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# DWT BASED INVISIBLE VIDEO WATERMARKING

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*Abstract*— **In this paper, we are proposing DWT (discrete wavelet transform) Based Invisible Watermarking Technique for Videos. Digital Watermarking is a data hiding technique where an information or message is hidden inside a signal. This method is used for copyright protection. Due to the signal representation Watermarking done easily, and thus this technology is developing very fast among the media industry. The two aspects of any image are the quality of the image & the capacity of the original image. A lossless data hiding scheme is presented based on quantized coefficients of discrete wavelet transform (DWT) in the frequency domain to embed secret message.**

**In DWT technique a frame selected from a video is get decomposed through the DWT in 3-levels. In this technique a multi-bit watermark is embedded into the low frequency sub-band of a original frame by using alpha blending technique.**

**The procedures of the proposed system mainly include embedding & extracting. During embedding, watermark image or some data/message is dispersed within the original frame depending upon the scaling factor of alpha blending technique.**

**Wavelet transform is used to converts an image from time or spatial domain to frequency domain. Decomposition of digital image will be pair of waveform with high frequency corresponds to detailed parts of an image & low frequency to smooth parts of image.**

**The digital message will be embedding in medium-high frequency components & the image will be reconstructed to get cover image with digital message hidden. Embedded image decomposed into inverse discrete wavelet transform.**

**Inverse wavelet transform is used to convert frequency domain to spatial domain. Hence it is frequency-time representation. Embedded image will be extracted in to sub-band frequencies using dwt method.**

**The digital data will be taken from the medium high frequency components & the extracted digital data will be compared with original message.**

***Index Terms*— DWT, Haar Wavelet, Information, Image Watermarking, 3 Level DWT, Alpha Blending.**

## I. INTRODUCTION

Video watermark approaches have been proposed for protecting the ownership in which the copyright information is embedded in video sequences. Copyright protection inserts authentication data such as ownership information and logo in the digital media without affecting its quality. In case of any dispute, authentication data is extracted from the media and can be used as an authoritative proof to prove the ownership. As a method of copyright Aegis, digital video watermarking has newly emerged as a significant field of interest and a very active area of research. Watermarking is the process that Plant data called a watermark or digital signature into a multimedia object such that watermark can be detected or extracted later to make an assertion about the, aim. The object is image, audio or video.

For the intent of copyright protection digital watermarking techniques must meet the criteria of imperceptibility as well as robustness against all attacks for removal of the watermark. Many digital watermarking schemes have been proposed for still images or videos. Most of them operate on uncompressed videos, while others plant watermarks instantly into compressed videos. Video watermarking introduces a many issues not present in image watermarking, because of inherent redundancy between video frames and video signals are extremely susceptible to attacks such as frame averaging, frame falling , frame swapping and statistical analysis.

Video watermarking approaches can be classified into two main categories based on the method of hiding watermark bits in the video. The two categories are Spatial domain watermarking where embedding and detection of watermark are performed by directly manipulating the pixel intensity values of video frame. Transform domain techniques, then again, change spatial pixel values of the host video according to a pre-determined transform and are more robust than spatial domain techniques since they disperse the watermark in the spatial domain of the video frame making it difficult to remove the watermark through malicious attacks like cropping, scaling, rotations.

In this paper propose an imperceptible and robust video watermarking algorithm based on Discrete Wavelet Transform (DWT). DWT is more computationally efficient than other transform methods like DFT and DCT. Due to its excellent spatial frequency localization properties, the DWT is very worthy to identify areas in the host video frame where a watermark can be embedded imperceptibly. It is known that even after the decomposition of the video frame using the wavelet transformation there exist some amount of correlation between the wavelet coefficients.

### *A. Embedding*

In the watermarking technique we take original image and message which we want to hide, then apply embedding technique and we get watermarked image.

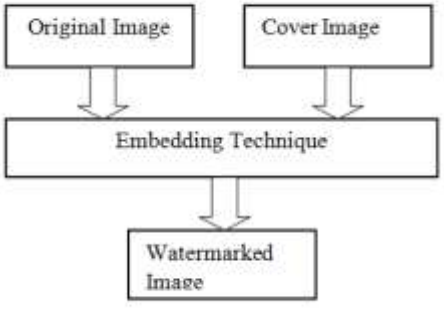



**Fig1-: embedding process**

### *B. Extraction*

In extracting process watermarked image is extracted from the original image.

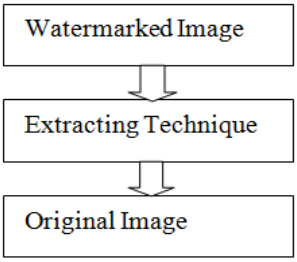



**Fig2-: Extraction process**

## II. RESEARCH BACKGROUND

### A. *Information hiding technique:*

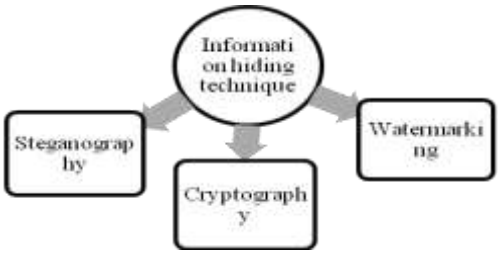



**Fig3-: Classification of Information Hiding Techniques**

*1) Steganography*

Main thing in steganography is to hide a message m in some audio or video (cover) data d to obtain new data d^, practically indistinguishable from d, by people, in such a way that an eavesdropper cannot detect the presence of m in d^.

*2) Cryptography:*

Cryptography is the most common method of protecting digital content and is one of the best developed sciences. But while decrypting the data we cannot recover original image as it is.

*3) Watermarking*

Enshroud message m in some audio or video (cover) data d, to obtain new data d^, practically indistinguishable from d, by people, in such a way that an eavesdropper cannot remove or replace m in d^.

### B. *Digital watermarking*

Digital watermarking is an elongation of watermarking concept in the digital word. A digital watermark is a process of inserting a watermark into a multimedia object in such a way that the watermark can be detected or extracted later easily to make an ascertain about the project and its owner is called digital watermarking.

Watermarking is the technique that allows any individual to add hidden copyright notices or other verification messages to digital audio, video, or image signals and documents.

Watermarking adds the additional requirement of robustness. An ideal watermarking system however would embed an amount of information that could not be removed or altered without making the cover object entirely unusable. So, watermarking is mainly prevent illegal copy or claims the ownership of digital media

Watermark--A visible or invisible signature embedded inside an image to show authenticity or proof of ownership. The hidden watermark image should be inseparable from host image, robust enough to protest any manipulations while preserving the image quality. So through watermarking, intellectual properties remains accessible while being permanently marked. This digital signature approaches use in authenticating ownership claims and protecting proprietary hidden information, discourage unauthorized copying and distribution of images over the internet.

*1) Spatial domain watermarking:*

The most common implementation of spatial domain watermarking is Least Significant Bit (LSB) replacement method. It involves replacing the n least significant bits of each pixel of a container image with the data of a hidden image.

*2) Transform domain watermarking:*

In this technique we apply some invertible transform to the host image before embedding the watermark.

Then the transform domain coefficients are modified to embed the watermark and finally the inverse transform is applied to obtain the marked image.

### C. *Transform domain techniques*

*1) Discrete Cosine Transform (DCT):*

This is the most commonly used transform for watermarking purpose. The DCT allows an image to be broken up into different frequency bands making it much easier to embed watermarking information.

*2) Discrete Wavelet transforms (DWT):*

This technique is also called as multiresolution technique. The important aspect of this technique is that watermark is introduced in imperceptibly significant regions of the data in order to remain robust.

## III. 3 LEVEL DWT BASED WATERMARKING:

Wavelet Transform is a modern technique frequently used in digital image processing, compression, watermarking etc[1]. The wavelet transform provides the time-frequency representation of a signal. The transforms are depends on small waves is called as wavelet, of varying frequency and modified duration. The wavelet transform break down the image into three spatial directions, horizontal, vertical and diagonal. Hence wavelets reverberate the anisotropic properties of Human Visual System (HVS) more exactly. Order of magnitude of DWT coefficients is larger in the lowest bands (LL) at each level of decomposition and is smaller for other bands (HH, LH, and HL).

A two dimensional transform can be accomplished by performing two separate one-dimensional transforms. Firstly, the image is filtered on the x-proportion using low pass and high pass analysis filters and decimated by two. Low pass filtered coefficients are put on the left part of the matrix and high pass filtered on the right. Because of decimation the overall size of the transformed image is same as the original image. Then, it is traced by filtering the sub-image along the y-dimension and decimated by two. Lastly, we have divide the image into four bands denoted by LL, HL, LH and HH and one level decomposition and figure shows one level and second level decomposition.

After decomposing the cover image and the watermark at the desired level, the watermark coefficients are hidden to the appropriate coefficients of the cover image

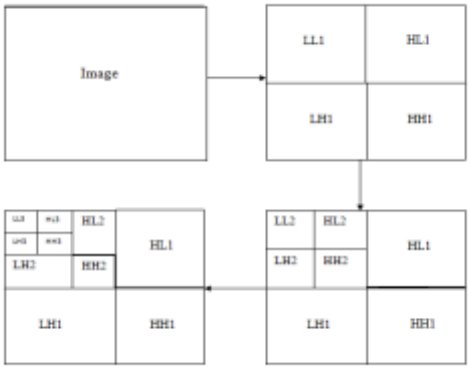



**Fig4-** level discrete wavelet decomposition

*A. Watermark embedding process*

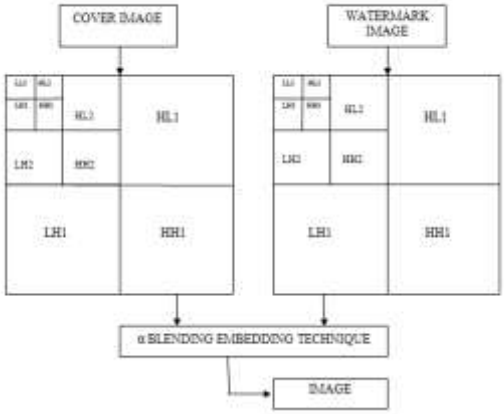



**Fig5- : Watermark Embedding Process**

In this model user has to provide original image, watermark image and scaling factor (α) as input for the embedding process. After that find out the wavelet transforms of original image and choose "Haar" wavelet in the high frequency band. During embedding process, embed the watermark coefficient with the highest value wavelet coefficient of original image. Apply inverse DWT to the image and get watermarked image. Firstly the gray scale host image is taken and 2-D, 3-level DWT (Discrete Wavelet Transform) is applied to the image which decomposes image into low frequency and high frequency components. In the same manner 2-D, 3-level DWT is also applied to the watermark image which is to be embedded in the host image. The technique used here for inserting the watermark is alpha blending [11, 15]. In this technique the decomposed components of the host image and the watermark are multiplied by a scaling factor and are added. Since the watermark embedded in this paper is perceptible in nature or seeable, it is implanted in the low frequency estimation component of the host image. According to the formula of the alpha blending the watermarked image is granted by LL2, LH2, HL2, and HH2.

WMI=K*(LL2) +*q (LL2)*kW

Where WMI = low frequency component of watermarked image, LL3 = low frequency component of the original image obtained by 3-level DWT, WM3 = low frequency component of Watermark image, and k, q = Scaling factors for the original image and watermark respectively. After embedding the cover image with watermark image, 3-level Inverse discrete wavelet transform is applied to the watermarked image coefficient to generate the final secure watermarked image.

*B. Watermark Extracting Process:*

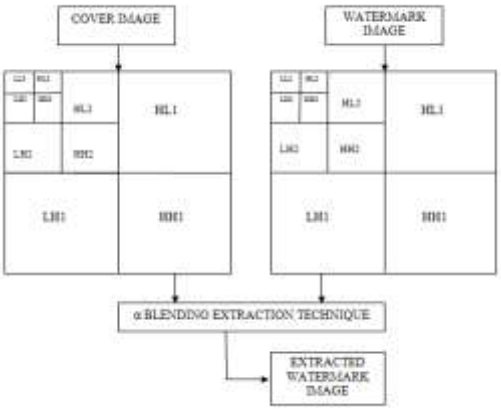



**Fig6-: Watermark Extracting Process**

In this process firstly 3-level DWT is applied to watermarked image and cover image which decomposed the image in sub-bands. After that the watermark is recovered from the watermarked image by using the formula of the alpha blending. According to the formula of the alpha blending the recovered image is given by

RW = (WMI - k*LL3) /q

Where,

RW= Low frequency estimation of Retrieve watermark

LL3= Low frequency estimation of the original image,

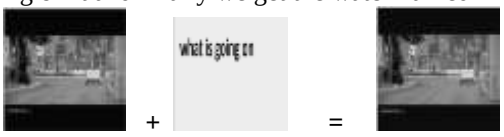
WMI= Low frequency estimation of watermarked image.

After extraction work, 3-level Inverse discrete wavelet transform is applied to the watermark image coefficient to generate the final watermark extracted image.

## IV. RESULS AND DISCUSSION

*A. EMBEDDING*

In this embedding process, from the selected video we get 776 frames out of them we select one frame as a cover image then any message which we want to hide in cover image them embedding on it and finally we get the watermarked image.




Cover Message Watermarked image

**Fig:7**

*B. EXTRACTION*

In this extracting process, from the watermarked image applying secret key we get the cover image and message as it is at the output.


Watermarked message Image secret key cover image

**Fig: 8**

### *C. COMPARISION OF PSNR VALUES AND MSE VALUES FOR DIFFERENT FRAMES:*

| **Frame No.** | **Embedding** | | **Extracting** | |
|---|---|---|---|---|
| | **MSE** | **PSNR** | **MSE** | **PSNR** |
| 1 | 9.57E-09 | 184.3758 | 61.2288 | 1.9109 |
| 55 | 9.54E-09 | 184.5712 | 61.0739 | 1.593 |
| 110 | 9.61E-09 | 184.5203 | 61.4992 | 2.2982 |
| 275 | 9.52E-09 | 182.7191 | 60.939 | 2.4794 |
| 360 | 9.26E-09 | 183.5006 | 59.2232 | 2.5364 |
| 475 | 9.71E-09 | 184.9364 | 62.1082 | 2.0376 |
| 515 | 9.67E-09 | 184.6696 | 61.8519 | 2.0804 |
| 634 | 9.67E-09 | 185.1039 | 61.9047 | 2.3075 |
| 712 | 9.71E-09 | 184.916 | 62.1377 | 1.8603 |
| 772 | 9.61E-09 | 177.7832 | 61.4739 | 2.5965 |

## V. CONCLUSION

A 3 level DWT based image watermarking technique has been enforced. This technique can embed the invisible watermark into the image using alpha blending technique which can be recovered by extraction technique. Above study shows that the quality of the watermarked image is dependent only on the scaling factors and the recovered watermark are independent of scaling factor. The recovered images and the watermark are better for 3 level discrete wavelet transform then 1 & 2 level discrete wavelet transform. All the results obtained for the recovered images and the watermark are identical to the original images.

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