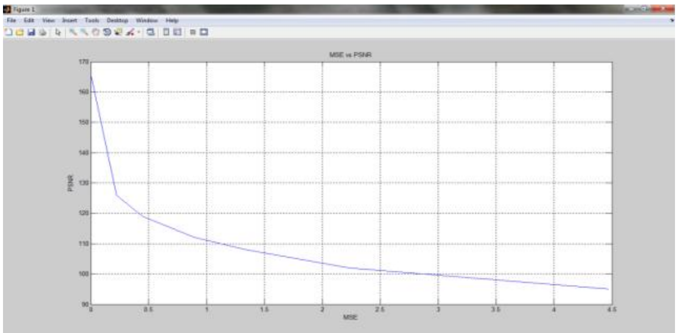


**Fig-16:** MSE vs PSNR

## 3.3 ROTATION ATTACK

**Fig-17:** Original frame

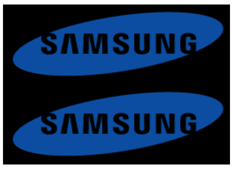
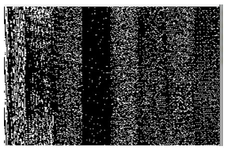
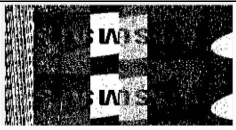
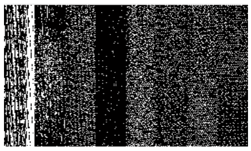



**Fig-18:** Original watermark

**Table-2:** For embedding strength x=30

| Rotation angle (in degrees) | Rotated Frame | Extracted watermark |
|---|---|---|
| 90 |  |  |
| 180 |  |  |
| 270 |  |  |

The above table shows the results for different rotation angles and their respective extracted watermarks. When the watermarked video is attacked with this rotation attack, all frames are rotated according to the rotation angles. Table-3 shows the parametric values at different rotation angles.

**Table-3:** Parametric values for various angles of rotation

| S.No. | Angle of Rotation (in Degrees) | Mean Square Error (MSE) | Peak Signal to Noise Ratio (PSNR) (in db) | Normalized Correlation (NC) |
|---|---|---|---|---|
| 1. | 0 | 1.3423 | 107.88 | 1 |
| 2. | 45 | 55.7699 | 72.3310 | -0.2830 |
| 3. | 90 | 1.3421 | 107.9 | -0.085 |
| 4. | 135 | 55.711 | 72.3302 | -0.1599 |
| 5. | 180 | 1.3423 | 107.88 | 0.399 |
| 6. | 225 | 55.7801 | 72.3282 | -0.0252 |
| 7. | 270 | 1.3421 | 107.9 | 0.485 |
| 8. | 315 | 55.7670 | 72.3301 | -0.1243 |
| 9. | 360 | 1.3423 | 107.88 | 1 |

It is observed that there is a slight decrease PSNR after rotation attack. NC value decreases as a result of rotation attack.

### 3.4 CROPPING ATTACK


**Fig-19:** Original frame (352*288)

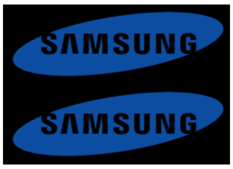
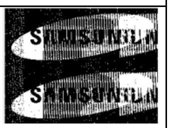
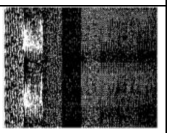


**Fig-20:** Original watermark

**Table-4:** For embedding strength x=30

| Cropped size | Cropping ratio | Cropped frame | Extracted watermark |
|---|---|---|---|
| 352*287 | 1.003 |  |  |
| 352*189 | 1.523 |  |  |

The above table shows the results for different cropping ratios and their respective extracted watermarks. When the watermarked video is attacked with this cropping attack, all frames are cropped. Table-5 shows the parametric values at different cropping ratios.

**Table-5:** Parametric values for various cropping ratios

| S.No. | Cropping ratio | Mean Square Error (MSE) | Peak Signal to Noise Ratio (PSNR) (db) | Normalized Correlation (NC) |
|---|---|---|---|---|
| 1. | 1.002 | 1.318 | 108.44 | 0.5476 |
| 2. | 1.003 | 0.9862 | 112.61 | 0.4634 |
| 3. | 1.009 | 0.604 | 123.39 | 0.0464 |
| 4. | 1.016 | 0.668 | 133.56 | 0.0646 |
| 5. | 1.032 | 2.9866 | 104.44 | 0.1826 |
| 6. | 1.035 | 3.06 | 104.14 | 0.0654 |
| 7. | 1.07 | 7.823 | 93.77 | 0.1147 |
| 8. | 1.111 | 12.98 | 88.33 | 0.1136 |
| 9. | 1.523 | 45.91 | 74.398 | -0.0516 |

It is observed that there is a slight decrease PSNR after cropping attack. NC value decreases as a result of cropping attack.

### 3.5 SALT AND PEPPER NOISE ATTACK


**Fig-21:** Original frame

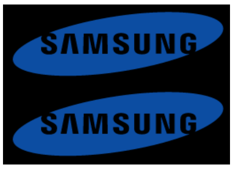
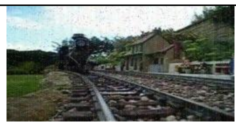
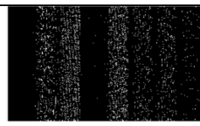
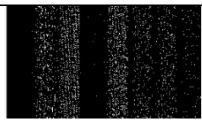
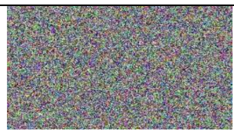
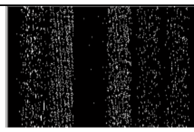


**Fig-22:** Original watermark

**Table-6:** For embedding strength x=30

| Noise Intensity | Noise added frame | Extracted Watermark |
|---|---|---|
| 0.02 |  |  |
| 0.5 |  |  |
| 1 |  |  |

The above table shows the results for different noise intensities and their respective extracted watermarks. When the watermarked video is attacked with this salt and pepper noise, all frames are attacked. Table-7 shows the parametric values at different noise intensities.

**Table-7:** Parametric values for various noise intensities

| S.No. | Salt & pepper noise intensity | Mean Square Error (MSE) | Peak Signal to Noise Ratio (PSNR)(db) | Normalized Correlation (NC) |
|---|---|---|---|---|
| 1. | 0 | 110.36 | 65.5002 | -0.4773 |
| 2. | 0.02 | 110.37 | 65.4992 | -0.4773 |
| 3. | 0.04 | 110.37 | 65.4983 | -0.4773 |
| 4. | 0.05 | 110.38 | 65.4977 | -0.4773 |
| 5. | 0.08 | 110.39 | 65.4962 | -0.4773 |
| 6. | 0.1 | 110.40 | 65.4952 | -0.4775 |
| 7. | 0.2 | 110.45 | 65.4901 | -0.4777 |
| 8. | 0.5 | 110.60 | 65.4750 | -0.4794 |
| 9. | 0.8 | 110.75 | 65.4599 | -0.4795 |
| 10 | 1 | 110.85 | 65.4499 | -0.4802 |

It is observed that there is a decrease in PSNR after salt and pepper noise attack. NC value decreases as a result of salt & pepper noise attack.

## 4. CONCLUSION

The algorithm used is the robust against various attacks. The watermark is embedded in LL and HH parts of all the video frames.The various performance metrics calculated are Peak Signal to Noise Ratio (PSNR), Mean Square Error (MSE) and Normalised Correlation (NC). The implementation results show that as the embedding strength increases PSNR value decreases.MSE and PSNR are inversely propotional to each other.It is observed that NC is always 1 without any attack and when watermarked video is attacked then the NC value decreases.The extracted watermark is almost acceptable, recognizable and fairly comparable with the original one. The algorithm is fairly robust against attacks like image cropping, rotation and salt and pepper noise.

Hence “DWT Based Scheme for Video Watermarking” is found efficient for the copyright purposes and as a proof of ownership when compared to other techniques.

## 5. FUTURE SCOPE

In future, the degree of perfection can be increased in the watermark extraction process. This watermarking scheme can be tested for other newly emerging various noise attacks, JPEG compression (coding) etc. The quality of extracted watermark from video can be improved by using combinations like DWT and DCT, DWT and SVD, DCT and SVD (Singular Value Decomposition). The combination of these techniques along with other techniques from different domain help in enhancing the robustness. SIMULINK model for this can also be implemented and verified on FPGA (Field Programmable Gate Array), which gives better accuracy and performance in terms of speed can be achieved. Digital video watermarking can also be utilized for Labeling, Tamper Proofing like applications.

## 6. REFERENCES

[1] Prachi V. Powar, S.S.Agrawal, "Design Of Digital Video Watermarking Scheme Using Matlab Simulink", International Journal of Research in Engineering and Technology, Volume: 02 Issue: 05, May2013.

[2] Chitrank Jha, Agya Mishra, “Video Watermarking Algorithms: A Literature Review”, Int.J.Computer Technology & Applications, Volume 5, October 2014.

[3] Chetan K.R, Raghavendra K.," DWT Based Blind Digital Video Watermarking Scheme for Video Authentication", International Journal of Computer Applications, Volume 4– No.10, August 2010.

[4] Priya Porwal, Ratnesh N Chaturvedi, Tanvi Ghag, Nikita Poddar, Ankita Tawde, “Digital Video Watermarking Using Least Significant Bit (LSB) Technique”, International Journal of Engineering Research & Technology (IJERT), Vol. 3 Issue 1, January 2014.

[5] Rakesh Ahuja , S. S. Bedi, “All Aspects of Digital Video Watermarking Under an Umbrella”, I.J. Image, Graphics and Signal Processing, 2015, pp:54-73.

[6] Darshana Mistry, Asim Banerjee, “Discrete Wavelet Transform using MATLAB”, International Journal of Computer Engineering and Technology (IJCET), April 2013.

[7] Kavitha KJ, B.Priestly Shan "Video Watermarking using DCT and DWT: A Comparision", European Journal of Advances in Engineering and Technology, 2015, pp:83-87.

[8] Sanjana Sinha, Prajnat Bhardan, Dipak k.Kole, "Digital Video Watermarking using DWT and PCA", International Journal Of Wisdom Based Computing,Vol:1(2),August 2011.

[9] Prof. Bebis ,"Wavelets", Chapter 7

[10] Anastasios Tefas, Nikos Nikolaidis, and Ioannis Pitas," Image Watermarking: Techniques and Applications",chapter-22,Aristotle University of Thessaloniki.

[11] T.Tabassum, “A digital video watermarking technique based on identical frame extraction in 3-Level DWT”, IEEE in proceedings of 2012.

[12] M.Sundararajan, "DWT based scheme for video watermarking", IEEE in proceedings of 2013.

[13] A.Graps, “An Introduction to Discrete Wavelet Transform (DWT),” IEEE Computational Sciences and Engineering, vol. 2, no.2, pp 50-61, 2004.

[14] Gwenael Doerr, Jean-Luc Dugelay,"A Guide Tour Of Video Watermarking", Handbook of Video Databases: Design and Applications, 2002.

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